CALIFORNIA INTEGRATED WASTE MANAGEMENT BOARD

MRFs: POLICY, PLANNING AND DESIGN

RESOURCE MANUAL

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CALIFORNIA INTEGRATED WASTE MANAGEMENT BOARD

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November 1991

NOTE: Legislation (SB 63, Strickland, Chapter 21, Statutes of 2009) signed into law by Gov. Arnold Schwarzenegger eliminated the California Integrated Waste Management Board (CIWMB) and its six-member governing board effective Dec. 31, 2009.

CIWMB programs and oversight responsibilities were retained and reorganized effective Jan. 1, 2010, and merged with the beverage container recycling program previously managed by the California Department of Conservation.

The new entity is known as the Department of Resources Recycling and Recovery (CalRecycle) and is part of the California Natural Resources Agency. It is no longer part of the California Environmental Protection Agency (Cal/EPA).

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INTRODUCTION

Across the state, cities and counties are in the process of implementing their Source Reduction and Recycling Elements to meet the requirements of AB 939. A consideration for many of these jurisdictions is the development of a centralized materials recovery facility, or MRF, to recover recyclable materials from the waste stream. A MRF can be as simple as a can separator or a conveyor with handsorting stations, or as complicated as a mixed waste processing system with numerous mechanical screens, separators and classifiers, or anywhere in between. Because there are no discrete boundaries as to what level of technology must be present, we have chosen to call all of them MRFs.

The planning and design of such a facility is a complex process. Many decisions must be made and options analyzed by a jurisdiction during the process of deciding the role, if any, a centralized processing facility will play in their integrated waste management plan. This manual has been produced, in conjunction with the videoconference, to be used as a reference manual to assist cities and counties in this decision making process.

Section 1 is an overall discussion of the role of MRFs in an integrated waste management plan for a jurisdiction. Discussed is the impact of source reduction activities on a centralized processing facility, policy considerations of source separation, and the very real impacts on and by existing waste management facilities and programs.

Section 2 examines the technical issues to be considered including the types and quantities of input materials, design criteria, expected recovery and participation rates, and "appropriate technology" - what equipment best fits the needs of the facility. A discussion of markets and market development is also included.

Section 3 is on ownership, financing, control and risk allocation issues of MRF planning and design. Discussed are the advantages of both public and private ownership, the various methods of financing, and the benefits of public, private and public/private partnership financing. A discussion of the various types and level of control that a jurisdiction may assume is included along with the technical, financial and environmental risks inherent to the development of a MRF.

Section 4 discusses regulatory and legal issues. Areas covered include flow control, siting considerations and diversion credits.

Each section has a corresponding appendix that contains papers and articles which address, in more detail, relevant issues pertaining to that particular section.

SECTION 1

THE ROLE OF MRFS IN THE INTEGRATED WASTE MANAGEMENT SYSTEM

The current concept of recycling was developed by community based groups trying to save some of the Earth's resources from being wasted. From this a strong second focus on preserving landfill space has developed. These two issues are the primary motivators of AB939, which has caused many jurisdictions to look for an easy, and cost-effective way to quickly achieve major reductions in the amount of material reaching the landfill. Only a few years ago, incineration of solid waste was seen as the most viable way to achieve that diversion. Waste stream volume entering the landfill could be reduced by about 70% and could also be used to produce energy. But concerns over environmental impacts, and the high costs associated with these incinerators, have caused them to no longer be a priority option. Further, the waste management hierarchy, reduce, re-use, recycle, presented in AB939, ranks incineration below recycling and allows "transformation" to not count for more than 10% diversion.

However, the concept of a centralized facility, at which the waste stream can be processed, still holds strong appeal. The next generation of technologies developed is the Materials Recovery Facility (MRF). While a debate continues over the definition of a MRF, it can be loosely defined as a central solid waste facility where waste materials, either source separated or mixed, are sorted and processed for sale to end users. It could be argued that where material is source separated, the recovery of marketable materials takes place prior to the facility, and that the facility is merely an Intermediate Processing Center (IPC). However, here we will consider all systems which process secondary materials as MRFs.

When deciding if a MRF should be part of your integrated waste management system the role of the MRF should be considered in the context of your community's overall waste reduction goals. The size and scale of the MRF, and the effect of a central facility on existing programs and community quality of life, are important to consider. Additionally, the effect of the MRF on existing or planned source reduction and recycling programs, source separation or mixed waste collection and processing, and the need for "flow control" by the facility are all important variables.

Effect of MRFs on Existing and Planned Source Reduction and Recycling Programs

There are solid waste officials and MRF company representatives who boast that their facilities will eliminate the need for source separation. Like the promise of the famous Los Angeles mayor, Sam Yorty, that residents will never again have to separate their trash, they can make the claim that at least a portion of the waste generated will be recycled. However, these facilities can have negative effects on existing waste diversion programs. Again, remember that

using a MRF does not necessarily mean the end of source separation. For those who use a mixed waste processing system, the message that they not longer have to separate their trash could discourage residents from participating in existing programs, especially drop-off services. For those communities with existing source reduction and recycling programs, MRFs can be part of an integrated approach to waste reduction. For those communities without existing programs, a MRF may be the center of the waste reduction program. In either case, when considering a MRF, careful consideration of existing recycling programs and service integration should be part of the planning process.

The siting of a MRF, especially one which promises to recover the amount of material needed to meet the AB939 mandates, can result in neglecting source reduction activities. The reduction in waste disposal provided by the MRF is more easily quantifiable than source reduction program options. However, siting a MRF does not mean that a jurisdiction should ignore source reduction strategies. For all communities in California, source reduction is to be the highest priority in the integrated waste management system; and conservation of resources is the most cost-effective way of reducing the amount of waste requiring disposal.

Source Separation vs. Mixed Waste Processing

There is disagreement over the value of source separation as compared with mixed waste processing. Source separation means that materials are separated in a conscious decision by the generator. Normally this means recyclables from garbage, or types of recyclables from each other. Source separation helps to instill the waste reduction ethic in both the residential and commercial sectors. Virtually all source separated recycling programs have commingled materials. Commingled has to do with what materials are mixed with which other materials, such as aluminum and steel cans collected together and separated before sale, or glass collected color mixed and sorted by color before sale. Commingled is normally equated with the mixing of cans, bottles (plastic and glass) and paper in some combination.

In source separation programs, participants become aware of the amount of waste they generate and the value of the materials they recycle. These separated waste streams have lower contamination and can result in a higher value recovered material. However, the recovery from these programs is dependent upon voluntary participation.

Mixed waste systems can mean that more of the waste stream is available for recovery and processing. In a mixed waste system, all waste, including garbage, is collected together, then recyclable materials are sorted out at a processing facility. However, contamination may be higher, and residents and businesses do not take individual responsibility for reducing their waste generation. These factors mean that the decision between source separation programs versus mixed waste processing is not only one of engineering or accounting, but one of environmental ethics.

SECTION 2

MRF TECHNICAL ISSUES

What is a Materials Recovery Facility ?

There has been a lot of confusion over the definition of a MRF. The type and degree of technology used in their design can be as simple as a can separator or a conveyor with hand-sorting stations, or as complicated as a mixed waste processing system with numerous mechanical screens, separators and classifiers, and anywhere in between. Because there are no discrete boundaries as to what level of technology must be present, we have chosen to call all of them MRFs.

When considering whether or not to build a MRF, there are a series of decisions which must be determined. First is why have a MRF. As the number and types of materials to be diverted from landfill is expanded, a MRF may be necessary to process the material.

It's believed that there is a limit to the number of categories of materials which the general public will take the time to keep separate, so that source separation programs can only divert a limited amount of materials. There is also a limit to the number of compartments which can be efficiently loaded by a driver/collector. When diversion goes beyond these limits, a processing facility or MRF may be needed.

Well then, what materials should be recovered? What do we want to divert from the landfill? What materials are there markets for? What are the preparation specifications for those materials? From these questions we can determine which materials will be targeted for recovery.

Input Materials

Historically, most MRFs have processed either the materials from curbside collection programs (cans, bottles and newspaper) or the dry commercial wastes from selected businesses (mostly offices and retail shops), or from beverage container recovery programs. This material is rich in a few select higher value materials, especially cardboard and office paper, and is well worth sorting for recovery.

As we try to divert larger percentages of materials from disposal in landfills, we need to increase the amount and types of materials being delivered to the processing facilities.
For most communities the next step may be to recover a larger portion of the commercial waste stream because this program may be more cost effective. Also, there may be popular support

for implementing, or expanding, the curbside collection program from the residential neighborhoods. Generally, in addition to cans, bottles and newspaper, the public wants to recycle junk mail and plastics, even if it costs more per ton of material recovered.

The next step is the determination of which specific materials will be collected, and what groupings of materials will be collected together with which other materials. These determinations could be based on the information provided in the Waste Generation Study required by AB939, or on decisions made by programs similar to the one which your jurisdiction is interested in implementing. Material can be input into the MRF in any one of many combinations from the two basic end points of fully commingled, or fully source separated.

In a fully commingled system mixed waste materials arrive completely mixed together. In this case, the wastes are brought into a processing facility and as many recyclables are removed as can be marketed. Existing mixed waste processing facilities are recovering between 25% -30% of the incoming wastes. While this achieves the requirements for diversion of 25% of the waste stream, it is felt that this is close to the maximum recovery rate for these facilities and a 50% diversion would be difficult to achieve using this technology. Additionally, as more recyclables are competing for a share of the limited market for these materials, the more contaminated materials from the mixed waste processing facilities are likely to be less acceptable, or receive a lower value.

In a fully source separated system each material type arrives at the facility separate from all others, or where only one material is recovered, as in a cardboard only collection from retail businesses. This concept breaks down when larger volumes of materials are recovered from large population centers.

All of the programs which fall between these two extremes are both source separation and commingled programs at the same time. The resident separates the recyclables from the garbage at the source, but commingles some or all of the recyclables with other recyclables, depending on the number of materials and the number of categories collected. In programs commonly considered to be source separation programs it is common for some of the materials to be mixed together, or commingled (i.e., aluminum and tin/steel cans in the same compartment, and then simply sorted with a magnet, or mixed color glass which needs to be sorted before sale), while others are fully separated (i.e., newspaper only). However, even when the materials are fully separated, someone needs to inspect them to remove any contaminants.

As we try to achieve higher diversion rates, a greater number of component material types are planned for recovery. From the residential waste stream, communities are investigating the recovery of mixed waste paper (junk mail), various grades of plastics (containers) and yard wastes, in addition to the more traditional cans, glass bottles, and newspaper. These materials could require a total of 12 separate compartments on a collection vehicle. But there is a limit to the number of separations which we can ask a citizen to do in the preparation of their recyclables, so more and more materials will be collected commingled. As a result, the degree

of mixing of materials should be based on the balance of the higher cost of collecting many separate materials and the higher cost of separating the mixed materials at a processing facility.

Therefore, almost all programs would include some source separation where the resident separates recyclables from garbage, but the degree of materials mixing and required sorting is the feature to be determined to meet local needs in planning your recovery program.

The residential waste stream is considerably more heterogeneous than the commercial waste stream. Often only two or three material types comprise over 90% of the wastes in commercial dumpsters.

Each of the source separation and commingled approaches has positive and negative aspects which should be explored. These include:

- Residential Waste - With source separation, the residential waste stream can provide a clean, easily recoverable source of recyclables. However, mixed residential garbage will result in increased contamination and a lower recovery rate. Some recyclable materials can be commingled with others and can be sorted out without contaminating the loads. These combinations are dependent on the specifications of the markets selected for the sale of the materials. For example, broken glass in baled aluminum or newspaper will lower their value, and ceramics in a load of glass makes the entire load totally unmarketable.

The move toward combined collection has been predicated on the need to keep collection costs down by using fewer vehicles, but today there are several well designed compactor vehicle types which will allow for the collection of several types of recyclables, or allow for the collection of source separated materials on the same truck as garbage, if this is desired.

- Commercial Waste - Commercial waste can be a relatively homogeneous stream of materials which can result in a high recovery rate. Specific target streams include cardboard from retail shops, high grade papers from office buildings, glass from bars and restaurants, and other materials from other sources. For these types of commercial establishments source separation of higher value materials and special route collection may lower the cost of waste disposal to the business, and be key to avoiding contamination while producing more marketable material.

The next level of program would be a collection of mixed dry recyclables. This material would be taken to a MRF for processing to recover the recyclables from the small amount of wastes. It is especially critical to keep commercial wet wastes (garbage) separate from dry recyclable materials for this type of program to work.

Design Criteria

Whatever the scale of the operation, certain fundamental design criteria are critical in the planning process. These include:

- Flexibility - to be able to respond to changes in the waste stream and market conditions, so that if new markets open up, or existing ones close down, the processing can accommodate the changes.

- Expandability - to be able to handle increasing amounts or types of materials. It should be realized that the MRF will be operational for over ten years, that conditions will change, and the increased diversion of wastes will become more important in the future, so that the facility design should be planned to accommodate this change.

- Simplicity - because unnecessary complexity can lead to operational problems later. Conveyors crossing over and moving materials unnecessarily may create problems in materials flow; or trying to sort too many things in too small an area may produce contamination.

- Reliability - to avoid shut-down of the facility due to equipment problems, it may be better to have redundancy of systems, two or more smaller sized pieces of equipment rather than one larger one. If most of the material is to be baled, and only one large baler is planned for and purchased, the entire system could become non-operational if there is a problem with the baler.

- Quality - to insure marketability of the processed materials, the MRF must be able to produce high quality materials which meet market specifications, especially as more communities begin or expand recycling efforts, and more materials become available in the marketplace.

- Integration - the Materials Recovery Facility should be integrated into other existing or planned diversion programs, such as source reduction and recycling, rather than replace them.

- Location - Proximity to transportation infrastructure, and adequate space and buffers from conflicting uses and other CEQA related issues should to be considered. Use of existing solid waste facilities, whether it be space at a landfill or the redesign of an existing transfer station, can ease the pressures of locating the MRF.

Design Issues

In addition, other design issues should be addressed at the beginning of the planning process. Issues such as sizing, layout, type of feed system, contamination, and staffing requirements should all be addressed. Some questions which should be considered include:

- Sizing - What is the appropriate size and scale for your facility? What amount of material will move through the facility? How many streams of input will you have? Will regional cooperation improve the economies of scale?

- Layout - The layout of the facility should be designed to reduce congestion from truck traffic and loader movement, handling problems from incoming vehicles, and weighing stations, unloading areas, in-feed conveyers, sorting stations, processing equipment, and residue management. Access to the equipment for ongoing maintenance is also critical.

- Building - The building size, expandability, aesthetics, durability, energy use (for lighting and heating/cooling), and visitor access are key factors. Further, it is important to insure that as the building is being designed that it is designed to local building codes.

  Adequate storm water runoff collection and landscaping are key factors for the area around the MRF.

- Sorting - The materials received at the MRF will be unloaded from a variety of truck types, and contain a variety of material types. These materials will have to be sorted into marketable categories. Most sorting is still done manually, with materials hand picked off of a moving conveyor. There are new technologies which allow some of the sorting to be done mechanically (these will be discussed later), although some visual inspection still needs to occur for most material categories to insure the removal of contaminants has properly occurred.

  The primary goal of the operation is to insure the efficient flow of materials through the facility. To be efficient a MRF must keep the materials moving, and reduce double handling. It is also important to minimize residue needing disposal while maintaining a low contamination rate in the sorted materials.

- Processing - For the most part, the materials sorted at MRFs are sorted into piles; either loose on the floor, or into surge hoppers or bunkers, where they are stored until processing (baling, granulating, crushing, densifying, etc). This reduces the amount of processing equipment needed, and reduces the likelihood of system shutdown if some of the processing equipment fails. However, at some facilities the material is conveyed directly to the next processing step, without storage. In these facilities, for example, each paper grade would be conveyed to a separate baler.

- Contamination - Generally the highest degree of contamination results from processing of mixed wastes; the more source separated the input materials, the lower the contamination. The commingling of only selected material types allows for a greater degree of sorting, and can result in a higher recovery rate for materials. The higher quality output can result in easier marketing and a higher value for the end product.

  The recyclables in mixed waste can become contaminated and result in a lower recovery rate. Decreased quality materials can be harder to market and may be used to make lower value products. This is an especially important issue given the increasing supply of recycled materials and tighter materials specifications by buyers.

- Staffing - Level of staffing needed to process the materials through the facility varies depending on the degree of mechanization. A highly mechanized facility will require less labor, but some hand sorting is still required and allows for greatest flexibility in processing.

  Worker safety issues, especially regarding ventilation and dust control, fire detection and control, light, noise, temperature are important considerations. Emergency exits, emergency equipment shut-offs, platforms access, guards on moving equipment, and overhead hazards need also to be carefully considered.

Recovery and Participation Rates

In the era of AB939, recovery rates are particularly important when considering a MRF or type of MRF. The amount of materials recovered is based on the participation of residents and businesses in preparing of the materials in an uncontaminated form. In part, the level of participation is based on the convenience perceived by the waste generator. Participation rates are not key determinants of recovery rates at a commingled, mixed waste recovery system since the participants may not be aware of their participation, but by providing a less separated, more contaminated material feedstock to the processing facility, the recovery rate may still be lower.

- Participation Rate - Unless source separation is mandatory, the amount of recovery from facility is largely dependent upon the voluntary participation in proper preparation of the materials by the residents or businesses. Without participation the diversion rate drops. It is critical that the residents and businesses become involved in the system to promote participation.

  Mixed waste processing means that all of the waste brought into the facility will be mixed. All of the generators will (maybe unknowingly) be participants in the program, but unless this is in addition to other source reduction and recycling programs, it may mean that the "recycling ethic" is ignored and that residents and businesses are not encouraged to reduce their wastefulness.

- Recovery Rate - The rate of recovery is partially dependent upon quality of input material. The amount of residue (i.e. contaminants, fines, etc), can be inversely proportional to the amount of separation at the source of generation. Powell, (Resource Recycling, October 1989) found that multiple sorting by the generator, source separation into several categories, can result in approximately 2-3% residue by weight, where some mixed bottle and can systems has residue levels as high as 20%. This is primarily a result of the breakage of the glass, with the loss in marketability of the smaller pieces of mixed color glass, and the loss of glass shards being shipped out with other materials.

As was mentioned before, contamination can result in lower recovery rate, especially for paper. It is important that a local jurisdiction do everything it can to ensure that a facility will recover enough material to meet the jurisdiction's waste reduction goals. It must be remembered that a jurisdiction, not a private recycler, is liable to financial penalties if the state mandates are not met.

Equipment Options

There can be a "continuum" of equipment needs. MRFs can be low-tech, labor intensive operations. MRFs need not be technologically complex. Increased mechanization can result in lower labor and operations cost, but have higher capital costs. In addition, increased mechanization can mean more frequent breakdowns. To avoid problems related to facility shutdowns, equipment redundancy and internal storage of both processed and unprocessed materials must be built-in.

Equipment which is used should be of heavy duty, quality construction, designed for maximum performance; it should require a minimum of service and maintenance, and should receive all maintenance required; the more standard the parts, the easier the maintenance; component sections of the processing system should be integrated; the equipment should include all possible safety features, and finally, all equipment should be purchased based on life cycle costs, not just initial purchase. Some of the types of equipment used in MRFs include:

- Scales - Scales are used to weigh and credit incoming material, and to weigh loads as they are shipped out to market. Scales come in a variety of sizes and levels of accuracy, and the scale selected should match the purpose intended. A large scale will be necessary for weighing incoming recycling vehicles, and for weighing truckload shipments of processed materials to market.

- Loaders - Loaders are used to move loose materials around the facility. They also come in a variety of sizes and fuel type requirements. When operating equipment inside an enclosed facility, consideration should be given to use of electric or propane powered vehicles. Primarily, loaders are used to push materials onto conveyer systems which move the materials to processing lines.

- Forklifts - Like loaders, forklifts come in a variety of sizes and fuel types. Mostly they are used to move containerized material around the facility, and to move baled and densified material into storage, and at time of shipment into trucks and on to trailers.

- Conveyers - Conveyors are used to move material through the facility in one of two capacities. Conveyors can be used to move materials along while sorters pick selected recyclables or discards off of the moving belt; or they can be used to move sorted materials to be mechanically processed, for example, sorted paper to be baled.

- Trommels - Trommels are used to separate larger materials from smaller ones. Trommels are large rotating drums with holes in the surface. The holes can be varied in size along the length of the drum, so that the small holes at the infeed end allow small pieces to drop out, then larger holes further along the drum allow larger pieces to drop out; and finally, the oversized materials drop out the end of the drum. This sorting process eliminates the need to hand pick material of various sizes from a belt, allowing for a cleaner sort as the small pieces are not hidden by the larger ones on the belt.

  However, the rotation of the drum is likely to break any material in the drum which is subject to breakage, especially glass, but also including other recoverable materials, and so must be used at the appropriate point in the processing system if it is not to have negative impacts on the marketability of the recovered materials.

- Vibrating Screens - These are used to separate larger or lighter materials from smaller, heavier materials. The size of the mesh may be varied to separate different materials, or several screens may be stacked with separate discharge areas to allow for multiple size sorts with one machine. The vibrating screen causes less breakage of glass than the trommel.

- Magnetic Separators - These are used to mechanically separate steel cans and other ferrous metals from other materials, especially aluminum cans, as a primary sort; and to remove contaminant iron from other materials such as glass or wood. Steel cans and other scrap metal pieces are removed from glass prior to returning it to a furnace to make new products; and nails and other metals are removed from ground wood before it is shipped to market as fuel or compost.

- Air Knives and Classifiers - These are used to separate lighter (i.e., plastic) containers from heavier (i.e., glass) containers.

- Balers - Balers are used to densify a wide variety of materials, including old cardboard containers (OCC), old newspapers (ONP) and other paper, for plastics, textiles or other light weight materials for more efficient transport. Balers are available in a wide range of sizes and capacities, and with a wide range of special features. Balers are typically the most expensive single piece of equipment in a processing facility.

- Granulators - These are used to chop plastics into small pieces which allows for more efficient transportation.

- Densifiers, Flatteners and Blowers - Densifiers are used to compress loads of aluminum cans into blocks, or individually flatten them, for more efficient transportation.

- Crushers - Crushers have been used to densify glass for more efficient transportation. However, as a full load can easily be achieved without crushing the glass, and as it is much more difficult to remove contaminants from crushed glass, these machines are not in widespread usage any longer.

- Bins - Bins are commonly used to store recyclables and residue before processing or shipment to market. Bins and debris boxes come in a variety of shapes and sizes, and can be moved or lifted by a variety of mechanisms.

Market Issues

Increased competition in the marketplace means that the market demands a higher quality material. A MRF must be able to produce high quality materials and be able to respond to increasingly strict materials specifications. Again, some source separation prior to input into the facility can ensure higher material quality. When making a decision on MRF design, conducting a survey of potential buyers of materials may be prudent. For some materials, such as aluminum, ferrous metals or plastics, source separation vs. mixed waste processing may not be an issue. However, there has been concern expressed by buyers of glass, and paper that mixed waste processing lowers the quality of the material recovered. Again, increasing competition for materials markets may mean that material which is acceptable today, may not be able to be sold tomorrow. Source separation programs facilitate easier location of willing high value markets.

Markets are available to a full range of recycling programs from very small volumes to very large operations. Making an effort to locate the best available market will be well worth the effort. In identifying markets, communities should look at the local, regional, national and international markets. Determine the best market opportunities by contacting a variety of buyers for each material type which will be recovered. Buyers can be located by asking operators of their recycling programs; checking the telephone directory for recycling companies, waste paper dealers, and scrap metal buyers. The CIWMB provides a quarterly report on the status of markets for recyclable materials. The California Resource Recovery Association, a state recycling association, will also be able to provide assistance.

Cooperative marketing may be a method used to provide economies of scale for transportation to markets and increased competitiveness for small jurisdictions or small facilities against larger jurisdictions. Quality of material is very important in these situations because contamination from one jurisdiction may mean that material collected from many jurisdictions

will be rejected. If a jurisdiction is marketing cooperatively, it must ensure a consistent commitment to material quality from the other participating jurisdictions.

Flow Control

The flow of materials to a MRF can effect, or be affected by, other recycling activities. Financing decisions would most likely be based on a projected revenue for the operation. Since the main components of revenue are usually tipping fees charged at the gate, and revenue from the sale of recovered materials, it is important to insure that the projected materials do arrive at the facility for processing. Also, incentives must be built in to insure maximum quantity and quality of end product. However, directing large portions of the waste stream to the MRF could negatively effect existing recyclers. When siting a MRF, integration with existing programs, rather than competition with them, should be a priority.

Conclusion

Most of the options listed are designed to optimize the amount of materials which can be diverted from landfill, and provide materials for recovery. There is no single system which is the best. Local decision makers should carefully consider the options which will provide them with the program which most closely matches the needs of their community.

SECTION 3

MATERIALS RECOVERY FACILITY OWNERSHIP, FINANCING, CONTROL, AND RISK ALLOCATION

Introduction

A jurisdiction(s) must determine the legal and financial framework which it intends to employ for the development of a materials recovery facility (MRF) within the geographical confines of a Service Area.

Then it must address a number of issues related to the Ownership, Financing, Control, and Risk allocation of such a facility. All of these issues are inter-related and depend, to a large degree, on the decisions which a jurisdiction makes regarding the following:

1. Preference for public or private ownership and control;
2. Method of financing;
3. Risk allocation between the private and public;
4. Desire for proven technologies and vendors; and
5. Capital and operating costs.

1. Ownership of a MRF

Theoretically a jurisdiction faces a spectrum of procurement and ownership options, from exclusive private development, operation and ownership to exclusive public enterprise. However the realized option will probably be a mix - a public/private partnership. For example, a jurisdiction may choose to own a MRF but procure design/engineering/construction from private architects/engineers/contractors. Such an arrangement may be referred to as a "turnkey" contract if the private contractor designs, constructs and starts-up the MRF, and meets performance tests prior to drawing down its final installment of payment. Some jurisdictions may also retain a private operator for their publicly owned facility. This may be especially true of MRFs, where public jurisdictions do not have experience in materials separation and marketing. One consideration to keep foremost in mind when making the public/private ownership decision, is that tax-exempt bond financing for publicly owned facilities - even those operated by private operators - do not require volume cap allocation (imposed on each State by the U.S. Internal Revenue Code to limit the amount of tax exempt private activity bonds with can be issued each year).

A final decision regarding a jurisdiction's preferred method of ownership of a MRF will involve consideration of:

1. Degree of control which a jurisdiction wishes to maintain over a MRF, particularly determining what materials are recovered, and how they are remarketed;

2. Risk allocation between the private sector and a jurisdiction;

3. The impact of capital and operating costs on the net cost of waste disposal for a jurisdiction.

There is a direct relationship among these various matters. For example, should a jurisdiction wish to pass more risk along to the private sector, then it can expect to pay a higher cost for waste disposal for such risk avoidance. Similarly, the greater the level of control which a jurisdiction wishes to impose on a MRF, the greater the likelihood that it will be a publicly-owned facility. Furthermore, the financing costs associated with private ownership may be greater than public ownership.

Advantages of Public Ownership

The principal advantages associated with public ownership of a MRF are as follows:

1. The possible use of certificates of participation bonds (COPs) to finance the MRF. The issuance of COPs can normally be expected to have a somewhat lower interest rate, lesser bond issuance expenses, and a lower annual debt service payment than the issuance of a similar amount of revenue bonds.

   In addition, waste system revenue bonds might be used to finance the MRF on a tax-exempt basis. Although uncertainty in waste composition (especially over the long term) and marketing revenues do not make MRFs good candidates for project financing, the pledge of a jurisdiction's enterprise fund comprised of revenues from an integrated waste system can form the basis for issuing ratable, marketable tax-exempt bonds, which can be expected to have a lower interest rate than taxable borrowings by a private vendor for a private MRF.

   Lastly, an important tax advantage should be highlighted: tax-exempt bonds issued for a publicly owned MRF, even though they may be private activity bonds because of long term operating agreements with private vendors, nevertheless do NOT require volume cap allocation from the State. (Private vendors which wish to borrow on a tax-exempt basis must compete with other private activities for a limited amount of the State's volume cap allocation, which restricts the amount of tax-exempt private activity bonds which can be issued annually within the State.)

2. The possibility of lower annual operating and maintenance expenses of the MRF as the MRF will not incur an annual management fee by a private vendor. A jurisdiction can anticipate that a management fee would cost from 10 to 20 percent of the annual operating and maintenance expenses of the MRF. However, such potential savings must be weighed against the facts that a private owner may have greater operating experience and perhaps greater incentive to efficiently operate the MRF. The effective management of a MRF requires certain specialized expertise which is not typically available. Furthermore, if the private operator knows that he/she is responsible for the operation of

the MRF over the long term (e.g. a 10-20-year period), he/she may be more inclined to undertake all required maintenance, renewals and replacements on a timely basis.

3. Continued ownership by a jurisdiction of a MRF upon termination of the service agreement. Depending upon the quality of the equipment originally installed, if the MRF is properly operated and maintained on behalf of a jurisdiction, and if all required renewals and replacements are made on a timely basis, the MRF could be expected to have a useful life of 10 to 20 years. If a MRF is privately owned, a private party will own the MRF upon the termination of the Service Agreement which may terminate when the MRF has residual value and useful life remaining. (Note, however, that purchase options could be negotiated.)

   If a jurisdiction has a service agreement with a private party, it might negotiate up front the option to renew the agreement for additional terms, corresponding with the remaining useful life of the MRF. Alternatively, in lieu of renewal, the jurisdiction might negotiate a purchase option, for a price equal to the unamortized portion of capital cost of the MRF, plus a bid residual value.

   Many jurisdictions feel that without public ownership (or the sorts of renewal or purchase options just described), a private owner can exact huge fee increases at the end of a short or mid-term service agreement. The jurisdiction has no leverage at the end of the service agreement term. Contrarily, if the jurisdiction owns the facility and has an operating contract with a private operator, it can replace the operator at the end of the operating term more easily than it could find a nearby service provider.

4. The potential to realize increased operating revenues from the sale of materials in the event the price of materials should significantly increase. Such increase in the price of materials would result in a lower cost of waste disposal to the jurisdiction. It should be noted that there is also the potential risk of a future decrease in the price of materials which would cause the net cost of disposal to increase. But similarly, if a jurisdiction enters into a put-or-pay service agreement with a private MRF vendor and the agreement provides the fundamental credit for a private activity bond issue to finance the private facility, then arguably the jurisdiction should be rewarded by keeping recovered materials revenues. (A put-or-pay agreement would provide that the contracting party assumes the risk of deliveries. Most public entities have legal constraints on the degree to which they can enter into put-or-pay obligations which would result in payment for no services.)

5. Greater control over the actual operation of a MRF. This is perhaps more important in the case of a MRF than a landfill or waste-to-energy facility, because the jurisdiction is developing MRF capacity, whether at a large scale, centralized facility or several smaller facilities, to help it meet waste diversion mandates, not merely to dispose of waste. If the jurisdiction does not meet the diversion mandates, it can be fined up to $10,000 a day. A private vendor develops a MRF to create a successful, profitable business enterprise. Consequently the interests of a public jurisdiction and private vendor differ, as do their economics. For example, a municipality might find it profitable to separate and sell certain component materials at a loss, which makes economic sense on an avoided cost basis (both alternative disposal costs and avoided penalties).

6. Greater flexibility in choosing a procurement approach when selecting a vendor to construct and operate a MRF, as it allows the jurisdiction to choose from among architectural and engineering, turnkey contractor and full-service vendor approaches.

7. A less complicated financing, since debt issued to finance public facilities, paid as a general or enterprise fund obligation, for example, are less complex to structure and issue than private activity (industrial development) bonds, where vendor or project credit may be weaker and require credit support.

Advantages of Private Ownership

The potential advantages associated with private ownership of a MRF include the following:

1. Vendor performance guaranties, whereby the vendor assumes the risk of technology failure and covenants to pay damages for failure to meet performance guaranties.

2. The private vendor will offer long-term performance guarantees for the operation of the MRF. Such long-term guarantees should include waste processing capability (including throughput and materials separation guarantees, by components and/or in aggregate, as well as the converse residue guarantees), plant availability, (especially if the municipality is not the vendor's only customer at the MRF) and environmental guarantees. (This advantage could also be made available under public ownership by entering into a long-term operating contract with the vendor).

3. Ability of the private owner, during the operating period, to utilize teams of technical specialists who are already employees of the private owner. Such technical specialists will be available to the MRF for both periodic and routine maintenance as well as for extraordinary repairs to the MRF. (This advantage could also be made available under public ownership by entering into a long-term operating contract with the vendor).

4. Ability of the private owner to make use of the prior experience which the vendor has obtained in the operation and maintenance of similar facilities. This can be important, since MRF technology and operating records are relatively new and experience limited (although again, the municipality could obtain this advantage also through a long-term operating agreement).

5. Guaranteed operating and maintenance fee subject only to increase in some agreed upon index. Therefore, if a MRF is more expensive to operate than originally anticipated, the private vendor will have to pay such increased costs out of the management fee. (This advantage could also be made available under public ownership of the MRF by entering into a long-term operating contract with the vendor).

6. Possible infusion of equity capital by the private owner as part of the financing of the MRF. Private owners can invest their own capital into the project, reducing the amount they need to borrow to complete construction. This reduces the aggregate amount of interest payments (debt service) and possibly the capital cost. Since the Tax Reform Act

of 1986 there are less tax advantages accruing from private ownership, so there are less tax reasons to own facilities and contribute equity.

However, equity may still be needed to fund issuance costs for private activity bonds, since the internal revenue code limits the amount of issuance costs payable from private activity bond proceeds to 2%. This limitation does not apply to tax-exempt bonds issued for a publicly owned MRF, which do not constitute private activity bonds e.g. by virtue of a long-term operating agreement with a private vendor.

7. The possibility for optimizing the efficiency and waste reduction capabilities of a MRF, if the contractor has an economic incentive tied to the ownership of the MRF. Of course, a private operator of a publicly owned MRF could also negotiate a revenue sharing arrangement to provide it with economic incentive.

8. If the MRF is financed with private activities (industrial development) bonds with repayment of the bonds guaranteed by the private vendor, the creditworthiness of a jurisdiction will be maintained by not relying on them to serve as the "deep pocket" (i.e. someone with large capital resources) for the financing. The ability to do this will be dependent upon the creditworthiness of the selected vendor.

There are a number of other important items which must be considered by a jurisdiction as part of the question of ownership. It is important for a jurisdiction to address such additional issues and begin to formulate their preferences with regard to ownership. Because of the relatively small difference in cost between public and private ownership of a MRF, questions of risk and control may become more important to a jurisdiction in determining its preference for ownership.

Based on a jurisdiction's previous experience with waste or other utility projects, there is a likelihood that a jurisdiction may determine that a MRF be publicly owned. There may not be an overwhelming economic incentive for the MRF to be privately owned. There is no one simple answer to this question as a jurisdiction must continually evaluate the different areas of risk, both technical and economic, and then determine what best meets their overall objectives.

There are several different combinations available. For example, one possible option for a jurisdiction, which should help manage the technical risk of a MRF, while at the same time maintain a significant level of control over the operation, would be the following:

1) A MRF could be publicly owned.

2) A jurisdiction could negotiate a contract with a financially-sound vendor for the design, construction, and performance testing of a MRF for a fixed construction price. Such a contract should include performance level guarantees and the provision for the payment by the vendor of liquidated damages in the event of failure to meet the required levels of performance. The measure of such damages should include the alternative costs of processing, not merely disposal, if the jurisdiction needs the MRF to meet its diversion mandate, and the cost of any consequent penalties that are assessed by the State. In addition, if the jurisdiction shares revenues, it should be compensated for lost revenues.

3) A jurisdiction could also negotiate a long-term contract with the same vendor to operate a MRF for a fixed annual amount, subject to increase with changes in some index. The operating contract could also include certain performance incentives and perhaps materials revenue sharing provisions.

However, even this option is not risk-free and is not likely to be the least expensive. A jurisdiction must evaluate those items of risk which are associated with the possible ownership options. The areas of risk can be effectively managed by a jurisdiction, but they cannot be completely avoided.

2. Methods of Financing

As previously mentioned, there are several alternative methods of financing a MRF. Presented below is a discussion on such alternatives.

Certificates of Participation

It is conceivable that a jurisdiction could issue obligations (like COPs) to pay for a MRF. The principal advantages of issuing COPs for a project of this type are: (1) it is likely to result in a lower interest rate than revenue bonds; (2) the cost of issuing the COPs is lower than other options; and (3) COPs are generally easier to market than revenue bonds.

However, in spite of such advantages, the use of COPs to pay for projects of this type is generally not recommended. Many communities are faced with general fund budget restraints. Since MRFs are capital intensive, communities could find it difficult to finance schools, hospitals, and other public work projects by budgeting from their general fund for a MRF. This is particularly true since a MRF of this type can be developed to be a revenue producing project (or system component) capable of repaying revenue bonds.

Municipal Revenue Bonds

A jurisdiction may be able to issue revenue bonds to pay for the capital costs of a MRF. Revenues from tipping fees for processing and from the sale of materials could be pledged to pay the principal and interest on the revenue bonds. Depending upon the ownership of a MRF, a commitment may be required of a jurisdiction to pay whatever level of tipping fee is required to guarantee the repayment of the revenue bonds.

A jurisdiction with an integrated waste system and enterprise fund, accounting for waste revenues and expenses separate and distinct from the jurisdiction's general fund, may also be able to issue revenue bonds payable from the system, (e.g. multiple waste disposal and diversion facilities; landfills, MRFs, composting facilities, transformation, etc.) not just MRF revenues. Given the uncertain economic projections for MRFs, the trend is towards system, not project financing.

For a more detailed discussion of municipal bond financing, please see Appendix C, "Introduction to Municipal Bond Financing of MRFs" by Constance Hornig, Esq.

Industrial Development Bonds

A tax exempt or non-exempt private activity bonds (or Industrial Development Bonds (IDBs)) may be a very viable option if a jurisdiction opts for private ownership. The issuance of IDBs may be similar to municipal revenue bonds regarding an unprovisional commitment on the part of the participating municipality(s) to pay off the bonds i.e. entering into a service agreement with the private vendor which provides for service payments sufficient to pay contracted operating and maintenance expenses plus debt service. Such a requirement will depend to a large degree upon the creditworthiness of the vendor.

IDBs of similar quality to the aforementioned municipal revenue bonds can be expected to bear the same rate of interest as municipal revenue bonds. The major advantage of IDBs is the possible infusion of equity by a private vendor. The jurisdiction will eventually have to review with their legal counsel and financial advisor the amount and the availability of volume cap allocation for industrial bonds in the State. Each project will vary in its ability to meet requirements and availability of IDBs. However, IDBs could provide additional incentive for private ownership.

3. Control of a MRF

A jurisdiction's control over MRF operations will vary, depending upon its dependance upon MRF separation for meeting diversion mandates, and upon its relationship with a private owner/service provider to the operator of its public facility. Control over MRF operations may include determining what items are picked (which may be market dependant) as well as where recovered materials are sold. (A Jurisdiction may prefer local markets.) Whether a jurisdiction enters into a service agreement with a private owner/service provider or an operating agreement with a private operator, part of the service fee or operating fee may be revenue sharing with the service provider operator. Their revenue share provides them greater incentive to maximize materials recovery. The ability to direct market sales may be related to revenue sharing. A jurisdiction may be willing to accept lower revenues in order to assure feedstock for a local market, whereas a private party which has less policy reason to support a local market may prefer to market materials for the highest cost, regardless of market location.

A jurisdiction can maintain the greatest level of control of the MRF by assuring that it is publicly owned. If a jurisdiction decides that public ownership is the preferred method, then it is recommended that serious consideration should be given to entering into a service agreement with the private vendor for the operation of a MRF. This will allow the jurisdiction to obtain the technical expertise possessed by the vendor; will provide incentives to the vendor during design and construction of the MRF; and will allow the jurisdiction to maintain a high level of control over the MRF.

In the event the MRF is owned and operated by a private party, a jurisdiction may wish to maintain some form of control over the construction and operation. During construction, a jurisdiction would have the option of having their representative monitor the design, installation, and construction. The level of monitoring can vary from a simple periodic review of construction and authorization of progress payments to continual on-site observation of design and construction. The purpose of such monitoring is to assure a jurisdiction that the MRF actually being built is in accordance with the plans and specifications set forth in the construction contract.

Following completion of construction, the jurisdiction will want to be represented during the Acceptance and Performance Testing Period. An acceptance test protocol will be developed which will

determine how the tests will be conducted, witnessed, and analyzed. The tests will generally be from 14 to 30 days in duration and will be designed to determine that, as constructed, the MRF is capable of meeting, at the minimum, the following performance guarantees:

1. Waste throughput and separation (and conversely, residue);

2. Flow rates;

3. Plant availability (i.e. hours per day and/or days per year of operation).

Once a MRF has passed all performance tests and been placed in commercial operation, the jurisdiction may wish to maintain further control by implementing either of the following measures: (1) periodic visits and reviews of the operation of the MRF by the jurisdiction; or (2) preparation by an independent engineer of a periodic survey and report on the operation and maintenance of the MRF.

It is also recommended that if the MRF is privately owned, a jurisdiction enter into a service agreement with a term that coincides with the term of any bonds issued to finance the facility. (Rating agencies want the assurance that while bonds are outstanding, there will be service fees paid and revenues received to pay off the bonds.) It is also recommended to negotiate an option to renew for an additional 5 to 7 years. The option will allow a jurisdiction adequate time to make alternative arrangements for waste disposal in the event of some unforeseen problem in the future.

Summary

The jurisdiction should be able to maintain proper control over the construction and operation of the MRF, whether it is publicly or privately owned, by including provisions in the various contracts which allow the jurisdiction to maintain an active role. Obviously, the greatest level of control will be able to be maintained under public ownership, but this also assumes and requires that the public owner has the required skill and expertise to maintain control.

If the MRF is privately owned, there is the possibility that upon termination of a waste disposal service agreement, the private owner could decide to refuse to take solid waste from the service area and opt to take solid waste at a higher tipping fee from other areas. However, this possibility is likely to be of relatively low risk to a jurisdiction because of the economics associated with long distance hauling solid waste from outside the Service Area. Furthermore, at the termination of such a service agreement most major generators of solid waste will have been required to find alternative means of proper waste disposal.

4. Risk Allocation

The development of a MRF carries certain inherent risks related to technical, environmental, and economic aspects. Generally speaking, the more risk which the public sector wishes for the private sector to assume, the more the MRF will cost to construct and operate. Furthermore, there are certain items of risk which will be borne by the public sector under any circumstances. Presented below is a discussion of the major items of risk associated with a MRF and an identification of the party generally responsible for assuming such risk under either a turnkey or full-service vendor approach to procurement. A summary of this information is presented on Exhibit III-1.

Technical Risk

A. The MRF fails to meet its performance guarantees with regard to the following:

1. Recovery rate (aggregate and/or component): the aggregate percentage of recovered materials that will be recovered (e.g. X% of a waste stream) and/or percentage of component materials that will be recovered (e.g. X% of glass, Y% of aluminum, Z% paper, etc.).

2. Materials throughput: the MRF processing capacity - how many tons per hour/day/week, etc. it can handle.

3. Residue fraction: how much waste remains after separating the recovered materials, either non-recyclable waste in a mixed waste stream, or broken or contaminated materials in a source-separated stream.

4. Safety: adequate protection (in accordance with OSHA or generally accepted standards in the industry) of workers, with respect to all operations (particulate, sharps, automated machinery).

5. Energy consumption: electric, gas and water use guarantees. (This is especially important if the jurisdiction pays utilities as a pass through cost in their service or operating fee.)

Financial Risk

A. Capital cost overrun.

The vendor should submit a fixed price bid for design/construction/start-up/testing, subject only to agreed escalation. (This might be one escalator such as a consumer price index applied to the total bid, or a combination of escalators related more particularly to labor, steel, materials, etc. applied to related line items in the bid or the corresponding percentage of the total bid.) Note that the definition of uncontrollable circumstances (called "force majeure" in contracts) which excuse performance should be closely scrutinized. Acts of God, like earthquakes and storms are standard exceptions, but strikes and changes in law are negotiable.

B. Operating expense overrun.

Similarly, vendors should submit a fixed price bid for operations, subject only to agreed escalation, as described above. Many operating fees will contain passthrough costs for items with costs that are difficult to project, like insurance or utilities. These are not incorporated into the fixed fee.

C. Miscalculation in the quantity of solid waste.

The owner will size its facility based at least in part upon the amount of waste that the jurisdiction contracts to bring there for processing. (It may have other contracts and/or over-build capacity in order to serve waste on a spot market basis.) If the facility receives less waste than projected or committed, its economic feasibility is threatened.

D. Reduction in the price of materials.

Together with uncertainties in waste stream composition over long periods of time, uncertainty in markets and market prices make it difficult to obtain financing for MRFs on a project basis and for developers to project profits. The public/private partners may share revenues - or lack thereof.

Ownership

A jurisdiction's decision regarding ownership of the MRF is likely to revolve around questions concerning risk management, allocation and control of the MRF. There are no apparent significant economic advantages between public or privately owned facilities.

Methods of Financing

A jurisdiction should look at the advantages of each of the financing options available. Revenue Bonds are recommended when the spread between COPs and Revenue Bonds is small. If a jurisdiction opts for private ownership of a MRF, Industrial Development Bonds may be a viable option.

Control

A jurisdiction will be able to maintain the greatest level of control over the construction and operation of a MRF if it is publicly owned. However, even if the MRF is privately owned, the jurisdiction has the opportunity to enter into contractual arrangements which will allow them to maintain a sufficient level of control over a MRF by undertaking continual monitoring during the construction and operation phases.

Risk

The major areas of technical and economic risk have been identified earlier herein. It is unlikely that all items of risk will be able to be completely avoided. Furthermore, there will be a trade-off

between cost and risk avoidance. Generally speaking, however, a jurisdiction can anticipate that specific items of risk will be allocated to that party who is in the best position to control the risk. There are experienced and established vendors capable of providing the jurisdiction with an environmentally and technically sound MRF. These same vendors can be expected to assume those items of risk for which they are qualified to control. The jurisdiction should familiarize itself with the items of risk, determine what is important, and then think about how it wants to negotiate a contract which properly allocates the risk between the jurisdiction and the selected vendor. Assistance from experienced legal, financial, and technical advisors will allow the jurisdiction to properly manage risk during all phases of the development of the MRF.

RISK ALLOCATION

ITEM OF RISK

TECHNICAL

(1) Faulty technology -- impossibility of performance at any price

(2) Performance shortfall -- project performs acceptably but below guaranteed levels

(3) Unsuitability of site for the project

(4) Project inability to comply with existing environmental laws

(5) Uncontrollable circumstances -- change in environmental or other law

ECONOMIC

(1) Uncreditworthiness or bankruptcy of Vendor -- inability to build or operate the project at contract price or to pay damages for failure of performance

(2) Uncreditworthiness or bankruptcy of Municipalities - inability to pay disposal charge or increases due to uncontrollable circumstances

(3) Hyperinflation/Deflation

(4) Unavailability of insurance

(5) Cost of landfill for residue disposal and backup

(6) Deflation of market price of materials

ITEM OF RISK

CONSTRUCTION

(1) Actual construction cost exceeds construction contract price

(2) Delay -- Failure of project to meet scheduled acceptance date

(3) Force Majeure Event/Change in Law

(4) General project mismanagement by Vendor

(5) Uncontrollable circumstances -- strikes or other labor matters non-site or project related

(6) Strikes or other labor matters site or project related

(7) "Walkaway" -- refusal or practical inability by any party to perform its contract

(8) Failure to meet Performance Guarantees

OPERATING

(1) Actual operation cost exceeds operation contract price

(2) Durability -- ordinary course of business repairs and replacements exceed allowance for them in operation contract price

(3) Unavailability of back-up landfill for residue

(4) Unavailability of waste tonnage committed due to mis-estimates or failure of flow control

(5) Uncontrollable circumstances -- strikes or other labor matters non-site or project related

(6) Strikes or other labor matters site or project related

(7) "Walkaway" -- refusal or practical inability by any party to perform its contract

(8) Force Majeure Event/Change in Law

(9) Utility Purchase Price higher than anticipated

(10) Change in waste composition

(11) Facility non-performance

SECTION 4

REGULATORY AND LEGAL ISSUES

Introduction

There is a proliferation of MRFs in this country - growing from two facilities between 1981 and 1985 to the 54 that are scheduled to begin operating by the end of 1991[1]. Although MRFs were originally confined to the Northeastern United States, California now has more MRFs than any other state, with 24 (45%) of the MRFs in the country.

Although the public sector is the major force encouraging recycling, it is not as dominant in terms of being responsible for the building and operation of MRFs. The current trend is toward private sector operation. The percentage of privately operated MRFs has increased from 45% in 1990 to 55% in 1991. In terms of ownership, the private sector owns approximately 73% of all operating facilities and operates 82%. Both figures have increased slightly from last year when 66% of operating facilities were publicly owned and 79% were privately owned. Evidence gathered in a 1991 Biocycle survey on planned MRFs seems to indicate that the shift toward private ownership and/or operation will continue. Of the 49 projects that have determined ownership arrangements, nearly 90% will be operated by the private sector and slightly more than half will be privately owned.[2]

Issues Facing MRFs

In addition to decisions surrounding public vs. private facility ownership, there are other major issues facing MRFs. These issues include but are not limited to:

- determining who "owns" waste or when material is declared waste. Traditionally flow control began and ended at the curb when trash was discarded. However, recent legislation encouraging recycling has created an economic interest in determining ownership rights to recyclable goods and prompted a reexamination of our definition of waste;

- resolving land use issues. NIMBY (not in my back yard) has, at least in Johnstown, Rhode Island, given way to YIMBY (yes in my back yard). Ultimately, this conflict must yield to integrated waste management being an issue that is, "in everybody's back yard";

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[1] *BioCycle*, July, 1991: "Sorting the Mix at Materials Recovery Facilities, pages 30 - 37.

[2] *Ibid.*, page 32

- designing facilities that are flexible enough to respond to constant changes. A MRF should be able to: keep careful record of the quantity and source of materials diverted, recover additional materials as the number of materials given redemptive value to encourage recycling increases, respond to changing legislation, accommodate changing amounts of throughput, plan for fluctuating price cycles and the impact of ADFs, etc.;

- standardizing waste definitions (i.e. mixed and waste paper). Without standards, definitions can change annually, not only from jurisdiction to jurisdiction, but intrajurisdictionally;

A full treatment of these issues is beyond the scope of this paper. However to provide a thorough introduction to the regulatory issues facing MRFs, this section discusses flow control, siting and permitting of facilities, and diversion credits as relates to the California Waste Management Act.[3]

Flow Control

The viability and success of a materials recovery facility depends on a predictable stream of material. As the integrated waste management system becomes more sophisticated and regulated, ensuring the economic viability of these facilities will become more difficult, thus requiring constant innovation and flexibility. An increasing number of jurisdictions are relying on legislation to control the waste stream. State laws and local ordinances authorizing restrictions on disposal sites and collection practices are common. This approach is designed to eliminate competition in solid waste collection and disposal arrangements for the sake of the "public interest". To implement the program, the governmental agency customarily issues revenue bonds, signs contracts, and sets fees. Typical agreements involve long-term guarantees (10-20 years), franchise agreements and determining where "flow control" begins to ensure that minimum tonnage guarantees are met. Put-or-pay contracts, which require that the contractee pay for a specified minimum tonnage whether they meet that requirement or not, are also common. These contracts may be displaced by new processing technology or citizens' successful recycling efforts (including taking recyclables elsewhere) and have the potential to create a tremendous financial burden. If facilities are built too large for available throughput, owners/operators could have a "white elephant" with which to contend.

Because of its obvious and intended anticompetitive effects, legislated waste flow control has led to court challenges on antitrust grounds wherever it has been introduced. However, these ordinances have been upheld in court. The case of Central Iowa Refuse Systems, Inc. v. Des Moines Metropolitan Area Solid Waste Agency, 715 F. 2d 419 (8th Cir. 1983) concerned an ordinance requiring all solid waste generated in participating jurisdictions to be sent to the

[3] Other, pending legislation is discussed in Appendix D.

defendant agency's landfill. The ordinance was upheld as a, "...necessary or reasonable consequence..," of, engaging in the authorized activity of constructing a waste disposal facility with funds raised by revenue bonds.[4]

Municipalities that engage in noncompetitive solid waste collection and disposal practices no longer face budget-breaking liability for money damages in federal antitrust suits. The Local Government Antitrust Act of 1984 (P.L. 98-544) limits successful plaintiffs to injunctive relief, that is, an order forbidding the city, town, sanitary district, or other unit of local government from engaging in legal actions. The law also extends the same protection to haulers and other private persons and firms who benefit from an exclusive municipal franchise. Roughly 300 antitrust suits were pending against municipalities when the law took effect. In these cases, a plaintiff may still seek money damages unless the local government defendant shows that it would be unfair (considering, among other things, how far the lawsuit has progressed) to allow the plaintiff more than mere injunctive relief.[5]

One example of flow control can be seen in an ordinance enacted by both San Diego City and County. San Diego City and County recently enacted a mandatory recycling ordinance which includes the following five primary components:[6]

1) Designation of materials to be recycled from residential, commercial and industrial sources;

2) A requirement that all collectors providing services in the unincorporated areas must provide their customers with collection of designated recyclables in accordance with the regional schedule;

3) A requirement that waste generators in the unincorporated areas of the County must store designated recyclables separately from solid waste for pick-up;

4) A prohibition against disposal of designated recyclable materials with mixed refuse at County solid waste facilities and a schedule for implementing enforcement measures;

5) An exemption from inspection for vehicles carrying loads from cities which have adopted and are diligently enforcing approved recycling provisions similar to this ordinance.

Both the City and County ordinances went into effect in August, 1991

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[4] Solid Waste Handbook, 1986, William D. Robinson Editor, Page 152 and 153

[5] *Ibid.*, Page 153

[6] County of San Diego, Mandatory Recycling Ordinance, Sec. 68.501 - 68.590

Siting

Permitting a Materials Recovery Facility

Facilities that receive mixed solid waste (MSW) for the purposes of manually or mechanically segregating various recyclable or reusable components of the waste stream, with residual waste being transferred to a landfill or transformation facility, are defined as transfer/processing stations, pursuant to Public Resources Code (PRC) Section 40200 and requires Solid Waste Facilities Permit (SWFP) concurred in by the State, pursuant to PRC Section 44001 *et seq.*

Materials Recovery Facilities which receive segregated materials for the purposes of densifying, baling, shredding or otherwise processing the materials for marketing to end-users with greater than 15 cubic yards of residual solid waste generated per day also require a SWFP. The "15-cubic-yard" standard is a policy derived from existing regulation, Title 14, California Code of Regulations (CCR), Section 17421. This policy shall be used until the California Integrated Waste Management Board has been able to fully consider the subject and/or adopt clarifying regulatory changes or recommend legislative changes, if necessary.

Siting a Materials Recovery Facility

The decision for the siting of any Solid Waste Facility rests with local government. When choosing a site, consider that the owner/operator must demonstrate that the facility can be constructed and operated in a manner which minimizes adverse impacts on the environment and complies with state and local standards. The CIWMB will confirm that these items have been considered before concurring in the issuance of a Solid Waste Facilities Permit.

Obtaining a SWFP

The solid waste facilities permitting process is initiated by submittal of a solid waste facilities permit application. A complete application package includes:

1. A completely filled out application form. (Attachment IV -3)

2. A Report of Facility Information. A Report of Facility Information is a document which defines the design and operation of various types of solid waste facilities. The reports required for Materials Recovery Facilities are:

   a. Report of Station Information (RSI). A RSI is required for all large volume transfer stations. A large volume transfer station receives 100 or more cubic yards of waste per operating day. (Attachment IV -4)

   b. Plan of Operation. A Plan of Operation is required for all small volume

transfer stations. A small volume transfer station receives less than 100 cubic yards of waste per operating day. (Attachment IV -5)

Either a Plan of Operation or a Report of Station Information is required to accompany the application package.

3. California Environmental Quality Act (CEQA) review document which describes the proposed project (PRC Section 21065) and all potential environmental impacts. If the review identifies mitigation measures, a Mitigation Monitoring Implementation Schedule (PRC Section 21081.6) must also be part of the package.

4. All required permits and/or exemptions from other responsible agencies, such as Waste Discharge Requirements (WDRs) from the Regional Water Quality Control Board, Household Hazardous Waste permits from the Toxics Substances Control Program, Air Quality Control District permits and Coastal Commission permits. For facilities which impact wetlands, an Army Corps of Engineer's Permit, a United States Department of Fish and Wildlife and California Department of Fish and Game permit may also be required.

5. All required local land use permits, such as Conditional Use Permits (CUP) or Zoning Permits, and Fire District Permits.

6. Local Enforcement Agency Certification of facility compliance with the requirements of PRC Sections 50000 and 50000.5. (Attachment IV -6)

a. Compliance with PRC 50000 is achieved if the project is identified in the most recent County Integrated/Solid Waste Management Plan.

b. Compliance with PRC 50000.5 is achieved by having the project be identified in or consistent with the County's General Plan. The following requirements must be met.

(1) The land the project is on must be designated or authorized for a Solid Waste Facility, and

(2) The land uses adjacent to the project must be compatible with the new facility.

The complete application package should be submitted to the appropriate city or county Local Enforcement Agency (LEA). Contact the Public Sector Assistance Section of the CIWMB for a List of the LEA's at (916) 255-2385.

When the LEA accepts the application as complete, he/she must prepare and submit a proposed Solid Waste Facilities Permit to the CIWMB of its action within 55 days. Once the Board receives a proposed permit it must act within 60 days. After the Board's concurrence in the permit, the LEA will issue the permit to the operator. Once the permit is issued the facility operator is authorized to begin operation of the facility.

Diversion Credits

Every regional jurisdiction within the State of California is required to document their waste diversion rates in accordance with the Solid Waste Management Act of 1989 (AB 939). Measurement methodologies must be developed to determine these rates. This issue is complicated when more than one jurisdiction uses the same materials recovery facility. In such instances, careful record keeping of wastes received and diverted will be required to accurately allocate quantities of diverted wastes to the appropriate jurisdictions. The jurisdictions involved will have to agree upon a record keeping system that will track both input data (i.e., incoming quantities and composition) and output data (i.e., diverted qualities and non-recoverable quantities of wastes received that are disposed in a landfill).

Examples of record types that should be kept for accurately tracking waste quantities received at and diverted by MRFs include the following:

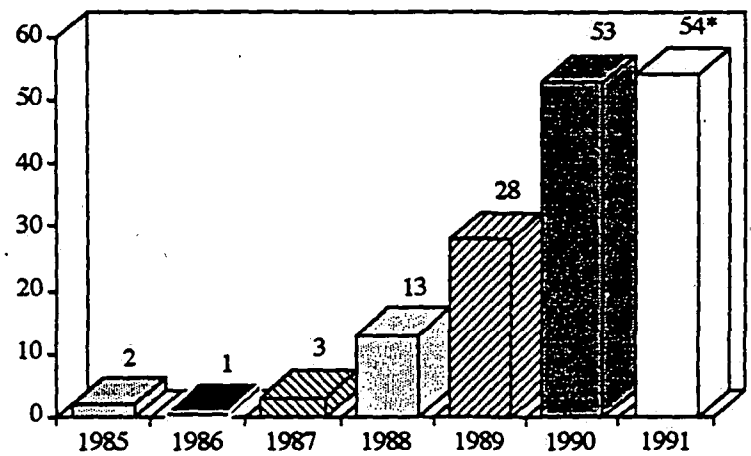
I. Input Data:
- weight (or volume) of wastes received, by vehicle
- date received
- type of truck (if weight and volume measurements aren't taken) and vehicle number, driver number, etc.
- origin of truck (e.g., route including jurisdictions represented, number of clients/route)
- general record of load composition (MSW, inerts, wood waste) or more detailed information

II. Output Data
- weight/volume of separated waste types
- date separated
- quantity not recoverable that is ultimately disposed
- landfill(s) used for such disposal

In order to receive waste diversion credit the jurisdictions and MRF operators should work with the CIWMB staff to establish acceptable tracking methodologies. Contact the staff of the Waste Generation Analysis and Environmental Review Branch at (916) 255-2341.

ATTACHMENT IV-1

Yearly Start-Up of Materials Recovery Facilities



* Projected to start operating in 1991. From January to April 1991, 27 MRF's had come on line.

Attachment IV - 2: Materials Recovery Facilities in California

LOCATION SPONSOR	STATUS OWNER	OPERATOR	THROUGHPUT (TPD)
Anaheim Taormina Industries	Operational Same	Same	300 (a) 1
Anaheim Taormina Industries	Construction Same	Same	600 (d) 1
Chino Western Waste Ind.	Operational Same	Same	30 (a); 100 (d)
Concord Concord Disposal	Operational Same	Same	N/A
Fremont Oakland Scavenger/WMI	Operational Same	Same	50 (d)
Fresno City of Fresno	Operational WMI	WMI	55 (a); 200 (d) 1
Lemon Grove San Diego Recycling	Operational Same	Same	120 (a); 300 (d) 1
Monterey Monterey City Disposal	Operational Same	Same	20 (a)
Napa Napa Garbage Service	Operational Same	Same	20 (a)
Pacheco Pleasant Hill Bayshore Disposal/BFI	Operational Same	Same	12 (a)
Redondo Beach Western Waste Ind.	Operational Same	Same	50 (a); 75 (d)
Richmond Richmond Disposal	Operational Same	Same	30 (a); 50 (d)
San Francisco City of San Francisco	Operational Norcal	Noracl	185 (a)1; 200 (d)1
San Jose BFI	Operational Same	Same	125 (a); 1600 (d) 1,2

LOCATION SPONSOR	STATUS OWNER	OPERATOR	THROUGHPUT (TPD)
San Jose Norcal - South Bay	Operational Same	Same	20 (a) 20 (d)
San Martin South Valley Refuse Disposal	Operational Same	Same	20 (a)
San Rafael Marin Resource Recovery	Operational Same	Same	
Santa Cruz County Santa Cruz County	Design n/a	n/a	500 (d)1,3
Santa Helena Upper Valley Disposal	Operational Same	Same	2 (a)
Simi Valley G.I. Industries	Operational Same	Same	45 (a)
Southgate Bestway Recycling	Design Same	Same	160 (d)
Stanton CR&R	Operational Same	Same	150 (a); 150 (d)
Venicia Pacific Rim Recycling	Operational Same	Same	2 (a)
Ventura City of Ventura	Operational Gold Coast	Gold Coast	125 (a); 400 (d)1
Walnut Creek Pacific Rim Recycling	Operational Same	Same	8 (a)

*Source: Biocycle, July, 1991; "Sorting the Mix at Materials Recovery Facilities" pp. 31-32.

(a) - actual throughput
(d) - design capacity
n/a - not determined or available

1 - based on two shifts per day
2 - approx. 90% is commercial material
3 - will take materials in a variety of ways

ATTACHMENT IV-3

CALIFORNIA WASTE MANAGEMENT BOARD

STATE OF CALIFORNIA

SOLID WASTE FACILITIES PERMIT APPLICATION

CWMB E-1-77 (Rev. 1/89)

ENFORCEMENT AGENCY

COUNTY

TYPE OF APPLICATION

- ☐ 1. NEW SOLID WASTE FACILITY PERMIT
- ☐ 2. REVISION OF PERMIT
- ☐ 3. PERMIT REVIEW
- ☐ 4. MODIFICATION OF PERMIT
- ☐ 5. EXEMPTION FROM PERMIT
- ☐ 6. FACILITY CLOSURE
- ☐ 7. AMENDMENT OF APPLICATION

FOR ENFORCEMENT AGENCY USE ONLY

FILE NUMBER (PERMIT NUMBER)	
DATE RECEIVED	FILING FEE
DATE ACCEPTED	RECEIPT NUMBER
DATE REJECTED	CO SWMP REFERENCE PAGE(S)

NOTE: This form has been developed for multiple uses. It is the transmittal sheet for documents required to be submitted to the enforcement agency. See instructions on back for completing this application.

I. GENERAL DESCRIPTION OF FACILITY

NAME OF FACILITY

LOCATION OF FACILITY (GIVE ADDRESS OR LOCATION. ALSO INCLUDE LEGAL DESCRIPTION BY SECTION, TOWNSHIP, RANGE, BASE AND MERIDIAN IF SURVEYED OR PROJECTED)

TYPE OF FACILITY

- ☐ LANDFILL
- ☐ TRANSFER STATION
- ☐ RESOURCE RECOVERY FACILITY
- ☐ SUMP
- ☐ COMPOSTING
- ☐ LAND SPREADING

TYPE OF WASTES TO BE RECEIVED

- ☐ AGRICULTURAL
- ☐ CONSTRUCTION/DEMOLITION
- ☐ LIQUIDS (INCLUDES SEPTAGE)
- ☐ ASBESTOS
- ☐ DEAD ANIMALS
- ☐ MIXED MUNICIPAL
- ☐ ASH
- ☐ INDUSTRIAL
- ☐ SEWAGE SLUDGE
- ☐ AUTO SHREDDER
- ☐ INFECTIOUS
- ☐ TIRES
- ☐ WOOD MILL

II. FACILITY INFORMATION

OPERATION	EFFECTIVE DATE	PROPOSED CHANGE (CHECK APPLICABLE BOX(ES))	EFFECTIVE DATE
☐ COMMENCED ☐ WILL COMMENCE		☐ DESIGN ☐ OPERATION ☐ NO CHANGE	

AVERAGE ANNUAL LOADING (TPY) _____ PEAK DAILY LOADING (TPD) _____ FACILITY SIZE (A) _____ EXPECTED CLOSURE YEAR _____

III. OPERATOR INFORMATION

For land disposal, if operator is different from land owner, attach lease or franchise agreement

OWNER OF LAND (NAME)	ADDRESS	TELEPHONE NUMBER
FACILITY OPERATOR (NAME)	ADDRESS	
ADDRESS WHERE LEGAL NOTICE MAY BE SERVED		TELEPHONE NUMBER

I hereby acknowledge that I have read this application and the Report of Station or Disposal Site Information, and certify that the information given is true and accurate to the best of my knowledge and belief. In operating the solid waste facility, I agree to comply with the conditions of the permit and with federal, state and local enactments.

SIGNATURE (LAND OWNER OR AGENT)		SIGNATURE (FACILITY OPERATOR OR AGENT)	
TYPED NAME		TYPED NAME	
TITLE	DATE	TITLE	DATE

IV. LIST OF ATTACHMENTS (CHECK THOSE APPLICABLE)

- ☐ REPORT OF FACILITY INFORMATION (REQUIRED)
- ☐ PERIODIC SITE REVIEW
- ☐ LOCAL USE/PLANNING PERMITS (REQUIRED)
- ☐ ENVIRONMENTAL REVIEW REPORTS
- ☐ WASTE DISCHARGE REQUIREMENTS
- ☐ SWAT
- ☐ CLOSURE PLAN
- ☐ OTHER REGULATORY AGENCY PERMITS
- ☐ OTHER _____

INSTRUCTIONS FOR COMPLETING THE APPLICATION

This application form is for a Solid Waste Facilities Permit to receive, store, process, or dispose of solid wastes regulated by the California Waste Management Board (Board). This form and the filing fee should be sent to the appropriate city or county Local Enforcement Agency (LEA). The exact amount of the filing fee is determined by the LEA.

Complete this form and return it with a photocopy and two copies of the appropriate attachments determined to be necessary by your LEA. All material should be submitted on 8½" x 11" paper. Maps and other oversize documents should be folded to that size.

The effective date of the application is the date when all required information and the correct fee are received by the LEA. The LEA will notify you of this effective date.

If you have any questions on the completion of this form, please contact the LEA or Board staff for assistance at (916) 322-3330.

No instructions will be listed for items that are self-explanatory.

I. GENERAL DESCRIPTION OF FACILITY

TYPE OF WASTES TO BE RECEIVED:

agricultural — wastes resulting from the production and processing of farm or agricultural products, including animal manures, prunings, and crop residues

asbestos — a naturally occurring family of carcinogenic fibrous mineral substance. The State Department of Health Services has classified friable wastes which contain more than one percent asbestos by weight as hazardous wastes. Friable means that the material can be crumbled with pressure and, therefore, is likely to emit fibers.

ash — the residue from the incineration of solid wastes, including municipal waste, infectious waste, woodwaste, sludge, and agricultural wastes.

auto shredder — the "fluff" consisting of upholstry, paint, plastics, and other non-metallic substances which remains after the shredding of automobiles, discarded household major appliances, and sheetmetal. The State Department of Health Services has classified untreated shredder wastes as hazardous.

construction/demolition wastes — waste building materials, packaging and rubble resulting from construction, remodeling, repair, and demolition operations, and consisting mainly of inert materials.

dead animals — animal carcasses requiring disposal that have not been previously used for medical purposes or with known infectious diseases.

industrial — solid or semi-solid wastes resulting from industrial processes and manufacturing operations, e.g., cement kiln dust, ore process residues, grit or screenings removed from a waste water treatment facility, etc.

infectious wastes — wastes which have disease transmission potential are classified as hazardous wastes by the State Department of Health Services. Infectious wastes include: pathological and surgical wastes, medical clinic wastes, wastes from biological laboratories, syringes, needles, blades, tubing, bags, bottles, drugs, patient care items such as linen or personal or food service items from contaminated areas, chemicals, personal hygiene wastes, and animal carcasses used for medical purposes or with known infectious diseases.

liquids — wastes which are not spadeable, usually containing less than 50 percent solids. These wastes include cannery and food processing wastes, landfill leachate and gas condensate, boiler blowdown water, grease trap pumpings, oil and geothermal field wastes, septic tank pumpings, rendering plant byproducts, some sewage sludge, etc. may be hazardous.

mixed municipal — residential and commercial refuse, garbage and/or rubbish. Residential waste is commonly thought of as household garbage; commercial waste contains less putrecible waste and more paper and cardboard.

sewage sludge — human (not industrial) residue, excluding grit or screenings, removed from a waste water treatment facility or septic tank, whether in a dry or semidry form.

tires — discarded tire casings.

wood mill — shavings, sawdust, sanderdust, chips, bark, slabs, deck scrapings, edgings, wood and other flammable waste material incidental to the processing of wood products.

II. FACILITY INFORMATION

PROPOSED CHANGE IN DESIGN OR OPERATION, OR NO CHANGE; EFFECTIVE DATE:

For existing permitted facilities, when the operator proposes changes in design, operation, operator, or owner, details of the changes must be sent to the LEA. If significant, the permit must be revised prior to implementation of the change. For an application for permit review, if there are no changes, so indicate.

AVERAGE ANNUAL LOADING (TPY):

The average amount of wastes the facility will receive on a yearly basis over the next five years, expressed in tons. Must be consistent with the RFI and any California Environmental Quality Act (CEQA) requirements. Volume figures should be converted to tons and the conversion factor should be documented in the accompanying Report of Facility Information.

PEAK DAILY LOADING (TPD):

The maximum amount of waste the facility is designed to receive, store, process, or dispose of per day, expressed in tons.

FACILITY SIZE:

The area of the facility in acres to be used for receiving, storing, processing, or disposing of wastes, including all monitoring locations and any buffer zone. This will be referred to as the "permitted acreage" and is considered the facility boundaries.

III. OPERATOR INFORMATION

For land disposal operations, if operator is different from land owner, attach lease or franchise agreement documenting operator's interest in the real property.

Report of Station Information

Section 17441. Report of Station Information.

In order to obtain a solid waste facilities permit, each operator of a transfer/processing station, as defined in Government Code, Section 66723, must file with the enforcement agency a Report of Station Information or, if the station is a Small Volume Transfer Station, a Plan of Operation. The information contained in the Report or Plan shall be used by the enforcement agency to determine whether a permit should be issued. In order to maintain the permit, the operator must file amendments to the Report or Plan whenever necessary to keep the information contained in it current. Such amendments or lack thereof may become the basis for changes in the permit or for revocation of the permit. A Report of Station Information shall contain the following:

(a) Plans and specifications for the station, including a site location map, a site plan, and identification of adjacent land uses and distances to nearby residences or structures.

1. a. Specifications shall consist of station engineering design documents. Include the maximum daily load capacity of the facility that the site could handle as a sustained ongoing load, and the average daily throughput expected.

   b. Also state the average load capacity the facility will receive on a yearly basis over the next five years, expressed in tons.

   If tonnage was figured from records of cubic yards, include conversion factor used.

2. Submit a site location map showing the exact location of the facility and including the names of all access roads. The property boundaries should be shown using a meets and bounds description.

3. Submit a detailed site plan showing surrounding land uses, all on site structures, and all structures within 1000 feet of the site boundary. Show distances to those structures. For the purpose of this report the term "structures" includes all buildings, easements, water wells, sewage disposal systems, leach lines, and power or telephone lines.

(b) **An engineering report describing processes to be used, including proposed pollution control devices and estimated quantities and types of solid wastes to be processed. Information of a proprietary nature need not be disclosed.**

1. Describe processes used at the facility. Processes used may include activities such as loading, unloading, compacting, shredding, salvaging, volume reduction, recycling etc.

2. Describe the wastes received by their type or nature (residential, commercial, industrial, demolition wastes, infectious, pesticides, etc.). Include the tonnage or volume of each type of waste.

3. Describe any special waste received. Examples of special wastes: liquids, dead animals, ash, agricultural wastes, etc. (Please note that only transfer stations specifically designed for a particular special waste should consider receiving any special waste.)

4. Describe climatic conditions at the station. This includes annual rain and snowfall, length of rain and snow seasons, and a wind rows or chart showing mean annual wind velocity and direction.

(c) **A descriptive statement of the operations conducted at the station.**

1. State hours of station operation.

2. State plans for waste handling.

3. List and describe equipment used for handling and disposal of wastes.

4. State plans for standby equipment availability.

5. Describe sanitary facilities for employees, including source of water supply and washing facilities.

6. If salvaging, volume reduction, or recycling is permitted, list the conditions to be imposed on each type of operation. For example, list the types of goods to be salvaged, the types of salvage vehicles or equipment utilized, the location of the processing area, the location of the storage of salvage area, and the frequency of removal of salvaged goods. Also include contingency plans for manpower and equipment availability during emergencies.

7. Include a statement as to whether noise from station operations is likely to create health hazards to persons using the site and/or to nearby residents. Indicate whether nearby residents have complained about noise from station operations. If noise measurements representative of station operations have been conducted, submit a copy of the results.

8. If special wastes are received at the station:

   a. State the types and relative amounts of each type received;

   b. List procedures for handling and processing, include the expected days of receipt, typical peak loadings, and the extent of fluctuation during the year;

   c. List and describe equipment used for handling and processing;

   d. Include the maximum storage time for each type of special wastes prior to disposal;

   e. Describe the procedures for confirming the identity of hazardous wastes specified in the manifests;

   f. Describe contingency plans for accidents or accidental discharge of hazardous wastes, including a listing of manpower and equipment availability for emergencies.

9. Describe the hazardous waste screening program. Screening programs should consist of the following activities: inspection of random in-coming loads; regular visual inspection of the wastes deposited at the facility; training of facility personnel in hazardous waste recognition and proper hazardous waste handling procedures; reporting incidents of unlawful disposal to specific agencies (the names and number should be stated); and installation of signs at the facility entry way indicating that no hazardous waste are accepted (a list of commonly unacceptable wastes may be identified).

10. Include a statement that adjacent zoning and surrounding land use is compatible with the facility or proposed facility. Describe adjacent and surrounding land uses.

11. Include a statement that the facility is consistent with the County Solid Waste Management Plan and city or county general plan.

(d) **A schematic drawing of buildings and other structures showing layout and general dimensions for unloading, storage, compaction, processing, parking, and loading areas.**

1. If public and commercial haulers use separate tipping areas, include the location of each area; public recycling areas should be identified.

2. Specify the storage area for salvaged goods, volume reduction materials, extra equipment and parts, and wastes awaiting transfer into vehicles.

3. Identify the parking areas for empty and loaded transfer vehicles, personnel vehicles, and vehicles used in salvaging or recycling operations.

4. Describe access provisions in detail. Discuss on-site traffic flow, provisions for turn across traffic, stacking lanes, traffic routing and road surfacing, methods of preventing unauthorized access, locking gates, etc.

5. Give the estimated numbers and types of vehicles using the site.

(e) A descriptive statement including the means to control litter, odors, rodents, and insects; emergency provisions for equipment breakdown or power failure; and the maximum length of time solid waste will be stored in the station.

1. Other items to be presented in this statement are methods of noise control, fire suppression, and dust control.

(f) The description of transfer equipment including type, capacity, and number of units.

(g) An estimate of the design capacity and current of anticipated daily capacity of the station in tons.

1. State the maximum peak load capacity, the maximum daily throughput that could be sustained in an ongoing basis, and the average daily throughput expected.

2. Include the calculations used in determining these capacities. Give these figures in tons per operating day. If tonnage was calculated from records of cubic yards, give the conversion factor used.

(h) A description of provision to handle unusual peak loadings.

(i) Anticipated amount and planned method for final disposal of nonrecoverable or nonmarketable residues or ashes.

- Include disposal methods and names and locations of disposal sites for all wastes removed from the station. Also include special and hazardous waste removal.

(j) **Anticipated volume of quench or process water required and planned method of treatment and disposal of any wastewater.**

1. Include wastewater derived from dust control methods, rainwater run off, and rinsing of vehicles. Describe the characteristics of the wastewater, and method of disposal.

2. Identify pumps or sumps that will be used in the processing of wastewaters.

3. Describe the maintenance procedures necessary for the proper operation of the wastewater collection system.

(k) **Resume of the management organization which will operate the station.**

1. The resume should provide details of station ownership and of the operator's experience with solid waste operations. Include names and mailing addresses for operator and all landowners.

2. Describe the operator's interest in the site, i.e., lease, percentage of ownership, etc,.

3. <u>List the names, addresses, and telephone numbers of persons to be notified in case of emergency.</u>

4. Show the assignment of tasks, supervision responsibilities, and the number of personnel required.

(l) **A compilation of the conditions, criteria, and requirements established by the various approval agencies having jurisdiction over the station.**

1. List and include a copy of all permits, requirements, etc. of other agencies regarding this site, such as: land use approvals, waste discharge requirements, air pollution control district permits, environmental impact determinations, and any other pertinent permits.

2. State or show on a map zoning of the site and adjacent properties.

Plan of Operation

Section 17423. Plan of Operation.

Each operator of a small volume transfer station shall prepare and submit to the Enforcement Agency a Plan of Operation for the station summarizing procedures for handling complaints, maintenance, health and safety, site controls, and frequency of removal of wastes from the station.

1. **Station Operation**

   a) State name of Station

   b) State location or address of Station

   c) Provide a delineation of the property boundaries. This should include the meets and bounds description of the facility; a map showing the location of the facility (1:2400 scale); and a detailed map showing all on-site structures and structures within 1000 feet and distances of those structures from the site boundary. Include names of all access roads. The total acreage of the facility must be specified.

   d) State hours of operation.

   e) Describe the type and nature of wastes accepted. Also list types of wastes not accepted.

   f) Include the maximum daily load capacity of the facility that the site could handle as a sustained ongoing load, and the average daily throughput expected. Provide these figures in tons per day or cubic yards per day (tons/day preferred).

   g) State name and location of final disposal site(s).

   h) Provide a schematic drawing of site showing all buildings or other structures, site access and on-site traffic patterns, layout for parking, unloading area, bins or waste holding area, compaction area (if any), salvage area, and transfer vehicle loading area. Indicate the site surfacing material used and any restrictions on access.

   i) Describe traffic volumes and types of vehicles using the site.

   j) Describe salvage operations.

   k) Provide a list of the names, addresses, and phone numbers of the operator and of the land owners of all or any part of the station. Also, if the entity named as the operator has a contract with someone else for the day to day operation of the facility, explain that contractual agreement and give the contractor's name, address and telephone number.

2. **Procedures for Handling Complaints**

   a) Describe methods and procedures for handling or responding to complaints regarding the operation of the transfer station.

3. **Maintenance**

   a) Describe practices and procedures for maintaining site security, litter control, for maintaining the site equipment in good working order, and for maintaining the fencing, structures, and sanitary facilities, if any.

4. **Health and Safety**

   a) Describe all measures employed at the site to provide for the health and safety of site users and the attendant, if any. Items to be considered include, but are not limited to, wheel stops or railings or any means of keeping site users from falling into the pit or bins, access, parking and sanitary facilities.

   b) If there is a site attendant, describe the following: sanitary facilities, source of drinking water supply, shelter, and a means of calling for help in case of an emergency.

5. **Site Controls**

   a) If any special wastes are received such as batteries, infectious wastes, dead animals, ash, sludge, etc., describe the procedures for handling them.

   b) Describe the hazardous waste screening program. The screening program should consist of the following activities: inspection of random incoming loads; regular visual inspection of the wastes deposited at the facility; training of facility personnel in hazardous waste recognition and proper hazardous waste handling procedures; reporting incidents of unlawful disposal to specific agencies (the names and number should be stated); and installation of signs at the facility entry way indicating that no hazardous waste are accepted (a list of commonly unacceptable wastes may be identified).

   c) Describe procedures for identification, storage, and handling of hazardous wastes identified in the screening program: give maximum storage time prior to removal and the isolation/storage location.

d) Provide a list of and a copy of all other permits or documents which control or limit the operation of this facility such as land use approval (if required) for the station.

6. **Waste Removal Frequency**

a) State the minimum frequency by which all the wastes will be removed from the site such that no given waste will remain at the station longer than the specified time. Minimum frequency is defined here as the longest period of time between one removal and the next. More frequent removal than stated in the Plan of Operation may occur, however, the wastes must be removed at least weekly or as required in the permit.

b) State the minimum frequency by which each type of salvaged material, if any, will be removed.

DIVISION 31. WASTE MANAGEMENT FACILITIES

(Division 31 added by Stats. 1989, Ch. 1247, Sec. 3)

50000. (a) Until a countywide integrated waste management plan has been approved by the California Integrated Waste Management Board pursuant to Division 30 (commencing with Section 40000), no person shall establish a new solid waste facility or transformation facility or expand an existing solid waste facility or transformation facility which will result in a significant increase in the amount of solid waste handled at the facility without a certification by the local enforcement agency that one of the following has occurred:

(1) The facility is identified and described in or found to conform with a county solid waste management plan which was in compliance with the law and regulations existing on December 31, 1989, adopted pursuant to former Title 7.3 (commencing with Section 66700) of the Government Code as it read on December 31, 1989. The conformance finding with that plan shall be in accordance with the procedure for a finding of conformance which was set forth in the plan prior to January 1, 1990.

(2) The facility is identified and described in the most recent county solid waste management plan which has been approved by the county and by a majority of the cities within the county which contain a majority of the population of the incorporated area of the county, except in those counties which have only two cities, in which case, the plan has been approved by the county and by the city which contains a majority of the population of the incorporated area of the county.

(3) Pursuant to the procedures in subdivision (b), the facility has been approved by the county and by a majority of the cities within the county which contain a majority of the population of the incorporated area of the county, except in those counties which have only two cities, in which case, the facility has been approved by the county and by the city which contains a majority of the population of the incorporated area of the county.

(4) The facility is a material recovery facility and the site identification and description of the facility has been submitted to the task force created pursuant to Section 40950 for review and comment, pursuant to the procedures set forth in subdivision (c). For purposes of this paragraph, "material recovery facility" means a transfer station which is designed to, and, as a condition of its permit, shall, recover for reuse or recycling at least 15 percent of the total volume of material received by the facility.

(b) (1) The review and approval of a solid waste facility or transformation facility which has not been identified or described in a county solid waste management plan shall be initiated by submittal by the person or agency proposing the facility of a site identification and description to the county board of supervisors.

(2) The county shall submit the site identification and description to each city within the county within 20 days from the date that the site identification and description is submitted to the county board of supervisors. The county and each city shall approve or disapprove by resolution the site identification and description within 90 days after the site identification and description is initially submitted to the county or city. Each city shall notify the county board of supervisors of its decision within that 90-day period. If the county or a city fails to approve or disapprove the site identification and description within 90 days, the city or county shall be deemed to have approved the site identification and description as submitted.

(3) If a city or county disapproves the site identification and description, the city or county shall mail notice of its decision by first-class mail to the person or agency requesting the approval within 10 days of the disapproval by the city or county, stating its reasons for the disapproval.

(4) No county or city shall disapprove a proposed site identification and description for a new solid waste facility or transformation facility or an expanded solid waste facility or transformation facility which will result in a significant increase in the amount of solid waste handled at the facility unless it determines, based upon substantial evidence in the record, that there will be one or more significant adverse impacts within its boundaries from the proposed project.

(5) Within 45 days of a decision by a city or county to disapprove a site identification and description, or a decision by the board not to concur in the issuance of a permit pursuant to Section 44009, any person may file with the superior court a writ of mandate for review of the decision. The evidence before the court shall consist of the record before the city or county which disapproved the site identification and description or the record before the board in its determination not to concur in issuance of the permit. Section 1094.5 of the Code of Civil Procedure shall govern the proceedings conducted pursuant to this subdivision.

(c) To initiate the review and comment by the task force required by paragraph (4) of subdivision (a) and subdivision (d), the person or agency proposing the facility shall submit the site identification and description of the facility to the task force. Within 90 days after the site identification and description is submitted to the task force, the task force shall meet and comment on the facility in writing. Those comments shall include, but are not limited to, the relationship between the proposed new or expanded material recovery facility and the requirements of Section 41780. The task force shall transmit those comments to the applicant, to the county, and to all of the cities in the county.

(d) On or before February 1, 1991, each county, by vote of the board of supervisors and the majority of the cities in the county containing a majority of the population of the incorporated area of the county, except in those counties which have only two cities, in which case the vote is subject to approval of the city which contains a majority of the population of the incorporated area of the county, shall adopt two resolutions after holding a public hearing. One resolution shall address solid waste transfer facilities which are designed to, and, as a condition of their permits, shall, recover for reuse or recycling less than 15 percent of the total volume of material received by the facility and which serve more than one jurisdiction. The second resolution shall address solid waste transfer facilities which are designed to, and, as a condition of their permits, shall, recover for reuse or recycling less than 15 percent of the total volume of material received by the facility and which serve only one jurisdiction. These resolutions shall specify whether the facilities shall be subject to the review and approval process described in subdivision (b) or the review and comment process described in subdivision (c). If the resolutions required by this subdivision are not adopted on or before February 1, 1991, those facilities shall be subject to the review process described in subdivision (c).

For purposes of this subdivision, a facility serves only one jurisdiction if it serves only one city, only the unincorporated area of one county, or only one city and county.

(Repealed and added by Stats. 1990, Ch. 1617, Sec. 4. Effective September 30, 1990.)

50000.5. (a) Until a countywide integrated waste management plan has been approved by the California Integrated Waste Management Board pursuant to Division 30 (commencing with Section 40000), no person shall establish or expand a solid waste facility or transformation facility unless the city or county in which the site is located makes a finding that the establishment or expansion of the facility is consistent with the applicable general plan of the city or county. This finding shall not be made unless the city or county has adopted a general plan which complies with the provisions of Article 5 (commencing with Section 65300) of Chapter 3 of Division 1 of Title 7 of the Government Code.

(b) In addition to the requirements in subdivision (a), any new or expanded solid waste disposal facility or transformation facility shall be deemed to be consistent with the general plan only if both of the following requirements are met:

(1) The facility is located in a land use area designated or authorized for solid waste facilities in the applicable city or county general plan.

(2) The land uses which are authorized adjacent to, or near, the facility are compatible with the establishment, or expansion of, the solid waste disposal facility or transformation facility.

(Added by Stats. 1990, Ch. 1617, Sec. 5. Effective September 30, 1990.)

Appendix A

Articles on the Role of MRFs

Papers

Brown, Michael and Deibler, Peter "Public-Sector Institutional Options for Regional Materials Recovery Facility Development and Operation", September 11, 1991.

_____ "Roles and Responsibilities of the Public and Private Sector in Materials Recovery Facility Procurement, Ownership, and Operation", September 11, 1991.

Puryear, David R. "Achieving Maximum Recovery Through Centralized Processing", September 11, 1991.

Ruffer, Deanna L. and Schaefer, Susan J. "Local Government Recycling Program Design: Integration of Existing Recyclers", June 15, 1990.

Articles

Apotheker, Steve "Mixed Waste Processing: Head-to-Head With Curbside Recycling Collection," Resource Recycling (September 1991) p. 32.

Laster, Tyrone and Roy, Natalie "Mandatory Recycling Works", Public Works (April 1991) p.71

O'Toole, Kevin "How to Build a Materials Recovery Facility That Works," Resource Recycling (May 1991) p. 40.

Parker, Lorie "Seattle's Road to Recovery," BioCycle (June 1989) p.28.

PUBLIC-SECTOR INSTITUTIONAL OPTIONS FOR REGIONAL MATERIALS RECOVERY FACILITY DEVELOPMENT AND OPERATION

Prepared by:
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Individual jurisdictions that wish to participate in a materials recovery or composting facility may choose from four institutional options for facility development and operation:

- **Individual Jurisdictions.** Individual jurisdictions may choose to sponsor, build, and/or operate one or more facilities that serve only that jurisdiction.

- **Lead Agency.** Two or more member agencies may share in the development and operation of a facility or facilities, with one jurisdiction playing the principal role as lead agency.

- **Joint Powers Authority.** A joint powers authority could oversee the development and operation of facilities.

- **Special District.** Two or more member agencies potentially could seek creation of a special district with responsibility for facility development and operation.

Each of the above institutional arrangements provides an umbrella under which there is a range of options for public and private sectors roles in procuring, building and operating facilities. In general that range of options includes:

- Most or all major responsibilities allocated to the private sector vendor (for-profit or nonprofit).

- Most or all major responsibilities are allocated to a public entity.

- Sharing of responsibilities within the framework of a public-private partnership.

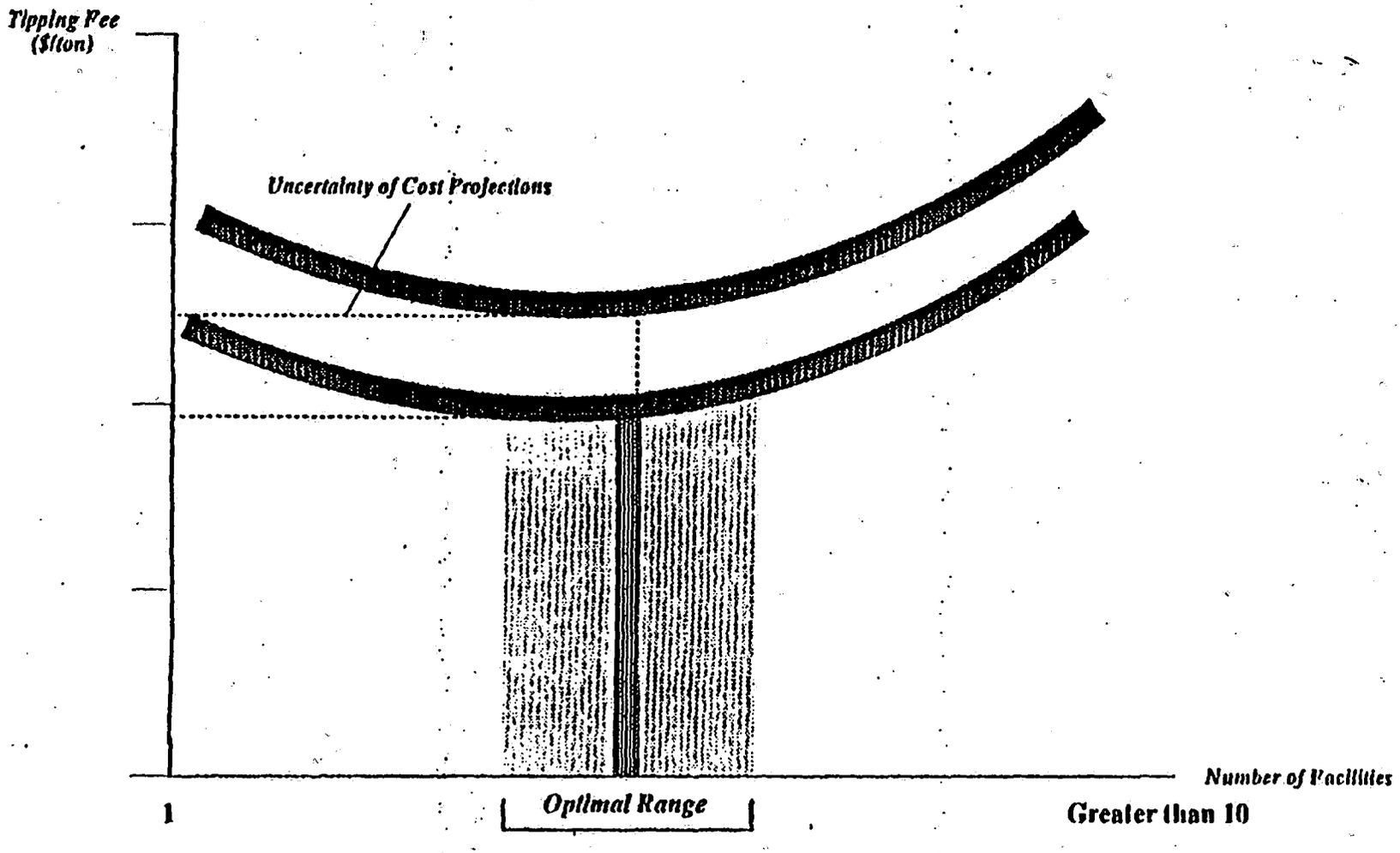
The remainder of this section focuses on the public institutional options identified above.

Local and Subregional Approaches

There are advantages and disadvantages to either single-jurisdictional or multijurisdictional facility development and operation. The principal advantage for individual member agencies in developing their own facilities rests with centralized control: one executive body and the staff of one agency direct all aspects of facility development and operation. The principal disadvantage is that this approach results in the proliferation of small, often inefficient facilities. The advantages of joint planning and development of facilities include economies of scale, lower cost facility financing, shared planning responsibilities, shared technical expertise, increased diversion potential, and risk sharing. The purpose of this section is to describe the subregional institutional options available to member agencies that wish to participate jointly in facility development and operation. Thus the remainder of the discussion centers on the last three options outlined above.

Economies of Scale. On the basis of cost alone, there tends to be an optimum range for facility size. Exhibit 1 illustrates the relationship of facility size to cost, and how, in very general terms, this relationship applies in Riverside County. In this context, cost includes two key components: the cost of hauling, and the combined per ton cost of building and operating a facility. At the left end of the graph, extremely large facilities (such as one facility serving the entire county) tend to be relatively more expensive because the transportation cost of longer hauls outweighs the decreased per-ton cost of a larger facility. In the middle portion of the

Exhibit 1
General Relationship of Facility Size to Cost



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graph, there is an optimal facility size range that combines shorter, lower cost hauling with the economies of scale that accompany the construction and operation of relatively large facilities. The relationship of facility cost and haul distance then reverses itself on the far right end of the graph. With a larger number of facilities, hauling expenses become very low, but this cost decrease is more than outweighed by the higher per-ton costs of building and operating relatively small facilities.

Lower Cost Financing. Major public works facilities often are financed through the issuance of bonds. Facility bonds that are structured on a multijurisdictional basis minimize the costs of any single jurisdiction, and may be perceived by financial markets to be of lower risk. Thus, system bonds may carry a lower rate of interest then individual project bonds, resulting in a lower cost of debt service.

Shared Planning Responsibilities. The significant facility planning and procurement responsibilities can be shared among the staff of several member agencies.

Shared Technical Expertise. Materials recovery and composting operations are sophisticated facilities that require skilled technical oversight. The pool of experienced personnel is limited, and the more desirable candidates are likely to gravitate towards larger subregional or multijurisdictional systems.

Increased Diversion Potential. One result of economies of scale with larger facilities is the ability to more easily divert materials with low economic value, and to develop innovative solutions, with a resulting increase in total diversion. Larger total revenues allow for the recovery of materials, such as mixed paper, which generally have a relatively low value. With larger revenues it also becomes possible to develop diversion options such as the co-composting of green wastes with other organics such as food and mixed paper.

Sharing of Risk. A system comprised of multiple shared facilities results in shared risk should revenues decrease because of depressed markets, or because specific technical aspects of the operation do not work as anticipated.

Subregional Institutional Options

Exhibit 2 summarizes the powers and the key aspects of the formation of lead agencies, joint powers authorities, and special districts. Exhibit 3 summarizes the major advantages and disadvantages of each organizational arrangement.

Lead Agency. Lead agencies are created when an individual jurisdiction (or a county) accepts the responsibility to plan and develop a facility for use by itself and by surrounding jurisdictions. The lead agency contracts with the other jurisdictions through cost-sharing agreements or memoranda of understanding. The participating jurisdictions generally share in the various costs of facility development and operation in proportion to their use of the facility. The lead agency generally sites the facility within its own borders and takes responsibility for procuring financing for the project and for managing the facility procurement process. The lead agency may either operate the facility itself, or contract with a private provider for the services. With a lead agency arrangement, siting decisions remain at the local level, but financing options are somewhat narrower. Guaranteeing a flow of materials to the facility remains the responsibility of each participating jurisdiction.

The lead agency approach can be ideal for developing specific projects, provided the lead agency has the technical and financial resources to lead the system development. Meeting the AB 939 goals will require a comprehensive and coordinated long-term effort. The lead agency approach works best if the lead agency enjoys the trust and cooperation of the other participating agencies.

Joint Powers Authority. Joint powers authorities (JPAs) are created by the governing bodies of the member agencies. The cities, counties, or districts sign a joint powers agreement which delegates certain powers to the JPA. JPAs may be given authority to site and develop facilities

Exhibit 2
Institutional Options for Subregional Facility Development

Legal Entity	Method of Creation	Powers		
		Flow Control	Land Use	Funding
Lead Agency (member agency)	Memorandum of understanding between lead and other agencies	Within lead agency and through contracts with other agencies	Within lead agency and through contracts with other agencies	Within lead agency and through contracts with other agencies
Joint Powers Authority	Joint powers agreement between member agencies	Through pledges by each member agency	Through agreement with affected agencies	Surcharge on facilities bond issues
Special District	Legislative enactment and/or voter approval	Through pledges by each member agency	Rights to eminent domain	Tax assessment surcharge on facilities bond issues

Exhibit 3
Advantages and Disadvantages of Subregional Institutional Options

Legal Entity	Pros	Cons
Lead Agency (member agency)	• Implementing individual projects • Expedited decision making • Implementing regional systems	• Subordinated role for non-lead agencies
Joint Powers Authority	• Regional outlook • Consensus oriented • Cost sharing	• More difficult to make decisions and resolve conflicts • Strong veto power of member agencies
Special District	• Regional outlook • Comprehensive powers • Expedited decision making • Cost sharing	• Loss of "home rule" • Requires legislative action

for the benefit of the member agencies. The JPA may hold property in its own right, enter into contracts, hire employees, construct and maintain facilities, issue bonds, and incur debts, liabilities, and obligations. A JPA has powers similar to a lead agency in regard to flow control and land use decisions. The financing options are somewhat greater for a JPA because its bonds are likely to be perceived as lower risk, and thus less expensive, than those issued by a lead agency. In addition, a JPA can levy facility surcharges to defray costs.

Because JPAs are composed of individual member agencies, they are by their nature consensus-building organizations. Each member agency has strong veto rights within its own jurisdiction. JPAs may have the right to expropriate lands from private individuals for public use, but not without the approval of the jurisdiction in which the land is located. Each participating agency needs to have control of the flow of materials targeted for diversion, and use that control to direct the materials to the designated facilities.

Special District. Special districts tend to have planning and coordination powers, as well as facility development and operation responsibilities, within a specific area of expertise. Special districts are created when a county board of supervisors determines that a portion of the county needs a particular facility or service. The proposal to create the district must be approved by the voters within the territory of the district. The district may include unincorporated areas of a county, as well as incorporated cities, provided that the governing body of each city provides consent by a two-thirds vote.

Sanitation, water, air quality, and transportation are examples of the kinds of special districts that have been created to implement certain regional plans. The powers of special districts are often broad, and the veto rights of participating jurisdictions are correspondingly narrow. Special districts may hire employees, issue bonds, enter into contracts, acquire land, levy taxes on the taxable property within the district sufficient to defray the costs of its operations, and draft districtwide ordinances. In particular, special districts are distinguished from JPAs by the right of eminent domain, the power to levy property taxes, and legislative authority.

State law currently provides for the formation of special districts for waste disposal or processing, which could include processing of mixed wastes into their component parts for recycling. However, the provisions of current law may not allow a district solely for developing a facility for source-separated recyclable materials. Thus, with relation to the facilities envisioned in this study, a special district could not operate a composting facility that accepts green wastes collected at the curbside, or operate a materials recovery facility that includes a processing line for curbside recyclables. In addition, at present a special district can not be made legally responsible for meeting, or failing to meet, the AB 939 diversion goals of its member jurisdictions.

Special districts share the advantages of JPAs with regard to regional planning. Furthermore, they have the capacity for decisive action in facility development, although at the cost of local sovereignty.

In general, the cost of facility financing and the range of financing options is more a function of the size of the facility than of the form of multijurisdictional arrangement.

ROLES AND RESPONSIBILITIES OF THE PUBLIC AND PRIVATE SECTOR IN MATERIALS RECOVERY FACILITY PROCUREMENT, OWNERSHIP, AND OPERATION

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Developing new materials recovery or composting facilities is a complex process.[1] Exhibit 4 is a generalized time line for accomplishing the steps necessary to develop operational facilities. The process is likely to take at least three to four years; however, it can be relatively smooth and short if two issues are addressed at the onset:

- Identification of the responsibilities of the public and private sectors in constructing and operating the facility;

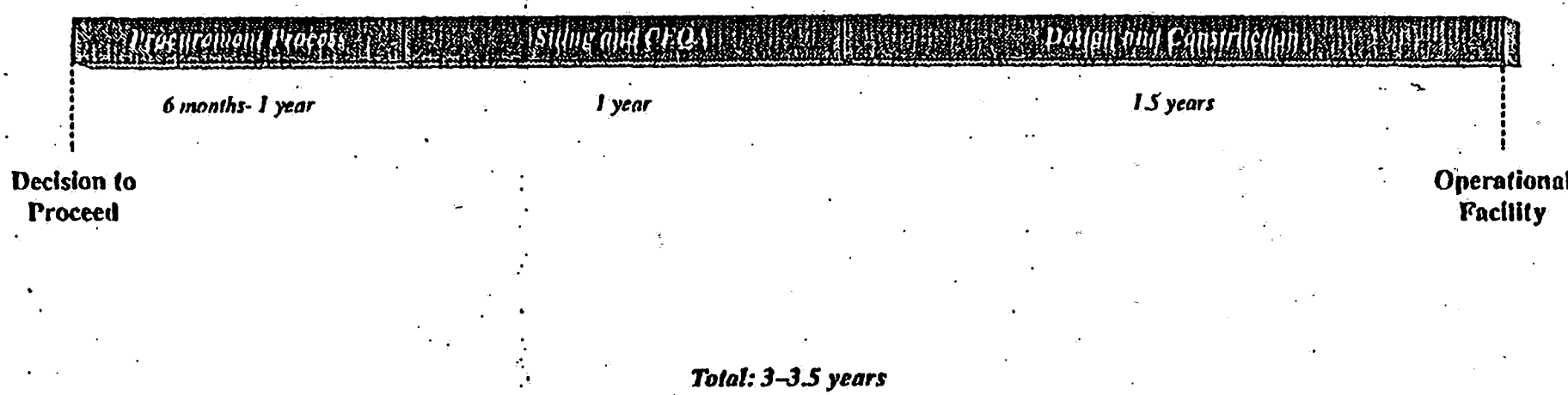
- Identification of key design parameters for the facility (materials to be processed, expected levels of diversion, etc.).

A jurisdiction can best exert control over the process, and will have the strongest probability of obtaining the desired result, if the procurement process is designed to meet these objectives.

This section discusses the assignment of public- and private-sector roles for each of the activities necessary to develop materials recovery and composting facilities, from procurement of an unbuilt facility at an unidentified location to full operation. In practice, a site may already be identified, or there may be an existing facility that can be modified or enlarged to accommodate

[1] Unless otherwise noted in the text, this section is applicable to materials recovery, composting or combined materials recovery and composting facilities.

Exhibit 4-1
Generalized Time Line for Developing Operating Facilities*



* Time line assumes procurement of a new facility at a site not previously identified. These are estimates of the average duration of each stage. Depending on the specific circumstances, the total time frame could be decreased to 2.5 years, or could be considerably longer.

materials recovery or composting activities. In that case, obviously, not all of the steps are necessary.

The remainder of this section focuses on the institutional question of which party should perform what function. The issues that must be addressed in developing and operating a facility are closely interwoven with the roles of the public and private sectors. In practice, developing and operating a facility usually requires a public-private partnership, with specific responsibilities assigned to each party. Exhibit 5 details eleven major areas of responsibility, and is, in effect, a checklist for allocating those responsibilities. The following paragraphs discuss each area of responsibility, detailing the pros and cons of public and private roles for each.

Siting

Facility siting responsibilities can be assigned to either party. Advantages in assigning siting to the public sector include the power of eminent domain, the ability to develop and conduct a siting process that may more fully address public concerns, and the ability to direct these activities to preferred sites. Private vendors may not take the time and care necessary to ensure that the chosen site will be politically acceptable. Another option for the two parties is for site selection to be made part of the procurement process. Thus, each proposer would identify a site as part of its proposal. If a strong proposer chooses a poor site, the procurement can be structured to select a vendor without necessarily requiring use of the vendor's site.

Permitting

Facility permitting responsibilities can be assigned to either party. Conducting permitting activities as a public function maximizes control, particularly if a facility must be developed quickly. Permitting can also require substantial staff time. Regardless of who conducts permitting activities, the public agency should be an equal partner in scoping the permit process and reviewing permit documents prior to public release.

Exhibit 5
Responsibilities for Facility Development and Operation

Task	Local or Regional Agency	Vendor
Siting		
Permitting		
Environmental compliance (CEQA)		
Rate setting		
Financing		
Ownership		
Construction		
Operation		
Transportation		
Materials marketing		
Disposal		

Environmental Compliance (CEQA)

As with permitting, environmental compliance responsibilities can be assigned to either party. As above, if these responsibilities are allocated to the vendor (particularly if a facility must be developed relatively quickly), the public agency should be actively involved in scoping the process, and in reviewing draft materials.

Rate Setting

Rate setting should be retained as a public function for the following reasons:

- The traditional justification for public control of the design of the rate structure and of rate setting is to ensure that rates are sufficient to keep the operator in business with a reasonable but not excessive return on the vendor's investment.

- As with electricity and water supply, the rate structure is an important tool for encouraging public behavior that can help maximize diversion levels. Under AB 939, responsibility for meeting the 25 percent and 50 percent diversion goals lies with individual jurisdictions, not the facility operator. For both the residential and the commercial/industrial sectors, the rate structure can be used to encourage reduction and to meet the diversion goals.

Financing

Financing and ownership issues are best considered together. If the public entity will be the ultimate owner (see ownership), then financing and debt service should also be public functions. Local public bond issuance is the option most likely to provide adequate and relatively low-cost financing for facility construction. In the past, vendors have often used state bonds issued through the California Pollution Control Financing Authority (CPCFA) to finance facilities.

However, because of the ceiling on state bond issuance, CPCFA financing over the next several years may be limited.

Ownership

There are a variety of options for facility ownership. If a public entity finances, and incurs debt service for a facility then it should also own that facility. In addition, public ownership maximizes control with regard to key aspects of facility operation. Thus facility modifications necessary to accommodate changes in the waste stream or market conditions, or to incorporate new or improved technology can be easily made by the public owner. Local government control, through ownership or through other less direct means is important given the responsibility for meeting the AB 939 diversion objectives.

Construction

The successful vendor is the most appropriate party to construct the facility. The vendor has proposed the technology and should be given the responsibility to construct, and to demonstrate that the facility operates properly. If the facility is to be owned by the public agency, it should be purchased only after full testing demonstrates that the facility is functioning successfully. The construction schedule should be governed by a contract between the vendor and the public agency.

Operation

Operation of the facility may be the responsibility of the public or the private sector. Public operation may be appropriate for jurisdictions in which major public works or utility activities are commonly conducted by the public agencies. Or, the vendor may be the more appropriate operator because the vendor proposed the technology used in the facility. Private-sector operation, however, should be predicated on the vendor's successful operation of a similar facility, with "proven technology" a key criterion in the vendor selection process. The operating

contract with the vendor should include significant performance guarantees and incentives based on reaching specified materials recovery rates.

Transportation

As with facility operation, unless the public agency has a history of waste transport, this activity is typically allocated to the private sector. Vendors may consider having the right to transport all materials to be a necessary trade-off for not owning the facility.

Materials Marketing

Materials marketing is an exacting activity, characterized by volatile markets and complex brokering networks. In addition, successful marketing of the materials is, in part, a function of the operation of the vendor's technology, and its ability to meet design specifications. For these reasons, day-to-day marketing activities are usually best performed by the private sector. If the facility is to be privately operated, the operations contract should include incentives both for the operator to maximize materials revenues and to ensure that materials with low value are marketed. However, the public agency should participate in development, and periodic review of the marketing strategy, and should have review and approval authority over longer term sales contracts. In addition, the public sector may take responsibility for developing local options for materials reuse.

Disposal

Disposal activities will generally be conducted with the same allocation of public- and private-sector responsibilities as existed locally prior to development of new recovery facilities. The local government should control the ultimate disposal facility to ensure the lowest cost and to eliminate the risks resulting from use of an improperly operated site.

ACHIEVING MAXIMUM RECOVERY THROUGH CENTRALIZED PROCESSING

by David R. Puryear

Western Regional Manager

National Recovery Technologies, Inc.

September 11, 1991

One of the pressing problems facing local and state governments today is that of finding economical and environmentally acceptable methods of handling and disposing of municipal solid waste. The subject has become a passionately debated topic, with proposed solutions ranging from the utopian "zero waste" to Draconian measures being levied upon those who generate more than their share. In between these extremes are a number of programs that have been designed and enacted to accomplish the goal of waste reduction and recycling. The topic of this paper is the Centralized Recovery Facility. The philosophy of centralized processing of mixed municipal solid waste is that no single method of recovery which targets only a specific portion of the waste stream is capable in itself of achieving both a significant reduction in landfill usage and a maximum rate of recycling and material recovery. Source reduction, source separation, composting, landfilling, and thermal energy recapture are all viable components to a sensible and effective waste reduction scheme, but are not solutions in and of themselves. The position of this paper is that centralized processing, which is the processing of all portions of the waste stream in one facility, is the complete stand-alone solution, and has the added benefit of being able to cooperatively utilize the best of all other programs.

The purpose of this paper is twofold: It intends to demonstrate both that centralized processing is a necessary component in achieving maximum recycling in the most efficient manner possible, and that recycling can, in fact, support itself economically, and does not need to add a financial burden to a community. This paper will discuss the how's and why's of these premises, and the methods needed to accomplish "maximum recycling through centralized processing".

THE EVOLUTION OF RECYCLING

Before discussing the current state of recycling technology, it is important to understand how recycling has evolved over the years. Historically, the recycling incentive has, at various stages, been driven by both economics and environmental considerations. Solid waste disposal, from its primitive origins, naturally included recycling or reusing everything possible, primarily from an economic viewpoint. Here, the fundamental building blocks of recycling were formed. Very little was wasted (source reduction), salvageable items were turned in for scrap or redeemed for money (source separation), refuse was gleaned for scrap value by haulers (materials recovery), food scraps were composted and returned to the soil (composting), and wood waste was burned for fuel. As the economy flourished after World War II, however, we evolved into a "throw-away" society, and the "town dump" became the final resting place for virtually everything that went into the trash can. The progression of ideas in managing solid waste has recently begun to move at an ever-increasing pace back toward its origins, away from the "dig and dump" philosophy toward one in which resources are conserved. In addition, the environmental movement has added force to the drive toward conservation and reuse of resources.

The advent of the modern landfill was the first step "up from the dump", so to speak, in that environmental factors were, for the first time, taken into consideration. Liners, leachate collection systems, methane collection and migration barriers, and odor control became required as sensitivity to air and ground water pollution increased. These new considerations, however, as major contributors to accelerating costs, moved landfilling from a "cheap" method of disposal to one where expense is a major concern.

In the early 1970's, the apparent solution to the disposal of municipal refuse promised to be mass-burning. The idea was to burn the entire waste stream to generate steam or electricity (or both), on the theory that anything that did not burn would go to the landfill as ash or non-combustible residue. This was a well-intentioned step, as it made good use of the combustible fraction as an energy source. A number of problems emerged, however. One was the pollution resulting from burning certain elements of the waste stream, including halogenated products, batteries, certain synthetics, and household hazardous wastes. Another problem was high maintenance costs caused by slagging from molten glass and metals, as well as corrosion to boiler tubes resulting from the burning of materials that release corrosive and toxic gasses. A third problem was that the non-burnable items were rarely recovered, and many combustible materials were suitable for uses other than as a source of energy.

Concurrently, the movement toward greater environmental awareness gained momentum in opposing the waste of processed resources such as metals, glass, paper, and plastics. The consumptive nature of the American economy became a point of shame for many, and programs designed to recover and reuse these assets gained public support at an increasing rate. The public showed a surprising willingness to participate and make a contribution toward this worthy goal. This

spawned the birth of source-separated curbside recycling programs, which were designed to allow the homeowner to be directly responsible for the recovery of materials through municipal, community, and private collection systems. Aluminum, steel, glass, newspapers, and occasionally some plastics were sorted in the home, placed by the homeowner in separate bins on the sidewalk, and then collected in multiple- or highly- specialized trucks. Many curbside programs are currently in effect. Despite their political support, however, they suffer from their marginal performance in actually achieving the desired results of significant diversion of the waste stream from the landfill or substantial recovery of recyclables. The biggest obstacles to effective curbside recovery have been:

- The inability of curbside to appreciably reduce the volume of waste going to the landfill (4-7% reduction being the average) due to limitations on what items they can recover, the limited ability to incorporate multi-family residences such as condos and apartments into the programs, and lack of real participation from the majority of homeowners.

- Prohibitively high costs, due primarily to inefficiency of collection and processing, the need for multiple and/or specialized trucks, multitudes of collection bins, increased labor, and the unpredictable reliance on revenues generated from the sale of recyclables, which are used to offset the costs of the program.

Consequently, there has been a growing realization that source-separated curbside programs cannot alone solve the problems of municipal solid waste disposal. The next evolutionary step was the collection of co-mingled recyclables, which involved the use of a single container for the mixed recyclables and another for rubbish. This required building processing facilities which used manual

labor to remove recyclables from the bags and sort them into individual component streams. Co-mingled recyclable processing represented marked improvement, by:

- Reduction of the number of collection containers the homeowner was required to keep in the home from as many as five down to two.

- Elimination of the need for highly specialized, expensive, and inefficient multi-bin collection vehicles and the associated manual labor by allowing the use of conventional collection trucks.

- Establishment of a centralized location, the processing facility, as the control point for the processing of the recyclables.

However, some problems still plagued the programs.

- A minimum of two passes through the neighborhood were still necessary, one for recyclables and one for rubbish. This created twice the truck traffic and pollution as a one-pass system.

- Its success was still directly linked to the participation of the homeowner.

- It was still difficult to administer in areas other than conventional single-family residences, especially apartments, high-rises, condominiums, and inner-city collections.

- The massive problems of commercial, industrial, and other contributors to the municipal waste stream were not addressed.

In order to deal with these drawbacks, the so-called "blue bag" system was developed. This approach allowed the residents to place recyclables in a separate bag inside of the rubbish container. This accomplished one-truck pickup, and greatly improved the collection efficiency. However, the problem of complete dependency on the homeowner for the actual success of the program was still the weak link. In addition, glass bottles placed together in bags without the cushioning effect of refuse has often resulted in increased breakage and consequent loss of the recoverable glass, as well as contamination of paper items.

THE CENTRALIZED RECOVERY FACILITY

The limitations of curbside collection, co-mingled recyclable collection, and "blue bags", with their low recovery rates and minimal impact on slowing depletion of landfill space, have made a strong justification for taking the next logical step, the Centralized Recovery Facility, known as a "CRF". This approach represents a utilization of the most effective and efficient technology available today for the sorting and recovery of municipal solid waste. The philosophy behind the centralized recovery facility is <u>to include all necessary means of recovery in one complex so that no further processing is necessary after the waste leaves the facility, and maximum recovery is accomplished.</u> Put simply, this means that as the waste stream enters the facility in any state up to and <u>including unsorted</u>, it will be subjected to a thorough and complete search for recoverable materials prior to being disposed of. Any number of options can be included on the front end, but it is imperative that <u>all</u> waste be subjected to a <u>thorough</u> processing. A combination of automated

and manual processing systems can be used to extract the recyclables from all waste delivered to the facility, including curbside collected materials, material dropped off at the facility by homeowners, collections by municipalities, commercial accounts, industrial building and demolition scrap, manufacturing scrap, and, most importantly, from unsorted municipal solid waste.

Examples of centralized recovery facilities are increasing as the concept gains widespread acceptance. Success stories are impressive. One such operation, the X-L Disposal facility in Crestwood, Illinois, is currently recovering over 40% of the municipal solid waste stream, capturing such items as aluminum, ferrous metal, newsprint, cardboard, glass, wood, plastics, and organic waste. In the absence of a viable market for waste paper in the Chicago area, another 30-45% of the combustible portion of the remaining fraction is being earmarked for the manufacture of processed fuel pellets. All of this reduction is occurring in a state which has a total ban on the collection of yard waste! In California, yard waste constitutes as much as 23% of the MSW stream, underscoring the need for a process than can extract this segment for composting.[1] Other centralized recovery facilities are currently in operation in California, New York, Florida, Ohio, and many other states, as well as in Europe and Asia, with an impressive and growing number under construction. Although economy of scale applies to the efficiency of operations and capital investment, any waste stream can benefit from a centralized operation. The centralized recovery facility is an applied concept, not an inflexible, pre-packaged system.

In addition to being able to recover a far greater diversity of items for reuse and recycling, the centralized facility gives the added benefit of allowing greater marketing efficiency in finding new homes and uses for materials extracted from the waste stream. Through economy of scale, the sheer volume of material being placed in markets allows the operator of the facility to flex a considerable

amount of muscle in the recyclables marketplace. The facility becomes, in effect, a brokerage house for recovered materials through market development efforts. Another intriguing possibility for larger operations is that of guaranteed secondary processing operations for certain recovered materials. For example, with a base load of 2000 tons MSW per day, it may become feasible to set up aluminum smelting and paper pulping operations adjacent to the facility. This will serve to increase the overall economic incentives to such an operation by providing a guaranteed supply of recovered materials to local industry while eliminating transportation (from the recovery facility to the intermediate processor) as a major expense.

In determining why a centralized facility is able to recover greater amounts of material, one must also consider the question: "Exactly what elements of the waste stream are recyclable?" The items most often thought of as recyclable are metal food and beverage cans, plastic bottles, glass bottles, and newspapers. Yet these items comprise only about 10-20% of the total combined waste stream.[2] There is, however, more metal in the waste stream, both ferrous and aluminum, than just cans. Aluminum foil products such as TV dinner trays, pie pans, and food wrap, as well as metal can lids, wire coat hangers, broken tools, and a wide assortment of large and small metallic items constitute a portion of the waste stream that is all too often overlooked. Cardboard is a recyclable item not easily recovered by homeowners due to its extreme bulkiness, but is readily recovered at a centralized facility. Yard waste and tree trimmings are the single largest component in many waste streams, especially California's, and are best processed in a centralized facility. Waste paper (junk mail, packaging, etc..) would require enormous effort by homeowners, collection crews, and processing centers to collect separately. In the very few programs where waste paper is collected at the curb, it is not unusual to expend from three to ten times the amount of money on collection than is gained from the sale of the product. A centralized facility can install existing technology to

recover waste paper at a fraction of this cost and bale it for resale, or process it into a clean, stable, fuel product manufactured to exacting customer standards.

These are just some examples of the many items that can be easily and efficiently processed in a centralized recovery facility that are not economically feasible in other programs. Add to these concrete, asphalt, wood, tires, textiles, white goods, batteries and several others, and it becomes apparent that there is much in the waste stream that cannot be dropped off at the local convenience zone or placed on the curb.

Centralization also allows the recyclable marketer to be flexible in determining the best uses for his product. One area which has proved rewarding is the development of an environmentally clean boiler fuel manufactured to strict user specifications from materials extracted from the waste stream. (Note "extracted from the waste stream", which is far different than the concept of mass burning). Junk mail, packaging materials, tires, tree trimmings, wood demolition debris, and industrial pallets are all items which originate from either wood or oil and have either a marginal or zero resale value as a recyclable. Yet, when properly processed by automated equipment, they make a remarkably clean, environmentally stable boiler fuel and may have a value as a fuel product in excess of $30/ton. Compare a positive value of $30/ton to a negative value of $20/ton cost to landfill and you have a differential of $50/ton for a segment of the waste stream that can be as large as 40% of the total mass. On a 400 ton per day waste stream using these conservative figures, this results in a monetary savings of $8000/day. It also uses a 25-year renewable resource, wood, to take the place of our non-renewable resources, oil and coal, to generate power.

An often heard statement is that the public must accept the fact that recycling is a cost to be borne by the citizens and the community. In less efficient and highly labor intensive methods, this is true. However, the key to making recycling "pay its own way" is through the principle of landfill diversion. This allows rubbish collection to be the prime source of revenue, just as it has always been, and then avoids the cost of disposal on a certain percentage through diversion from the landfill through recycling. A simplified example is as follows:

A transfer station accepts 400 tons of waste at a tipping fee of $25.00 ton. This generates $10,000 in revenue. The centralized facility diverts 50% of the waste stream by removing recyclables such as paper, glass, ferrous and non-ferrous metals, plastics, compostable organic material, and other goods, leaving 200 residual tons to be disposed of at a landfill. Assume the landfill tip fee is $25.00. 200 tons x $25.00/ton = $5000. Let us assume also that the cost of processing the material through the facility is $12.50 ton. 400 tons x $12.50 = $5000. Therefore, $5000 cost of residual disposal + $5000 processing costs = $10,000. With revenues of $10,000, this facility has reached the break-even point <u>without even considering the value of the recyclables.</u>

It should be noted that the figures in the above scenario are artificial and over-simplified in order to attempt to clearly demonstrate the principal of profit through diversion. There are, of course, a host of other factors to consider, such as hauling costs of the residual to the landfill, the ability to offer a higher tip fee at the facility and still be competitive due to location, the value of the recyclables, capital recovery, and other factors associated with the project. In a real scenario, the higher the diversion the higher the profit, and this incentive to perform is the very basis for a free market structure.

Here is how a typical centralized recovery facility operates:

The facility itself is designed to handle the volume of the entire waste stream being treated, not just the recyclable portion. Even if other methods are used for extracting recyclables prior to waste entering the facility, it is important that the plant be capable of handling everything by itself in order to insure the thorough processing of all waste for recyclables. Designed to act as an interceptor of recoverable materials, siting would ideally be at a transfer station, landfill, or incinerator. The facility accepts waste in a similar manner as a transfer station, with MSW entering via a tip floor. Trucks enter the plant and are directed to the appropriate area of the tip floor according to load content. Residential, commercial and mixed loads are unloaded onto the centralized tipping floor for segregation by front-end loader, where bulky and hard-to-handle items would be removed from the input feed. Industrial waste, tree trimmings, demolition debris, manufacturing scrap, and all other such items are directed to the industrial processing area.

In the first process area, unsorted residential waste is transported by conveyer from the tipping floor to the input feed. Here a series of manual and automated processes open the bags, remove paper, cardboard, aluminum, ferrous metals, plastics, and glass for recycling, and organic matter such as yard waste and food scraps for composting. In addition, hazardous items such as batteries and gas cylinders are removed and dealt with accordingly. Automated technologies currently available include bag opening, aluminum, ferrous metal, glass, and organic waste recovery, and plastic sorting by polymer. (Technology currently under development includes such promising processes as optical glass cullet sorting and mechanical film separation). Any curbside collected recyclables and drop-offs are processed through the appropriate separation equipment. Organic material not suited for other uses will enter a composting facility usually, but not necessarily, located

on-site. A properly planned and executed process can recover well over 50% of a typical California waste stream, and 90% and beyond if further processing options such as waste paper recovery are utilized for the remaining fraction.

In the second process area, commercial waste is sorted on a process line specifically designed to handle waste heavy in cardboard, paper, and metals. Automated and manual processes will once again be coordinated to recover 70-90% of this stream.

The third process area contains several different pieces of equipment, including shredders designed to shred yard waste and tree trimmings, tires, and metal. White goods are disassembled to allow removal of capacitors, motors, and compressors to guard against PCB and fluorocarbon contamination prior to shredding and processing for scrap. For construction and demolition waste, there is a process line to separate wood, metals, concrete, brick, asphalt, and stone. Organic waste such as wood debris and tree trimmings would be either composted or sold as fuel. Concrete and asphalt would be processed to be manufactured into new product. Much of the remaining inert fractions can be used in place of dirt as daily landfill cover.

THE BOTTOM LINE: PROS AND CONS

Are there no drawbacks to centralized processing? Predictably, supporters say no and critics say yes. Supporters would list the following benefits as its strongest selling points:

- Central recovery allows conventional, one-truck, one-pass pickup of waste, by far the most efficient method of collection. An important aspect to this, often overlooked, is that a single

pickup means half the pollution, half the traffic and consequent vehicular danger on streets, and half the maintenance and expense to the collection company as opposed to a two truck collection system. It also eliminates the typical surcharge for collecting the curbside recyclables.

- Centralized processing concentrates all processing activities at a single location, allowing greater flexibility to react to changing markets and market requirements.

- Centralized processing automatically accomplishes 100% user participation, since **all** waste is processed for recyclables and recoverables. It does not remove the homeowner from participation, but relieves the recycling process from being dependent upon the homeowner for success. Regardless of the existence or effectiveness of drop-off or curbside programs, central processing gives access to the entire range and volume of recyclables because it is not dependent upon voluntary participation at the source.

- Centralized processing allows the concentration of capital resources, so that the utilization of the most modern technology and processing methods available will assure maximum recovery at all times. This is crucial to the success of recycling in a field as rapidly evolving as solid waste management.

- Centralized processing, in an era of escalating landfill disposal costs, is, without question, the most efficient and cost-effective method of processing. While homeowner-dependent systems claim success with recovery rates of 5-15%, often at a cost of $150/ton or higher, some

centralized processing systems can achieve 50% and higher recovery rates for as little as a $25-30/ton tip fee (dependent upon other factors, including local landfill disposal costs).

The most frequently heard criticisms of centralized processing are the following two arguments, followed by rebuttals:

- Complaint: Centralized processing undermines the public awareness campaign by relieving the homeowner of the responsibility to reduce waste.

- Response: Education of the homeowner and the general public is, and should be, a high priority. Tangible waste reduction will only occur at the demand of the public, both through their purchasing power and the modification of consumer habits. Consequently, public education should be implemented by the most expedient grounds possible, as directed by AB 939 and other legislation. This will involve a concerted effort by individuals, businesses, and society as a whole. But it is not wise to sacrifice one's effective ability to maximize recovery for reuse for the sake of passive measures. Aggressive public information and government guidelines are important for achieving the goals of waste reduction through changes in packaging, manufacturing, distribution, and disposal. Citizen drop-off and blue bag programs should be continued, along with concentrated collection of recyclables in office buildings and in areas where such participation is economically feasible. Solid waste recovery and recycling facilities, however, should do just that: recover and recycle.

- Complaint: Material is subject to contamination by being carried in packer trucks and processed through automated equipment.

- Response: This can be reduced to just two recoverable items: glass and newsprint. It is simply not true that glass is broken by being carried in a packer truck. Glass has amazing tensile strength, but is very subject to sheer fractures. The majority of glass broken in recovery operations is broken not from pressure but through coming in contact with other glass. This is a downfall of co-mingled materials that include glass being placed in blue-bags. Glass is best received from packer trucks mixed with ordinary refuse, which cushions it during the transfer and recovery processes. With newsprint, it is true that leachate from the collection vehicles can contaminate a certain percentage of the paper. However, this percentage is quite low, as evidenced by newsprint recovery rates at X-L Disposal and other mixed-waste recovery plants operating in this manner. In terms of processing, it is true that both newsprint and glass would be damaged if processed through certain components of automated recovery systems. However, it is customary to remove these items at the front of the process, prior to entering any damaging equipment. Ferrous metal, aluminum, and plastics are not damaged or reduced in value at all provided they are not shredded. Shredding should be avoided whenever possible.

CONCLUSION

At the beginning of this paper, it was mentioned that centralized processing allows the incorporation of any and all recycling programs the public desires. But if centralized processing "does it all", then is it necessary to incorporate any other programs? Absolutely! It would be a great injustice not to acknowledge the hard work and effort by those who have pursued and achieved effective recycling public awareness campaigns. Without a doubt, these programs, and public education efforts in general, are largely responsible for the current awareness of the solid waste

problems facing us. Never before has society been so attuned to the amount of waste generated, and how much of it is unnecessary. Source reduction should continue to be heavily emphasized, simply from the standpoint that it is not morally, economically, or environmentally defensible to be wasteful of energy and resources. Drop-off centers, wherein the public is provided with facilities at which to deposit their recyclables, are excellent ways to nurture a sense of community and individual responsibility and involvement. Curbside programs do the same, and if a community desires to offer curbside collection as a public service, this is easily incorporated into the overall concept of a centralized facility. Backyard composting is an excellent way to return organic materials to the soil without burdening the waste system, and educational efforts to further this practice should be encouraged. But, although each of these can have a positive impact on the waste problem, it is important to recognize their primary benefit as educational, not as a means of serious reduction of the volume of waste in and of themselves.

Most importantly, all of these other methods of recycling can be used in conjunction with a centralized facility with little or no financial impact on its operation (although they may, in themselves, incur a cost). The rate of return for a centralized recovery facility is dictated by the percentage of diversion, not by the gross revenues generated from the sale of recyclables, which leaves the viability of the program largely unaffected by fluctuations in the waste stream and provides insulation from radical rate escalations that have plagued stream-specific programs.

We find, then, that the advent of centralized processing as the most economical and efficient method of resource recovery has been the result of an evolutionary process. This process has been driven by overlapping incentives, ranging from environmental consciousness to landfill shortages to the hard facts of economic reality. As developing technology allows centralized processing to more

efficiently accomplish the goals of earlier collect-and-sort systems, the centralized facility emerges as the core component of a balanced, effective means of solid waste reduction and recyclables recovery. More importantly, it allows the process to function as much as possible according to the natural laws of a free-market economy, and not through well-intentioned but unenforceable mandates. Recent events throughout the world have reinforced this principle, and there is no reason to believe that it will not apply itself to the particular application of solid waste management as well.

[1] Office of Appropriate Technology, "Sorting it Out: Recycling Options in California" Pg. 6.

[2] Franklin Associates, Ltd.

National Recovery Technologies, Inc. of Nashville, Tennessee is a full-service solid waste processing company offering design, engineering, construction, and operations of turn-key solid waste handling and recovery facilities using NRT's state-of-the-art, proprietary technology. NRT is privately owned and has equipment in operation in seven states in the U.S. and in several locations abroad. NRT was recently selected as a joint venture partner by Marubeni and Shinmeiwa of Japan as the technology of choice to provide solutions to Japan's solid waste disposal problems.

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LOCAL GOVERNMENT RECYCLING PROGRAM DESIGN: INTEGRATION OF EXISTING RECYCLERS

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LOCAL GOVERNMENT RECYCLING PROGRAM DESIGN
INTEGRATION OF EXISTING RECYCLERS

INTRODUCTION

Markets are essential to local government recycling programs. When assessing the feasibility of recycling and designing recycling programs, local governments typically (and rightly) place priority on determining what markets exist. In many instances this results in the identification of local recyclers who have been in business for many years. It is also fairly common for local governments to look to these local recyclers for help in the marketing of recyclables collected from municipally sponsored programs. Yet, too often, the capability of local recyclers to process as well as market materials has been overlooked. As a result, recycling programs are designed and facilities are built which may duplicate the capabilities of the local recyclers. In some instances, unneeded materials recovery facilities are constructed, costing local governments both time and money, and ultimately competing with private recyclers.

While it may be that existing recycling firms are not providing the materials collection services needed for many local government recycling programs, the use of existing recyclers to process materials collected through other means versus government sponsored development of a materials recovery facility may be crucial to the long term success and fast track development of recycling programs. Local recyclers can, if considered, be valuable partners with local governments and provide an important component of successful municipal recycling and composting programs while at the same time saving the local government capital costs and implementation time.

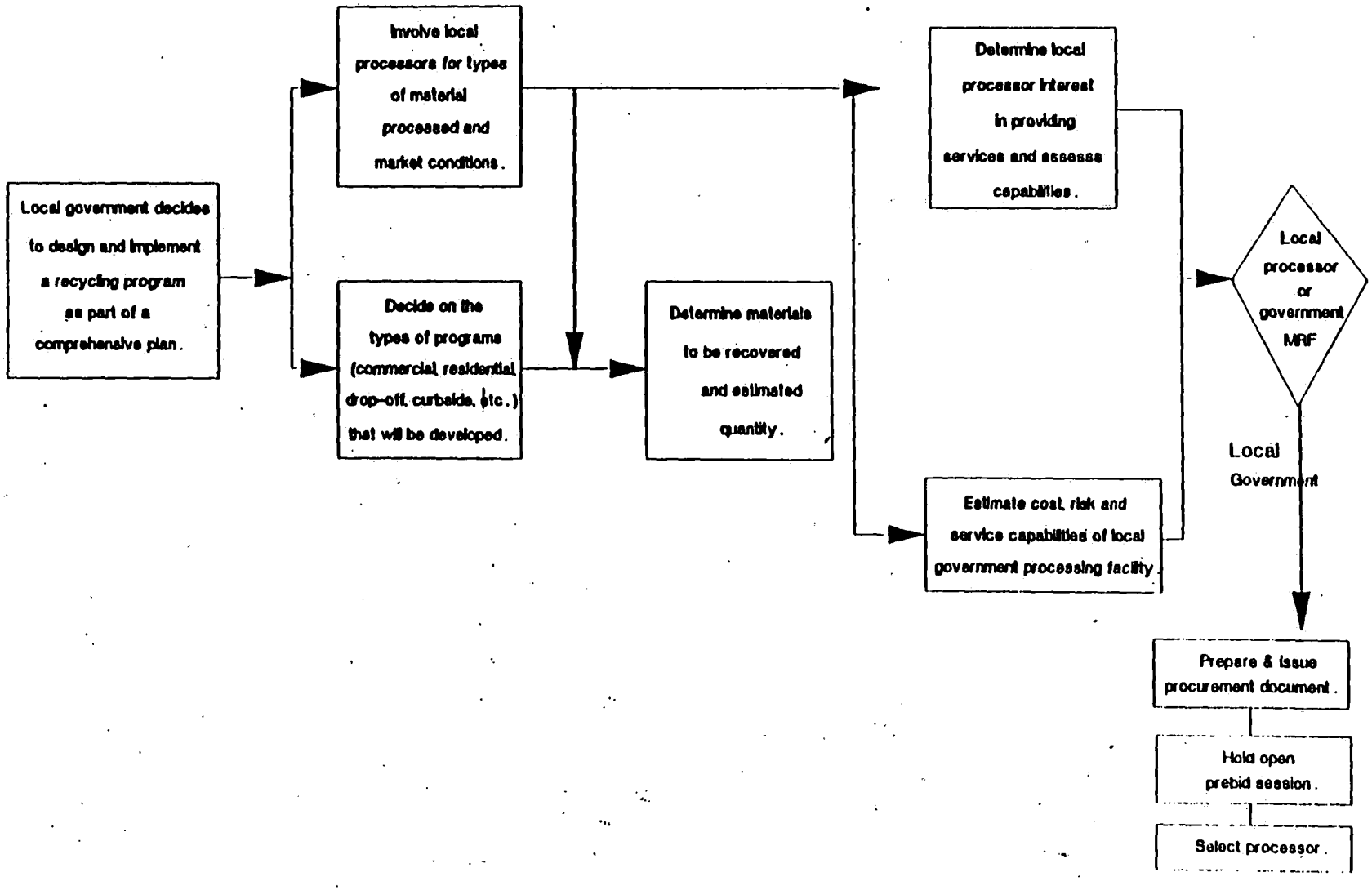
THE PRIVATE SECTOR - THE BACKBONE OF RECYCLING EFFORTS

Collection, sorting and processing materials, which would otherwise be disposed of as waste, for reuse as raw materials has been happening for decades. Thousands of companies throughout the country and world have been the backbone of these recycling activities. These businesses, some of which have been passed down through several generations of family members, possess valuable expertise in separating, processing, marketing and reusing metals, paper, glass and other materials.

Before addressing the services these companies may be able to offer to a local government recycling program, it is necessary to define who "local recycling firms" are. This can be done by characterizing the type of service these companies provide. These include:

- Brokers - are essentially commodity movers who have limited involvement in the collection, sorting, processing or end use of recovered materials.

FIGURE 1
LOCAL GOVERNMENT RECYCLING PROGRAM DESIGN FLOW



- Processors - are firms that buy, process, and sell materials for reuse. These firms must have an understanding of what materials are recoverable and at what cost, what market conditions are, what the values of different materials are, and what must be done to prepare the recovered materials for market.

- Dealers - typically have the ability and flexibility to provide whatever service is needed to satisfy market needs and conditions. Their services may include collection, sorting, processing, and marketing of materials. In some instances they may also be the actual end user of the recovered materials. Many dealers are "full service" recyclers.

- End users - of recovered materials may accept materials directly from the source and typically have established relationships with brokers, processors, and/or dealers. Their objective is the receipt of a useable raw material meeting specifications to allow new products to be manufactured.

This paper focuses on the capabilities of the local recycler who is a processor and on those dealers that have processing capabilities and the role these firms can have in government sponsored recycling programs. Specifically, an argument is made for utilizing the processing capabilities of local recycling firms, where possible, versus the development of government sponsored materials recovery facilities. To avoid any confusion, for the purpose of this discussion a materials recovery facility is defined as a facility which processes for marketing either commingled or source separated recyclables.

LOCAL GOVERNMENTS - THE NEW KID ON THE BLOCK

In comparison to the private sector recyclers, local governments are the new kids on the recycling block. While some local governments may have experience in collecting, processing, and marketing materials for recycling, many are just entering the field and have had little experience that gives them the needed skills and capabilities that can be critical to the success of a recycling program. In fact, bureaucracy and institutional constraints of local government leave it poorly equipped to deal with the fluidity of recyclable markets. Quick response is needed.

It is also important to keep in mind the primary reason local governments are in recycling. The driving reason local governments implement recycling activities is to solve part of their solid waste disposal problem or crisis. The commonality with the local recycler/processor is that it is the local government's objective to divert material from the waste stream, and it is the local recycler/processor's objective to consolidate material for sale. However, local governments are involved in recycling activities to reduce the need for disposal capacity, where the recycler/processor is involved in recycling because the diverted materials, or the processing services, have a value that provides a profitable business opportunity. While this difference in reasons for recycling may result in misunderstandings between recyclers and government entities, it is not irreconcilable. In fact addressing this

issue during program design may reduce the risk of local governments misunderstanding the costs and benefits of waste reduction through recycling.

MEETING PROCESSING REQUIREMENTS

To our knowledge there has been no formal survey of the percentage of local governments nationally who are utilizing existing recyclers for the marketing of recovered materials. However, informal inquiries indicate that many local governments have recognized and are utilizing the marketing skills of local recyclers. The broad based knowledge of these firms about recovered materials markets and market specifications is of value to local governments. Local recyclers have a hands-on understanding of what materials are marketable and to whom, where markets are located, how to negotiate deals, the value materials have in the marketplace, and the market specifications.

In a number of communities, the local governments are looking to the existing private sector to provide both processing and marketing services. We believe this is a trend that will continue to grow and in fact will put into question the need for many local governments to develop materials recovery facilities except in cases where no local recyclers exist.

A recent survey by BioCycle magazine (June 1990 issue) of materials recovery facilities in the United States concluded that most existing MRFs have been public sector sponsored, yet the actual owner-operators are predominately from the private sector. The question which now needs to be asked, and should be a fundamental issue addressed during the design of any government sponsored recycling program, is whether or not these materials recovery facilities duplicated or will duplicate overlooked processing capacity of local, existing private sector recyclers?

In those communities where there are processing capabilities in the existing recycling community, it makes economic and service provision sense to integrate this capability into the government sponsored program.

STRENGTHS AND WEAKNESSES OF LOCAL RECYCLERS/PROCESSORS

The greatest strength of the local recycler/processors is that they are entrepreneurs. They have made successful businesses out of reusing materials otherwise bound for the waste stream long before government incentives and subsidies existed. The recycler/processor is innovative, flexible, and typically looking ahead for opportunities to improve its business. The recycler/processor has a broad base of knowledge about markets, market specifications, commodity pricing, recovery techniques and costs, processing equipment, operations and costs, and recycling business fluctuations, pitfalls and strengths. End users are more comfortable with the recyclers'/processors' ability (as compared to a new entity's) to provide materials which meet specifications and are delivered in a timely manner.

By virtue of their substantial experience, commercial recyclers/processors have expertise which can be drawn on to provide a service that is potentially more efficient and

cost effective than can be provided by government or newly created recycling entities. And finally, if given the opportunity the existing recycler is usually more than willing to work with local government in the development and enhancement of local recycling activities - it only makes good business sense for them to do this.

The strengths of local recyclers/processors do not come without potential weaknesses - at least from a local government perspective. Often the local recycler/processors have no firm contracts for the sale of materials. Rather, deals are worked through a network of processors, dealers and end use markets. This may seem threatening to local governments who are more accustomed to requiring long term contractual relationships. However, this isn't an unusual situation even for local governments developing MRFS, but these networks can often result in better material revenues and more reliable markets for the materials collected. In addition, as more materials come into the marketplace, the long term relationships these firms have with markets can be beneficial to the negotiation of materials sales contracts.

Another potential weakness from a local government perspective is that the government may have little direct control over how materials are processed. Typically, the processors knowledge in this area will far exceed that of the local government. In addition, the processor may consider some aspects of their operation to be proprietary. As a result, the basis of an arrangement between the processor and local government will more than likely be performance and incentive based rather than based on specific processing requirements.

The existing recycler is above all else an autonomous, independent, entrepreneur. He/she is probably not used to reporting to anyone, let alone to a public sector entity. This could cause concerns about program reporting requirements. Typically these concerns can be addressed through the clear delineation by the local government of what will be required for program reporting and open discussions with the recycler/processor about how this information can be gathered, compiled, and reported.

Concerns about involving private, traditionally independent and proprietary firms as an integral partner in a government program should be discussed openly. And finally, measures to alleviate any nervousness about a public/private partnership should be established and should be clearly delineated in the contractual arrangement between the local government and the recycler/processor.

Regardless of the final decision about using local recycling processing capabilities, a thorough identification of processor capabilities and costs, and a comparative analysis of the capital and operating costs of development of a municipal materials recovery facility should be undertaken early in the process of defining local government recycling programs. This analysis should also include an evaluation of institutional issues such as the desirability of private sector involvement, allocation of risks, and contractual requirements of each approach. Table 1 summarizes the strengths and weaknesses of recyclers/processors.

TABLE 1

RECYCLERS/PROCESSORS STRENGTHS AND WEAKNESSES

Strengths	Weaknesses
• Entrepreneurs • Often innovative and flexible • Typically forward looking in processing and marketing opportunities and improvements • Broad base of knowledge about: - Markets; - Market specifications; - Commodity pricing; - Recovery techniques and costs; - Processing equipment; - Collection equipment; - Operations and costs; - Recycling business fluctuations/trends. • Long standing relationships with end users • Can offer more timely implementation of programs • Usually willing to work with local governments in the development and enhancement of local recycling activities • May have processing equipment in place, with excess capacity.	• Often have no firm contracts for sale of material (however can result in better material revenue and more reliable markets) • Local government may have little direct control over how materials are processed • Often not accustomed to formal reporting requirements • Often not accustomed to working with a public sector entity • Limited experience with public sector procurement

IDENTIFYING PROCESSOR CAPABILITIES

There are several parameters and criteria that can be used to identify processor capabilities. Some of the most important are as follows:

- Financial community, surrounding private community and market perception of the recycler/processor;
- The length of time the recycler/processor has been in business;
- The types and quantities of materials handled and the ability to expand the type and quantity of materials;
- The willingness of the firm to work - as a team - with the local government:

- finding solution should problems occur with the overall recycling program, marketing requirements, or processing needs and capabilities;
- reporting the information necessary to allow the local government to adequately monitor the recycling program; and
- suggesting refinements to the program or processing arrangement.

- The cost, pricing, and accounting arrangements proposed for providing services.

One of the questions raised by local governments wishing to evaluate the capabilities of existing local recyclers is how to get the information, support and cooperation needed to thoroughly assess capabilities. The inability to get substantive information which can be confirmed has been an impediment to local recyclers' involvement in government sponsored recycling activities. As would be expected, the information requested by the local governments should provide a detailed profile of the local recycler's ability to perform and be competitive and successful as a private sector business in a free and competitive market place. As a result, there is a natural and legitimate reticence on the part of the local recycler to share what is considered to be proprietary information with the public sector. Particularly since, even if the local government elects not to utilize the capabilities of the recycler or if the capabilities do not match needs, the recycler wants to stay in business, doing what they have been doing well for years.

While there is no simple answer to this situation, the best approach is to openly acknowledge the concerns of the local recycler and the needs of the local government. Experience indicates several approaches or combination of approaches can be used to effectively satisfy both parties. A commonality is the importance of involving local recyclers in the early planning of recycling programs. Here again, their experience and knowledge can be very helpful to the local governments in realistically assessing what types of programs best fit local needs and what waste reduction expectations can realistically be achieved.

The local governments should communicate to existing local recyclers their interest in developing recycling programs, their interest in involving the private sector, the need to understand the capabilities of the private sector, and their objectives and concerns. In turn the local recyclers need to indicate their interest in working with local governments to community leaders and program planners, to participate in solid waste and recycling planning and study groups, and to make people aware of their capabilities. This communication must be open and honest at all times. Private recyclers are more likely to participate in program planning if they know that the local government is interested and committed to a partnership than they would be if there is a belief that the government will end up in competition with the recycler.

Communication and information gathering can take a variety of forms including any or all of the following:

- Informal "round table" discussions;

- Formulation of advisory committees including recyclers;

- Individual visits to the local recyclers' facilities and visual inspection and evaluation of capability;

- Formalized solicitation of qualifications/capabilities, possible through a Request for Qualification/Capabilities and Request for Proposals (RFP) process; and,

- Utilization of an independent third party to assess capabilities while still maintaining confidentiality of individual firms and their business arrangements.

One important point to keep in mind throughout this process is that just as local governments can be characterized as the new kid on the recycling block, local recyclers typically have limited experience with public service procurements. As a result, the dialogue that is established with the local recyclers must truly be a two way dialogue, with the recyclers helping local governments learn about recycling and the local governments helping the recyclers learn about providing services to the public sector.

CONTRACTING FOR SERVICES

As part of the process of defining the local government recycling program the types of material to be collected, and collection and processing requirements must be determined. To this point our discussion has focused on how processing requirements will be met and what role local recyclers might have in the provision of this service. An equally important consideration is how the recyclables will be collected. In actuality, the provisions for collection services must be defined before the provisions for processing services can be defined.

One of the first decisions that must be made is where materials will be collected: at the point of use; at drop-off points; or at the point of consolidation/processing for marketing. For those programs in which collection will be at the point of use, ie "curbside", there are three basic approaches that can be taken to the collection of recyclables. These are: the local government can collect the materials; collection services can be franchised; or collection of materials can be provided through a contract with a private company. If the local government is collecting the recyclables, the local government usually will provide for the processing of collected recyclables. If collection is franchised or contracted, the local government must decide whether the franchisee or private collection contractor is responsible for processing and marketing of materials or if the local government will take responsibility for the provision of processing and marketing services.

There are reasons for either approach, and local circumstances may dictate which approach is used. At minimum, the local governments must assure themselves of adequate ability to monitor performance of each element of the service provided and recognize the interdependencies between collection and processing and the different skills required for each. Some of the factors which may be taken into consideration in making this decision include:

- administrative requirements;

- local firm capabilities individually or in joint venture relationships;
- desired competitive environment; and
- program monitoring and evaluation objectives.

In general, separating the provision of collection and processing services may increase the administrative costs of the recycling program. However, in a program which utilizes the private sector for collection and processing, the local government will have increased oversight over program results and may realize cost savings if these services are contracted for separately. In addition, competition may be increased due to the larger number of companies that would bid on providing for either collection or processing than would bid on providing both services.

If collection and processing contracts are separated, attention must be given to contract provisions in both contracts and to acknowledging the interrelationships between the two contracts. Recognizing this interrelationship is of particular importance to the processing contract as the ability of the processor to perform can be directly related to how and what materials are delivered to the processor. At minimum, the procurement of a processor and the processor contract must address:

1. The terms of the contract
2. The requirements of the local government, including specification to the processor on:
   - how the material will be collected and delivered to the processor;
   - the quantity and type of materials that the processor will process and market or a guaranteed minimum quantity;
   - the method of payment for services;
   - the treatment of materials revenues; and,
   - the right of the local government to audit the operation and all records related to the program.
3. The requirements of the local processor concerning:
   - providing adequate services needed upon receipt of material at the processing facility may include:
     - truck turnaround time (may specify maximum);
     - weighing of materials;
     - operating schedule; and,

- processing turnaround time (may specify maximum);.

- provisions for processing the recovered material to the degree necessary to be marketable at the greatest rate of return.

- reject specifications and residue disposal requirements;

- accurately weighing all processed material by type;

- marketing all materials delivered and processed;

- accurately accounting for all materials sold by type, quantity and price received;

- provisions for the return or sharing of revenue earned from sale of material;

- reporting to the municipality the amount of recovered material delivered, processed materials, residue produced, processed materials sold and unsold, price received for materials, and material rejections;

- the period of service needed; and,

- contract termination conditions.

4. Future options open to the local processor including:

   - other residential programs;

   - addition of materials;

   - commercial programs; and,

   - government programs.

The local government will also want to request references, a confidential listing of markets used and, of course, a cost to process the material. Subsequent contract negotiations will often focus on revenue sharing with the processor, indemnification from any hazardous waste that may inadvertently be delivered to the facility and a guaranteed minimum amount of materials delivered to the facility to protect the processor should quantities not reach that expected. There are really no set standards for these negotiable items. The two parties must simply negotiate until they become comfortable with the terms and conditions of the contract that they both must live with.

After the program has had time to stabilize, it is often beneficial to have an independent party monitor the provision of service by both the collector and hauler. Contract with processor may even include an independent audit clause for which there could be specific remedies if unfavorable. The goal of the collector assessment should be to assess the pick-up and delivery of items to the processor. The assessment of the processor should assess

the ability of the contractor to receive, process, and market the recyclables. The approach taken to the review may include reviewing the proposals and contracts of the collector and processor and developing a list of questions, conducting an onsite inspection of the processing facility, reviewing with the processor the procedures for marketing materials, terms and conditions and current pricing schedule. Reports submitted to the local government from each of the contractors should also be reviewed. This process has been seen as providing comfort to the local government that the program is running as it should, and as a way to provide both the collector and processor with feedback as to their performance and possibly suggestions for improvement.

CONCLUSIONS

Recyclers, brokers, processors and dealers have been the backbone of recycling activities for decades. To avoid overlooking a significant amount of processing capability and expertise, local recyclers/processors should be considered by local governments when designing recycling programs. Processing capabilities or material recovery facilities (MRFs) are an essential part of a recycling program. Development of MRFs by local governments can too easily lead to putting governments: into a business that they often do not want to and do not have the expertise to be in; and, in competition with a critical link to essential markets. Looking to local recyclers, where possible, for processing capabilities can avoid: capital investment; design, construction and procurement time; risk of development of a new facility; and, risk associated with processing and marketing resulting from being a relative newcomer to the local recycling community.

Along with the benefits realized from using local recyclers/processors there may be some potential drawbacks. However, these drawbacks can be overcome by thoroughly identifying local processor capabilities and carefully structuring procurement and contract documents through the methods and guidelines outlined in this paper. Being honest about the local government's intentions throughout the process and soliciting the same open discussions from the local processor is important in assessing the capabilities of local processors.

Local governments and local processors can create a partnership that can provide an essential component to successful municipal recycling programs while saving the local government valuable implementation time and large capital costs.

Mixed waste processing: head-to-head with curbside recycling collection

by Steve Apotheker
Resource Recycling

Mixed waste processing is the new kid on the block.

The City of Bremen, Ohio recently asked vendors to supply it with bids for garbage-only collection and for garbage collection plus curbside recycling collection. Rumpke Recycling thought it had the contract locked up when it submitted the apparent low bids for both service categories.

However, it was surprised when another company, which provides garbage collection and material recovery using mixed waste processing, made an alternate proposal with a price tag lower than Rumpke's bid for garbage collection and recycling combined.

Bremen is not the only city looking at mixed waste processing. Other communities, especially those new to recycling, are taking a serious look at mixed waste processing as the way to achieve state-mandated recycling goals at the lowest cost.

With mixed waste processing (MWP), garbage is taken to a facility where manual and mechanical means are used to recover recyclable materials. In some cases, these systems divert a portion of the remaining waste stream to make a fuel product, compost, or both (see "Garbage in, but what comes out?" in the September 1990 issue).

Using the MWP approach, communities avoid the uncertainty about whether citizens will participate in a curbside recycling collection program and maintain that involvement over time. "Why pick corn if you have a combine to do it," says Rallyn Van Beek, president of Iowa-based Bio Mass Energy Recycling, a distributor of MWP systems.

But can MWP systems really succeed in capturing enough materials from the waste stream to make a dent in it? One California mixed waste processor that thinks so is willing to guarantee in writing that it can recover 25 percent of the residential waste stream. By comparison, only those curbside recycling collection programs that accept mixed scrap paper have been able to achieve similar results, and then the service population does not usually include multi-family units (see "Mixed paper recycling practices in North America" in the January 1991 issue).

The MWP experience as a substitute for curbside recycling collection is still rather recent and evolving. Few states can boast of more than one operating example of these systems. Most of the MWP facilities are less than two years old and usually are private sector operations. Independent documentation of costs, markets, recovery rates, and especially, the safety of working conditions, is lacking or not available in many cases. Nevertheless, the experience of some communities that have gone down the MWP path illustrates how this approach might be successful and some of the pitfalls that have been encountered.

One high point of MWP

Carl Wills, public works director for the City of High Point, North Carolina, is an outspoken advocate of MWP. His staff now operates the first MWP system in North Carolina for this city of 73,000 and surrounding counties (see Table 1). In summer 1989, the city evaluated its solid waste recycling options for reaching the state's 25 percent recovery goal by 1993 and selected the mixed waste processing route.

Says Wills, "There is no cost justification for curbside recycling, especially in a state where landfill tipping fees are only $15 to $20 per ton. Also, curbside recycling diverts only 5 to 8 percent of the total solid waste stream." By going with MWP, Wills calculated he could avoid adding monthly collection charges of $1.50 to $2.00 to the residential solid waste bills, and the city would realize the revenue from the sale of the recovered materials.

Public works staff looked at some other MWP models in the U.S., then hired a consulting engineering firm to design the processing facility. After interviewing sev-

Table 1 — Selected communities using mixed waste processing instead of curbside recycling collection

	Buena Vista County, IA	High Point, NC	Newport Beach, CA
Processor	Buena Vista County	High Point	CR Transfer
Start-up date	December 1990	February 1991	January 1991
Type of waste	Residential, commercial	Residential, commercial	Residential
Throughput (tons/day)	40; 100 capacity	400; 550 capacity	150
Recovered materials	G, M, OCC, P	OCC, G,M,P W, WG	ONP, OCC, MSP G,P,M
Products	Compost, pellets (1)	None	None
Site area (acres)	100	6-8	5.5
Building size (square feet)	19,280	60,000	40,000
Capital cost (million dollars)	1.9	3.2	N.A.
Operating cost ($/ton)	25	12	N.A.
Tipping fee at facility ($/ton)	32	21-25	35.95
Landfill tip fee ($/ton)	32	21	22.75
Labor (FTE)	12	41	20-25
Operating schedule (days per year/ 8-hour shifts)	250/1	234/1.1	260/1
Source separation	ONP at drop-offs; commercial OCC recovery	ONP at drop-offs, yard waste collection	None
Recovery rate, in percent (2)	25-35 (3)	20-25	26

N.A. = Not available

ONP = Old newspapers.
OCC = Old corrugated contaners.
MSP = Mixed scrap paper.
G = Glass containers.
P = Plastics, usually HDPE and PET.
M = Metals, non-ferrous and ferrous.
W = Wood.
WG = White goods.
FTE = Full-time equivalents.

(1) No market for pellets.
(2) Rate is calculated based on the waste stream described by the type of waste and throughput categories and does not represent the entire waste stream of the community.
(3) Adjusted to remove source-separated materials delivered to facility.

Source: *Resource Recycling*, 1991.

eral prospective vendors, the city contracted with Delta Waste Services, a one-year-old firm, to construct and operate the $3.2 million plant. However, by April 1991, less than two months after the plant's opening, the city had terminated Delta's eight-year contract, asserting that the company was not "managing and maintaining the facility properly." In protest, Delta has filed a lawsuit against the city.

Now under city management, the facility is handling about 400 to 450 tons per day of residential and commercial solid wastes, four days per week. One half-day is reserved for a complete cleanup of the plant.

The incoming garbage is dumped onto a tipping floor with different areas for waste from commercial and individual generators. Workers monitor the dumping to keep household hazardous wastes and liquids out of the processing line. Pickers on the tipping floor separate the bulky items, such as white goods (refrigerators, stoves, etc.), scrap metal, old corrugated containers, pallets and other wood, and store them in piles for later processing.

The remaining mixed waste is loaded onto one of two conveyors, which are flush with the floor. The waste is then elevated 14 feet to two horizontal picking conveyors, each staffed by 10 pickers. Aluminum cans, steel cans (including aerosols), scrap metal, flint and amber glass bottles, natural (milk jugs) and colored high density polyethylene containers, and all types of polyethylene terephthalate plastic bottles are retrieved.

Owens-Brockway's glass container plant in Winston-Salem recently lowered its prices for green glass bottles from $55 per ton to $15 ton. Consequently, that scrap material is no longer being recovered at the High Point facility. (For more information on markets for green glass bottles, see "Glass containers: how recyclable will they be in the 1990s?" in the June 1991 issue.)

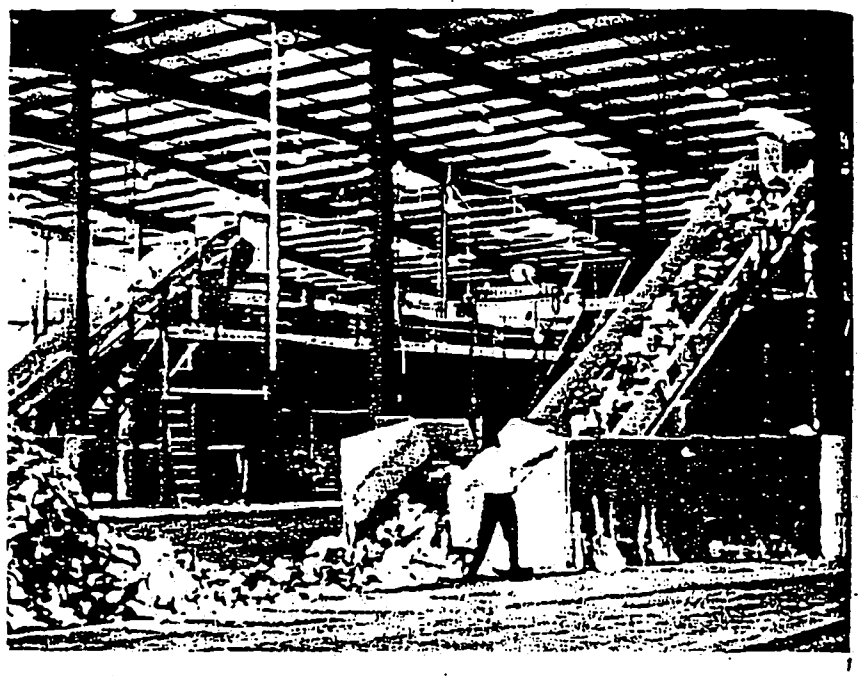
The initial facility design incorporated

magnetic pulleys to remove ferrous metals, but these were discontinued due to plastic and other contaminants that got trapped in the removal process. The waste material remaining after the picking line is baled for landfilling.

The recyclable items from the previous day's collection are processed in the morning before the garbage trucks start arriving. The plastics, metals and paper are baled. The glass bottles, pretty well broken by the fall from the picking line to the storage bin, are loaded into a 40-cubic-yard roll-off container, which when full, makes a 20-mile trip to the glass container plant.

Source-separated materials are also handled at the facility. As the furniture capital of the world, High Point's 138 furniture manufacturers generate numerous loads of clean wood that are diverted at the facility, without further sorting, to a tub grinder. Clean loads of computer printout and other high grade paper are also diverted for immediate baling.

A buy-back operation for separated recyclables is located at the processing facility. Finally, the city's 11 fire stations serve as drop-off recycling collection sites for old newspapers. Almost 50 tons of old newspapers are being recovered each month from these two collection programs.



1

In 1991, the state legislature increased North Carolina's recycling goal from 25 percent to 40 percent by 2001. Wills is unsure whether the MWP plant will be able to reach the higher goal. According to Perry Kairis, the assistant solid waste director who oversees the management of the MWP plant, the picking line has been averaging 20 percent recovery of waste material delivered for processing. Another 5 percent recovery is obtained on the tipping floor by separating wood, white goods and old corrugated containers from mixed loads of garbage. These rates do not include source-separated materials, such as wood, yard waste and newspapers. Kairis feels recovery can be improved, and the system made more efficient, by replacing the current manual system of opening the garbage bags with an automatic bag opener.

2

At High Point, North Carolina's mixed waste processing facility, incoming garbage is dumped onto a tipping floor where bulky items are removed (1). Pickers separate recyclables from waste along a horizontal conveyor and drop the retrieved materials down the appropriate chute (2).

After the city gains greater familiarity with the operating ability of the plant, additional workers or a partial second shift may be used to increase the facility's throughput by another 150 tons per day in order to handle all the waste normally going to High Point's landfill from that community and surrounding counties.

To get a higher recovery rate for the

Workers along this picking line average 20 percent recovery of waste material delivered for processing.

Recovery rates and cost

Comparing the material recovery rates and costs of Newport Beach's MWP approach and Seattle's curbside recycling collection provides a good contrast of the two options. For old newspapers, Newport Beach's processor, CR Transfer, is retrieving an estimated 62 percent from the residential solid waste (see Table 1).

By comparison, Seattle's curbside recycling collection has a recovery efficiency of over 80 percent for old newspapers from single-family households, or about 65 percent of the residential waste stream when multi-family homes are included. Seattle has not fully implemented a convenient collection service for all multi-family dwellings, so the newspaper recovery rate could go up significantly when that service option is available.

In 1989, Seattle's cost for curbside recycling collection and processing was $55 per ton, about 50 percent higher than Newport Beach's payment of $35.95 per ton to CRT. Seattle's cost per ton breaks down to a charge of $1.25 per month for each of the eligible 147,000 single-family household units. Newport Beach has added $1.54 to each residence's monthly bill to cover the cost of CRT's processing fee. With CRT's new automated processing system starting operation this fall, the company expects to achieve somewhat better recovery rates with a greater cost efficiency. (For a better understanding of the relation between per-ton and per-household program costs, see Stephen Engel's article, "Controlling plastics recycling collection costs," in the May 1991 issue.)

community, a yard waste collection program was started in June. The city did not incur any additional collection cost, because it shifted one of the two weekly garbage pickups to a weekly collection of yard waste only. Separation of yard waste from garbage is mandatory for High Point residents. The collected yard waste will be composted.

One criticism leveled against the MWP approach is that it does not involve the public actively, as curbside recycling collection does. Kairis points to a full-time recycling educator through the local Keep America Beautiful program and the availability of the buy-back and drop-off collection programs as addressing that concern.

Overall, Wills and Kairis are very pleased with the plant's fiscal and operating performance. The city is increasing its tipping fee at the facility from $21 per ton to $25 per ton in order to cover the debt service on the MWP plant's capital cost. More specific operating costs and material recovery numbers for the plant were not available due to the pending litigation.

We guarantee 25 percent recovery

Like Wills, David Niederhaus, director of general services for the City of Newport Beach, California, is unequivocal in his choice of MWP over the better publicized curbside recycling collection option. Newport Beach is a resort community and finance center whose residents average over $80,000 in income. Half of the population lives in rental units. Niederhaus believes that the "cost savings, convenience and [material recovery] potential" are greater with an MWP approach.

For Newport Beach's 70,000 population, he estimated an annual savings of $350,000 for MWP over a curbside recycling collection service. Included in the cost of the curbside recycling collection is $1 million of capital equipment. "This is a big financial risk," says Niederhaus, "when there is no guarantee of sufficient citizen cooperation to meet California's new mandated recycling goals. Apartment dwellers don't want to bother with [the] inconvenience [of curbside recycling collection]. Fewer people will remember the landfill crisis in the future and participation [in a curbside program] will drop," he believes.

The city's private garbage haulers, to whom city officials would normally turn for advice, have not provided much assistance in making the choice between curbside recycling collection and mixed waste processing. Niederhaus contends that MWP is not as popular with private

garbage haulers as curbside recycling collection because the haulers cannot financially benefit as much from the former as the latter, unless the hauler can own the processing facility.

California's new legislated recycling goals of 25 percent by 1995 and 50 percent by 2000 have communities looking aggressively at any program that will help divert materials. The company that Niederhaus' community selected, CR Transfer Inc., guarantees in writing to recover at least 25 percent of the waste sent to its facility. CRT is a subsidiary of CR&R, one of California's largest collectors, processors and brokers of recyclable materials; it also provides garbage hauling services. Five other California communities have followed Newport Beach's example, bypassing a curbside recycling collection program in favor of the MWP option provided by CRT.

Newport Beach has had some experience in operating a curbside recycling collection program. In 1974, it began monthly collection of old newspapers. In 1989, the city doubled the collection frequency from monthly to bi-weekly and saw the recovered tonnage go up from 100 tons to over 250 tons per month. According to Niederhaus' calculations, the program was netting a profit of over $1,000 monthly.

However, the curbside recycling collection program for newspapers was discontinued at the end of 1990 with the startup of the MWP contract with CRT. The company had requested that it receive the entire residential waste stream, including the old newspapers. Niederhaus also cited a desire by the city to lessen the traffic congestion and contribution to smog from recycling collection vehicles.

CRT's payment in the 10-year contract with the city is tied to increases in the landfill tipping fee and annual changes in the consumer price index. As of August, CRT was being paid $35.95 per ton to process the waste. The company also bears the risk but gets the revenue from selling the recovered materials. To make up the difference between the processing fee and the landfill charge, residents are charged $1.54 monthly, a cost that has doubled since the beginning of the program.

In January 1991, CRT began receiving Newport Beach's residential waste at its processing facility in Stanton. The company is meeting its contract obligation by averaging 26 percent diversion from the monthly delivery of almost 3,000 tons (see Table 1). With residential waste composing only 20 percent of Newport Beach's total solid waste, that recovery figure is producing a 5 percent reduction in the total solid waste stream.

The company currently uses 20 to 25 workers to remove scrap paper and glass, metal and plastic containers from residential waste. The conveyor system purchased by CRT was designed for hand-picking. The manual sorting approach diverts 15 to 20 tons of recoverable materials per hour. Recovery rates for the various materials generally exceed 50 percent (see Table 2).

CRT is building a new $10 million processing plant that will be on-line this fall. Michael J. Silva, president of CRT, estimates that the new system will be able to achieve a throughput of 150 tons per hour and maintain, or improve on, the current recovery rate. If things go as planned, productivity per worker will triple to about 2.5 tons per hour of recoverable material.

The heart of the new processing system will be a gigantic trommel about 70 feet long with different screen sizes. The garbage will be fed into the higher end of the sloped trommel. The trommel is designed to open the bags of garbage and perform the initial size sorting of the waste materials. To obtain higher recovery, material exiting the trommel is conveyed past magnetic separators, pickers and an air classifier.

The new system will give CRT the ability to handle residential and commercial wastes. Beach and commercial wastes make up the bulk of the city's waste stream. All Newport Beach haulers providing commercial collection are required to meet annual recovery goals, starting with 10 percent in 1991 and going up 5 percent annually. "Haulers that fail to meet these recovery goals will be in danger of not having their permit renewed," says Niederhaus.

CRT feels very confident that it can market the additional volumes of processed materials. "Markets have not been a problem," says Silva. He uses the same domestic and export material markets for Newport Beach that he does for the scrap materials that are collected from the source-separated curbside programs that the company operates. "And, we've never had a rejection of any of Newport Beach's material," he emphasizes.

One mill where Silva has shipped old newspapers separated from mixed waste is the newsprint mill operated by Weyerhaeuser in Washington. John Herpers, general manager of the Quality Sort Center in Portland that purchases the mill's old newspapers, says, "In general we prefer not to buy old newspapers recovered from mixed waste. However, if the paper meets our quality standard, then we will probably accept it."

Not a smooth ride for MWP

The experience of other communities that have chosen mixed waste processing instead of curbside recycling collection programs has been more fitful. Some companies have underestimated the operating income needed to sustain a business in the initial stages.

Muncie Paper Process, the first MWP unit in Indiana, was unable to survive on a $20-per-ton payment for handling the

Table 2 — Newport Beach, California residential waste stream recovery for June 1991, in percent (1)

Material	Waste stream	Capture rate	Percent recovered (2)
Newspapers	21.40	62.10	13.29
Corrugated containers	4.81	56.30	2.71
Mixed paper	21.23	41.90	8.90
Glass containers	4.18	32.40	1.35
PET containers	0.21	86.70	0.18
HDPE containers	1.35	68.90	0.93
Aluminum cans	0.24	89.40	0.21
Ferrous metals	1.90	72.40	1.38
Other (3)	44.68	0.00	0.00
Total	100.00		28.95

PET = Polyethylene terephthalate.
HDPE = High density polyethylene.

(1) Newport Beach delivered 2,871.16 tons in June to CRT's mixed waste processing plant. Residential waste is 20.5 percent of Newport Beach's total solid waste stream.
(2) Percent recovered represents the fraction of the incoming waste stream that has been captured, e.g., newspapers are 21.40 percent of the waste stream and are captured at a rate of 62.10 percent, equalling 13.29 percent of waste stream recovered.
(3) Includes yard waste, 19.51 percent; food, 4.39 percent; wood waste, 4.87 percent.

Source: City of Newport Beach, California, 1991.

city's incoming residential garbage and shut down its operation in June. The company had spent more time and money than anticipated in trying to de-bug its $2 million MWP system and was unable to find a market for the fuel pellets it produced.

However, it was able to recover and market about 35 percent of the residential waste stream, according to Ron Fridenmaker, general manager for the Muncie Sanitary District. After the district looked at the cost of a comprehensive curbside recycling collection program, the company received a new contract with a payment of $28 per ton that enabled it to restart operation in August. However, for every ton that goes through the plant and back to the landfill, the company must repay $28 per ton to the Sanitary District.

Newport Beach, California's manual sorting approach diverts 15 to 20 tons of recyclable materials per hour.

The City of Omaha, Nebraska initially contracted with Refuse Resource Recovery Systems to provide MWP for 145,000 tons annually of residential waste, including yard waste. The company offered to provide the service for a payment of $8.70 per ton. In less than six months, the company was losing too much money to continue operating under the current financial arrangement, an occurrence that provides some insight into the magnitude of a bottom line tipping fee needed to sustain MWP.

RRRS subsequently submitted a proposal for MWP that was in the $20-per-ton range. Omaha went with a lower cost option of about $15 per ton proposed by Waste Management to process co-collected bagged recyclables only (see "Do recyclables belong in the garbage?" in the May 1991 issue).

Will MWP materials see fewer markets?

There is still an unanswered question about whether recovered materials from MWP systems can meet the increasing quality levels required by end-use markets. In Nashville, the then-mayor and some city council members led a drive to expand the capacity of the city's incinerator and put an MWP system in at the front end of the burner. No plans were made to expand the city's pilot curbside recycling collection of 20,000 households.

A group of seven Southeastern paper and paperboard manufacturers wrote Nashville's Metro Recycling Office in November 1990 stating that when old newspapers are "commingled with garbage, [it] cannot meet the standard levels of quality for the . . . mills. Therefore, we are not interested in purchasing this material in the future." These mills consume 2,000 tons per day of old newspapers and represent a sizable regional market.

Last summer the pro-incineration mayor was defeated in an election that saw both of his opponents come out against the expansion of the incinerator. The proposal to boost the incinerator's capacity has now been withdrawn from the city council, and the pilot curbside recycling collection service is now being offered to 70,000 households. The MWP system is on hold for further review.

An MWP system operated by Cherokee County, Iowa was initially designed to produce a mixed scrap paper grade. However, this approach was discontinued when food contamination made the scrap paper difficult to market to the Waldorf Corporation and other boxboard mills. A spokesman for Waldorf indicated that the mill has been able to use old corrugated containers recovered from the waste stream in general.

Some recycling industry observers and environmental groups are concerned that contaminated mixed scrap paper will be dumped on the export market. Low-paid overseas workers will be used to sort the scrap paper, with the unusable contaminated portion being landfilled. U.S. processors will get credit for having diverted the entire amount of the scrap paper shipped, even though a significant portion may be landfilled on a regular basis.

A similar accounting problem has occurred in some materials recovery facilities that process commingled recyclables. Glass containers broken during collection may be counted as "recovered" when delivered to the processing facility, but may frequently end up as a landfilled residue because broken pieces cannot be color-sorted for glass container manufacturers.

No U.S. track record for occupational hazards

In a report by the U.S. Environmental Protection Agency's Office of Air Quality Planning and Standards titled *Municipal Waste Combustion: Background Information for Materials Separation*, the agency was unable to find any studies documenting the safety and health hazards associated with handpicking materials from mixed waste. However, by analogy to the work history of sanitation workers, the report warns about exposure to biological hazards, such as the hepatitus virus or microorganisms present due to animal or human excrement (i.e., from diapers). Physical hazards can include backstrain, lacerations and eye injuries. Finally, workers are exposed to chemicals from household hazardous waste.

In its 1988 *Proceedings*, the International Solid Waste Association published the results of a 1987 Danish study on "The Working Conditions at Danish Sorting Plants." The workers interviewed at three mixed waste sorting plants reported an average of two health nuisances. Dust was generated from moving materials. The presence of food contributed to the proliferation of microorganisms and odor. Sharp objects constituted an accident risk. The monotonous work on ill-designed conveyor systems produced ergonomic strains, such as carpal tunnel syndrome. In the plant at Kåstrup, Denmark, over half of the staff had respiratory problems with asthma or flu-like symptoms.

Conclusion

A growing number of communities are trying MWP, especially in combination with some type of source separation, such as yard waste collection or drop-off collection sites. The simpler the better seems the rule for financial and operational success. MWP systems with higher capital investments in equipment designed to produce pellets or compost have had a harder time finding markets to justify those capital costs.

MWP is attractive to communities because of its low cost and its ability to address not only the single-family waste stream, but also the waste stream generated by multi-family households and businesses. Traditional source-separation approaches take longer to implement, requiring more interaction with the public.

Some MWP companies are finding that siting the facilities is not as easy as putting in a source-separated materials processing plant. XL Disposal in Crestwood, Illinois thought its MWP system, located on the site of its transfer station, was a recycling processing plant, which would be unregulated by the state. The state considers MWP processing to fall under the rubric of a waste disposal site and is considering action against XL Disposal if the company does not go through the permitting process.

Companies like XL Disposal and others that process mixed wastes are beginning to build a track record that indicates a recovery rate of 15 to 30 percent from centralized processing may be possible. However, it's too soon to tell whether such systems will be able to achieve the higher recycling goals of 40 and even 50 percent that a growing number of states are adopting.

In addition, MWP systems need a longer history to compile data on operating experiences and to determine the ability of large volume markets, such as newspaper deinking mills, to handle materials from MWP operations. In contrast, thousands of curbside recycling collection programs (some of which have been operating for a number of years) serve as fairly visible models of what can be done to recover recyclable materials and the cost to do it.

Steve Sargent, director of recycling for Rumpke Recycling, Inc., says his company is going to keep an eye on MWP as an alternative to curbside recycling. The company does operate a 150-ton-per-day facility that pulls scrap paper out of selected loads of dry commercial waste. However, right now Rumpke can hardly keep up with the demand from its customers for source-separated curbside recycling programs. **RR**

■ TAKOMA PARK residents are required to use their recycling buckets to separate bottles and cans from other solid waste.

Mandatory Recycling Works!

NATALIE ROY
and
TYRONE LASTER

Ms. Roy is Recycling Director and Mr. Laster is Assistant Director, Takoma Park, Maryland Department of Public Works.

IN April 1989, Takoma Park became the first municipality in Maryland to begin a mandatory recycling curbside collection program, picking up newspaper, aluminum cans, and all three colors of glass.

The Takoma Park Department of Public Works (DPW) provides weekly curbside refuse and recycling services for 4,190 households, nearly 10,000 of its 16,000 residents. Participation rates are extremely high, with the cumulative participation rate in the recycling program an astounding 88 percent—91 percent participation of the single family households served and 81 percent participation of all multi-family households served.

In the program's first year, over 1,140 tons of recyclable materials were collected, over 16 percent of the waste stream, avoiding nearly $50,000 in disposal costs. The program was so enthusiastically received that in June 1990, Takoma Park added tin containers, corrugated cardboard, and leaf and yard waste to its curbside recycling program. In addition, drop-off containers to collect plastics, used oil, and antifreeze were placed at the public works yard.

The city also sponsors special mixed-paper recycling drives to collect hard-to-recycle materials, such as telephone books, magazines, and junk mail, from residents. Together with the annual public works leaf vacuuming program, the city recycles about 36 percent of its waste stream, far surpassing county and state goals.

Starting the Program

In 1987 Takoma Park began to recognize, as did the rest of the country, that a trash crisis was imminent. The trash fairy, who had magically made trash disappear, had passed away. Landfill capacity was diminishing and disposal costs were soaring. As a result, waste reduction and recycling were going to become necessary. In January 1988, the city appointed 15 community members to a recycling task force assigned to explore revamping the city's recycling efforts.

The task force recommended expanding the existing newspaper collection to include glass and metals. It also recommended hiring a full-time recycling coordinator and issuing a request for proposals (RFP) for private collection of recyclables.

The RFP received only one bid, which was deemed unresponsive because of the high cost. As a result the city decided to do the collection itself. To incorporate recycling into the city's existing sanitation services without increasing costs, the city eliminated behind-the-house refuse collection and redesigned the refuse routes for more efficiency. With these changes and the fact that less garbage was being generated because of recycling, the sanitation staff's time in the field was greatly reduced. The department was able to decrease the number of refuse trucks and reassign one refuse crew (three people) to recycling with no added labor costs.

The city also issued an RFP at that time for processing and marketing the collected recyclables. The city hired a private hauler (currently BFI) to pick up the commingled recyclables and take them to an intermediate processing facility that markets them to an end-user.

Start-Up Costs

The city's biggest expenses were the dedicated recycling vehicle and buckets, some site preparation work for the recycling container at the DPW yard, and public education. These costs totaled $52,500.

The truck, a "CurbSorter" (Kann Manufacturing Corporation, Guttenberg, Iowa) recycling body on a Navistar 4600 chassis, cost $38,000. The city received a state grant, through Maryland Environmental Services, to pay for the vehicle.

The yellow 5-gal recycling buckets distributed to residents each cost $2.19. Area businesses and individuals were solicited for contributions. Contributors' names were displayed on the side of the buckets along with the city's recycling logo.

Preparing the DPW yard cost about $5,000 and involved digging out an area to enable the recycling truck to tip into a 40-cu yd container. This construction was performed in-house under the direction of the assistant deputy director, Tyrone Laster. Public education materials cost $2,200 the first year.

One of the best known features of Takoma Park's recycling program is its enforcement program. Periodically the recycling coordinator will travel the recycling routes and inspect residents' trash for recyclables. If recyclables are found in the trash, a reminder notice is given. If noncompliance persists, warning notices are given. If the resident continues to put recyclables into the garbage, trash collection is stopped until the resident starts complying and a $20 municipal infraction citation is issued.

After the first well-publicized ticketing effort, the city's initial 72 percent participation rate jumped to 88 percent.

Future Plans

Takoma Park is currently assessing options to expand its recycling efforts, including: 1) adding plastics and mixed paper to its regular curbside program; 2) changing its procurement practices to purchase recycled paper and other recycled materials; 3) developing a recycling plan for multi-family buildings, many of which are not yet serviced by the municipality; and 4) focusing a waste reduction program on commercial establishments and institutions such as schools and community buildings. □□□

How to build a materials recovery facility that works

by Kevin O'Toole

Kevin O'Toole is the general manager of Recycle America of Orange County. Before taking charge of the Orange County materials recovery facility, O'Toole served as a vice president of operations for Waste Management of North America's Northern Region.

Orange County, Florida designed its residential curbside recycling collection program and its MRF to work together.

It was a case of putting the horse before the cart.

When officials of Orange County, Florida, mapped out their plan for a residential curbside recycling collection program, central to it was having a guaranteed destination for the materials that would be collected — and an assured price for what was delivered.

"All our research indicated that having a materials recovery facility would keep the cost of collection down," says Jim Becker, recycling coordinator for Orange County, The alternative, truck-side sorting of the newspapers and the plastics, glass and metal containers that would be collected from 130,000 homes, "burns gas and burns time," he says. "We decided that if we could contain the collection costs, we could pass the savings on to the customers and therefore encourage participation."

Florida's 1988 Solid Waste Management Act mandates that all 67 counties in the state cut their waste generation 30 percent by the end of 1994. "For us to meet this goal," Becker says, "having a MRF was key."

Rather than making it an add-on at some future date, construction of a materials recovery facility (MRF) became an integral component of Orange County's recycling plan.

Successful symbiosis

The county solicited proposals in the spring of 1989 for construction and operation of the processing center. Waste Management, Inc. of Florida was the successful respondent, and the contract was finalized that November. The result is Recycle America of Orange County. It's a MRF that works — for everybody.

The county, which will ultimately own the facility, is insulated from severe market fluctuations because of the set floor price established in the five-year contract. In return, the county commits itself to deliver a specified number of tons annually. The minimum for Year One of operations is 12,000 tons. The amount increases in annual increments to a 45,000-ton ceiling in Year Five. For Waste Management, this translates into a guaranteed flow of materials to process.

"It's the best of both worlds for each party," says Bert Luer of this public-private symbiosis.

Luer, who coordinated Waste Management's proposal and assisted in the plant's design, is market development manager for Waste Management of North America's recycling programs in Florida. The company calls its program Recycle America, and it includes both collection and processing services. Recycle America of Orange County is one of about 60 processing centers presently under the Waste Management banner nationwide.

Tons: 64.5, glitches: 0

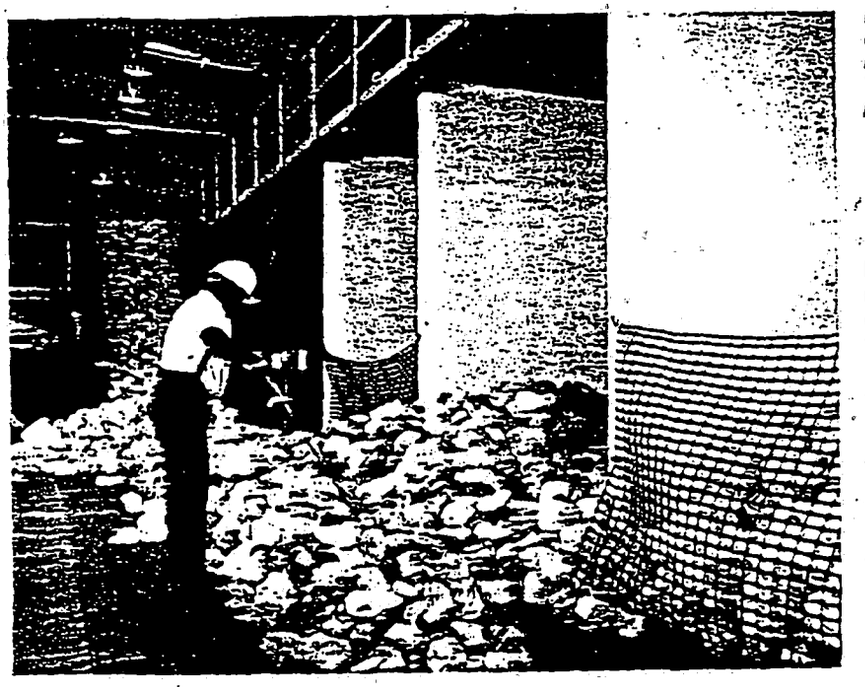
Orange County's processing center opened the first day of collections, August 1, 1990. By August 13, the county had more than met its delivery quota for the month.

There were cases, says Becker, when a collection truck would be filled after six blocks. "We were pulling in as much as 560 tons in one week," he says. "We couldn't have handled it without an efficiently run MRF."

Testament to its efficient design was the MRF's performance on Day One — 64.5 tons were processed without a major glitch.

The plant averages about 80 tons a day, although the figure climbed as high as 223 tons during the first six months of operation. Processed materials include steel, bi-metal and aluminum household cans; PET and HDPE plastic bottles; clear and colored glass containers; and newspapers.

Design capacity for the 27,000-square-foot facility is 120 tons per day for paper, plus 50 tons per day for commingled material, over two 8-hour shifts. Initial results,



On an average day at Recycle America of Orange County, workers process 80 tons of materials along the plant's 10 conveyors. The facility's ultimate capacity is 300 tons per day.

however, indicate that the plant can already process as much as 200 tons per day. The facility's ultimate capacity is 300 tons per day.

Designed primarily to process materials collected from Orange County's residential recycling program, neighboring municipalities outside of the county program purview are also eligible to use the plant. One city that has opted to do so is Winter Park. A local Waste Management division, Central Service Corporation, handles recycling collections for Winter Park's 6,800-plus households as well as about 63,500 households in Orange County. (Orange County's collection system is described in a sidebar.)

Steamlined and functional

"Impressive" is how Becker describes the plant. "It's a very clean-looking facility. What strikes you is how quickly the materials are sorted."

"The plant serves as a template for other processing centers the company is designing around the country," says Bill Moore, formerly director of waste reduction and recycling for Waste Management of North America and now vice president of Paper Recycling International, a joint venture of Waste Management and Stone Container Corporation. "One of the things that makes the Orange County facility work," says Moore, "is a streamlined and functional layout."

The plant is designed around a 10-conveyor system with separate, below-ground infeed conveyors for the paper and commingled fractions. Materials arrive at the facility in collection vehicles that feature a minimum of two compartments, one for newspapers and one for the commingled glass, plastics and cans. The trucks deposit the two fractions onto specified areas of the tipping floor.

The paper infeed goes directly from the tipping floor to the baler, which is positioned in front of the storage bunkers. The commingled fraction, meanwhile, is lifted onto an elevated sorting line. From there, the materials move to the main picking conveyor. Ferrous metals are first pulled magnetically. Any contaminants are then screened onto two residue conveyors. (Representative of how closely county and company work together is the near absence of contaminants that find their way from curbside to the MRF. The contamination rate hovers below 1 percent.)

Half of the plant's 24 personnel are employed as sorters. They manually separate the remaining materials — plastics, aluminum and glass containers. The latter, sorted into loads of clear, brown and green glass containers, travel by three conveyors to bunkers outside the building.

Currently, the residue is buried in the

How they get there: commingling the load

The majority of materials that reach the MRF from approximately 130,000 single-family homes are collected in Orange County's weekly curbside recycling collection program. The MRF also services similar programs in the cities of Apopka, Ocoee, Winter Garden and Winter Park.

Participants use two color-coded, stackable bins to store their recyclables until collection day. A green bin holds glass bottles and jars, HDPE and PET beverage bottles, and metal cans. The latter includes food, beverage and pet food cans made of steel, aluminum or bi-metal.

Newspapers go in a separate orange bin, with any overflow placed in a paper bag.

Based on haulers' estimates, overall participation rates for the program run between 60 and 80 percent, depending on the neighborhood.

Baled PET and HDPE bottles are shipped to the Plastic Recycling Alliance plant in Philadelphia. A joint venture of Waste Management and Du Pont, the Plastic Recycling Alliance refines the recycled materials so they can be used to make high grade consumer products.

Orange County Landfill. Plans are in the works to have it approved for use as daily cover for the disposal site. The residual fraction initially ran around 7 percent, but adjusting the screen sizes has helped drop it down to about 5 percent.

Built-in markets

The MRF has the added advantage of guaranteed markets for much of the material that's processed.

Waste Management participates in a number of joint ventures in the recycling arena. One is with Stone Container Corporation, a leading producer of packaging products. Another is with the Du Pont Company, whose expertise in polymer technology is widely recognized. Both ventures provide Recycle America of Orange County with assured outlets fc all papers and plastics, respectively.

Some of the newspapers baled at th MRF are shipped to a Stone Containe affiliate in Jacksonville, Florida. PET an HDPE bottles, meanwhile, go to the Plas tic Recycling Alliance facility in Philade phia, Pennsylvania. ("Plastic Recyclin Alliance" is the Waste Managemen Du Pont joint venture.) There, the recycle plastics are modified and upgraded intc the base material used to make high qual ity consumer products.

Waste Management and American Na tional Can Company have also formed joint venture that will broker all glass anc metals collected under the auspices o Recycle America.

Planning for the future

As emblematic of Orange County as Disney World and Universal Studios are the area's burgeoning population and the attendant traffic jams. In Florida, growth o every kind must be factored into operatinc a MRF.

Already, Recycle America of Orange County has established a transfer statior for collection trucks that service the northwest sector of the county. The transfer station facilitates delivery of materials to the MRF, which is located on a parcel of land at the Orange County Landfill in the southeastern quadrant.

The future has also been factored into the plant itself. A more mechanized separation system for plastics and aluminum cans will be installed when commingled throughput exceeds the original system's capabilities.

Built-in flexibility

Having the MRF also allows for flexibility in the county's program. As Becker says, "We can add materials beyond those originally designated for collection." A case in point was the temporary addition of telephone books to the collection routes. Between last December and this February, participants could set out their old phone books along with their newspapers. Recycle America of Orange County shipped the books to a U.S. Gypsum plant in Jacksonville, to be recycled into wallboard.

Recently the facility began phasing in commercial recyclables. A small amount of old corrugated containers (OCC) is currently being processed. (OCC is sorted on the floor rather than on the conveyor.) Long-term plans for processing other grades of commercial paper will take hold sometime after 1991. In the meantime, the MRF has been known to salvage loads of outside haulers' commercial recyclables. On occasion, a hauler whose load has been rejected by vendors because of improper sorting has brought the materials to the processing center so they could be separated for recycling.

No surprises

Just six months after Recycle America of Orange County opened its doors, 10,544 tons of processed recyclables had gone out them (see sidebar). In addition to the facility's design, Moore cites another reason for the facility's success.

"In terms of both material composition and flow, there are no real surprises," he says. This same strategy of, as Moore puts it, "knowing exactly what you're working with," will form the basis of all future plans at the MRF.

"That's why this plant works," he says, "and works so well." **RR**

Saving trees and a whole lot more

From August 1, 1990 through January 31, 1991, Recycle America of Orange County processed enough newspapers to save nearly 120,000 trees from harvest.

Here's how the MRF's first six months of operation added up:

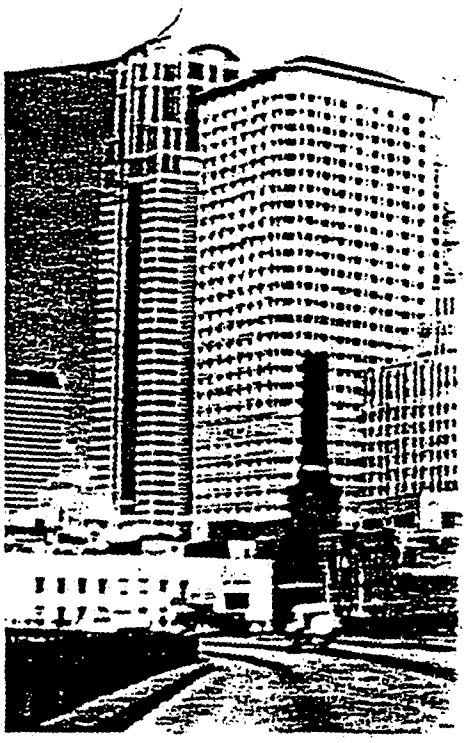
Material	Tons processed
Newspapers	7,049
Steel and bi-metal cans	533
Aluminum cans	278
Clear glass	1,172
Brown glass	331
Green glass	410
PET & HDPE bottles	572
Telephone books	199
Total	10,544

Source: Waste Management/Recycle America of Orange County, 1991.

Special Report: Curbside Collection

COMPREHENSIVE RECYCLING

SEATTLE'S ROAD TO RECOVERY



Designed to change Seattle's lifestyle through waste reduction and accomplishment of a 60% recycling and composting goal, the City's new integrated solid waste management plan focuses on future, and present, realities.

Lorie Parker

THE SCENE is Seattle in the year 2010. In many ways the City is much the same as 20 years ago: diverse neighborhoods, a prosperous downtown, a vigorous port and industrial area, a landscape green and beautiful all year round. Looking closer, however, one finds people living and working in a different way. They don't talk about it much, because it seems the natural way to be, but they are thinking differently too. As a result of thousands of unconscious choices, people in Seattle are throwing away much less than they did in 1989.

Source separating recyclables and compostables has become a way of life. In most homes, every room has a recycle can. A small waste can is tucked away in a corner of the kitchen for occasional use. Many homes have a compost or worm bin, either in the backyard or on the patio or deck. Every home has a special container for food waste. At work, in school, in shopping malls and on street corners, people casually toss their pop cans, bottles, newspapers and paper into recycling cans and scraps of food into compost buckets. Employees are rewarded for discovering ingenious new ways to reduce waste or recycle office materials.

To make waste reduction and recycling easier, dozens of products, invented by enterprising small businesses, are now manufactured and distributed widely. In-home recycling containers and compost bins of all shapes and sizes are available at most hardware stores. Other commonly sold products are reusable canvas bags and bulk food containers for groceries and carry out foods, plastic bag drying racks and stylish mess kits for eating out at fast-food restaurants.

Recycling is a flourishing business, with many firms competing to collect a wide variety of recyclable materials. Recyclables and compostables are collected once a week from nearly every home, office and industry in the City. Waste collection is necessary less often.

Processing of recyclables has become a major industry in Seattle, employing hundreds of people. The brightest, most creative young men and women often choose careers in developing new recycling technology and designing new products made from recycled materials and with minimal, easily recyclable packaging. Recycled products and secondary materials are among the port's fastest growing exports.

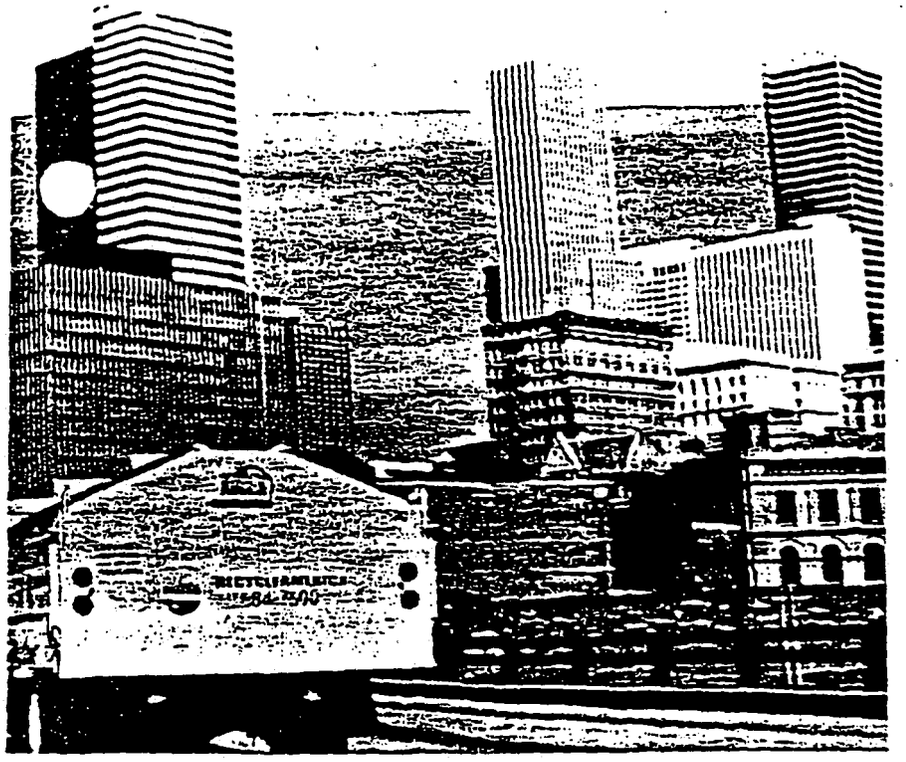
These days, so much material is recycled or never thrown away in the first place, that relatively little is left over that can be called "waste." That remaining nonrecycled waste is shipped by train to a landfill in eastern Washington or Oregon where it is buried safely.

GETTING THERE

That long term vision of the future will become reality with the successful implementation of Seattle's recently proposed Integrated Solid Waste Management Plan. The City of Seattle has a population of half a million and in 1987 generated an estimated 686,695 tons of waste. Of this, about 25 percent (170,283 tons) was recycled by private recycling companies, leaving 516,412 to be disposed of. The City has just spent a very intense year—both politically and technically—really looking at itself, its waste and what it should be doing. As a result, the City Council has made some momentous decisions, four of the most important being:

- A goal of recycling and composting 60 percent of the City's waste by 1998 was established, and programs designed to accomplish that goal were approved;
- Development of a waste-to-energy plant was set aside to give citizens a chance to show how much recycling can be done, and because of uncertainties about future regulation of ash disposal;
- A collection system and rate structure were adopted to give Seattle consumers choice and control over the rates they pay for garbage collection; and
- A choice was made to gain control of waste disposal by leaving the county's disposal system and procuring a new landfill through a competitive request for proposals.

These decisions were made after a great deal of study and forethought. The Solid Waste Utility last year completed a 10 volume Environmental Im-



pact Statement on Waste Reduction, Recycling and Disposal Alternatives which used a computer model to closely examine the costs and effects of six recycling scenarios involving 21 different cycling programs and matching them ch 13 disposal options, including near and distant landfilling, mixed solid waste processing and waste-to-energy plants of various sizes and types.

The City has also conducted a complete waste stream analysis, probably the most thorough yet undertaken in the country. Samples were collected monthly for a year from both commercial and residential waste to ensure an accurate record of seasonal trends in the disposal of solid wastes as well as differences from various sectors.

To achieve the 60 percent reduction and recycling goal, the City is implementing a wide range of programs including public education, curbside collection of recyclables and yard waste, commercial and apartment recycling and mixed waste processing of select loads of waste. The City will also consider developing a food waste composting facility.

WASTE REDUCTION AND RESIDENTIAL RATE DESIGN

Although waste reduction is the City's highest priority for solid waste management, efforts so far have been limited. The Utility has piloted a few community educational projects and has inserted selective shopping tips in garbage bills. Setting an example for others, the City has adopted a policy prohibiting City purchase of plastic beverage cans and polystyrene foam food and beverage containers. Also, the City has lobbied for Federal and State packaging legislation.

The most effective waste reduction strategy has been the variable can rate structure which gives customers a financial incentive to reduce the amount of garbage they throw away. Residents must pay for the amount of garbage they produce. As they reduce the amount they set out, they are rewarded by a cheaper garbage bill. Since 1981 when the variable can rate structure was established, the average subscription for residential ratepayers has dropped from 3.5 to 1.4 cans.

The City's new rate structure is summarized below:

- *Multi-family Variable Rates.* Multi-family building owners can choose any level of service, whereas previously they were limited to subscription levels equal to multiples of the number of units. Allowing these customers more service level flexibility will provide increased incentive to reduce the volume of waste disposed.
- *Compacted Waste.* A new rate for compacted waste in detachable containers is charged to reflect the increased cost of disposal from the increased weight. Weight limits control the amount of compacted waste that can be put in a can.
- *LIEH Subsidy.* Qualified low income, elderly and handicapped customers are eligible for a subsidized rate for one and two cans.
- *Backyard vs Curbside Pickup.* Customers are offered a choice between curb/alley and backyard service. Rates for backyard pickup are 40 percent more than bringing the can to the curb. This 40 percent premium represents about double the cost of service, but provides a strong incentive to bring waste to the curb and eventually lower collection costs.
- *Basic Rate Structure.* The one-can rate is $13.75 per month. There is no charge for curbside recycling service; this cost is included in the garbage rates. The second and third can each cost an additional $9 rather than the 1988 $5 differential. This was done to provide an increased incentive for waste reduction and recycling. In the long run, customers should be charged based on the actual weight of the garbage they produce each week. The current variable can rate is as close as the City can currently get to an infinitely variable rate.
- *Extra Waste.* A pre-paid trash tag for extra waste is available for $5.
- *Yard Waste.* Curb/alley collection of yard waste is available weekly or bi-

Contracted curbside collection of recyclables is handled by two companies: Recycle America (a Waste Management Inc.) on the north end of the city, and Recycle Seattle (Rabanco Co.) in the south.

weekly for $2 per month, with a required annual subscription. As many as 20 cans, bags or bundles of yard waste will be collected each month. The fee is low to encourage subscription, but not so low as to discourage backyard composting.

- *Mini-can.* A new 19 gallon mini-can service is available to those who produce little waste and/or recycle and compost most of their waste. This rate provides a significant incentive for waste reduction and recycling for customers who were not filling one garbage can.
- *Bulky Item Pickup.* For a $15 fee, bulky items such as refrigerators, stoves, mattresses and sofas will be collected. The service is on-call.

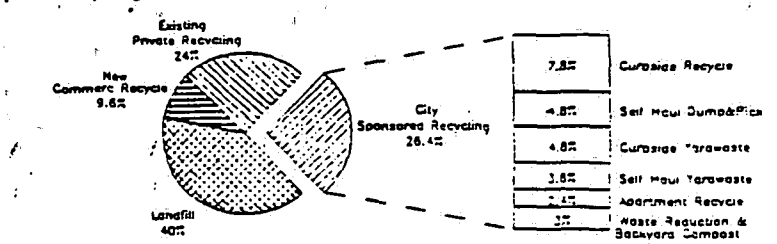
CURBSIDE RECYCLING

Begun in February 1988, the curb/alley recycling program serves all single family houses and multi-family units up to four-plexes. The City is divided into two sectors, north and south of the Ship Canal, for contracted curbside collection of recyclables. Materials collected include newspaper, mixed paper, cardboard, glass, tin cans and aluminum. The north end contractor, Recycle America (a Waste Management, Inc. company), picks up these materials weekly in three stacking bins. The south end contractor, Recycle Seattle (a Rabanco Company), collects the same materials monthly from 60 or 90-gallon wheeled toters.

The 1988 collection and processing costs for the curbside program were $1,070,000. Recycle Seattle received $47.75 per ton, has no guaranteed minimum annual payment and shares the risk with the City for recycling market prices. Recycle America received $48.15 per ton of recyclables, has a minimum payment based upon 40 percent sign-ups in the first year and bears all the risk for recycling market prices. Each year the price paid per ton will be adjusted at 80 percent of the change in the Consumer Price Index.

In its first year the program has exceeded the original projections for participation and for tonnage. At the end of the first year, over 65 percent of the eligible housing units in the City had signed up to receive bins or toters, and the City had collected and marketed 30,000 tons of recyclables through the curbside program. The program's success can be attributed to several factors, including the solid promotion done by the City and the contractors, the program's convenience and the fact that many people in Seattle already were recycling to some extent. The 1988 recycling tonnage from the curb/alley recycling program represents about ten percent of the residential waste stream and about 3.5 percent of the total waste stream.

Figure 1. Seattle Solid Waste Management Plan (60% Recycling and 40% Distant Landfill in 1998)



APARTMENT RECYCLING

On January 30, 1989, the Seattle City Council approved an Apartment Recycling Diversion Credit Program. According to the diversion credit program, the City would pay private recyclers for each ton of recyclable material that they diverted from the apartment building waste stream. The diversion credit was to be paid to any recycler who could meet the terms of a form contract approved by the City Council. The program was seen as a way to provide a variety of recycling services to multi-family buildings (five or more units) and to mitigate the effects of the curbside program on private recyclers.

As of May 1, 1989, only one private recycler (Nuts 'n' Bolts Recycling) had signed the Apartment Recycling Contract. Upon further questioning of other private recyclers, the Solid Waste Utility determined that no other recyclers were interested in signing the existing apartment recycling contract. Since Nuts 'n' Bolts Recycling is a very small company that is not able to adequately serve the entire city, the City decided that it needed to take a different approach.

The Solid Waste Utility has, therefore, begun developing a Request for Proposal for a contractor(s) to serve multi-unit buildings. The City will be divided into sectors, allowing proposers to submit proposals to serve smaller parts, or all of the City.

Meanwhile, as the Request for Proposal is being developed, the Solid Waste Utility will also negotiate with the current curbside contractors to add apartment recycling to their routes. If a reasonable price and service can be negotiated during this process, the Solid Waste Utility will suggest to the City Council that the City take this quicker, simpler route towards adding comprehensive multi-family recycling to the City's recycling programs.

If contracts can be negotiated with the Curbside Contractors, an apartment recycling program will be in place by Fall, 1989. If the City issues an RFP, it will be early 1990 before a program is in place. In either case, the Solid Waste Utility plans to allow Nuts 'n' Bolts Recycling to continue collecting recyclables (for $35/ton) under their present diversion credit contract.

In 1988, a full-time apartment recycling coordinator was hired to develop and implement the apartment recycling program. The coordinator is responsible for informing apartment owners, managers and dwellers how to recycle, promoting the availability of the program throughout the City, and coordinating information between the City, recyclers and apartment building owners, managers and tenants.

Call 684-7600

Seattle Solid Waste Utility

City of Seattle Monthly Residential Rates

Container Size	1988 Rates	1989 Curb/Alley	Backyard Service
Can (Gallon)	N/A	$10.70	N/A
One-Can (30 Gallon)	$13.55	$13.75	$19.25
Two-Can (60 Gallon)	$18.55	$22.75	$31.85
Three-Can (90 Gallon)	$23.55	$31.75	$44.45
Each Additional Can (30 Gallon)	$ 5.00	$ 9.00	$12.60

YARD WASTE COMPOSTING PROGRAMS

In October 1988 the City Council mandated that yard waste be separated from garbage. To handle this yard waste, the City has begun a three-pronged yard waste management strategy of backyard composting, curbside yard waste collection and expansion of the transfer station clean green collection program.

The Utility has budgeted $530,000 for the first year of the backyard composting program, with 75 percent of the cost to be covered by a Washington Department of Ecology grant. The City will hire a consultant to coordinate program which will employ the valent of six full-time trainers to reach 6,000 residents. Each participant will receive in-home instruction on composting techniques and a free composting bin or $25 equivalent.

On January 1, 1989, as part of new garbage collection contracts, the City began curbside collection of yard waste from all City residences. For a fee of $2 per month, as many as 20 cans, bags or bundles of yard waste will be collected. Yard waste is collected on the same day as garbage using a one-person rear-load truck. General Disposal collects weekly in the northern two-thirds of the City. U.S. Disposal collects monthly November through February and biweekly during the remainder of the year in the southern third of the City.

Yard waste is hauled to the Cedar Grove Compost Facility, a new composting facility located on 26 acres adjacent to the Cedar Hills Landfill and owned and managed by the Rabanco Company. Cedar Grove has been permitted for operation and is beginning to receive material. The facility is designated to process 30,000 tons annually, but with additional equipment d accommodate more. The yard e is shredded by a tub grinder, screened and piled in windrows to compost. The finished compost will be sold as a soil amendment or landfill cover.

EDUCATION AND COMMUNITY RELATIONS

Market research indicates that the public cannot and will not adopt a new behavior or participate in a new program unless they know about it, are persuaded of its benefits, find it easy to do, and are frequently reminded to do it. These concepts have been the basis of the Utility's community relations efforts for the past two years.

To ensure an integrated, consistent approach to gaining public support for the City's waste reduction and recycling goals, the Utility has assigned four staff to be responsible for planning and managing the information, education and involvement activities. A promotional consultant and staff from the City's recycling and waste collection contractors join the Utility staff in both the planning and implementation phases of promotion and education activities. The cost of these activities is about $375,000 per year, not including staff salaries, but including consultant services, costs of slide shows, bill inserts and other audio/visual and print materials.

This year the Utility will establish a Block Leader Program to organize volunteer citizens to distribute Utility literature door-to-door on their block, encourage participation in Utility programs and educate their neighbors about waste reduction, recycling and composting behaviors which will be necessary for the City to meet its 60 percent recovery goal.

Historically, new recycling and composting programs have included a budget for publicity and information. As programs are designed, the Utility will continue to include sufficient emphasis on getting the word out. This includes written and audio-visual media. In addition to using public service announcements and press releases, the Utility is going to develop a newsletter for distribution by block leaders. Neighborhoods with low sign-up rates for curbside recycling will be targeted for special attention.

Although the Utility does not contract for collection in the commercial and industrial sectors, it has a role to play in promoting waste reduction and recycling in these sectors and providing information about private recycling services. Commercial garbage customers need information on how to reduce waste and where to find recycling service providers. The Greater Seattle Chamber of Commerce has offered to be a partner in such an effort. The City is working with the Chamber to establish a Recycling Council to serve as the point of information for all commercial waste reduction and recycling services.

COMMUNITY ENGINEERING

The aim of the Utility's public education activities is that school children, citizens and rate payers understand the need for waste reduction and recycling so they will produce less waste and recycle more, both at home and at work. Through its public education program, the Utility advocates change in the way people treat solid waste, from a throw-away mentality to a conservation ethic. Educational themes include selective shopping, reusing products, buying durable products and avoiding excessive packaging.

Through school programs, ratepayers of tomorrow can be influenced to change waste reduction and recycling behavior. Waste management education and waste reduction and recycling practices are being incorporated in school classrooms from K-12. A 1988 study, *Recommendations for an Elementary School Curriculum and Education Program on Recycling*, which included focus groups of Seattle teachers, recommended that the Utility develop a comprehensive solid waste education program for the Seattle Public Schools. The schools' programs should aim to establish a waste reduction and recycling ethic in primary grade children, to demonstrate that ethic by establishing reuse and recycling programs in the schools, and to promote participation at home in recycling and composting programs.

With this comprehensive approach to management of its waste, the City is well on the road to reaching its ambitious 60 percent recycling goal. Though a challenge, it is not an impossible task. With careful implementation, and with mid-course corrections when and if needed, the goal can be accomplished. ■

Lorie Parker is the Recycling Coordinator for the City of Seattle. Part of this report is based on her presentation at the BioCycle West Coast Conference in San Francisco, California, March 1989.

Appendix B

Articles on Technical Issues

Papers

New England Crinc "Material Recovery Facility"

Savage, George M. "Design of Materials Recovery Facilities (MRFs)"

Articles

Apotheker, Steve "Market Quality Issues Loom for MRFs," Resource Recycling (May 1990) p. 28.

Arnold, Hans G. and Guttentage, Roger "What is a MRF?" Waste Alternatives p. 37.

Cameron, Margaret and Garnier, Thomas "How to Select a Shredder," Waste Age (July 1989) p. 121.

Diaz, Luis F. and Golueke, Clarence G "Quality Control and Waste Management", Biocycle (July 1989) p.65

Diaz, Luis F. and Southworth, Matthew J. "Transfer Station Recycles 100 Tons Per Day," BioCycle (November/December 1987) p. 34.

Goldberg, Dan "MRFs Thrive on the East Coast," Waste Alternatives p. 50.

Johnson, Bruce "San Francisco Recycling Proves Less is More," Resource Recovery (September 1989) p. 41.

Kneass, Don "Parking Lot to Processing Facility," BioCycle (September 1989) p. 67.

Kohrell, Mary and Olson, Gary J. "What's the Future of Cooperative Marketing," Resource Recycling (June 1990) p. 34.

Marcelino, Michael "MRF Automation Making Strides Into High-Tech," Recycling Today (July 1989) p. 38.

Peluso, Richard A. and Ruckert III, Ernest H. "Transfer Stations Can Recycle, Too!," Waste Age (July 1989) p. 125.

Salimando, Joe "Rhode Island's MRF," Waste Age (September 1989) p.126.

_____ "New York's Laboratory In Harlem," Waste Age (June 1989) p. 100.

_____ "Nation's First Merchant MRF," Waste Age (February 1989) p. 79.

Watson, Tom "Cooperative Marketing: a Delicate Balance," Resource Recycling (February 1991) p. 26.

_____ "The Latest European Import: Wet/Dry Collection Systems," Resource Recycling (April 1991) p. 19.

NEW
ENGLAND
CRINC.

MATERIAL

RECOVERY

FACILITY

NEW ENGLAND CRINC
74 Salem Road
N. BILLERICA, MASSACHUSETTS 01862

What is a MRF?

A Material Recovery Facility, or MRF, is an intermediate processing center which transforms recyclable solid waste materials into marketable industrial feedstocks for subsequent manufacturing processes. The MRF, as designed and operated by New England CRInc., incorporates two separate processing lines - one for paper recyclables and one for mixed recyclables, e.g., glass and mixed metal beverage and food containers and selected plastics. While most MRF's currently in operation employ labor-intensive sorting and processing techniques, New England CRInc.'s MRF capitalizes on near-total automated technology.

How does a MRF work?

Figure 1 shows the layout of a typical New England CRInc. MRF. Recyclables are delivered to the MRF separated into two streams or fractions: paper and mixed recyclables. The method of collection and delivery of recyclables to the MRF is independent of the effective operation of the MRF. However, the most effective method is source separation into the two separate fractions by the waste generator and curb-side collection by compartmentalized collection vehicles on a regularly scheduled basis.

For optimum MRF operational efficiency certain standards must be met at the time source separation and curb-side collection and delivery to the MRF take place. For example, all newspapers should be dry and either tied in bundles with string or placed in brown (kraft) paper bags. All glossy-finish photographs or brochures should be removed. All beverage and food containers (metal, glass or plastic) should be empty, rinsed, dry and unbroken, not crushed, with all tops/caps/lids and labels removed. Adherence to such standards should cause minimal inconvenience to the waste generator. Additionally, most source separation/curb-side collection programs provide a plastic box (made of recycled plastic), free of charge, to each household for the source separation and curb-side set-out of mixed recyclables.

Upon arrival at the MRF, each recyclable delivery vehicle is first weighed and then proceeds to an inspection station for load acceptance and movement to the drive-thru at the tipping floor end of the facility. The tipping floor derives its name from the fact that this is where the vehicles dump or "tip" their loads of recyclables. Since each load is divided into two fractions (paper and mixed recyclables), the vehicle can easily dump its load of paper in the vicinity of the paper processing line pit and its load of mixed recyclables in the vicinity of the mixed recyclables processing line pit. Once dumped on the floor, the load is further inspected for delivery standards compliance and is accepted or rejected accordingly. The delivery vehicle exits the facility and returns to the scale where it is weighed again. Thus, accurate records of total tonnage of recyclables delivered can be maintained. Front-end loaders are used to push the paper and mixed recyclables into the respective processing line pits.

The paper processing line is rather simple, involving only sorting to marketing standards and baling. The resulting bales are taken directly from the baler by forklift and loaded onto trailers for shipment. This is New England CRInc.'s handle-once-baler-to-trailer concept.

The mixed recyclables processing line is the heart of New England CRInc.'s MRF. The system employs near-total automated sorting and processing techniques. The sorting technology itself is of European origin and design. Basically, the system breaks the mixed recyclables waste fraction down further into ferrous metal, aluminum, amber glass, green glass, flint (clear) glass, PET (polyethylene), plastic and HDPE (high density polyethylene) plastic fractions. Each of these resulting fractions are then processed to meet marketing standards specific to each fraction.

Figure 2 depicts the layout of the mixed recyclables processing line. From the mixed recyclables pit, material is fed by the stock conveyor (#1) to a chain conveyor (#2) to a belt conveyor (#3) to a magnetic separator (#4) which separates or sorts out all ferrous metal. The latter is then directed via another conveyor (#11) to a shredder where it is shredded according to marketing specifications. The remaining fraction, consisting of aluminum,

glass and plastics, is then directed through a screening machine (#5) which divides the material stream into two streams and screens out waste (non-recyclables) and broken glass (both being directed by conveyor (#20) to a residue container). Each material flow is directed to inclined sorting machines (#6, 6.1) where heavy materials (glass) are separated from light ones (aluminum, PET and HDPE). The glass is directed by conveyors (#7, 7.1) through another screening machine (#10) and then onto a sorting conveyor (#12) where it is sorted by color. Since flint glass comprises 55 percent of the glass fraction, green and amber glass are "negatively pulled" manually and directed by separate conveyors (#17, 18) to crushers which crush each color glass separately. Since the flint glass was not pulled, it proceeds along conveyors (#12, 19) to its own crusher, where it too is crushed according to marketing specifications. Going back to the inclined sorting machine, the light materials are directed through screening machines (#8, 8.1) and aluminum separators (#9, 9.1) which sort out the aluminum. The latter is directed via conveyor (#16) to a flattener or baler where it is processed according to marketing specifications. The remaining plastics fraction is sorted into HDPE and PET fractions and directed via conveyors (#13, 13.1, 14) for subsequent processing. The HDPE is granulated and the PET is perforated and baled according to marketing specifications. The system is designed to accept additional recyclable fractions upon market development, i.e. comingled plastic.

The Recycling-MRF Rationale

Study after study, conducted across the United States, has shown that returning discarded materials to industry for re-use as manufacturing feedstocks makes good sense. Recycling also contributes to the following major national priorities:

- Energy Conservation - The use of recycled materials as manufacturing feedstocks conserves large quantities of essential energy resources.
- Effective Raw Material Utilization - The use of recycled materials conserves critical non-renewable natural resources for generations of Americans to come.

° Sound Environmental Management - Recycling not only reduces the volume of the waste stream which must ultimately be landfilled, but it removes potential contaminants, such as heavy metals, from the waste stream.

Recycling has also been demonstrated to be the most cost effective solid waste management option available. New England CRInc.'s near-total automated MRF offers significant advantages over other labor-intensive systems:

° Facility Capacity - While facility capacity can be scaled to meet specific daily tonnage requirements, 80 tons of mixed recyclables and 60 tons of paper per day can typically be processed for a community of 250-300,00 population.

° Marketing Specification - Materials are processed automatically to meet specific marketing standards.

° Marketing Advantage - Due to the high volume and good quality of marketable materials processed by the MRF and New England CRInc., premium market prices are obtained for all materials sold.

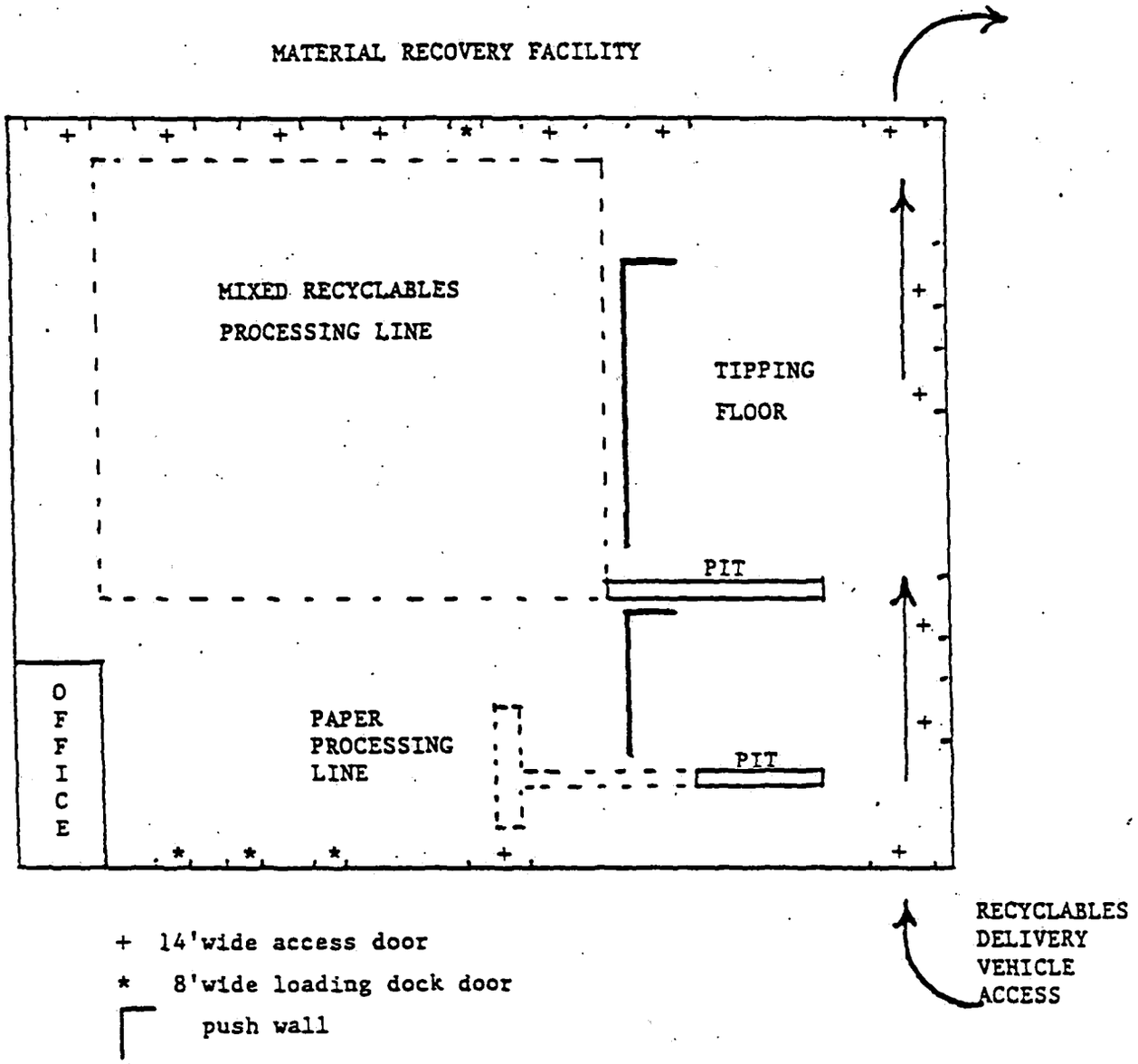

MATERIAL RECOVERY FACILITY
MIXED RECYCLABLES
PROCESSING LINE
TIPPING
FLOOR
PIT
PIT
O
F
F
I
C
E
PAPER
PROCESSING
LINE
RECYCLABLES
DELIVERY
VEHICLE
ACCESS
+ 14'wide access door
* 8'wide loading dock door
push wall

FIGURE 1

MIXED RECYCLABLES PROCESSING LINE

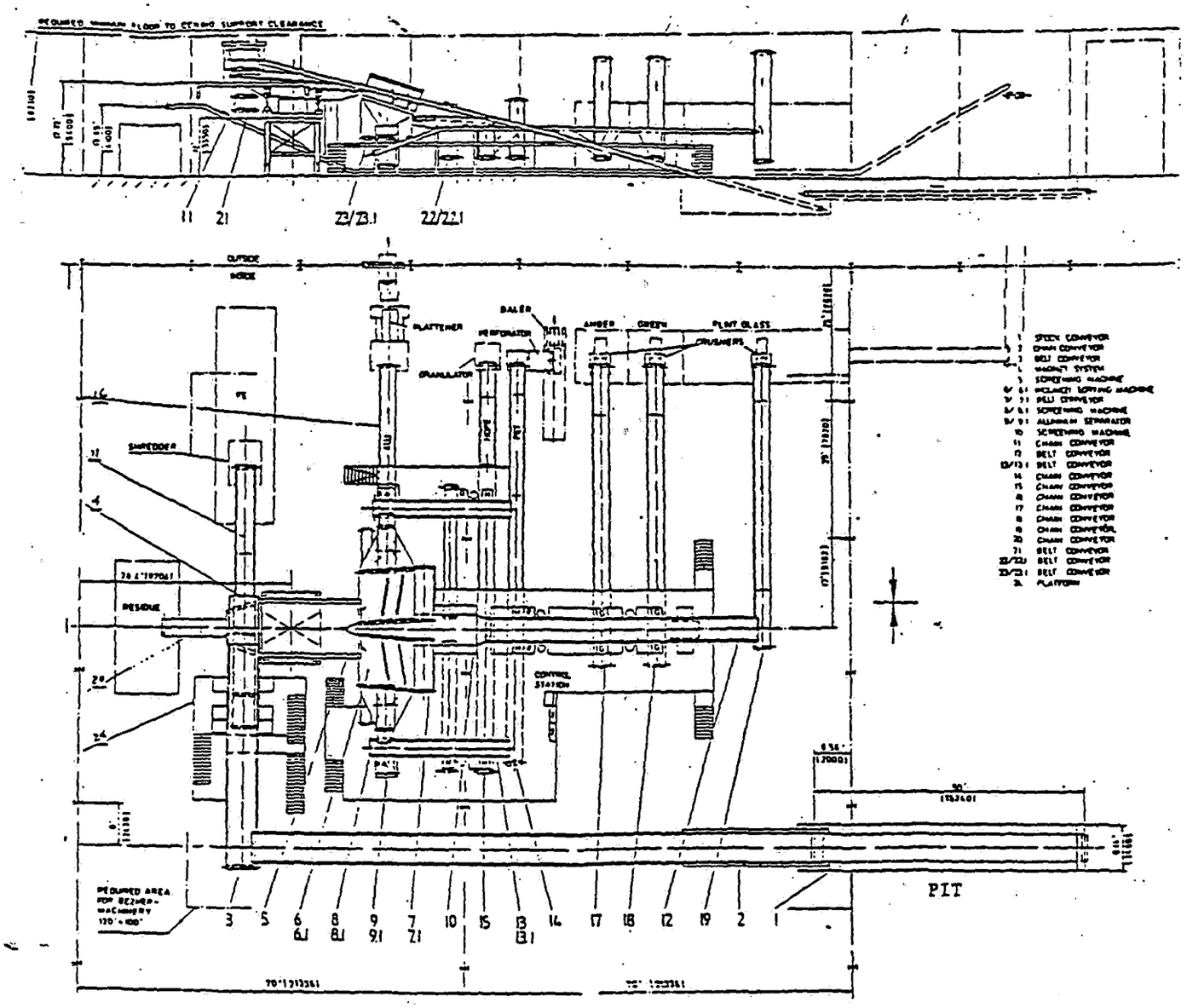


FIGURE 2

DESIGN OF MATERIALS RECOVERY FACILITIES (MRFs)

George M. Savage
CalRecovery, Inc.

Abstract

The design of MRFs is discussed, including the design criteria for the facilities, the available equipment, and system performance. The topic is approached in a broad context, addressing the processing of feedstocks in the form of singular recyclable components, of commingled recyclables, and of mixed municipal solid wastes.

Examples of designs of processing lines and facilities are presented along with descriptions of design rationale and consequences.

Introduction

The design of a materials recovery facility (MRF) follows a series of basic considerations, which generally include the following:

1. Identifying the characteristics of the wastes to be processed.

2. Maximizing recovered product quality.

3. Maximizing diversion of wastes from landfill.

4. Utilizing proven system concepts.

5. Provision for receipt of municipal solid waste (MSW), based on the types and frequency of vehicles delivering the material.

6. Utilizing manual labor for those operations where current automation technology is lacking, unproven, or but marginally effective.

7. Establishing the throughput capacity, required availability, and desired redundancy for the system.

Materials recovery facilities can be classified into two general types based on the characteristics of the input municipal solid waste; namely source-separated or mixed. Taken here, source-separated wastes refer to those that are collected in singular (i.e., segregated) components or in commingled form (a mixture of several components, e.g., metal and glass containers). Mixed wastes are not separated prior to collection and obviously such a mixture contains numerous components.

Source-separated recyclables do not suffer from the higher degree of contamination from food wastes and other contaminants exhibited by recyclables in mixed MSW. Thus,

the percentage recovery of recyclables from source-separated wastes is substantially greater than that from mixed wastes.

The following discussion considers first the design of a MRF for processing source-separated materials. Subsequently, the design of a MRF for processing mixed MSW is considered.

Source-Separated MSW

Process flow diagrams for a 120 TPD materials recovery facility project are shown in Figures 1 and 2, respectively, for a paper processing line and a container processing line. Each of these flow diagrams is also a mass balance showing the tonnages of the various recyclables as they enter and exit the system.

The process design in this example assumes that 25% of the available recyclables arrive at the facility in pre-segregated, singular form (e.g., tin cans) and that the remaining 75% is commingled. Each of the flow diagrams shows provision for redundancy in receiving, sorting, and processing.

Breakage and contamination generally amount to approximately 7 to 10% of the in-feed total. Glass breakage during collection and material handling at the facility results in the loss of small particles of glass as residue, if markets for mixed colored cullet are not available. Contamination must be removed within the ranges dictated by the market specifications. Common contaminants include corrugated and magazines included with residential newspaper collections, and low-grade paper (such as envelopes with windows) in commercial high-grade paper collections.

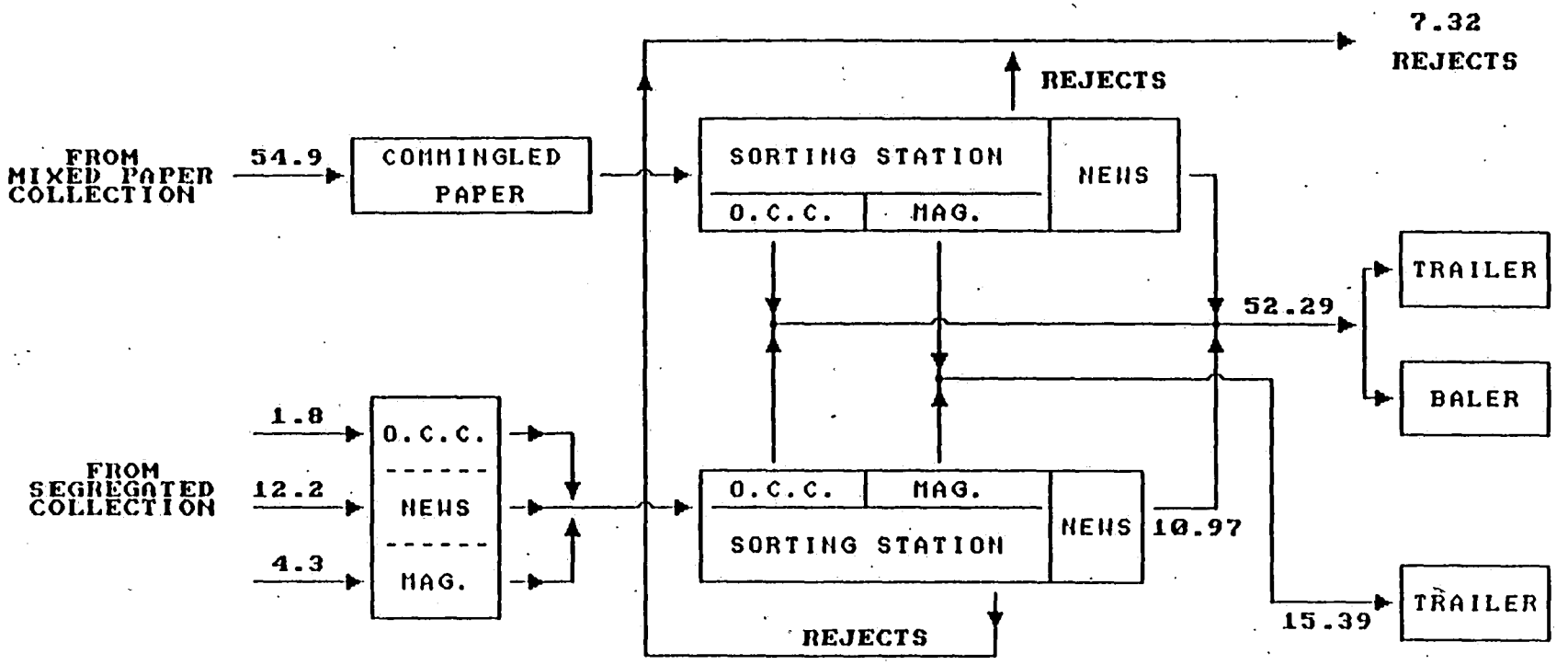


Figure 1. Paper Processing Line / Design Capacity = 75 TPD
75% Commingled Collection
25% Segregated Collection

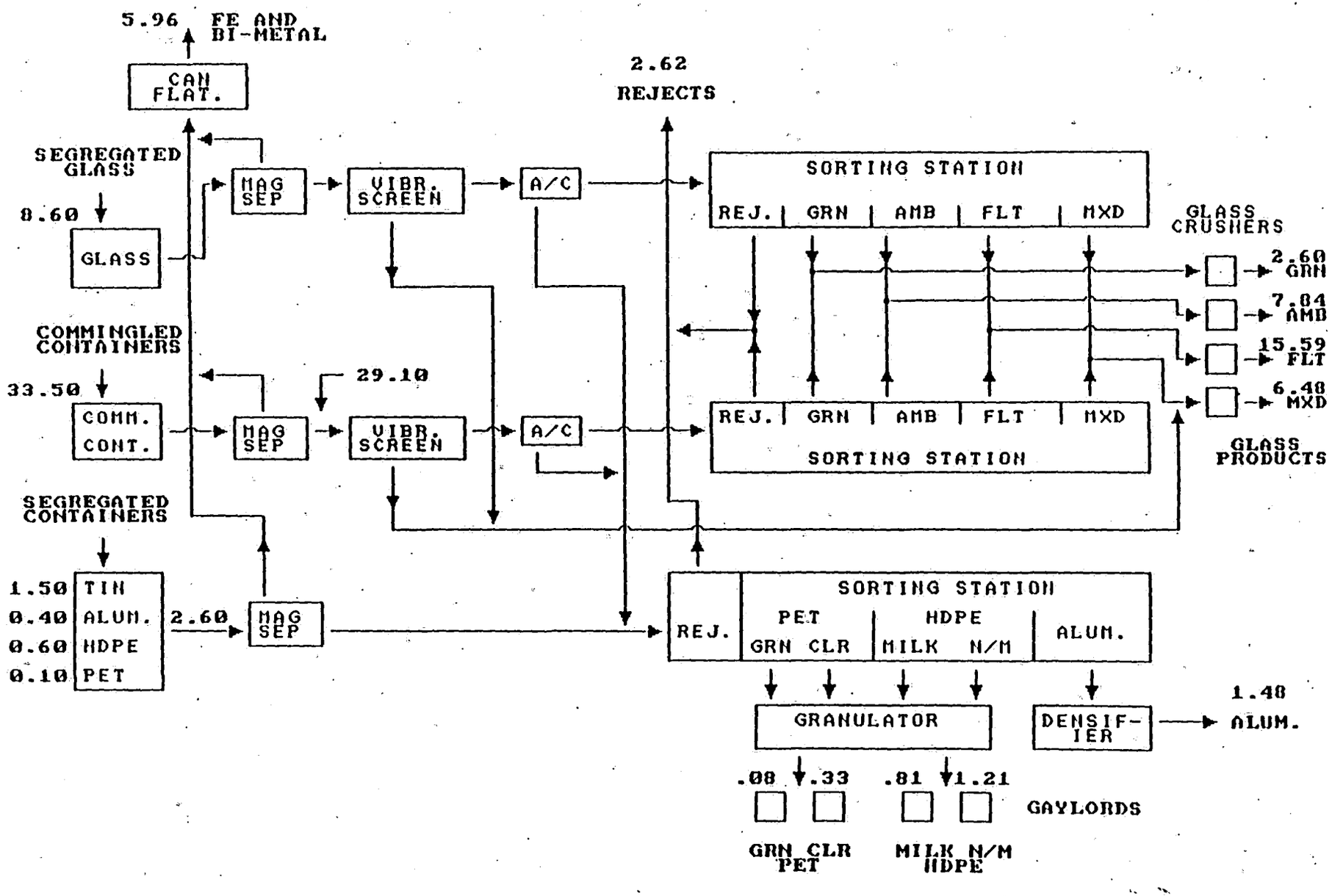


Figure 2. Container Processing Line / Design Capacity = 45 TPD
75% Commingled Collection
25% Segregated Collection

Figure 3 is an example plan view of a facility matching the flow diagrams described above. The facility is designed to provide a high level of redundancy, both in paper processing and in container processing.

For the paper line, two receiving pits are shown and each line is capable of handling either the maximum anticipated mixed paper waste or the maximum anticipated segregated paper waste.

Similarly, for the container line, three receiving pits are shown. Two of the lines are totally redundant, with each capable of handling either the maximum anticipated mixed container waste or the maximum anticipated segregated container waste. The third line is provided to handle segregated plastic and aluminum containers exclusively.

The tipping floor and product storage areas are sized for a minimum of one day's storage of all materials.

This particular design provides for a facility with a minimum risk of downtime resulting from equipment failure. However, the provision of extensive redundancy is expensive. Substantial economies may be realized by eliminating redundant processing capability and operating on at least a two-shift basis. However, in any plant, machinery can and will break down. In the case of a plant with little or no redundancy, plans must be in place regarding how to meet anticipated breakdowns to minimize the effect of an outage.

Mixed MSW

Recyclable materials can be recovered in a mixed MSW processing facility. Such materials recovery facilities segregate and recover the recyclable components from the heterogeneous-mixture MSW. As opposed to MRFs processing commingled and segregated

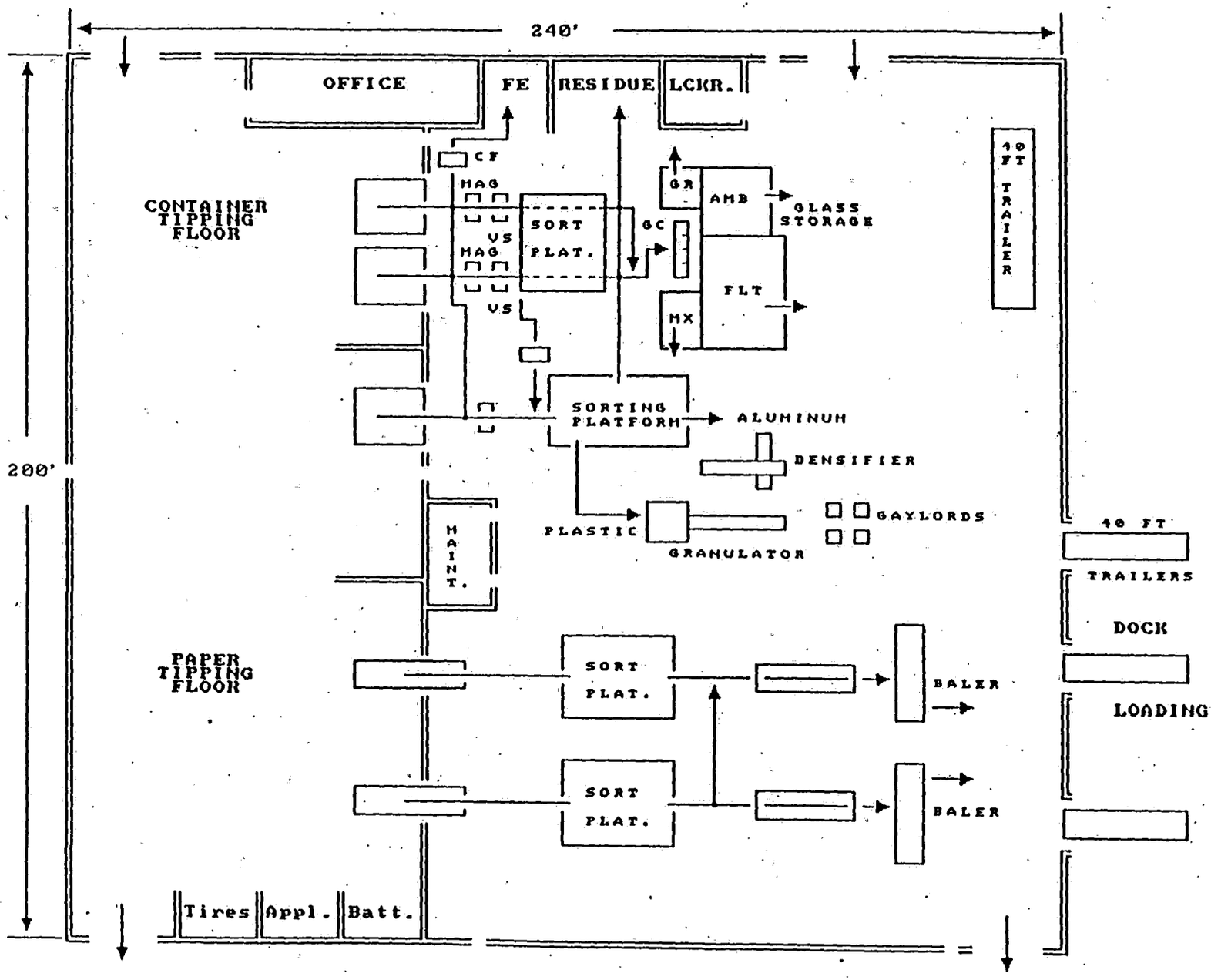


Figure 3. Plan View of Materials Recovery Facility

components wherein 90% or more of the input materials are recovered in the form of marketable end-products, MRFs processing mixed MSW can recover approximately 10 to 20% of the input in the form of marketable grades of metals, glass, plastics, and paper. Additional resource recovery can be achieved by integrating into the facility design additional processing operations to recover refuse-derived fuel (RDF) or a compostable feedstock. These options for integration can increase the total diversion to within the range of 75 to 85% if markets for the other materials exist.

An example of a materials recovery facility design configured for the primary purpose of processing and recovering recyclable materials from mixed municipal solid waste, including ferrous, HDPE, PET, aluminum, and several grades of paper, is presented in Figure 4. The processing capacity is assumed to be 50 TPH. The processing system incorporates both mechanical and manual separation processes in order to optimize the recovery of marketable secondary materials. The design recovers approximately 15% of the input mixed waste in the form of marketable grades of recyclables.

Wastes are assumed delivered to the facility via transfer trailers or refuse collection vehicles. A description of the facility design follows.

Wheel loaders and a picking crane are employed to remove large, heavy objects and other nonprocessibles from the waste stream prior to the waste entering the processing equipment.

Provision is made in the facility to segregate corrugated and other marketable waste paper grades by wheel loader that arrive in loads of waste composed predominantly of paper materials. When sufficient corrugated or other paper grades are removed on the tip

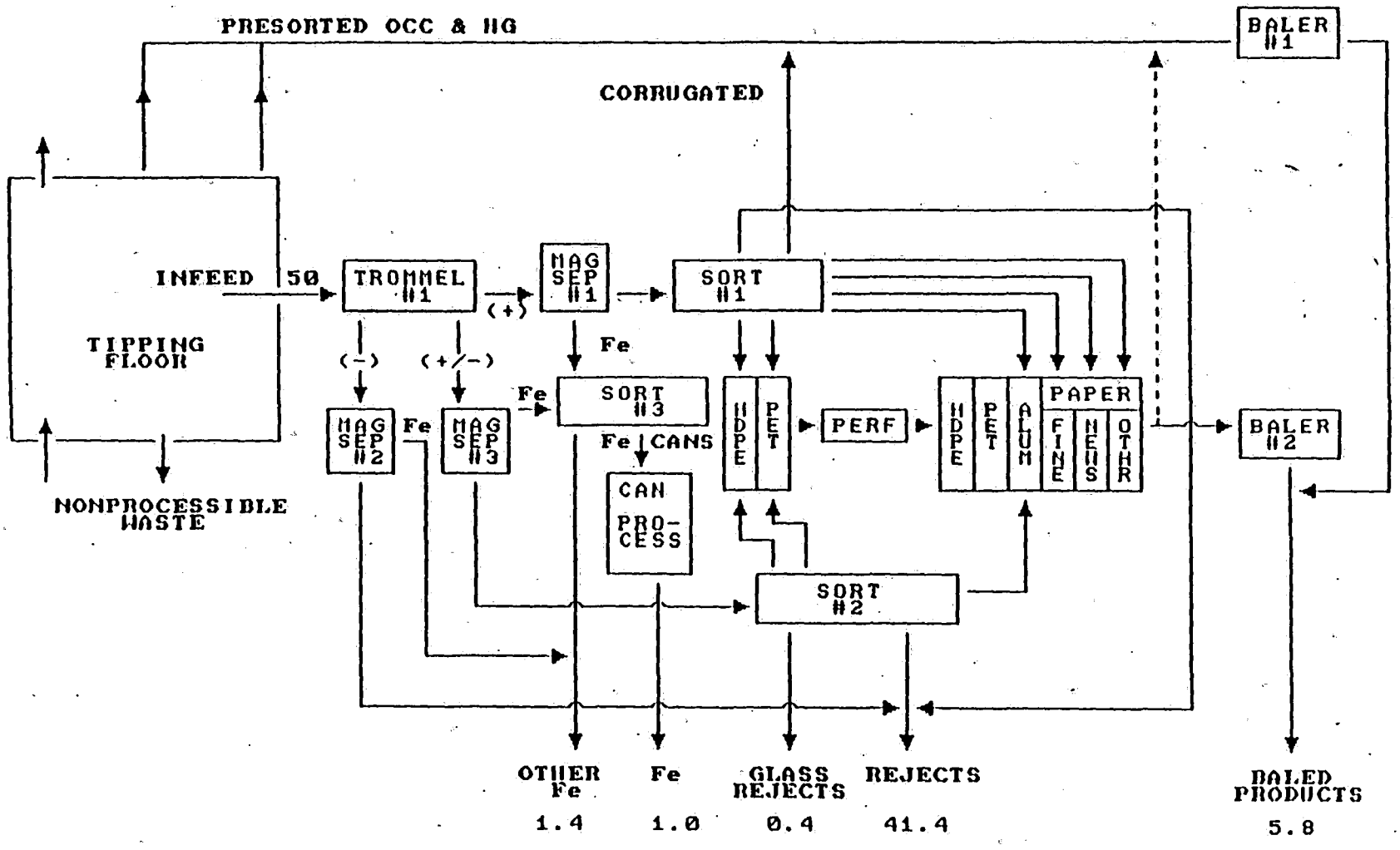


Figure 4. Flow Diagram for a Mixed MSW MRF (TPH)

ping floor by wheel loader and accumulated, the materials are transported directly to a baler, bypassing the mixed waste processing equipment.

Mixed MSW is introduced to a two-stage primary trommel, with the first stage undersize material passing by a magnetic separator for ferrous extraction. The resulting process residue is routed to the output residue stream.

The primary trommel second-stage unders pass through a magnetic separator, where the ferrous is removed and conveyed to a sorting station. At the sorting station, ferrous from the trommel oversize material extracted by a magnetic separator joins the ferrous extracted from the second-stage trommel unders. Ferrous cans are sorted from other ferrous and sent to a can processing subsystem to provide a product with minimal contamination.

After passing through a magnetic separator, the primary trommel overs are conveyed to a second sorting station where HDPE, PET, aluminum, cardboard, and various paper grades are manually separated. When sufficient quantities of these materials are accumulated, they are processed by one of two balers. The second baler serves as a component of processing redundancy for the facility.

A third sorting station receives undersize from the second stage of the primary trommel after ferrous removal. HDPE and PET containers are manually sorted at this station, as well as aluminum and some high-grade paper. The remaining waste joins the waste from the sorting station processing the trommel oversize stream.

Substantial manual sorting is utilized for segregation of plastics and aluminum because manual sorting is efficient for recovering the various plastic polymers and aluminum beverage containers and because of the opportunity for employment development.

Additionally, mechanical and electro-mechanical separation systems for plastic polymers and aluminum materials are developmental for waste processing applications.

Process residues account for about 85% of the incoming solid waste. Much of the process residues are combustible and biodegradable organic materials. These materials require landfill disposal unless processed for energy recovery or converted to a compostable feedstock for subsequent composting. For example, if refuse-derived fuel recovery is integrated with materials recovery, the residue stream could be reduced to 15 to 25% of the input MSW.

Conclusions

The design of materials recovery facilities is dependent upon a number of considerations. One key consideration in the selection of appropriate facility designs is the form of the delivered feedstock, i.e., source-separated recyclables or mixed municipal solid waste. A second key consideration is the level of recycling or waste diversion that is required. Source separation programs (i.e., collection and processing) may achieve 20 to 30% diversion, while mixed waste processing may be required if diversion goals are 30% or greater. Of course, markets must be available for the recovered products in either case.

The impetus toward greater rates of waste diversion from landfills places a greater burden on the designer to efficiently and cost-effectively process and recover additional components of the waste stream. This paper has presented the rationale of process design and examples of facility designs to illustrate the variety of processing means available to achieve waste diversion.

Market quality issues loom for MRFs

by Steve Apotheker
Resource Recycling

"As more secondary materials become available to industry for recycling, contamination levels will be cause for greater concern," warns Chaz Miller, director of recycling for the Washington, D.C.-based Glass Packaging Institute. The ability of traditional markets to handle off-specification recycled material by blending it with quality recycled, or virgin, material will be less successful. The recent convention of the Institute of Scrap Recycling Industries featured a forceful panel presentation by aluminum and can company representatives about contamination problems seen in used aluminum beverage can (UBC) recycling. In both the glass and aluminum can industries, the message has come down hard and clear that more attention to higher quality standards is needed by processors, particularly by materials recovery facilities (MRFs) that accept commingled recyclables for sorting at a central location.

There are three arguments for using a commingled approach, say MRF vendors. First, MRFs contribute to higher citizen participation rates by allowing the convenience of setting out commingled recyclables. Second, collection can be done quicker and more efficiently in a truck with one or two compartments; the driver spends less time sorting and the storage capacity of the collection vehicle is maximized before unloading must occur. Finally, a centralized processing operation combines technology and people to upgrade a mixed recyclable stream to the high quality materials acceptable to buyers.

On the other hand, a number of representatives from the glass and aluminum can industry are emphasizing the need for greater efforts to be made by MRF operators to provide a quality product. While these representatives have seen the MRF concept evolve, with reasonably successful efforts on the parts of some companies, there is still a need for greater improvements in technology and better training of workers so that quality standards can be met consistently.

Aluminum can companies feel impact of curbside material

With an increase in the aluminum can recycling rate from 54.6 percent in 1988 to 60.8 percent last year, aluminum companies have seen more UBC coming in from curbside collection programs. A number of the programs collect glass, plastic, steel and aluminum containers together for processing at a MRF. This has led to contamination from these other materials in loads of aluminum UBC shipped to the smelters.

The aluminum companies acknowledge that the cleanest used aluminum beverage containers come from deposit and redemption states because of the closed loop system back through the retailer that eliminates exposure to adverse weather or to other recyclable materials. Next in line in terms of clean UBC are buy-back programs that produce high quality scrap cans separate from other materials, although dirt and sand can be a factor in materials from roadside and beach collectors.

Interviews with material buyers indicate curbside programs generate a much broader range of quality, from very good to very poor. When cans are mixed with other containers, the potential for contamination increases. Broken glass chips often stick to cans or end up inside them. Light plastic containers may remain with the cans during an air separation process. Finally, the look-alike bi-metal beverage cans that sneak through magnetic separation also cause problems in those regions where they are prevalent.

Contamination causes serious safety, production and quality problems. Dave Smith, vice president with Continental Resource Recovery in Oak Brook, Illinois, points out that plastics in a UBC delacquering furnace upset the delicate thermal balance needed to remove the paint from

the cans. Plastics can cause hot spots, or fires, that oxidize the aluminum metal instead of just burning off the paint. Not only are fires dangerous to personnel, but the furnace may get too cold and incomplete delacquering may occur.

Lee Benbenek, vice president with Kaiser Aluminum in Oakland, California, recalls one MRF that shipped UBC with some lead downriggers, weights used with nets in the fishing industry, with its cans. Lead is poisonous and the can companies must meet a U.S. Food and Drug Administration upper contamination level of 0.01 percent for lead in cans — or, put another way, six pounds of lead in a 60,000-pound rail car. The lead also causes problems with forming the can sheet into cans.

A problem that many MRFs encounter at one time or another is glass or dirt mixed in with the cans. These materials don't melt, so they are incorporated into the final product, often raising the silicon content above specification. If the addition of expensive primary aluminum cannot bring the batch of metal into specification for use in cans, then the recycled aluminum is sold for another use.

Many UBC buyers are quick to point out that while the quality of the materials from MRFs is not top of the line, it does range from very good to very poor. Most of the older MRFs have paid their dues, working with the markets to solve quality problems. Sometimes the solution is as easy as not storing material outside before processing so that used aluminum beverage containers do not pick up moisture and dirt. According to the recently published *Materials Recovery and Recycling Yearbook*, this is one lesson new MRFs are learning. Only 47.5 percent of existing facilities now use indoor storage, but 90 percent of planned operations will be staging their materials inside before processing.

Ron Kofmehl, the UBC buyer for the Ravenswood Aluminum plant in Bedford, Indiana, believes that "Capital investment in available technology is important to achieve a good product. MRFs need to be committed to making this investment, which does not often have to be much. Sometimes the addition of a screen or a trommel will provide that extra bit of help to produce a consistent product." Some MRFs have been unwilling to make these processing equipment additions, relying solely on handpicking of UBC after magnetic separation.

Most buyers feel that it is important to provide clear training to workers about the quality of product needed. MRFs need to make sure their workers know they are providing an important raw material for the beginning of a manufacturing process, rather than merely separating out garbage. This is a distinction sometimes easy to miss by low-paid employees operating in conditions that are often not optimally designed for the high production demands made on them. It does not take much loss of attention to allow a few inappropriate containers to slide by with the UBC.

Contamination causes serious safety, production and quality problems.

Glass markets ask collectors to adapt

The glass container companies are concerned with two major problems. With the higher quantities of glass containers being recovered, it is necessary for collectors to provide color-separated glass so that furnaces can maximize their consumption of the scrap glass, known as cullet in the industry. Until early in 1990, mixed-color glass had been accepted as part of a normal sorting process for many recycling programs in the Midwest and California. Mixed-color glass is also generated from MRFs due to the breakage that occurs from multiple handling of the glass containers from curbside collection until the containers reach the sorting conveyor at the MRFs. Some emerald green furnaces in the country are already operating consistently with an 85 percent level of cullet from source-separated green glass in their batch. In the past, mixed-color glass has been used in green furnaces, but these high operating rates now leave little furnace capacity to absorb mixed-color glass.

A second, and perhaps more serious, problem is the increasing level of ceramics in glass loads. Austin Fiore, eastern regional manager for Owens-Illinois, notes, "Ceramics, such as cups and plates, can not be removed mechanically by our beneficiation systems at the glass plants that routinely handle the metal, plastic and paper." Often the ceramics are broken in the glass, making detection impossible at the glass plant until the contaminated material has gone into the furnace. Ceramics cause blisters in the new glass bottles, making them unsuitable for use. Correction of the problem may entail draining a furnace of several hundred tons of material and shutting down a production process that normally goes 24 hours a day.

MRFs are experiencing a problem where 10 to 25 percent of the collected glass containers ends up as a mixed-color fraction, basically due to breakage, and is either disposed of as residue or sold to the asphalt industry for a price less than $10 per ton. Color-sorted glass sold to container plants usually brings $40 per

Continued on page 81.

MRFs

(continued from page 29)

ton or more, except for regions where some color might be in oversupply.

Some MRFs, realizing that selling mixed-color glass to the glass container industry is a diminishing prospect due to the abundance of source-separated green glass, are actively pursuing public and private asphalt producers that will use this material to produce glasphalt. Mixed-color glass can serve as a replacement for 10 to 40 percent of these companies' raw material needs.

For companies in the East, especially where landfill tipping fees average $50 to $100 per ton, the economics seem to support a strategy of glasphalt markets. Ceramic-contaminated material does not pose a problem for glasphalt markets.

Rethinking the need for MRFs

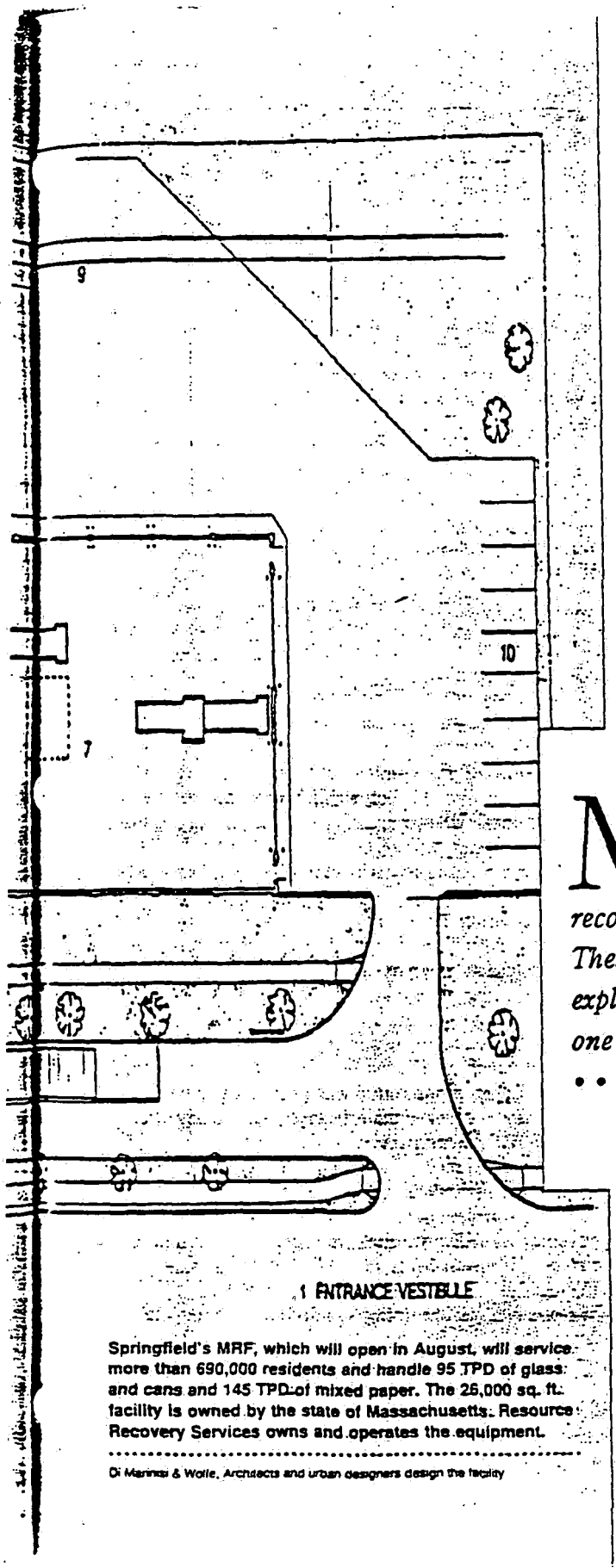
While some MRFs do a good job, there is definitely a range of quality levels. Many market representatives acknowledge that MRFs are an evolving technology and several MRF vendors have shown the ability to move forward with very acceptable quality material. However, the number of new MRFs is expected to double in the next two years with the average size getting 82 percent larger. Secondary material consumers are concerned about absorbing ever-increasing quantities of recycled glass and cans from companies that might not understand the need for quality materials.

George Cobb, president of Alcoa Recycling Company, observes, "There may be the need for some research and development so that a better sorting technology can take some of the burden off the human element."

Many executives at the glass and can companies question some of the fundamental premises of the MRF, as well as its capital cost. More sophisticated technology will drive the capital cost, which averages $33,000 per ton of daily capacity, even higher. Why not look, they say, at moving some of the two dozen sorters in a MRF out onto the collection vehicles? Delivering color-sorted glass, cans and plastics to MRFs in separated compartments would drastically reduce the complicated technological requirements and the capital costs of separating and processing mixed recyclables. The savings in capital costs for processing equipment might even buy a few curbside collection vehicles.

Some glass and can company executives feel that with a truckside sorting approach there is no loss of convenience to the citizens who may still set out their recyclables in one or two containers, an important factor as many communities ask for increasingly greater numbers of materials to be recovered. One important benefit of a truckside sort is that it allows the collection crew to provide immediate feedback to citizens who set out contaminated material, such as troublesome ceramics with the glass containers.

With the need for industry to receive better quality material as recovered quantities increase, some consumers may use differential pricing levels to emphasize quality. To date, pricing has not provided a bonus for low-moisture or dirt-free UBC, but that may change. While MRFs allow a collection system to continue to perform as it always has, that is, putting everything in one truck (albeit only recyclables), there is a lack of data on the performance of collection systems that pay attention to quality and sorting at the front end, and that educate citizens in a timely fashion at the point of collection. Perhaps changing economics and the need for quality in the marketplace will cause communities to re-evaluate the direction they are going in designing collection programs and processing systems. **RR**



Springfield's MRF, which will open in August, will service more than 690,000 residents and handle 95 TPD of glass and cans and 145 TPD of mixed paper. The 26,000 sq. ft. facility is owned by the state of Massachusetts. Resource Recovery Services owns and operates the equipment.

Di Mannisi & Wolle, Architects and urban designers design the facility

What Is A MRF?

Materials recovery facilities? These authors help explain just what one is.

LIKE MANY OTHER PROFESSIONALS, SOLID WASTE managers coin technical jargon to describe industry developments. However, confusion, not clarity, results when multiple terms are created to describe the same concept. Within the last several years, readers of solid waste publications have come across references to a class of facilities called MRFs (material recovery facilities), MRCs (material recovery centers), and IPCs (intermediate processing centers)—as well as other less familiar terms. It is commonly understood that all of these facilities have the same purpose: recycling more waste materials. There is far less consensus, however, over the facilities' function and design.

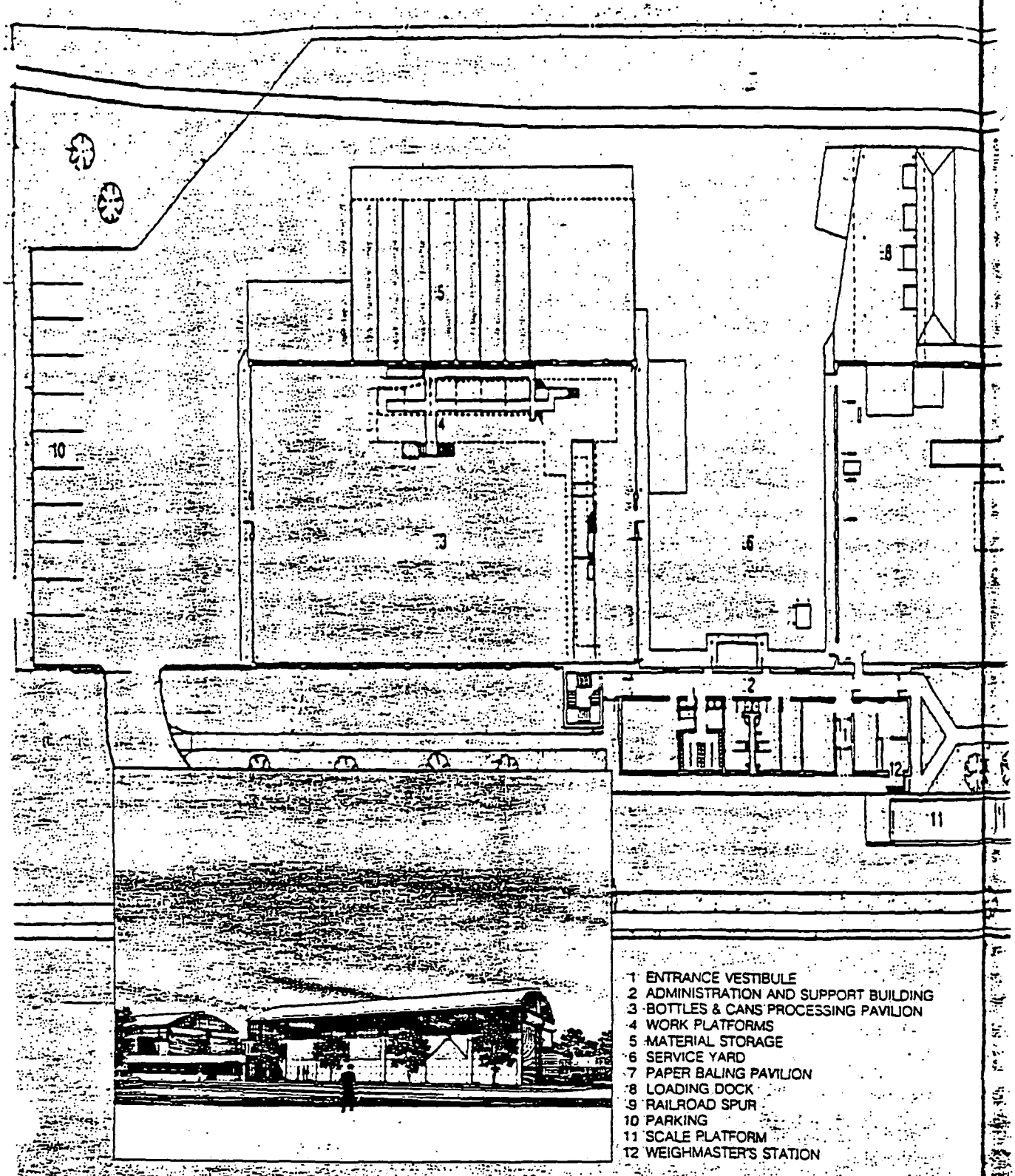
For simplicity, this article will refer to MRFs as all facilities that receive, process, and market mixed recyclable materials that are source-separated from municipal waste streams. Some of the critical issues regarding the MRF's role, development, and design are drawn from experiences with existing or planned MRF projects; in particular, the development of a 200-tpd MRF for New York's Oneida and Herkimer counties, which have a combined population of approximately 325,000.

Why have MRFs suddenly become important? For a variety of reasons, including new legislation, public pressure, and disposal capacity shortages, localities are turning to recycling to reduce their waste disposal burdens. Many states, including New York, have legislated solid waste

BY ROGER GUTTENTAG AND HANS G. ARNOLD

Guttentag is the technical director of recycling at Cosulich Associates. Arnold is commissioner of the Department of Solid Wastes in Oneida County.

MATERIAL RECOVERY FACILITIES



management hierarchies that require maximum materials recycling before disposal. To meet these legislated goals and to avoid a disposal capacity crisis, these states must recover and market large quantities of a broad range of materials. Municipalities need to develop large-scale material recovery systems for the residential and small commercial sectors.

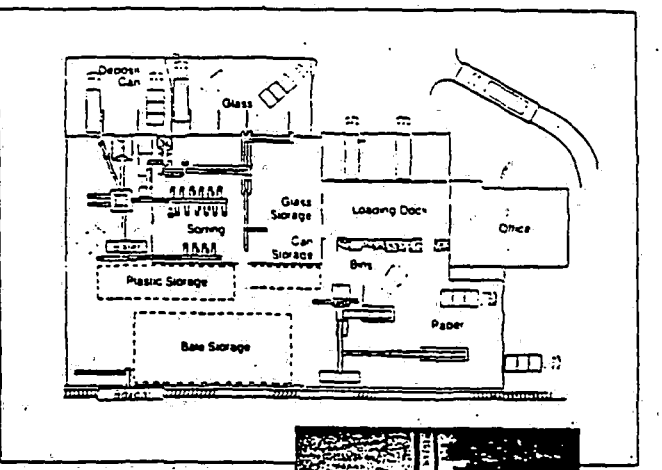
Two problems must be addressed, however, before a MRF can be developed. First, waste generators and collectors tend to regard any request to segregate their wastes into a large number of categories as an inconvenience, despite economic incentives or legal requirements. A public attitude survey conducted in Oneida and Herkimer counties found that most residents are unwilling to make more than two additional separations from their mixed wastes. Second, the quality standards of recycling industries tighten as their consumption of secondary materials increases. Glass cullet consumers, for example, must reduce the percentage of non-cullet materials that can be tolerated as the percentage of cullet rises in their new material mixes.

MRFs can be a technical response to these problems and the keystone of an infrastructure supporting high recycling levels. By accepting and processing mixed streams of recyclable materials, the MRF enables localities to develop collection systems that can recover multiple materials without making excessive preparation demands on waste generators. The MRF also provides the means by which localities can respond effectively to their markets' material quality concerns. The MRF is not just a building with machinery; it is a necessary marketing tool for encouraging consistent source separation practices by waste generators and increasing the acceptance of these recovered materials by commercial or industrial consumers.

The role of the MRF

Design of a MRF depends on its expected functions within an integrated solid waste management system. These functions should be consistent with the MRF's role in increasing participation and material recovery rates. There are several important functions for a MRF:

Reducing marketing risk to the project sponsor. Marketing risk is defined here as the chance of being unable to market recovered waste materials. That risk could result from soft local demand, inferior product quality, or economic inaccessibility to the existing market. A properly designed and operated MRF should be capable of minimizing these risks. First, the design of the processing system should be matched to the specifications of dominant material consumers. Second, the fact that the MRF processes large quantities of waste product justifies the investment in efficient volume-reduction equipment, making significant transportation savings feasible. In turn, the project sponsor should be able to reach more distant users (e.g., overseas markets) economically. Finally, the availability of a high-tonnage source of quality material will attract buyers interested in reliable product sources.



Recycling truck delivers separated recyclables to a MRF for further processing.

This floor plan is of Empire Return's Syracuse, N.Y., facility.

Increasing compliance with regional recycling goals. A region can adopt ambitious material recovery goals, but it must then be prepared to develop a practical system for achieving them. This requires, above all, cultivating large-scale participation by the public and private sectors.

Municipalities' and haulers' reluctance to participate in a regional recycling system may be a result of the economic risks they believe are associated with recycling. The fear of being unable to find an economical disposal alternative for recovered materials is usually the predominant concern. This concern can be reduced significantly by transferring the marketing risk from local communities and businesses to a regional agency, as Oneida and Herkimer counties have done. The two counties are sponsoring a MRF to reduce their exposure to marketing risks. The availability of a MRF also simplifies the municipalities' material delivery responsibilities by providing one site for accepting a wide range of recyclable materials.

Creating a mechanism for standardizing collection methods. Market specifications will ultimately define how collection systems should be operated. Changes in specifications could adversely effect participation rates, since people resent having to modify the habits they

'ere ..ked to learn when collections were started. The 'RF, however, acts as the buffer between collection ystems and markets.

For example, residents in Oneida and Herkimer coun-.es will be required to separate paper and containers glass, metal, and plastic) from their mixed waste and do ome other minor material preparation. The MRF op-rator, in conjunction with the two counties, will be esponsible for ensuring that the set-out and delivery equirements remain stable over the long term. These equirements will, however, be reviewed periodically and evised when necessary to ensure that they are compat-ble with the MRF's task of marketing materials while eeping operating costs as low as possible.

Increasing participation rates. Recycling programs hroughout North America have found that one of the ey methods for increasing participation is to limit set-ut requirements. The survey in Oneida and Herkimer ounties confirmed that residents' perception of the nconvenience of participating in a recycling program ncreases with the number of separations and pre-paration steps requested. Survey results showed that the majority of residents were willing to make up to two separations from their mixed wastes. The percent-age esidents willing to participate dropped significantly when three or more separations were required. The Oneida-Herkimer County MRF, therefore, will not require residents or businesses to make more than two separations.

Reducing total costs for regional recycling. MRFs may not be the cheapest method for recovering materials, but they can be the cheapest way to increase recycling over an entire region. This result can be accomplished by increasing recovery rates (i.e., avoiding costs), obtaining the best value for recovered materials, and adopting the most efficient operating practices. Efficient operating practices are achieved through economies of scale that can be reached at higher tonnage levels. First, the fixed capital cost per processed ton is diminished. Second, the most efficient combinations of equipment and labor are used to keep down variable processing costs per ton. Finally, cost control measures are easier to implement through the MRF's central management structure.

MRF development

Four critical issues must be examined sequentially during the implementation of a MRF project to ensure a successful facility: marketing, operating, project, and supply management.

.eting management concerns matching materials that are recoverable from the municipal waste stream with available markets, then using this information to guide the processing systems' design. The project developer must, at this point, know the size of the municipal waste stream and the percentage of recyclables such as newspaper, corrugated, glass, metal, and plastic. This information is necessary for determining the MRF's required capacity, especially total daily and per shift tonnage throughput. To develop the mass balance of the MRF's process flow, a further breakdown by type or grade, such as knowing how much of the glass is flint, green, or amber, is essential. Recent and accurate solid waste quantity composition data are invaluable.

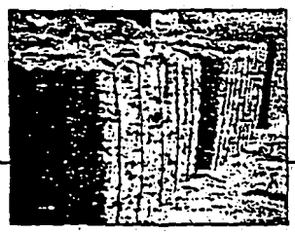
Oneida and Herkimer counties, before initiating design work on their MRF, developed a solid waste quantity and composition data base derived from a 1988 four-season field study. Furthermore, the protocol underlying the solid waste characterization work was guided by a regional market assessment for recyclable materials. These data also provide the market quality and delivery specifications needed for designing the processing system.

Operating management includes how materials will be received, what types of collection or delivery vehicles must be accommodated, what the operating schedule will be, what the material inventory policies will be, how labor safety will be guaranteed, how the processing systems will be configured, and how incoming material quality will be monitored. Answers to all these issues determine what processing and marketing services will be made available to public and private collectors.

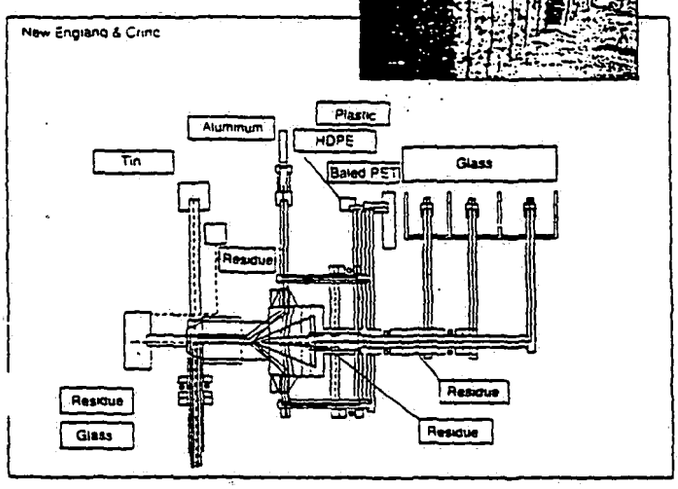
Decisions made about the processing and marketing services will affect the building's size and function. Dimensions will be determined by the number and height of vehicles permitted to unload simultaneously in the MRF tipping area. Dimensions will also depend on how much finished product will be stored indoors, in what form, and for how long. The types of outgoing containers to be loaded also affects buildings dimensions. Labor safety will also affect building and process system design by determining, for example, which areas must be environmentally protected and climate controlled for MRF personnel. Oneida-Herkimer developers decided the building needed an enclosed tipping hall separate from the processing/storage areas, as well as limited storage of the processed material inventory. This design also provides an environment conducive to worker health and safety, going beyond Occupational Safety and Health Administration standards in some instances.

Material quality upgrading is what dictates the incoming material specifications. This, in turn, affects the level of marketing risks to which the MRF will be exposed, as well as the processing costs incurred in order to reduce

them. The delivery specifications for the Oneida-Herkimer MRF will be consistent with the goal of limiting process residues. In particular, a major effort will be made to preventing nonrecyclable wastes from being accepted.



MRFs process recyclables to enhance their market value.



Project management, or who will own and who will operate the MRF, includes three basic configurations: The public can own and operate it; the private sector can own and operate it; or the public can own it and the private sector can operate it.

Other owner-operator configurations are possible if the MRF project is further segmented into such areas as construction, operation, and marketing. Project management will depend on how much control the sponsoring region will have over the MRF, the recycling system implementation schedule adopted by the region, and the estimated costs of each configuration. The Oneida-Herkimer MRF, like many similar facilities, will be publicly owned. Economic analyses are now being made to determine the appropriate agency to operate, maintain, and oversee markets for the facility.

Supply management takes measures to ensure that the MRF will get material, using either an economic or regulatory approach. Economic incentives include offering a per-ton value for materials received at the MRF, using differential tipping fees that favor source-separated wastes or providing funding to municipalities and haulers in support of collection programs. Regulatory measures include requiring municipalities or haulers to establish collection systems themselves or through third parties, banning large amounts of recyclable materials at regional disposal facilities, and mandating the source separation for specific classes of waste generators. The region can, under formal or informal agreements, specify that municipalities or haulers delivering materials to the MRF comply with these regulatory measures. Oneida and Herkimer counties, for example, have adopted mandatory source separation and require that all municipalities report to the county on how they will establish recycling programs.

The use of economic incentives and regulatory measures are not mutually exclusive; in fact, they can be complementary. Besides regulations, Oneida and Herkimer counties are planning to establish a zero tipping fee at their MRF. Economic and regulatory relationships can be mediated through informal arrangement or by contracts.

Overview of MRF design

The design of a MRF should conform to the following criteria: meet market quality and delivery specifications; reduce all materials handling procedures; integrate all materials receiving, processing, storage, and shipping functions; procure high-quality equipment that can be easily maintained, repaired, or replaced; increase processing efficiency; provide sufficient space for all operations; use flexible layouts that can respond to changes in incoming material quality or market specifications; and provide a safe and aesthetically pleasing work environment.

One critical issue early in the design process is the number and composition of the incoming material streams. The minimum number would be a single stream consisting of a broad mixture of recyclables materials (e.g., paper, glass, metal, and plastic). Some localities have adopted this approach using solid waste compacting trucks to avoid the expense of specialized collection vehicles. Problems result from cross contaminations, however, especially due to glass fragments in the paper or aluminum, which the processing system cannot eliminate completely. This approach may severely compromise the MRF's mission of producing high quality raw materials for consuming industries.

An alternative approach to simplify processing demands and eliminate cross contamination problems is requiring delivery of highly segregated streams of materials (i.e. only newspaper, glass, or metals). Maintaining these separations, however, places a greater responsibility on the waste generator or the collection agent.

An effective compromise between these two approaches is splitting all collected recyclables into two

Table 1 Where The MRFs Are — A List Of Some Of The MRFs And Their Locations

Facility location	Ownership (public or priv.)	Service area	Contractor	Population	Design capacity	Building size	Site size	Status
Browning-Ferris Industries Eden Prairie, Minn., Facility	Browning-Ferris Industries	Hennepin County		35,000	150 ton per shift; 300 ton per day	25,000 Sq. Ft.	7 acres	January, 1990
Browning-Ferris Industries Invergrove, Minn., Facility	Browning-Ferris Industries	Hennepin County, Dakota County		35,000	150 tons per shift/300 tpd max	25,000 Sq. Ft.	7 acres	September, 1989
Browning-Ferris Industries Knoxville, Tenn., Facility	Browning-Ferris Industries	Knoxville			100 tpd	25,500 Sq. Ft.	4 acres	
Browning-Ferris Industries Mansfield, Ohio, Facility	Browning-Ferris Industries	Mansfield, Richland County		Commercial basically	600 tons per month	5,600 Sq. Ft.	1.5 acres	October, 1988
Browning-Ferris Industries Newby Island (San Jose) Calif. Facility	Browning-Ferris Industries	Santa Clara County		322,000	350 tpd	77,000 Sq. Ft.	10 acres	June, 1990
Browning-Ferris Industries St. Louis, Mo., Facility	Browning-Ferris Industries	St. Louis County			150 ton per day	30,000 Sq. Ft.	2.4 Acre	Late 1989
Browning-Ferris Industries Akron, Ohio Facility	Browning-Ferris Industries	Akron, Ohio		Commercial businesses	Paper, 600 ton per month	9,000 Sq. Ft.	5.5 acres	July 15, 1988
Browning-Ferris Industries Cleveland, Ohio Facility	Browning-Ferris Industries	Cleveland, Cuyahoga County		Commercial businesses	1,500 ton per month	13950 Sq. Ft.	2.5 acres	November 1, 1987
Browning-Ferris Industries San Mateo, Calif; Facility	Browning-Ferris Industries	San Mateo County		78,000	220 tpd	44000 Sq. Ft.	February 20, 1989	
Browning-Ferris Industries Tampa, Fla., Facility	Browning-Ferris Industries	Hillsborough County; Pinellas County		no curbside	3,000 ton per month	16,000 Sq. Ft.	20 acres	August, 1989
Bucks County Satellite Facility, Bucks County, Pa.	Bucks County		Empire Returns Corporation		32 tpd	17,500		January 3, 1989
Camden Recycling Facility, Camden, N.J.	Camden County	County curbside collection program and some selected outside communities		Approximately 640,000	60 tpd of bottles and cans	Leased inside space 6,600 Sq. Ft.	Leased outside space 18,000 Sq. Ft.	
Cape May County Intermediate Processing Facility, Woodbine, N.J.	Cape May Municipal Utilities Authority		Empire Returns Corporation		225 tpd	33,750 Sq. ft.		
Distributors Recycling, Inc., Newark, N.J.	REI Distributors	Central & Northern N.J.	REI Distributors	Approximately 2 million	130 - 180 tpd	MRF = 30,000	2 1/2 acres	February, 1988
East Harlem Recycling Facility, New York, N.Y.	The City of New York	City's curbside collection and apartment house recycling programs	Resource Recovery	450,000	40 tpd (bottles & cans, 20 tpd; newspapers, 20 tpd)	5,000 Sq. Ft. shed 30 x 40 Sq. Ft.	Approximately 1 acre	June 10, 1988
Empire Returns of Syracuse, Inc. Syracuse, N.Y.	Empire Returns Corporation		Empire Returns Corporation		300 tpd: 2 shifts each day	58,000 Sq. Ft.		
Groton Recycling Facility, Mystic, Ct.	The Southeastern Connecticut Regional Resource Recovery Authority leases the building and equipment from the town of Groton	A regional recycling center accepting bottles and cans from 21 communities and paper from Groton	Resource Recovery	244,160	55 tpd: Bottles, 40 tpd; newspaper, 12 tpd)	7,200 Sq. Ft.	Approximately 1 acre	July 1, 1982
Modern Landfill, York County, Pa.	Waste Management	York Co.			Commingled material, 25 tpd; paper, 35 tpd	15,000 Sq. Ft.	2 acres	Fall, 1988
Monmouth Recycling Corp., Long Branch, N.J.	Monmouth Recycling Corp.	Monmouth County, N.J., and communities from Ocean, Middlesex, Union, and Essex Counties, N.J.	Monmouth Recycling	approx. 500,000	Design: 10 tph; actual 50 tpd	18,000 Sq. Ft.	2.6 acres	September, 1987
Omni Recycling, Westbury, N.Y.	Omni Recycling of Westbury, Inc.			1,000,000	6-10 tons per hour	900 Sq. Ft.		September, 1988
Rhode Island MRF, Johnston, R.I.	Public, operated by New England CRInc.	State of Rhode Island	New England CRInc.	330,000 - 500,000	140 tons per shift	37,600 Sq. Ft.	4 acres	April, 1989
Springfield Recycling Facility, Springfield, Mass.	facility by the State of Massachusetts; equipment by Resource Recovery Systems	87 towns in western Massachusetts		Approximately 691,195	95 tpd of bottles and cans and 145 tpd of mixed paper, newsprint and corrugated paper	28,000 Sq. Ft.	2.75 acres	November, 1989
Waste Management Seattle, Wash., Facility	Waste Management	City		85,000	100 tpd	43,000 Sq. Ft.	3 acres	October, 1988
Waste Management, San Jose, Ca., Facility	Waste Management	Santa Clara, San Jose		150,000	Design, 100 tpd: actual 70-90 tpd	48,000 Sq. Ft.	2 acres	October, 1988

streams—mixed containers and mixed paper (primarily newspaper). This approach is consistent with the need to keep set-out requirements simple while reducing the risks to product quality through material mixing. The Oneida-Herkimer MRF have adopted this approach.

The technical designs for MRF processing systems are volume sensitive. At low volumes (two to three tons per hour) a simple, labor-intensive layout is appropriate. This would consist primarily of conveyor systems moving past picking stations, where materials would be manually separated. Processing would usually be restricted to magnetic separation and small-scale volume reduction equipment.

At higher recovery levels, a more capital-intensive semi-automated processing system is appropriate. This includes, in the case of the Oneida-Herkimer MRF, using sophisticated machinery such as light/heavy material separation equipment and high-density automatic baling systems. During the design process, special attention was paid to the material sorting order, the number of times the material should go through the processing system, incoming material specifications, and load-out procedures. The primary design objectives are to use labor productively, limit down time, reduce process residues, and conserve capital costs by using equipment that can handle multiple types of materials.

In general, all processing designs must be responsive to the needs of the consuming markets. Such needs include the specifications shown in Table One. Once a design has been selected to satisfy these concerns, it can be refined to provide extra benefits, such as higher material prices (by marketing sorted instead of mixed high-grade papers) and transportation savings (e.g., by adding a process to granulate instead of baling plastics).

MRF development in the United States is still in its beginning stages, so there are no systems with long track records that can be regarded as industry standards. Understandably, the early facilities and systems have encountered problems that should be avoided by facilities now being developed. There are several problems for new MRF developers to keep in mind.

Insufficient space, especially for tipping and product storage areas, can result in a lack of weather protection for received or processed materials and can also cause the operating environment to degrade due to uncontrolled litter, dust, and noise sources. By not allowing for future process changes or expansions, MRF developers may not be able to respond to market demands for higher quality levels or to take advantage of still-developing markets for such materials as plastics. Inadequate provisions for worker safety or comfort can cause high liability insurance and worker's compensation costs, as well as increased employee turnover and poor productivity.

Without an overall design approach, processing rate constraints and quality control problems can arise when the volume and composition of delivered materials exceeds the design limits of the installed equipment and facilities. Siting difficulties shouldn't be underestimated, either. While MRFs perform a desirable task in a solid waste management system, they are subject to the same type of siting problems as other solid waste facilities. Opposition to the siting of proposed MRFs has occurred, for example, in New Jersey and North Carolina. The MRF siting process must be guided by a well-defined set of site requirements and screening procedures.

The false assumption that improvements in material recovery rates are due solely to the MRF's operation can cause friction with the collection agent. Close attention must be paid to creating an effective partnership between the MRF and recyclable collection systems, through the incoming material quality and delivery specifications. Otherwise, the MRF is exposed to the risk of receiving unacceptable levels of contaminants or generating higher amount of process residues due to improperly prepared recyclables. This also increases the operations budget. ■

Material Recovery Facilities Contractors and Operators

Here is a list of some of the companies involved in the construction and operation of materials recovery facilities.

Browning-Ferris Industries
757 N. Eldridge
P.O. Box 3151
Houston, TX 77253
(713) 870-8111 (regional office)
(713) 870-1888 (corporate office)

Empire Returns Corporation
1506 Whitesboro Street
Utica, NY 13502
(315) 724-0878

Monmouth Recycling Corp.
492 Joline Avenue
Long Branch, NJ 07740
(201) 870-0093

New England CRInc.
74 Salem Road
North Billerica, MA 01862
(508) 667-0096

Omni Technical Services, Inc.
50 Charles Lindbergh Boulevard
Uniondale, NY 11553
(516) 222-0708

R.E.I. Distributors, Inc.
P.O. Box 5250
Somerset, NJ 08875-5250
(201) 271-1355

Resource Recovery Systems, Inc.
7 Duck River Lane
Old Lyme, CT 06371
(203) 434-9633

Waste Management Of North America
3003 Butterfield Road
Oak Brook, IL 60521
(312) 572-8823

vendor's view:

HOW TO SELECT A SHREDDER

A supplier of low-speed rotary shear shredders covers the advantages they offer to recyclers.

When it comes to selecting volume reduction equipment for material recycling, most material processors would agree that the low-speed, high-torque rotary shear shredder is a good choice. Low energy usage, reduced noise, and low dust generation are some of its advantages.

In addition, the low capital and operating costs of this equipment allow even the small operator to enjoy the benefits of shredding.

All low-speed rotary shear shredders operate on the same basic principle: Materials are drawn past two or more counter rotating cutter shafts. The shafts, outfitted with cutting blades and spacers, rotate from approximately 10 to 50 rotations per minute. The cutting blades, available in various thicknesses and diameters, typically have one or more hooks for size control. These hooks intermesh with the cutter blades on the adjacent or opposing shafts to grab, then shear, fracture, or tear the in-feed materials.

When properly designed, operated, and maintained, low-speed shredders help to automate the volume reduction process, increase product value, and maximize transportation capacity.

The relative newness of the low-speed rotary shear shredder in the commercial processing market is evident in the limited data base of available purchasing information. Unfortunately, when processors improperly select shredding equipment, they can limit the effectiveness of the processing system. They can also expose downstream equipment to potential damage, resulting in lost revenues.

By THOMAS GARNIER and MARGARET CAMERON
Garnier is cofounder and president of Shredding Systems, Inc. (Wilsonville, Ore.); Cameron is the company's director of public relations. The company makes low-speed rotary shear shredders.

How can processors avoid these problems? They must take the time to completely understand and review the entire processing system, including auxiliary equipment. Processors who understand their needs will be better prepared to evaluate the numerous types of low-speed shredders available.

Material evaluation

Before selecting a shredder, one must analyze the size, density, and volume of the materials to be processed.

Of course, other considerations include the different types of materials and combinations to be processed and the rate at which they are to be shredded. Are ferrous, nonferrous, wood, plastic, or paper materials being shredded? What are the dimensions (length, width, height) of the materials? How many tons per hour should be reduced?

There is one way to process all materials to a desired size and at a specified rate. If a variety of materials will be processed, prioritize the final characteristics desired — to arrive at a balance that will best meet all needs.

Ultimately, the shredding system selected must provide a useful service, produce material at the correct production rate and particle size, and maintain maximum system efficiency and on-line reliability.

Shredder selection considerations

The best way to start this process is to consider the desired end result: the successful shredding of the intended materials. To accomplish this, first properly size the shredder to the job.

The basic rotary shear shredding principle is: *The shredder should be designed to grab only as much of the intended materials as it has power to shred, while providing protection against nonprocessable items.*

This translates to a shredder that has:

• an adequate in-feed opening to accept materials;

• an adequate cutter diameter and correct cutter configuration to grab materials;

• adequate power to shred the materials — with a self-metering design;

• a cutter configured to produce the desired particle size; and

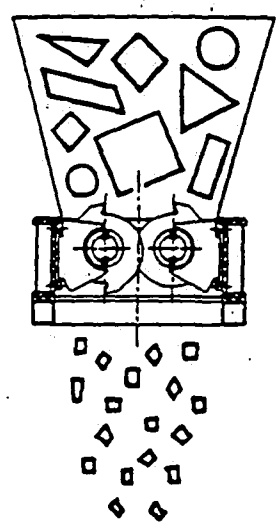
• built-in protection against overload and nonshreddable materials.

Processors also need to ensure that the cutter hook configuration — that is, cutter thickness, hook profile, and number of hooks — and its corresponding power suit their needs. A common rule of thumb is that the smaller the cut and the more hooks per cutter, the smaller the end particle size.

Another important element in shredder selection is power. Once the shredder has grabbed the intended materials, it must have enough torque or power to complete the shearing process without overloading the drive system. The power requirement must be matched to the desired feed rate without compromising the service factor of the equipment.

All equipment has design limitations.

Figure One
Low-Speed Rotary Shredder



Overload & shock-absorbing protection

The same equipment must also be able to detect when something is nonprocessable or when overloading has occurred. A shredder should be designed to automatically shift into a reversing or unjamming mode to clear the overload condition. This will minimize machine damage and wear and reduce potential downtime and cost. This is characteristic of the slow-speed rotary shredder.

Shock protection is necessary to cushion against excessive shock loads. Otherwise, instantaneous stops damage the shredder's drive components such as shafts, gears, and couplings. Between the two types of shredder drive arrangements — hydraulic and electric — the hydraulic drive generally offers better shock load protection. The electric drive is more energy efficient and mechanically less complicated, but is limited in the amount of uncontrolled feed stock that it can process.

Multi-stage shredders

Single-pass reduction may not be appropriate for high-capacity processing when a small shredded end product is required. Multi-stage shredders provide processing of materials prior to subsequent reduction. They also reduce potential overload conditions, lessen power requirements for secondary equipment, and achieve smaller particle size.

In-feed & discharge methods

There are two methods to consider when feeding a shredder: meter and batch feeding. Meter feeding is achieved with a conveyor belt. Batch feeding uses a forklift or grapple loader.

Meter feeding is the most common choice, as the shredder can control the rate at which it receives materials. This helps minimize overload conditions. However, in some cases, meter feeding is inappropriate.

Discharge of materials is also a factor to consider in the system design. Materials need to be removed at an appropriate rate in order to avoid interference or accumulation.

Accessory considerations

While sizing, power requirements, production rate, and particle size are the primary criteria in shredder selection, processors should look at other accessory features, such as the following:

Explosion-proof components: Hazardous material processing may require the use of explosion detection and suppression systems, explosion proof panels and controls, and shredding chamber ventilation systems.

Ram feed: In-feed hopper rams provide positive positioning of bulky in-feed materials and use the shredder and the system's horsepower better.

Enclosed hopper: Enclosable hoppers contain materials within the shredding chamber that are prone to shatter when shredded.

Summary

The success of any processing system depends on how well matched the components are to the materials to be processed. The planning and selection criteria for the system are extensive: material analysis; system sizing, power, and production rate; particle size; and in-feed and discharge methods. With the proper planning and correct system selection, processing systems can be greatly improved. ■

QUALITY CONTROL AND WASTE MANAGEMENT

THE CASE for quality control is quite straightforward because quality control has a direct bearing on recycling—and recycling, in turn, is a distinguishing feature of modern waste management. Quality control applies to (1) the influence on characteristics of materials before and after they are discharged into the waste stream; and (2) the effect on the quality of resources reclaimed from the materials.

Because its aim is to upgrade the quality of the resource reclaimed for recycling, quality control has a decisive bearing on the outcome of a recycling effort. That effort is based on the direct relation between recycling and waste reduction which requires that a fundamental condition be met: namely, a market must be found for the recycled resources. In the absence of a market, the apparent lightening resulting from the short-lived recycling episode becomes illusory. Unless an outlet, i.e., market, can be found for the reclaimed material, it will accumulate until the resulting accumulation becomes unmanageable. At that point, it will again be discharged into the waste stream, thereby aggravating rather than mitigating the disposal problem.

The necessary market cannot be provided simply by legislative fiat. On the contrary, marketability is a function of the attractiveness of a product in terms of one or more of its properties. Quality control is an essential means of ensuring that attractiveness. Although legislation might generate a small market by compelling public agencies to use recycled materials, such a market would be excessively minute for practical purposes. Moreover, chances are that even the minute compulsory market would be boxed in with sufficient exceptions to enable an agency to side-step the requirement.

Marketability is a function of the attractiveness of a product in terms of one or more of its properties. Quality control is an essential means of ensuring that attractiveness.

Clarence G. Golueke and Luis F. Diaz

QUALITATIVE CRITERIA

A measure of the quality of a reclaimed resource is in large part not only that of its homogeneity, but also of its freedom from contaminants. The contaminants may be in the form of remnants of former contents, of labeling material, and of miscellaneous "foreign" materials acquired during storage and collection. The greater the degree of freedom from contaminants, the better the quality.

Quality control can begin in the manufacturing stage. In this stage, the product is designed, raw material is selected and suitably modified and then converted (manufactured) into a product that is ready to be placed on the market. Design is a key point because it determines the composition and form (i.e., physical and chemical characteristics) of the finished product. Therefore, logically, quality control for eventual recycling should begin when the product is being designed. Accordingly, a raw material should be selected that is readily amenable to reclamation after the product eventually has been discarded. The design should call for constituent materials (resources) that will be readily amenable to reclamation. Moreover, the design should be such that the product lends itself to easy removal from the waste stream—whether the removal be done manually or mechanically.

SELECTION OF RAW MATERIAL

If more than one type of material is involved in the design of a product, the choice should be either of compatible blends or of blends of materials that can be readily separated from each other. The importance of this requirement stems from the fact that homogeneity often is a *sine qua non* for most re-

loaded. With respect to the compost product, size reduction and screening are key quality control measures, inasmuch as particle size distribution is one of the more important of quality-related criteria.

Municipal Solid Waste

If municipal solid waste is involved, segregation constitutes the "preprocessing" or "front-end processing" prescribed for composting, refuse derived fuel (RDF) production, biogasification of refuse, and other forms of recycling. ("Back-end processing" or "post-processing" refers to the steps taken to upgrade the reclaimed product, e.g., compost, biogas, RDF.)

Segregation may be done manually, mechanically, or by combinations of the two. Excepting very small operations or situations in which labor is both abundant and inexpensive, completely manual segregation is impractical and hence is rarely encountered. On the other hand, combinations involving a small amount of manual removal are quite common. One would intuitively assume that quality control could be better maintained with manual segregation than with completely mechanical segregation. The reality is that any potential for better quality control through manual segregation is soon overwhelmed in a practical operation by the sheer volume of the waste stream in relation to the finite physical capacity of even the most fit and highly motivated worker.

Depending upon the number and types of resources to be recycled, segregation can range from the relatively simple to the fairly complex. Thus, segregation is a relatively simple operation when only the ferrous fraction is to be recovered, whereas it becomes far more complex when all potentially useful resources are to be recovered. With ferrous removal, segregation simply consists in exposing the wastes to magnetic force. The exposure is done by depositing the wastes as a shallow layer on a moving conveyor belt, such that all ferrous materials in the layer pass in close proximity to a magnet or magnets. Because the act of removal does not affect characteristics related to quality control is perforce directed towards maintenance of peak removal efficiency and magnitude rather than to improvement in quality. Of course, removal and segregation do facilitate further processing to improve the quality of the recovered ferrous material.

Multiple resource segregation also constitutes the "pre-processing" ("back-end processing) that must be applied to municipal solid wastes destined to be composted, to be anaerobically digested (biogasification), or to be converted into RDF. Multiple resource segregation is done by passing the waste stream through a series of unit processes that usually includes size reduction (grinding, shredding), particle size classification (screening), magnetic removal (ferrous metal removal), and air classification. Some operations additionally include flotation and centrifugation.

In air classification, the light and heavy fractions of MSW are separated from each other through the interaction that takes place between a moving air stream in an "air classifier" and shredded refuse introduced into the unit. The light fraction consists mostly of paper and plastics and other less dense combustible materials. The heavy fraction contains the metallic and other inorganic items, heavy organics, and inorganic fines.

The equipment should be arranged in a sequence such that each piece functions at its maximum efficiency without over or underloading the succeeding piece of equipment. For example, passing raw refuse through a trommel before introducing it into the grinder, increases the effectiveness of the grinder and lowers its power consumption.

Logically, quality control for eventual recycling should begin when the product is being designed.

CONCLUSIONS

The following observations and conclusions regarding quality control in recycling are a sampling of the many we have made as a result of our direct experience as well as of our continuing comprehensive perusal of the literature.

1. A prerequisite for quality control is the establishment of an acceptable level of quality for particular uses and materials. Despite the urgent need by the industry, procedures and standards have been neither sufficiently nor widely established in the U.S.

2. Quality can be controlled by having a sound understanding of performance of equipment. With a sound understanding, it is possible to develop appropriate designs on which to base predictions of output specifications. Contrary to popular belief, sufficient knowledge is available for predicting the quality of recovered products.

3. Each increment of quality improvement is attended by a corresponding increase in amount of residue to be disposed, whether the disposition be by way of combustion or by landfilling.

4. In addition to the production of a particular material, quality control has a potential application in a wide variety of areas of waste management. This variety includes such diverse areas as the selection of qualified professionals, the choice of equipment and materials, and data collection. ■

This paper was presented at the 19th Annual BioCycle National Conference on Composting and Recycling, May 8-10, 1989 in Washington, DC. *Dr. Golueke is senior editor of BioCycle and research director of Cal Recovery Systems. Dr. Diaz is consulting editor of BioCycle and president of Cal Recovery Systems.*

TRANSFER STATION RECYCLES 100 TONS PER DAY

California's Marin Resource Recovery Center receives over 350 tons per day of mixed waste, diverting 30 percent for beneficial use.

Matthew J. Southworth and Luis F. Diaz

WHEN it comes to solid waste, the goal of most public sector solid waste managers is to reduce the quantities of waste being landfilled. In Marin County, California, a private sector organization has the same goal, for reasons of pure economics.

The San Quentin Disposal Site, a landfill used by several waste haulers in Marin County, California, was slated for closure in the early 1980s. The Marin County Solid Waste Management Plan called for construction of a transfer station to divert solid waste from the San Quentin facility to the Redwood Sanitary Landfill located some 15 miles north of the San Quentin facility. Unfortunately, the expected life span of the Redwood landfill was known to be severely limited. In order to extend the life of the Redwood landfill, the waste management plan also called for resource recovery to take place at the transfer station. Waste processing equipment was to be added to the transfer station at a later date.

A transfer station was built in San Rafael in 1981 near the San Quentin Disposal site. However, not until 1986 did Joseph J. Garbarino and partners of Marin Sanitary Service, a central Marin County refuse collector, decide to proceed with the construction of a resource recovery facility. That facility is known as the Marin Resource Recovery Center and is located adjacent to the San Rafael transfer station.

FACILITY DESCRIPTION

The $9 million resource recovery facility is enclosed within a 130,000 square-foot-building, which combines both receiving and processing of waste from the public, and from roll-off debris box trucks. The facility has been designed to rely on sorters to recover several recyclable materials. In addition, the facility is capable of mechanically processing large loads of wood and yard waste. Disposal fees are set at $6.00 per cubic yard (with higher fees for hard-to-handle debris). The fee assessed at the Redwood Landfill for wood and yard debris has been set at $5.50 per cubic yard.

During receiving hours, public vehicles and small commercial vehicles unload from stalls on an elevated floor, dumping onto the main tipping surface located three feet be-

Sorting area at Marin Resource Recovery Center is shown above.

Public vehicles and small commercial trucks unload onto main tipping floor, where wastes are pushed onto one of three conveyor systems.

low. Roll-off trucks and other large vehicles discharge directly onto the main tipping floor.

On the main tipping floor, rubber-tire loaders are used to sort and push wastes onto one of three conveyor systems: one for wood and yard waste; one for other sortable wastes; and a third for non-sortable or heavily contaminated wastes.

Wood and yard waste is pushed onto a conveyor and processed first through a magnetic separator, [then through a 400-horsepower horizontal hammermill] and finally through a flat, vibrating screen to remove fines. The shredded material is collected in an overhead hopper and sold to a nearby papermill where it is burned to produce steam and electricity. The recovered fines are sold as a soil amendment.

Waste loads of mixed material that appear to be sortable are conveyed to an elevated sorting platform where the material is split onto two parallel sorting belts. Laborers hand-sort the material by selectively removing mixed paper, newspaper, corrugated, wood, ferrous metal, aluminum, and glass, dropping all materials through chutes to belts or bins below the platform. Bins collecting paper are regularly emptied into a baler. Glass and metal are transferred to larger containers, and wood is conveyed back to the main tipping floor for transfer to the wood and yard waste processing line. Residue not collected during the sorting operation is conveyed to the adjacent transfer station for disposal.

Material judged by the loader operator to be uneconomical to sort is pushed onto a conveyor for transfer to the adjacent transfer station and subsequent removal to the Redwood Landfill.

COLLECTION EFFICIENCY

Since operation began in March 1987, collection efficiency has gradually improved. During the month of August, the resource recovery center received over 350 tons per day of mixed waste, from which approximately 75 tons of wood fuel and soil amendment and a total of 25 tons of paper, glass and metals were recovered. Thus, the total amount recovered is on the order of 100 tons per day, or approximately a 30 percent recovery rate.

Marin Resource Recovery's efforts are increasing the life span of the Redwood Sanitary Landfill. Diverting 100 tons per day from the waste stream currently amounts to approximately 10–15 percent of the landfill's waste load.

Airborne dust has proven to be a bigger problem than was expected when the resource recovery facility was designed. To reduce dust concentrations within the building, a $190,000 dust collection system is being installed and a street sweeper is being added to the inventory of rolling stock.

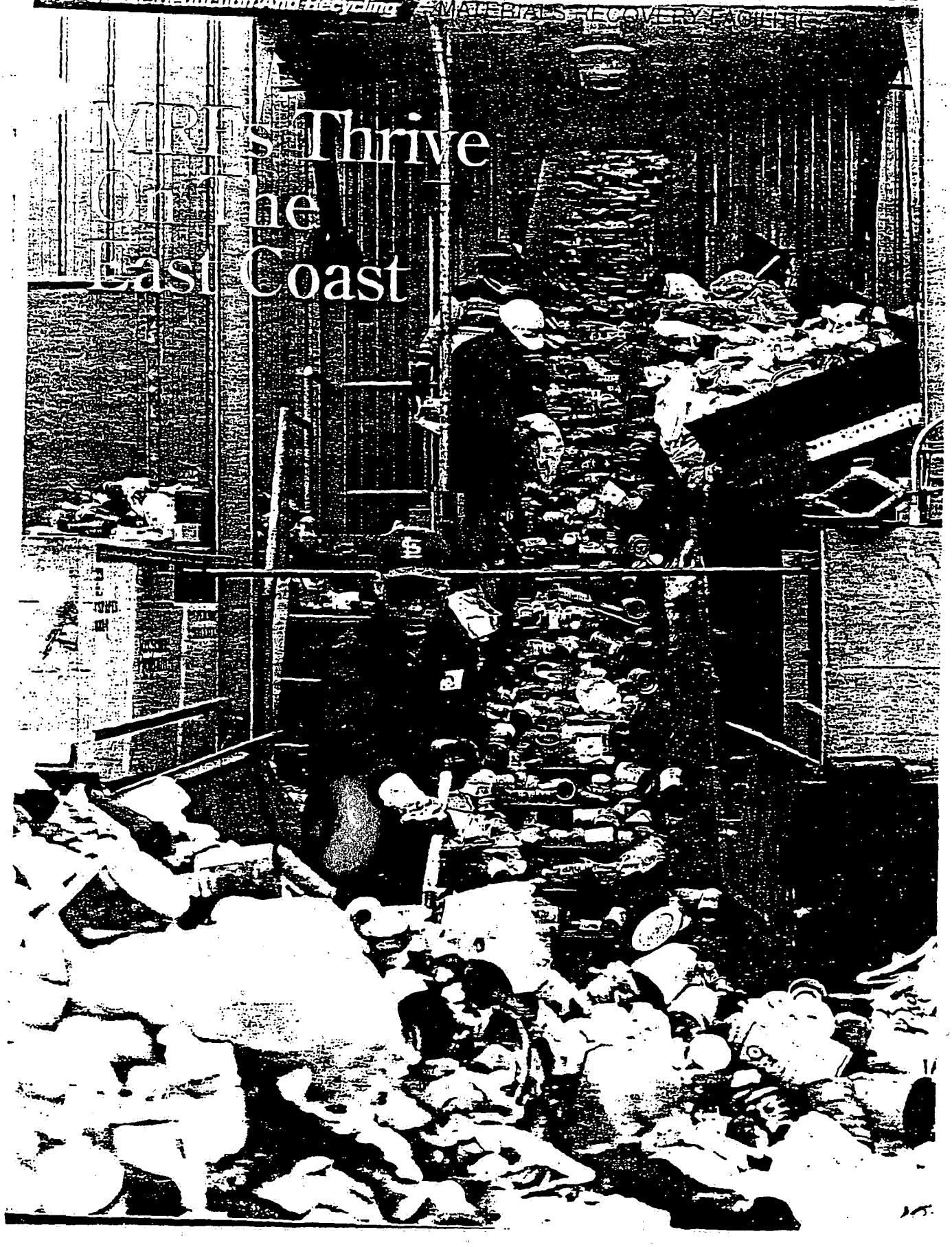
In order to improve the efficiency of sorting and to collect items not currently being recovered, an increase in sorting line staff is being considered. The sorting line currently employs six laborers to separate recoverable materials. However, considerable extra space was built into the line to allow for additional sorters. Plans also are being made to add textiles and polyethylene terephthalate (PET) bottles to the list of recovered materials.

Supplemental operations, such as composting organic wastes and producing densified refuse-derived fuel (d-RDF), are being seriously considered by Garbarino as a means of further increasing the recovery rate. In fact, Marin Resource Recovery purchased land adjacent to the existing site for an eventual compost operation.

Marin Resource Recovery has plenty of incentive to increase the recovery rate of the facility. Garbarino expects disposal fees at the Redwood Landfill to increase to $12/ton and figures his transport cost to the landfill at about $12/ton. Therefore, for each extra ton of material recovered, the total avoided cost of transport and disposal will be about $24/ton. ■

Matthew Southworth and Luis Diaz are affiliated with Cal Recovery Systems.

MRFs Thrive On The East Coast



MATERIALS RECOVERY FACILITIES (MRFS) HAVE been running for years in some East Coast locations. Looking at some established MRF operations provides a primer for anyone looking for the technical concepts needed to spec similar facilities.

The MRF concept has been around long enough that solid waste management professionals are familiar with it. While many people recognize the term, however, many don't really understand what makes a MRF a MRF. A look at three sizes of MRFs, all operated by private contractors on the East Coast, points out some technical and functional similarities to consider in planning one.

One trait of MRFs that doesn't really help define them is size—they come in all sizes. Economy of scale is definitely a factor, but as long as a facility accepts, separates, and processes recyclables to ship to users, it fits the basic definition. A MRF can serve one community or several, hundreds of thousands of households, even population areas counted in the millions.

Because of the quantities of material to be separated, successful MRFs have become highly automated operations, using proprietary systems or integrated systems marketed by companies such as Lundell or Bezner. In integrated systems, a series of screens, conveyors, magnets, and other devices separate each type of material from the main stream.

If you want to learn about how materials recovery facilities operate, the East Coast is the place to learn.

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Rhode Island's MRF

Contractor New England CRInc., designed the MRF constructed by Rhode Island around a system for the German manufacturer, Bezner. The installation, the first for Bezner in the United States, will handle all the metal, glass, and plastic recyclables from a population base of about 400,000. (Paper is tipped separately and baled with a Bollegraaf baler.) Spring 1989 marked the beginning of the MRF's full-scale operation, with the system capable of processing 80 tons per day (tpd) of mixed recyclables in one shift.

The only places where humans are involved with the system are at initial inspections before the material enters the sort mechanism and at glass and plastics sorting stations. After pre-inspection on an early conveyor section, the recyclable burden is screened and leveled, removing small tramp elements and flattening the conveyor burden to one-item depth. The material first passes under an overhead belt magnet, which removes ferrous items. After a second pass through a screen to remove broken glass, bottle caps, and other smaller fragments, the conveyor stream splits in two and material heads up inclined, vibrating sorting conveyors to a series of chain curtains that separate light elements from heavy—meaning glass goes one way and aluminum and plastics go the other.

On the glass line, several workers sort the material by color. At the same time, an eddy-current generator attracts the aluminum, pulling it from the plastics. The aluminum heads for a can flattener, while valuable high-density polyethylene (HDPE) and unsalable tramp plastics are handpicked from the main stream of polyethylene terephthalate (PET).

Once the materials have been separated, each is processed depending on the user's needs. HDPE is granulated and the PET is baled. Tinplate cans are shredded. Separated glass is crushed into cullet for sale to glass container manufacturers.

Other MRF operators have developed their own proprietary separation equipment. They protect their designs zealously as the demand for MRFs—and the MRF contractors—grows. However, the Bezner example shows how separation techniques are based on the particular characteristics of the material loaded onto the conveyor: magnets capture ferrous; eddy current units attract nonferrous aluminum; blowers remove lightweight plastics and aluminum from heavier materials; and screens and curtains separate materials by size and weight.

Distributors Recycling of Newark

After years of research and development, the oldest separation equipment, human hands and eyes, remains in the system. No machine has replaced a worker's ability to identify glass by color or plastic by resin and separate them at conveyor speeds. According to Simon Sinnreich, president of Distributors Recycling (Newark, N.J.) nothing he has seen can match a low-skill manual laborer pulling three to four units per second. Some workers can separate up to 10 units, he adds.

Distributors Recycling is clearly the largest MRF operator in the East, processing 160 tpd of recyclables in one shift in its Newark, N.J., facility. It's proprietary separation equipment currently processes common re-

BY DAN GOLDBERG

Goldberg is a freelance writer based in Shaker Heights, Ohio.

cyclables, such as glass and metals, and in May will add plastics. Distributors serves communities of all sizes, from its home of Newark to New Jersey villages "so small their mailing address is in another town," says Sinnreich.

Despite the impressive capacity the Distributors line handles, Sinnreich says the MRFs labor force still plays an important role in maintaining the quality of the processed materials. "We've already got every quality control mechanism that can be bought—multi-hundred-thousand-dollar machines—but there's nothing better than an extra set of eyes," he says.

There is an upper limit to what automated systems can achieve in terms of output quality. "You've got to have the human element for quality control," he says. "Out of eight people on our (nonplastic) line, five of them are in quality control functions.

"With the machinery we've seen, everyone starts talking in the 90% range for quality," he says, "but our customers want better than 90% quality. We're looking to supply them with 99.9% quality. You can't do that with machinery right now."

There is a cost in adding employees, though, and the number of employees operating a typical MRF is not large. Usually 20 or fewer people will comprise a MRF's staff, with no more than 10 in sorting, picking, or quality control jobs. "When you put a person on line, you need to rely on that person as part of your process," says Hal McGaughey, director of operations for New England CRInc. "You're wedded to a person there for the life of the contract, which could be 15 or 20 years. That requires 15 or 20 years of vacations, sick time, benefits," he says, adding this factor becomes more important in areas where labor is at a premium, as in some of the New England states.

Fortunately, low-skilled laborers can be trained to perform most of the critical line positions. Distributors trains and employs developmentally handicapped people from a local sheltered workshop to work line positions. The low-tech nature of the line jobs also means MRF operators can draw from a larger labor pool.

Resource Recovery System of Manhattan

A side benefit of drawing from a large workforce is being able to target a certain group or area for the few low-skill jobs a MRF offers. Such has been the case for Resource Recovery Systems (RRS), operators of a pilot-sized MRF in Manhattan. A number of the 14-person staff members were drawn from the economically depressed East Harlem neighborhood where the center is located.

RRS began operating its facility for the New York City Department of Sanitation in an existing building. The firm installed its proprietary separation equipment and made some other improvements. At 5,000 square feet, the working space is too small for anything more than a pilot plant. The location is good, though: Close to the Tri-Borough Bridge and the Major Deegan Expressway, key outlets to the city's other boroughs, the worst thing about the location is how much it would cost to build a reasonably sized plant there—if a big enough parcel of land could be found. The East Harlem MRF site occupies about an acre of land, the price of which could swallow the entire solid waste management budget of a small city.

Workers at Distributors Recycling's Newark MRF can color-sort between four and 10 bottles per second by hand.

Plants and Equipment

Where recyclables are going, and where they're coming from is likely to influence the location of a planned MRF. In New York, with its high population density, it may make sense to site the MRF closer to the collection routes to save truck operating costs. The Rhode Island MRF operated by CRInc., will serve rural, urban, and suburban communities from about 20 miles north of Providence, the service area's largest city. Rhode Island constructed a building to house the MRF at the state-run landfill, integrating its solid waste operations at one site. Distributors, with its roots in servicing the container industry, developed its main MRF in Newark, N.J., down the road from customers who regularly deliver bottles and cardboard beer cases for recycling.

How much space is enough? Again, it depends on how big a population base a MRF is going to serve. The population size will influence the two functions that must be accommodated within the plant: separation/processing and tipping space. One half to one third of the facility will be required for the tip floor. In most MRFs, paper is tipped and processed separately from other recyclables. In the Rhode Island MRF, for example, 18,000 square feet of the 40,000-square-foot building is earmarked for separate

tipping areas for paper and mixed recyclables.

MRF designers and operators also factor expansion into the overall space configuration, to handle additional material as the incoming recyclable stream grows. That growth results from more communities coming on-line with collection programs or communities wanting to add new materials, such as plastics, to the mix of recyclables they send to a MRF.

MRF separation technology is designed in modular systems, which make it easy to add capacity. Distributors, for example, added a line to its system that will handle plastics beginning in May, 1989 and bring its total capacity up to somewhere around 400 or 500 tpd.

"Every plant we operate has the capacity for additional equipment to be added to it," says Matthew McCauley, RRS vice president of operations, noting that aluminum handling equipment could be added to the East Harlem facilities if the collections tonnage grows to the point where it's necessary. "The real emphasis is on removing additional materials from the processing line," he adds, mentioning iron and other metal scrap as an example.

Both Sinnreich and McCauley note that modular design and second lines give MRF operators flexibility in dealing with downtime and maintenance. Typically, a MRF staff will include a full-time, dedicated service technician and an assistant. They correct unexpected equipment breakdowns and do daily maintenance, including inspecting belts, electrical components, and impact areas. Glass and metal pieces subject equipment to a lot of wear and tear, notes McCauley. Most operations shut down at weekly or 10-day intervals to do major preventive maintenance.

Future MRF Designs

As cities specify a wider range of recyclables they want to pull from their wastestream, future MRF designs may include separating more types of material. One of the technical changes that may come on-line in the Nineties is automatic color identification of glass, which would eliminate more sorting workers. While the technology has been developed, improving the speed is the next task for engineers. As more plastics are pulled from the residential wastestream, automatic separation by resin type may become the next target for equipment designers.

MRFs will be the place where quality control is likely to be handled for much of the recyclable stream. In the case of Distributors Recycling, all principals had experience in the markets they supply, so they have a keen awareness of how that material would be delivered best. "If you can't deliver quality," says Sinnreich, "all you're doing is creating separate mountains of garbage."

"The money we're spending is all in quality control. We're establishing a quality control lab to increase our standards. Our internal standards are already higher than any industry requirements."

Distributors Recycling's Newark MRF processes 160 tpd of recyclables per shift.

At the point in the recycling process where materials are prepared for use, MRFs' ability to attract users with consistent and improved quality, as well as quantity, will be a key to the increased use of recovered materials and to the success of recycling in general.

New York City Gets Its MRF Background

New York City solid waste management planners are using their pilot materials recovery facility MRF (in East Harlem) to develop a base of collection and recycling data that they will use in planning full-scale MRFs. Proposals call for the city to be served eventually by as many as six MRFs, according to Alison Blackmon, contract manager for the East Harlem MRF.

Resource Recovery Systems (RRS), which operates MRFs in Groton, Conn., Camden, N.J., and other cities won a bid to rehabilitate a city-owned building and operate a MRF there. A nonprofit group had used the space where it tried unsuccessfully to recycle "bottle bill" glass from returnable beverage containers covered by New York's container deposit law.

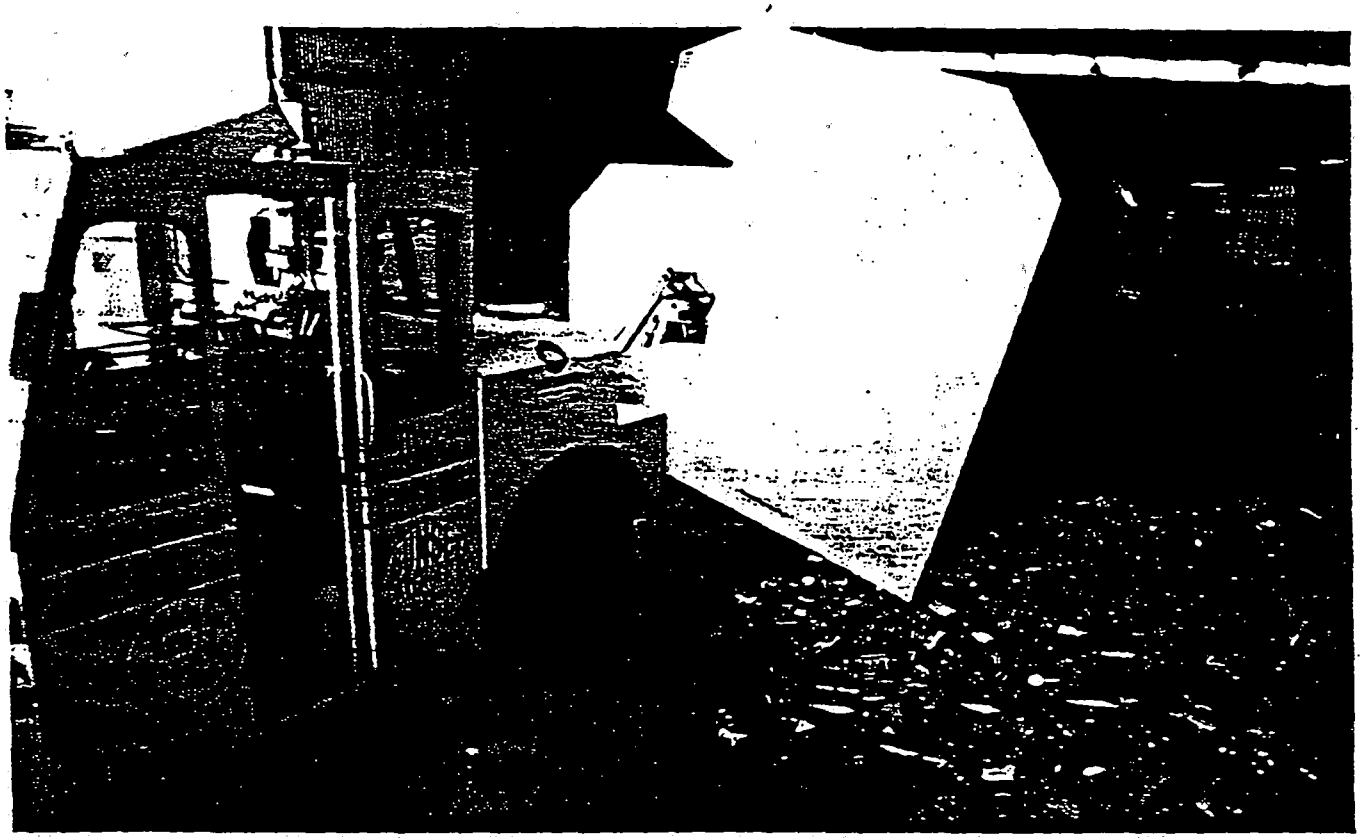
With a city as densely populated and diverse as New York, collection problems will undoubtedly influence final plans for the city's MRFs. The sanitation department began collecting recyclables in June, 1988. By the beginning of 1989, more than 360,000 households in various neighborhoods in the five boroughs were on routes where recyclables could be collected. The routes sampled areas that included multi-family units and single-family homes. By June, 1989, the department expects to increase the sample group to 500,000.

"The question as to whether people will participate has been answered," McCauley says, noting a steady stream of recyclables coming to the MRF. In January, the facility received about 573 tons of material. Most of the recyclables sold have been bottles, cans, and newspaper. Even though the city hadn't asked for plastics, a fair amount has been found in the pickups, indicating a good awareness of its recyclability. "New Yorkers proved to be much more avid recyclers than we expected," agreed Blackmon. ■

San Francisco Recycling Proves Less Is More

San Francisco's first major recycling program is on its way to becoming a smashing success, since the city made it so easy for everyone to participate.

By **Bruce Johnson**



The area recycling center receives about 100 tons of recyclables weekly from the program.

More than half the homes within a section of San Francisco are participating in the city's first major curbside recycling program — a success by any standards. A key reason for this success may be the program's avoidance of most source separation.

Other than determining what is recyclable and what must go into the garbage, the only separation of materials required is that residents bag or bundle paper products separately. All other recyclable items are placed into a single plastic bin.

"We wanted to make this as convenient as possible for residents," said Tom Padia, curbside recycling manager for Sunset Scavenger Co., concerning the decision not to require residents to sort aluminum, tin, glass and plastics into separate containers.

Other factors favoring a minimum amount of source separation, he said, are a lack of space for storing curbside collection bins inside many of San Francisco's homes and apartments and a desire to discourage curbside theft of recyclables.

"The more mixed up the materials are, the less valuable they are to thieves," Padia observed. Separating aluminum, tin, glass and plastic at Sunset's recycling center, rather than before these materials are placed on the curb for collection, "doesn't stop theft but it dampens it," he said.

A curbside recycling program, covering the south central portion of San Francisco, was inaugurated last April. The area contains about

Each household participating in the program receives one free 14-gallon bin for holding mixed recyclables.

29,000 residential units ranging from single-family units to six residential units per building (a full-fledged recyclables collection program for apartment buildings is scheduled to commence next year).

Within two years, the curbside collection program will be extended to residential areas throughout the city consisting of approximately 180,000 residences (not including about 130,000 apartment units, about two-thirds of which will be covered by the program).

Although the recycling program had a good initial acceptance, the pilot area had advantages and disadvantages. Although the program had a logistical advantage in being located close to Sunset's recycling center, south of San Francisco, the area population is probably less prone to recycling than the city's populace at large.

Padia said that the area contains mainly middle-income residents. The area also included pockets of high-income and poverty-level dwellers, has a wide variety of ethnic representation and consists of both flat and hilly terrain and both wide and narrow streets.

"About 30 percent of the homes on any given day have materials set out," Padia said concerning initial results of the collection program, which is offered weekly on the same day as the regular garbage pickup service.

"Well over 50 percent" of the homes in this 29,000-residential-unit section of the city are participating at least once a month in the program, he reported. Most of the participating residents are setting out their recyclables every other week when the plastic bin is full of materials.

The nearby City of San Bruno, where curbside recycling has been under way for some time, is achieving about 50 percent household recycling participation on the weekly recyclable pickup day, Padia reported. But the phase-one program in San Francisco, he reported, already is generating the same amount of material as the San Bruno program.

"We've been getting lower percentage per household (on a weekly basis) but the same volume as the San Bruno program," he said. This, he noted, is enhancing the efficiency of the recyclable collection operation because the collection bins at participating San Francisco homes tend to be placed on the curb only when they are filled to capacity — meaning fewer stops for the truck.

The citywide curbside collection program is based at the Sunset-operated facility adjacent to the huge Sanitary Fill Co. transfer station at Brisbane, on the south side of San Francisco (see pages 24-26 in the September 1988 issue of *World Wastes*).

Sunset Scavenger, a subsidiary of Norcal Solid Waste Systems Inc. is conducting the program for the city. Golden Gate Disposal, also a Norcal subsidiary and one other company franchised for refuse collecting within the city also will be involved in the program when it goes citywide.

Currently, the Sunset-operated recycling center is receiving about 100 tons of recyclables per week from the phase-one curbside collection area, according to Padia.

About 70 percent of the materials is newspapers and other paper products, which residents bag or bundle together. The other 30 percent is comprised of other recyclables which are placed in a 14-gallon Rehrig Pacific high-density, polyethylene bin made of 10 percent recycled plastic resin. One bin is provided free of charge to each household. Of the paper products collected, about 70 percent are newspapers and the other 30 percent mixed paper.

When the curbside collection program is extended citywide, it is anticipated that the recycling center will receive about 150 tons of curbside collected recyclables per day, Padia reported.

"But this is just an incremental increase for us," he said. "This is not a whole new ballgame."

Padia said the Sunset facility — before the phase-one curbside program got under way — was recycling more than 500 tons per day of materials collected from commercial and industrial sources mainly. Some of those recyclables come from buyback centers, including one at Sunset's facility.

A key factor motivating both the curbside recycling program and commercial, industrial and buyback recycling is the city's high cost of waste disposal.

San Francisco has a tipping fee of $45.20 per ton, making it one of California's highest such fees, Padia noted. The transfer trailer haul from the transfer station of Sani-

tary Fill, is 56 miles one way to a regional landfill at Altamont, in eastern Alameda County.

So far, there is no extra charge for residents participating in the curbside collection of recyclables — even though Padia estimates that the net cost of the curbside program will run about a dollar per household per month when the program is extended citywide.

Padia noted that the city's last rate increase was granted about 18 months before the first-phase curbside collection program was implemented and that after the rate increase, the parent companies of Golden Gate and Sunset were merged through Norcal's restructuring as a 100 percent employee-owned company.

Even though the newsprint market is depressed and most of the aluminum is sold by non-profit organizations or residents themselves, the efficiencies obtained from the merger have enabled the companies to absorb the cost of the phase-one curbside collection, Padia said. (Markets for glass and plastic items are relatively strong.)

The immediate lack of a rate increase or surcharge to cover the costs of the curbside recycling program has not discouraged Sunset from using first-class equipment for the program.

"We believe in using good equipment," Padia said. This, he noted, makes things run smoother and provides a better image for the program.

In operation are new, low-profile Lodal Bi-Loader trucks custom designed for the San Francisco program. Each one-driver, dual-drive truck is equipped for manual loading into two bins — one for paper products and one for other recyclables — from the containers placed at curbside and for mechanized loading of contents from apartment building-placed 60-gallon Waste-Wheelers (90-gallon carts also can be handled in the future with these loading devices).

The trucks have a 20-cubic-yard bin for paper and an 11-cubic-yard bin for glass, tin, aluminum and plastics. Both sides of each bin have cut-out panels so that the bins can be manually loaded up to two-thirds capacity. The driver then secures the hinged side panels to complete loading with a 60-gallon carts. There is a cart-tilting device at the front of each bin.

Once the side panels of the bins are secured, the driver dumps the contents of the curb-placed containers into the 60-gallon cart until it is full (after five or six stops). At that point, the mechanical loader is activated to dump the cart's contents into the top of the truck-mounted bin.

The same bin-loading devices can be used for loading carts up to 90 gallons in capacity. This size of carts will be used for many of the larger apartment buildings once the recyclable collection program is extended citywide. The trucks were designed to serve both the apartments and the more traditional curbside dwellings, according to Padia.

San Francisco's curbside recycling program has been successful so far, for a variety of reasons. But one reason is obvious — making it easier for residents to participate yields better results. □

Bruce Johnson is a freelance writer who lives in Tacoma, Wash.

PARKING LOT TO PROCESSING FACILITY

The sort line includes manual sort stations for brown glass, clear glass and aluminum cans. An operator controls the time and rate of dumping onto the processing conveyor.

WITH WISE PLANNING, material recovery facilities can incorporate processing capabilities for additional recyclable wastes at little additional cost. Our processing plant in Seattle is an example of a low technology, high volume MRF built around a curbside collection program but designed with flexibility to process a variety of waste streams. From humble beginnings, processing 20 tons per day on a temporary parking lot site, the Seattle plant has grown to a 100 tpd commercial and residential MRF in less than a year. It is projected to become a 400 tpd regional processing center serving the entire metropolitan area in 1990.

The Recycle America MRF is part of Waste Management's Seattle Division, which includes a waste collection service, a transfer station and long haul operation, as well as the North Seattle curb collection program. The waste collection company, Bayside Disposal, is one of only two companies licensed by the state to serve commercial customers in the City. The transfer station receives all the company's collected commercial waste and loads it into long haul trailers for transport to the King County landfill east of Seattle.

Seattle project moves from humble beginnings at temporary site to projected 400 ton per day regional center serving entire Metro area.

Don Kneass

In late 1987, Recycle America contracted with Seattle's Solid Waste Utility to offer weekly curb/alley recycling service to some 65,000 households. Public education was begun, bins were delivered and collection began within the six-month timetable established in the contract. The Solid Waste Utility currently pays Recycle America $49.43 for every ton of recyclables the service removes from the waste stream.

In the first year of the program, over 80 percent of all eligible households signed up for service, doubling the city's initial projections of 40 percent. By year end 1988, material recycled through the curb collection pro-

Trucks delivering paper tip material onto the sort floor adjacent to the baler conveyor.

gram totalled 14,700 tons—the largest weight per eligible household in the country.

The material recovery facility designed to process the collected recyclables opened in October, 1988, after being temporarily housed on Bayside Disposal's parking lot. Located on a three acre industrial site in south Seattle zoned for manufacturing, the leased building has a 37,000 square foot receiving, processing, and bale storage area. The building also contains 6,000 square feet of office space for management and operations staff.

Although the building was selected because of its suitability for recycling processing, significant leasehold improvements were required to achieve efficiency objectives. Modifications included adding entrance and exit ramps, removing support posts to create a large clear span tipping floor, creation of processing equipment wash down areas, and installation of an HRB 8 baler and below grade baler conveyor.

Currently the plant is processing approximately 100 tons per day. The majority of the recyclable material is delivered from the 65,000 household Seattle curb collection program. Additional material comes from nearly 9,000 households receiving curb collection in the suburban metropolitan area, five community recycling stations, source separated commercial cardboard accounts, and select loads of mixed commercial waste containing high percentages of recoverable material. Total plant capacity is 400 tons per day.

OPERATIONAL SCHEME

Material collected at the curb is delivered to the plant source separated by residents into three categories: newspaper, mixed waste paper (junk mail, cereal boxes, catalogs, magazines, cardboard, etc.); mixed glass bottles and cans. There are two material processing stations within the facility: one for sorting, quality grading, and baling paper; and the other for sorting the bottle and can mix.

Four grades of paper are currently being processed in the plant—mixed residential waste paper, newspaper, cardboard, and com-

A small loader spreads paper so employees can remove contaminants and sort the remainder into the most valuable market grades.

mercial waste paper. Trucks delivering paper tip the material onto the sort floor adjacent to the baler conveyor according to the material contained in their load. A small loader spreads the paper so that employees can remove contaminants and sort the paper into the most valuable market grades. Twine, kraft and plastic bags, and non-newsprint paper are removed from the newspaper in order to sell it as a de-ink quality secondary fiber. Cardboard, a high value paper grade, is sorted from the low value mixed paper prior to baling. Paper grades are brokered to a variety of foreign and domestic mills.

The glass and can sort system was designed to minimize glass breakage to facilitate the color separation required by the local plant, Ball-Incon Packaging. Commingled bottles and cans are emptied from the collection vehicles into two receiving hoppers at the head of a sort conveyor. As one hopper is emptied, the other hopper is available to receive the next truck load of material. An operator on the processing line controls the time and rate of hopper dumping.

The sort line includes manual sort stations for brown, clear glass, and aluminum cans. Tin-lined food cans are magnetically separated and only green glass is left on the belt to be conveyed into a storage and shipping container. Paper, plastic, and foil are also sorted from the mix for recycling. Sorted aluminum and tin cans are conveyed into large wheeled cages which, when full, are pushed to the baler conveyor and dumped for baling. Less than three-tenths of one percent of all collected material is contaminated beyond recovery and must be landfilled.

Design considerations for adding material processing flexibility included provisions for a large flat tipping floor with a centrally located baling operation. Significant clear span area allows for obstruction-free materials handling on the floor. A variety of mixed and source separated paper grades can be quickly tipped onto the floor, visually inspected, and when necessary, spread by the small loader for easy sorting and upgrading. Graded paper can be pushed onto the baler conveyor from two sides, maximizing baling capacity while minimizing handling.

Other considerations in the building design include: adequate storage space for input surge capacity and bale storage; multiple entrance and exit doors for ready access to the tipping floor and quick turnaround for collection vehicles; and a large outdoor yard for overnight collection truck parking, material storage, and plant expansion.

We anticipate a bright future for the facility due to rising disposal costs, a Seattle goal to recycle 60 percent of its waste by 1992, and the surrounding King County goal to recycle 65 percent. ■

Don Kneass is the Mountain Region Recycling Manager for Waste Management of North America and formerly served as recycling coordinator for Seattle.

What's the future of cooperative marketing?

by Mary Kohrell and Gary J. Olson

Mary Kohrell is a consultant with Resource Integration Systems, Ltd., and is the former market development manager for the New Hampshire Resource Recovery Association. Gary J. Olson has been NHRRA's executive director since 1982.

Cooperative marketing, as NHRRA's experience shows, helps even out the ups and downs in the recycling marketplace.

Anyone who's been involved with planning or operating a recycling program can appreciate the value of reliable markets for recyclables. Recent growth in public and private sector recycling programs across North America has produced an overabundance of certain recyclable materials, particularly newspaper, and has many recycling program operators concerned. To overcome market uncertainties, many recycling program managers are looking to the concept of cooperative marketing to solve their recycling woes.

The concept of cooperative marketing is not new. Take farmers, for instance — they've long sold goods cooperatively to achieve efficiency. Applying the concept to recyclables instead of food or agricultural equipment, is what is new.

Traditionally, cooperative marketing programs for recyclable materials have been used in rural areas, where low tonnages and long distances to market have hampered recycling efforts. Various forms of cooperative recycling efforts have long been practiced in New Hampshire, central Nebraska, and Montgomery County, Pennsylvania. Recent trends show a marked increase in consideration of cooperative recycling techniques by other rural areas. For instance, the New York Department of Economic Development, Office of Recycling Market Development, has recently embarked on a grant program offering funds to regional municipal entities throughout New York to develop and implement anywhere from two to six regional cooperatives. In addition, New Hampshire's cooperative program has just joined forces with the State of Vermont, launching the first bi-state cooperative marketing effort.

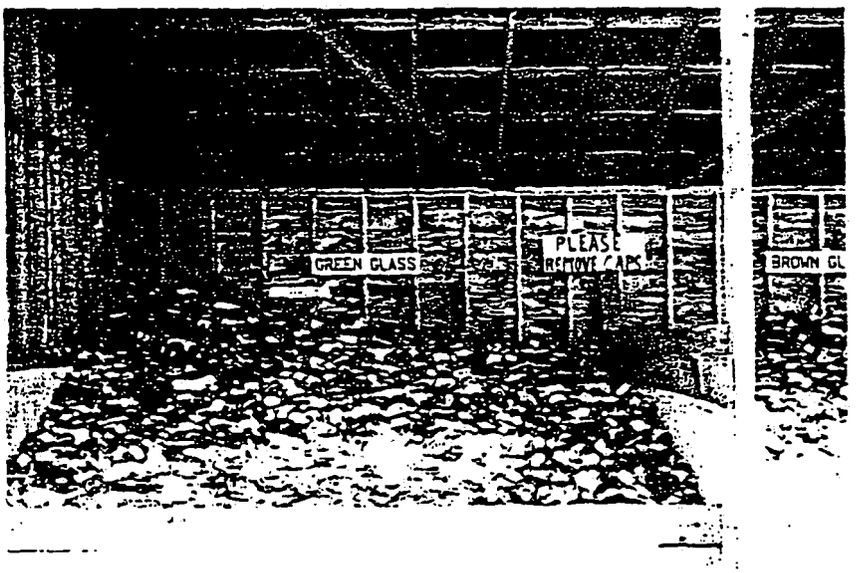
Another development on the cooperative marketing front is a focus by more densely populated urban centers. The Metropolitan Washington Council of Governments, representing such major population centers as Fairfax County, Virginia, Montgomery County, Maryland and the District of Columbia, recently commissioned a study to evaluate the feasibility of cooperative marketing efforts among its membership. Suffolk and Nassau counties, which together make up Long Island in New York, have likewise considered cooperative marketing efforts.

Where are all of these cooperative marketing efforts heading? Is cooperative marketing the solution to the country's market glut problems?

It started in New Hampshire

Cooperative marketing of recyclable materials was essentially born in New Hampshire in 1981, when the New Hampshire Resource Recovery Association (NHRRA) was incorporated as a nonprofit organization by four rural New Hampshire municipalities with a desire to pool their recycling knowledge and resources. NHRRA's efforts got off the ground thanks to a $20,000 grant from the state's energy office; NHRRA hired a single employee to identify potential recycling markets while providing recycling know-how to its members. According to Bud Moynihan, public works director in Rye, New Hampshire, who represented one of the four initial municipalities, those efforts were good, but not good enough. "We needed more than market information," Moynihan says. "We needed a way to make recycling work in small towns by combining our marketing efforts."

"Today, with an operating budget of nearly $500,000, NHRRA employs seven people and counts 200 of New Hampshire's 234 municipalities among its members," says NHRRA president, Michael Simpson. "As a nonprofit group, we've come a long way in a few years." Operating funds come from a variety of sources, such as the annual New England Resource Recovery Conference and Exposition that the association hosts, federal and state government contracts, private foundation grants, membership dues, and cooperative marketing fees.



Glass is stockpiled in concrete bins, then marketed through NHRRA's cooperative glass marketing program (1). A scrap metal baler processes metal in New Boston, New Hampshire through NHRRA's cooperative scrap metal marketing program (2).

1

Working together has paid off

The bulk of New Hampshire's one million residents live in small towns with populations less than 5,000. Through its cooperative marketing program, NHRRA acts as a brokering organization for recycling programs in these smaller towns, as well as for larger programs, and sells recycled materials to specific buyers. (See sidebar for guidelines on planning a cooperative marketing program.)

"By acting as a broker representing a number of municipal programs," says NHRRA marketing program manager, Russell Allen, "we can guarantee larger amounts of quality materials to buyers than individual recycling programs here could generate alone. This factor often allows us to secure higher contract prices for recyclables on behalf of our member municipalities."

However, it's the security of long-term contracts and dealing with reputable buyers who will provide service whether the market outlook is good or bad that

2

:ovides the biggest incentive for mu-:cipalities to participate. Simply put, :HRRA finds there's strength in numbers.

According to NHRRA's Allen, participat-ng communities are responsible for collecting and processing their recyclables to designated market specifications and storing them at their facilities; NHRRA is responsible for marketing the materials to selected buyers. With few exceptions, buyers provide transportation of materials, picking them up from each seller's location in full- or partial-load quantities. (In the case of partial loads, the buyer stops at two or more places to collect a full load in one trip.) NHRRA currently operates programs to cooperatively market its members' newspaper, old corrugated containers, mixed waste paper, glass containers, scrap metal, and HDPE and PET plastics.

Peg Boyles, NHRRA cooperative market development manager, says, "In most cases, New Hampshire's programs are a win-win situation." According to Boyles, municipal officials like the program because they don't have to worry about finding markets, and they are assured that NHRRA does everything it can to work with reputable markets. They just pay their membership dues and place a phone call to NHRRA when they have materials ready to sell.

Buyers like the program because they don't have to deal with overworked municipal officials or volunteers. They wait for a phone call from NHRRA telling them when and where to have a truck, and they are guaranteed a relatively smooth pick-up. Of course, there are occasional glitches in the program. Allen recalls a few incidents, such as the buyer's truck showing up on the wrong day, and the time a snowstorm required that the town's recycling loading equipment be used to plow snow. But overall, things generally run smoothly.

Adds Boyles, another premium for buyers is that through the use of signed contracts, they are guaranteed a relatively stable quantity of materials, which generally doesn't happen with individual recycling programs.

Moving to the big league

Cooperative marketing has been a successful strategy for maintaining stable recycling markets in rural areas such as New Hampshire. But can it work outside of a rural environment? The Recycling Committee of the Metropolitan Washington Council of Governments (COG) recently hired a recycling consulting firm to analyze that issue. The answer? Yes, a cooperative marketing brokerage for COG members' recyclables is feasible. So, will cooperative marketing become a reality in the Metropolitan Washington area?

"Probably not, at least for the time being," says Joan Rohlfs, COG recycling coordinator. "Even though the Council of Governments' board of directors has endorsed the concept of regional marketing, and has expressed interest in implementing such programs when the opportunity arises, the reality of the situation is, the opportunity may simply not arise." Rohlfs offers two reasons why cooperative marketing may never take place among COG's members.

First, the impetus for the study came from problems associated with the regional newspaper market. But when the single largest local buyer, Southeast Recycling, was approached about becoming the sole buyer for the area, it declined to work with a contract of that size since it would be placing too many eggs in one basket. "Thus," says Rohlfs, "local governments felt forced to compete to satisfy immediate newspaper marketing needs." In the process, they refined their marketing skills, and found themselves guarding market information rather than sharing it. This sense of competition has done nothing to foster the spirit of cooperation needed to implement a cooperative marketing effort.

Second, large county recycling programs, such as in Montgomery and Prince George's counties in Maryland, are in the process of securing their own processing facilities. Private operators of those facilities will likely market the materials directly, eliminating the need for participation in a cooperative marketing program.

While cooperative marketing might not be in COG's future, the Maryland Governor's Advisory Council on Recycling has expressed an interest in obtaining the COG study. However, it is too early to say

Guidelines to planning a cooperative marketing program

There are five basic steps involved in evaluating the feasibility of a cooperative marketing program and then planning and implementing a successful effort.

Inventory needs and plans

Potential participants should be contacted to determine their interest in participating and their level of commitment to the program, which recyclables to include in the program, tonnages available (current and anticipated), and the existing or planned capabilities to process those materials. Legal restrictions to participation, such as procurement procedures and flow control legislation, should also be acknowledged.

Determine who will coordinate

Of all the tasks involved in planning a cooperative marketing effort, this one is the most essential, and probably the one that is most often overlooked. If a cooperative marketing effort is to succeed, an organization that will provide leadership and coordination for the program must be determined at the outset.

Plan and design the cooperative marketing program

It's time to make decisions. Key planning determinations to be approved by participants include the specific materials to be marketed and the schedule for including them; the process for choosing markets; staffing needs; and budgetary needs and appropriate funding mechanisms.

Implement the program

The coordinating organization should undertake specific tasks to assure the program is properly implemented, which can include some or all of the following, depending on the plan. Hire or appoint staff with a clear understanding of marketing recyclables who will serve as a good liaison between local recycling personnel and markets. Select buyers for materials and, if appropriate, sign contracts. Inform participants about market specifications so they can process recyclables accordingly. Make arrangements to have recyclables transported to market.

Monitor the program and make necessary changes

Make sure the cooperative marketing program is meeting participants' needs, and make appropriate changes if necessary. But if it's not broke, don't fix it.

what, if anything, will develop from that expression of interest.

Where from here?

Interest in cooperative marketing programs is high these days, since it appears to be a successful marketing mechanism. However, as recycling moves to the front burner and private sector interests vie for a share of the marketplace, efforts like New Hampshire's can be viewed as "competition" by private firms. In addition, market competition between urban recycling programs may supersede cooperative efforts.

According to Michael Simpson, NHRRA's president, NHRRA's board of directors and staff recently grappled with the appropriate continued role for NHRRA. The focus of discussion — should NHRRA maintain the role it has held for almost 10 years as a cooperative marketing organization, or step aside and let private interests take over marketing?

For supporters of cooperative marketing, the verdict was positive. NHRRA decided to forge ahead in the realm of cooperative marketing, and expand programs to meet members' needs. For each marketing program offered — be it glass, paper, plastic or metal — there will be multiple options to service the full range of members' collection and processing capabilities. This expansion of options means that NHRRA staff will locate buyers that offer multiple marketing options, or that NHRRA will contract with several buyers for a single material. Emphasis in the expanded programs will be placed on filling the raw material needs of New Hampshire end-use markets. In addition, NHRRA will diversify its sources of materials to include commercial and industrial recyclables.

It's the security of long-term contracts and dealing with reputable buyers that lure municipalities to participate in cooperative marketing.

"If larger quantities of high quality material improve marketability, then working with private sector generators of recyclables will improve NHRRA's market clout for our municipal programs," says Peg Boyles. "There are significant generators of plastic, scrap metal, glass and paper that never reach municipal recycling programs. We need to involve them in our cooperative marketing efforts."

NHRRA believes recycling cooperation must be elevated to a higher level, both geographically and philosophically. Says NHRRA's Simpson, "What we are truly competing against is the ease with which raw materials are mined and harvested, and the throwaway society of which we are a part. Cooperation across political and geographic boundaries must occur, so that the recycling society we envision becomes a reality."

If NHRRA is right, the possibilities of cooperative marketing have only begun to be realized. **RR**

MRF Automation Making Strides Into High-Tech

As first-generation material recycling facilities begin to close and the need grows for separating high-quality recyclables and keeping them out of the waste stream, demands on MRFs will increase. Technology is answering the call.

A few years ago, municipal solid waste officials started talking about siting MRFs — Material Recovery Facilities — as a means of pulling recyclables out of the solid waste stream.

A relatively unknown concept at the time, the highly-automated sorting systems are beginning to serve a pivotal role in efforts to solve the nation's solid-waste crisis. During the next 20 years, it is likely that the term "MRF" — pronounced "murf" — will be as common to Americans as "dump" is now. While MRFs all serve basically the same purpose, each one can be quite different from others. Their definitions vary, reflecting the emerging separation technology and methods. In broad terms, MRF has been defined as a facility that transforms recyclable solid-waste materials into marketable feedstocks.

In its most advanced form, a MRF efficiently sorts hundreds of tons of commingled recyclables a day, with a minimum of manual labor and yielding high-grade marketable commodities such as paper, glass and mixed-metal beverage and food containers and selected plastics. The emergence of highly automated MRFs parallels the growth of large-scale curbside pickup of recyclables in communities across the country.

Today there are no more than 10-15 relatively advanced MRFs in the U.S. Stephen A. Katz, manager of recycling and business development for the New England CRInc. division of CRInc., sees the number of advanced, high-volume MRFs sorting recyclables climbing dramatically to at least four times that number in just five years.

In 20 years, Katz said, he sees "a full-scale recycling program in every large-sized community in the country, and a coast-to-coast network of MRFs processing the materials generated by those programs."

Minimal manual labor

A CRInc. MRF, which began commercial operation May 1 in Johnston, R.I., is processing 240 tons of materials a day in two shifts with eight sorters per shift. The sorters perform the only manual tasks — separating glass by color and plastic by resin type. The Rhode Island CRInc. facility is the first MRF using state-of-the-art Bezner sorting technology.

CRInc. is the exclusive North American licensee for the technology of Maschinenfabrik Bezner of West Germany. The company began making material-handling systems primarily for the timber industry in 1889. In the 1970s, when the solid-waste crisis surfaced in Europe, "they applied their expertise to develop sorting system for recycled materials," Katz explained. Twenty MRFs using Bezner technology are today operating across Europe.

CRInc., a company spawned by the passage of state bottle-deposit laws in the 1970s, is operating or constructing nine recycling material processing facilities, including seven separating commingled recyclables. CRInc. is applying the Bezner technology in an even more advanced facility scheduled to begin operation in Brookhaven, Long Island, N.Y., next summer. This MRF will process 400 tons of metal, paper, glass and plastic per day.

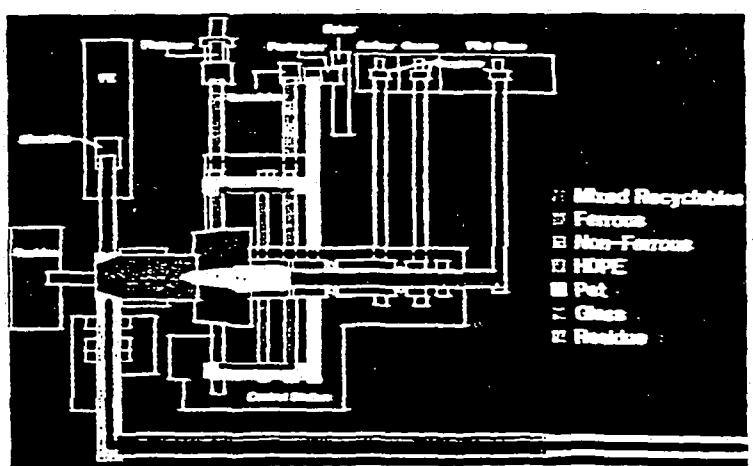
The Council For Solid Waste Solutions, a program of the Society of the Plastics Industry, estimates as of early 1988, 10 U.S. MRFs were operational, with another 35 under construction or in the late planning stages. The council, and other arms of the plastic industry, are rapidly developing an automated system of sorting plastics by resin, opening the way for recycling a wide range of plastics.

In the next three to five years, Katz predicted, the recycling industry will achieve full automation in the sorting of recyclable materials. CRInc. and Bezner have developed a technology to automatically sort glass by color. A prototype of the automated glass-sorting system, using optic scanning, is operating in a MRF in Denmark.

Application of this glass-sorting technology must wait for the U.S. recycling industry to mature and evolve a final design.

The Rhode Island CRInc. MRF is significant, Katz maintained, because it moves the processing of recyclable materials "from crude sorting methods to an automated factory-type sorting system."

Though crude, labor-intensive MRFs can be traced to the very beginning of collection and processing of scrap materials, advanced MRFs first emerged here in the mid-1980s. Actually, a research plant to process commingled glass and metal containers was established in 1975 in Branford, Conn., by Resource Recovery System Inc., one of only a handful of companies now supplying an entire system.



Mixed recyclables process flow, Rhode Island MRF. (Courtesy N.E. CRInc.)

A central element

"MRFs are really, really central to the whole (solid-waste) situation. You can't have a MRF without collection, and you can't have collection without a MRF," explained Pete Dinger, di-

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rector of technology for the Council For Solid Waste Solutions in Washington D.C. "Studies have shown household collection (of recyclables) is more effective if a MRF is used to sort the materials."

Besides labor and cost savings, the more advanced MRFs make it more convenient and easier for consumers to participate in curbside collection programs. Usually, consumers need only separate their paper from other recyclables, increasing the recycling rate. In addition, advanced MRFs produce a higher-quality commodity in volume, enhancing marketability.

According to Adam Marks, operations engineer for Rhode Island Solid Waste Management Corp., the Rhode Island MRFs perform two functions: "sort in a centralized way and assemble a high quantity of material for the market."

Solid-waste-management decisions in Rhode Island, first to mandate recycling state-wide, are based on economics. "We recycle here because it is the least-costly way to manage those materials," said Marks.

As a general rule, Marks explained, using a MRF is more cost-effective than separating materials at the curbside when a recycling program serves more than 50,000 households. "If you don't have a local market to truck glass to," Marks added, for example, "you will have to accumulate to ship to a central market."

Both Marks and Katz see a variety of problems associated with more labor-intensive material-sorting facilities and corresponding benefits with more automated MRFs.

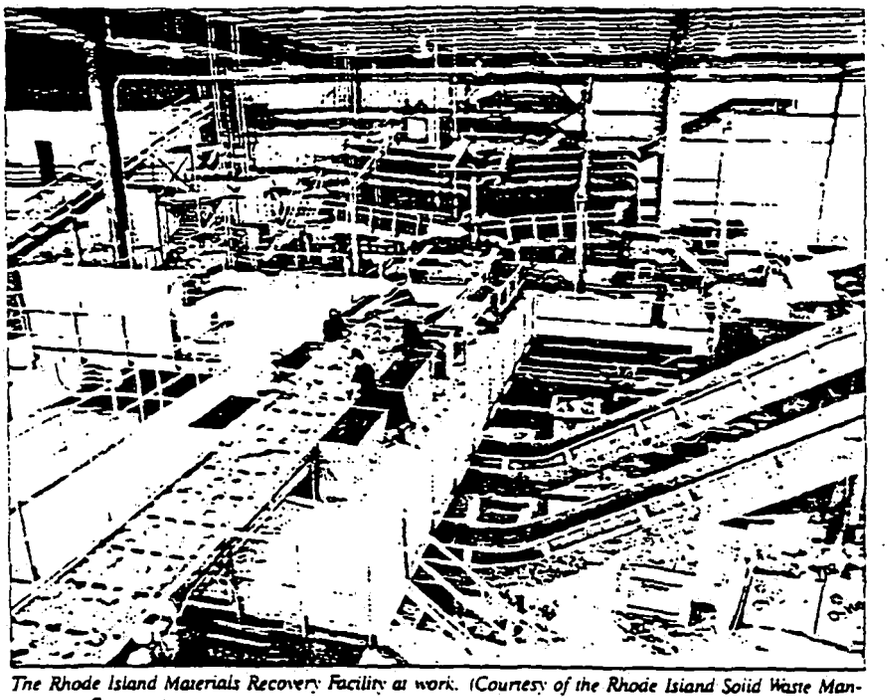
First, the task of sorting is tedious and the pay is low. And, if the residue isn't automatically screened before the workers handle materials, the job is environmentally unpleasant.

"It's a tough job," said Marks. "I've seen workers essentially pick through garbage. That's not the way the industry is going to go."

For example, CRInc.'s MRFs emphasize improved environmental conditions and methods to promote efficiency and reduce worker fatigue. Sorting stations for paper and commingled recyclables are enclosed and environmentally controlled. Material approaches the sorter head-on — not sidelong: material is guided — not lifted — into a hopper; and negatively-sorted material automatically falls to the next conveyor.

"We don't have guys who get tired after three hours," asserted Katz. "Machinery doesn't come to work on drugs," he added, noting, "We're getting bottom-of-the-line labor in these plants. There's no absentee problem.

"Because we rely on an automated separation, we end up with a cleaner, more contaminant-free product more marketable to industry," Katz added.



The Rhode Island Materials Recovery Facility at work. (Courtesy of the Rhode Island Solid Waste Management Corporation.)

Adams agreeed automated processing facilities have environmental advantages. "More automated plants tend to be cleaner, and the working standards are going to be raised. You might find areas that want to create jobs with recycling, but down the road it will be what is the cheapest to operate."

Savings in the millions

An example of cost savings possible by using a more automated system is cited by the final evaluation report to the Brookhaven, N.Y., Town Council. The analysis reveals that in evaluating the CRInc. MRF compared with less-automated systems, the CRInc. system produces at $1.6 million to $5.2 million savings over a five-year term, depending on a range of tonnage processed from 24,000-72,000 tons per year.

The most important question when evaluating quality in a MRF, according to Marks, is "to look how solid and reliable it is." Noting that equipment successfully used in industry enhances those factors, Marks added, "You want equipment you can send a rock through."

More crucial equipment in a MRF are magnetic separators — which separate tin from ferrous metal — and eddy current separators, which separate aluminum, Marks explained. While separation equipment may be unique, processing equipment such as balers, glass crushers and aluminum flatteners are more standardized components.

One advantage of the CRInc. system, said Marks, is that residue is screened early in the process so there is less debris for workers to sort through. "It's not high-tech equipment: it's how it's arranged."

Marks estimates that by using sophisticated MRFs to enhance both the collection and marketing of recyclables, communities are able to recycle 15-20 percent of the waste stream. A practical limit of 30-35 percent can be reached with addition of composting.

This level is approaching goals set by the Environmental Protection Agency and by individual states. Ten states have mandatory recycling laws, and more than 500 communities collect recyclable materials at the curb, about twice the number five years ago, according to a recent *New York Times* feature focusing, in part, on the emergence of advance MRFs.

MRFs also aid the nation's efforts to divert more solid waste from costly and environmentally risky landfilling by promoting a centralized and integrated approach. An integrated approach locates a MRF, waste-to-energy plant, composting facility and landfills in a central area.

MRFs, according to Dave Newton, recycling coordinator for Suffolk County, N.Y., "are primarily a municipally operated sorting facility."

Suffolk County and neighboring Nassau County, with a total of 2.6 million residents, make up two-thirds of Long Island. This area is recognized as one of the most advanced in solid-waste management and recycling because New York state has ordered all landfills closed by the end of next year to protect the fragile groundwater on Long Island.

About nine years ago, Newton explained, the Town of Islip on Long Island "built one

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MRFs
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of the first MRFs in the nation within an existing incinerator building." The town is now building a state-of-the-art facility with the ability to sort out plastics.

Newton pointed out that processing recyclables often is a two-stage operation in which a town collects the recyclables, separates the materials and sends them on to intermediate processors and then onto end users. He notes, in some instances, that "the quality (of recyclable material processed) isn't top-grade. Plants are old and the towns were forced into recycling because landfills filled up, and they worked within the existing collection systems.

For example, the Town of Babylon, N.Y., collects newspaper one week and mixed cans and bottles the next and stockpiles them in an old airport hangar before they are shipped for processing.

Newton estimated at least 75 companies are involved in intermediate processing of recycled materials in the two-county area. "Everybody who bales paper or crushes glass is operating a MRF," he pointed out.

An example of a labor-intensive MRF, said Newton, is a large, privately operated system that handles construction and demolition material for eastern towns. Here, materials are pulled off the trucks by hand. Wood is chopped up and sold as fuel while metals are sorted. Even dirt is stockpiled and sold as fill.

"The pressure (of laws) is there. They (towns) are responding, and tremendous amounts of money are being spent. Recycling is moving along. There are plans for expansion, extended education and attempts to stabilize the markets," said Newton.

"There's been a lot of effort in the front end — source separation and processing — and now the effort is on economic and market development," added Newton, who said towns are researching cooperative markets.

"We are working with towns and the state to expand industries that can use these recyclables, improve the quality of materials and stabilize the market so recycling can be sustained," he explained.

Recycling experts fear market backups. Recently, for instance, waste paper has flooded the northeast markets, and communities which previously earned money for their paper are paying $20 to $25 per ton to have it hauled away. However, this cost still is small compared with tipping fees of $100 per ton or more in the area.

"They're (recycling programs) all unique in their own way. They are all geared to address their specific situation and all doing a pretty good job," Newton added.

Danger in going overboard

But at least one veteran of the recycling field expresses caution about going overboard for automation.

"We look upon recycling not as a facility that provides total automation, but as a waste-disposal facility that separates materials," said Peter Karter, president of Resource Recovery Systems Inc., a pioneer in developing and operating MRFs using its own technology.

"One of the problems is the new emerging technology. Every paper dealer and scrap dealer is operating a MRF. There's a lot of snake oil being sold in this business," Karter warned.

Karter's company has painstakingly developed its MRF since initial research nearly 25 years ago.

"After many years of suffering and learning, we finally solved the problem and invented new equipment and put the first commercial plant into operation in Groton, Conn., in 1982," he said.

Old Lyme, Conn.-based Resource Recovery Systems now guarantees its facilities for seven years. The company opened a second plant in Camden, N.J., in March 1986, processing more than 80 tons of bottles and cans a day. Its second plant opened in June 1988 on 127th Street in Manhattan, and is sorting more than 50 tons of bottles, cans and paper a day.

Karter said the company's largest and most advanced MRF willl begin operating in Springfield, Mass. It will process 240 tons of mixed recyclables a day. In a cautious approach, the company is sorting plastics on only a limited basis. Though the plants are capable of processing plastics, Karter explained, he is waiting for the market to be more certain.

Resource Recovery Systems developed machines which separate most labels, food and caps from containers without damaging rings, metal and caps. Karter pointed out the New York City MRF "ran into trouble with badly broken glass, ceramics and crockery and clay flower pots. We receive source-contaminated materials, but they are still contaminated."

"We tested and produced a finely graded aggregate made from the residue that we give to the city asphalt plant," explained Karter.

"It's (material separation) developmental, and the thrust is to remove as much from the waste stream as possible and re-use it. We are continually perfecting machinery, markets and processing," continued Karter.

"The key is to produce quality products with reliability so buyers have faith in you and your operation," added Karter. The company's MRFs are automated except for separating glass by color and for quality inspection.

More labor-intensive facilities where the intent is to produce jobs, Karter believes, will be limited to smaller-volume processing of five to 10 tons a day.

> In the next three years, the recycling industry will achieve full automation in the sorting of recyclable materials, Katz said.

To make the point, Karter explained, in one day, the Camden, N.J., MRF processes enough recyclables to fill a room eight feet high by 20 feet wide and 72 feet long. "How are you going to deal with that (manually) day-in and day-out?"

The Resource Recovery Systems MRF can produce as many as 14 different commodities.

"In almost all cases, recycling is cheaper than other options (burning and landfill)," said Karter.

As part of the continuing refinement of MRF operation, CRInc. is developing a method of separating residue into glassphalt (now used for road bed material) and fiber to market the glass residue to low-quality cullet or glassphalt and send the fiber to waste-to-energy facilities.

Pete Dinger of the Council For Solid Waste Solutions sees the development of MRFs driven by need and economics due to the diminishing number of landfills and high cost of landfill-disposal of waste.

In addition, Dinger said, "The threat of legislation has provided the incentive. We've gotten the ball rolling. Let the private sector see what it can do."

Further development of MRFs and solid-waste management will be aided by coordination, data and information-collection and research sponsored by industry groups, such as the Council For Solid Waste Management, Dinger predicts.

"The cooperation that's going on in industry is good. Governments are turning around, not so much on the band kick, but looking for solutions." —*Michael Marcellino* ■

The author is a freelance writer based in Cleveland, Ohio.

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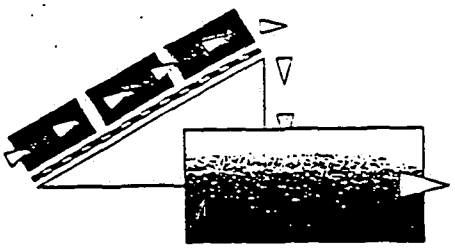


TRANSFER STATIONS CAN RECYCLE, TOO!

This, the last of eight articles in our series on waste transfer, deals with integrating waste reclamation into these facilities.

Installing a conveyor and picking station in a transfer station is one way to incorporate recycling at a facility.

Recycling. It's the current buzzword in the solid waste industry and is coming to the forefront of solid waste planning discussions.

If you are a collector/hauler or transfer station operator, you probably are faced with rising disposal costs. Perhaps you are backed into a situation where a governmental entity has mandated source separation of recyclables and has left the onus of collection, upgrading, and marketing on the private sector.

How can you meet these challenges — and business opportunities — with your existing transfer station? . . . or with one that you are planning to build and operate?

Recycling approaches

Traditionally, recycling activities at transfer stations have relied predominantly on manual labor. Almost all transfer stations have some sorting activities, even if the primary sorting/recycling operations take place along a conveyor system.

Floor sorting is used for at least three purposes:

- to recover large bulky items;
- to recover recyclable materials (e.g., corrugated boxes, white goods, wood pallets); and
- to remove materials that are not suitable for processing (e.g., large pieces of metal, which can tear up the sides of aluminum transfer trailers).

Open-top roll-off containers are commonly placed near this sorting area for holding these hand-sorted materials. Small wheel-loaders and skid-steer loaders, with grapple buckets, are used to assist the laborers. The loaders spread loads out on the concrete receiving floor, handle larger items (such as wood pallets, bulky metals, and corrugated paper), and load processing equipment (conveyors, balers, packers, etc.).

Conveyor layout ideas

Conveyors are typically employed with baling facilities. Steel-belt conveyors are used for receiving the waste materials that are to be baled or compacted.

By RICHARD A. PELUSO, P.E., and ERNEST H. RUCKERT III, P.E.

Peluso is a senior vice president and Ruckert is a project manager for Wehran Engineering, a Middletown, N.Y.-based solid waste consulting firm.

Options are available for continuing the steel-belt conveyor to the baler or for discharging from the steel-belt conveyor onto a rubber-belt conveyor for sorting. Cost advantages may be realized using rubber-belt conveyors.

Another strategy is to install picking stations next to conveyor belts. These stations, common sights at materials recovery facilities, have been used at transfer stations, too.

Depending on the processing equipment at the transfer station, many conveyor layout and operation alternatives are possible. For instance, a single conveyor system could be used to feed a baler. If high-percentage corrugated loads are dumped onto the conveyor, the contaminants (other paper types, strapping, plastics, etc.) could be removed by the workers at the picking stations. Bales of old corrugated cardboard would be made.

Alternatively, if low-percentage corrugated loads are dumped onto the conveyor, the corrugated would be picked off and refuse bales would be made. Corrugated would be baled later in the work shift.

Multiple conveyor systems could be designed where one conveyor would feed a baler and another conveyor would receive the non-paper materials and feed another baler or packer.

Conveyors also work handily for separating mixed recyclables. Picking areas are set up alongside the conveyor and the recyclable materials are picked off and dropped into a chute or bin below the conveyor. Wheel-loaders, forklifts, or skid-steer loaders would move the sorted materials and consolidate loads for shipment to markets. A word of caution: Be sure to incorporate all appropriate safety guards, emergency stop cords, signage, identification, etc. on the conveyors.

Separation equipment has been employed at some facilities to separate materials based on size and, consequently, to improve the materials recovery operations. Separation equipment typically includes trommel screens, disc screens, magnetic separators, and, occasionally, air classifiers. Conveyors transport the materials between, and away from, the screening operations.

System vendors market processing systems for materials recovery and recycling purposes. The equipment varies according to the vendor, but it can include screens, conveyors, hand-sorting magnetic separators, balers, and flatteners-densifiers-crushers. The *Waste Age* "Yellow Pages" can be consulted to locate vendors.

Materials markets: Know your markets for recyclable materials. Talk to them to determine their specifications for materials they accept.

Density, contamination levels, minimum quantities, and delivery vehicle type are several factors to consider. Based on materials market feedback, decisions must be made regarding processing equipment for your transfer/recycling station.

Some sample transfer/recycling operations

Here are some approaches that others in the industry have used.

Orange County, N.Y.: Landfill volume is diminishing here. The county has mandated residential separation of clear (flint) glass and newsprint, and commercial separation of corrugated.

One hauler has responded by constructing a source-separated waste recycling/transfer station. Incoming loads of source-separated wastes are unloaded within a pre-engineered metal building addition constructed adjacent to the existing collection vehicle garage. Glass is dumped from the collection vehicles onto open 20-yard roll-off containers.

Corrugated and other grades of paper are hand-separated on the receiving floor. The paper is then batch-fed onto a steel-belted Mayfran conveyor, which in turn feeds a Selco baler. Export bales are produced. Minimal amounts of residue are transferred to the landfill.

Danbury, Conn.: One hauler designed his facility here around paper recycling. An existing warehouse was renovated to accommodate primarily commercial solid waste loads. Sorting is conducted manually on the receiving floor with the assistance of wheel-loaders.

Corrugated paper is separated and pushed onto a steel-belted conveyor that feeds an HRB baler (which produces export-specification bales). Nonrecoverable materials are loaded onto a steel-belted conveyor that feeds a Dempster compactor (transfer trailers haul this residual material to a landfill).

New Jersey: The operator of an open-top transfer station in this state is planning to branch out into recycling. The facility was originally designed as a transfer station ("garbage in" equal to "garbage out"). With 18 months of operating experience, it has a reasonably good handle on the types of recyclables that are available in the incoming wastes.

A several-bay expansion to its existing transfer station is in the planning process. It will give the company the floor space to dedicate to recovery of recyclable materials. Paper, wood, and metals will likely be manually recovered.

New York: A transfer station operating in New York currently bales and ships out-of-state all of the solid wastes it receives. The facility operator is considering the installation of a materials recovery system as provided by a systems vendor. Conveying, screening, and sorting operations will be employed to concentrate the recyclable materials and improve the efficiency of the recovery operation. ■

RHODE ISLAND'S

Can you describe the Johnston MRF as high-tech if one of its main tools (gravity) is literally as old as the hills?

Bezner. Bezner. Bezner. Bezner!

That's all one hears from New England CRInc. and its customer, the Rhode Island Solid Waste Management Corp., when it comes to the new, semi-automated materials recovery facility in Johnston, R.I. The unit makes use of technology from West Germany's Maschinenfabrik Bezner, which is said to have equipment in 20-odd MRF-type facilities in Europe.

Located next door to RISWMC's Johnston Landfill, this first American CRInc/Bezner MRF is said to process an hourly average of 10 tons of mixed glass and plastic bottles and aluminum and tin cans. The reported residue generation rate is 9% (for material direct-delivered from curbside pick-up). The plant also prepares as much as 60 tpd of newspaper for recycling.

But the achievement of a 10 tph processing rate for commingled material — with what seems a minimum of human strain and potential risk compared with other MRFs — is what makes the 40,000-square-foot plant "state-of-the-art." The CRInc executives credit this mostly to the Bezner machinery, for which the company has the exclusive North American license.

This seems to have the CRInc folks high on life. "This isn't the 'MRF of the Month'," says Stephen Katz, a marketing manager for CRInc, which is based in North Billerica, Mass. "It's the MRF of the year!"

Beyond that ecstasy, there is the cold hard fact that the RISWMC, which had planned to build two MRFs in addition to the unit at Johnston, has now scaled back to just one. The achievement of the 10 tph average, with two shifts at both plants, has reportedly led the Corporation to scale back its plans to include just one more.

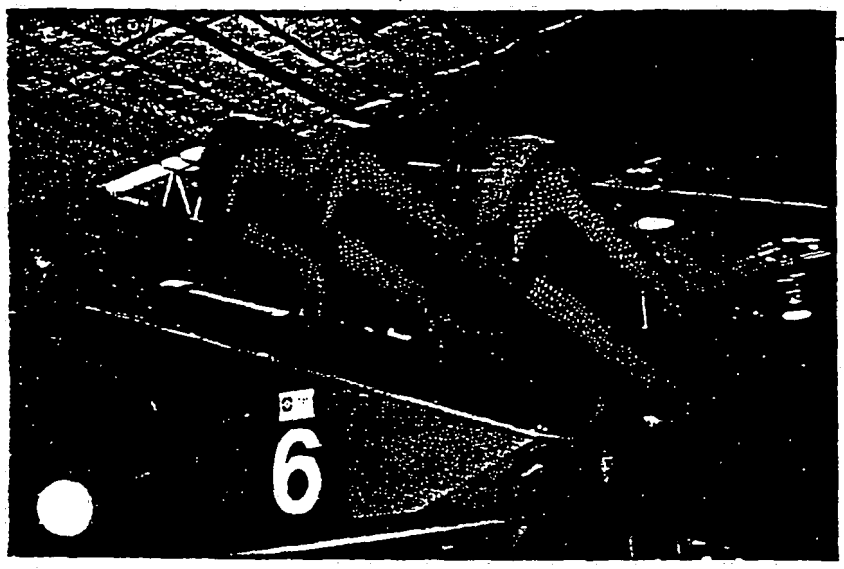
By JOE SALIMANDO

Not all was roses

While the actual volume of recyclables currently collected daily by Rhode Island municipalities requires only one 8-hour MRF shift, CRInc has been running a second processing shift since the plant opened in late April. The workers have been processing a large pile of bottles and cans stored in a yard behind the building.

This pile was built up in the year between the date of the plant's planned opening and its actual first work day. RISWMC contracted separately (in 1986) for plant opera-

STATE-OF-ART PLANT



Above: The three "chain curtains" that, with the help of gravity, separate glass from plastics and aluminum. Left: Rush of Rhode Island recyclables from initial conveyor is metered to even out the flow on the belt.

tion and construction, and the building contractor (not CRInc) couldn't get it built on time. The material stored in the backyard has been quadruple-handled by the time the MRF machinery and workers get to it: Into the curbside container, into the truck, out of the truck and into the yard, and then from the yard (via front-end loader) into the MRF's loading area.

"We're getting a lot higher percentage of residue out of that backyard material than from what comes in directly from the curb," says Katz. "Beyond the breakage problem, it's the material stored up from the first year of collection." In other words, it's the stuff citizens put out for recycling before their collective level of education on the program's needs rose.

According to Katz, the backyard should be cleared of recyclables by the end of this month.

Separation with help of gravity

T w of recyclables fed to the MRF's loading hopper is "regulated" by a computer wired into sensors at the hopper's feeding mechanism. These sensors "feel" the pressure generated by the volume of cans and bottles behind them, and change both the speed materials are released and that of the conveyor onto which they drop (from a low height). The idea here is to keep the flow of recyclables at an even stream — avoiding the loading of massive 2- and 3-item-deep piles onto the feed conveyor.

This conveyor elevates the recyclables to a height 20 feet above the tipping floor, a step made necessary because the Bezner process makes creative use of gravity.

First step in the process is inspection of the flow, and removal of contaminants, by two workers. This material is fed onto a residue conveyor, which feeds a roll-off box.

Next the recyclables are run under a magnetic belt. Cans containing steel "fly," sucked up by the belt, and are fed off to be processed separately. Aluminum cans and plastic and glass bottles continue down the line.

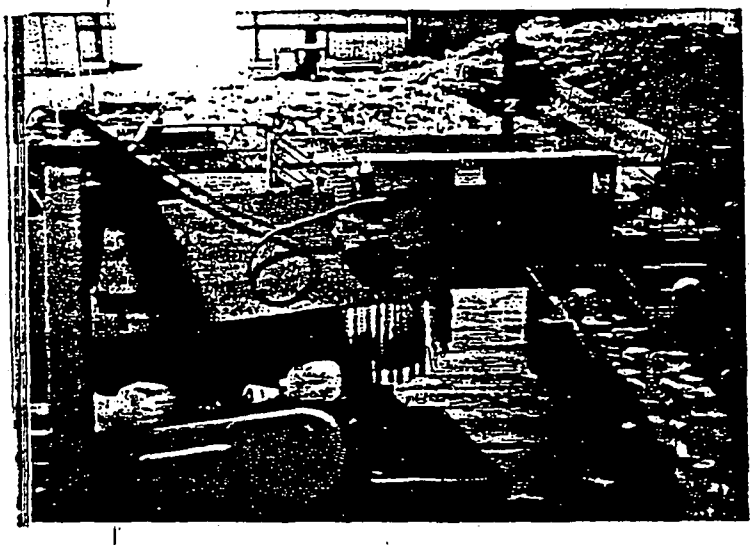
Gravity is next brought into play. As the material begins to tumble down through a row of moving conveying equipment, three sets of metal bars, suspended by chains, move across the recyclables. These three "chain curtains," which together are somewhat weird to look at, separate the glass from the plastic and aluminum.

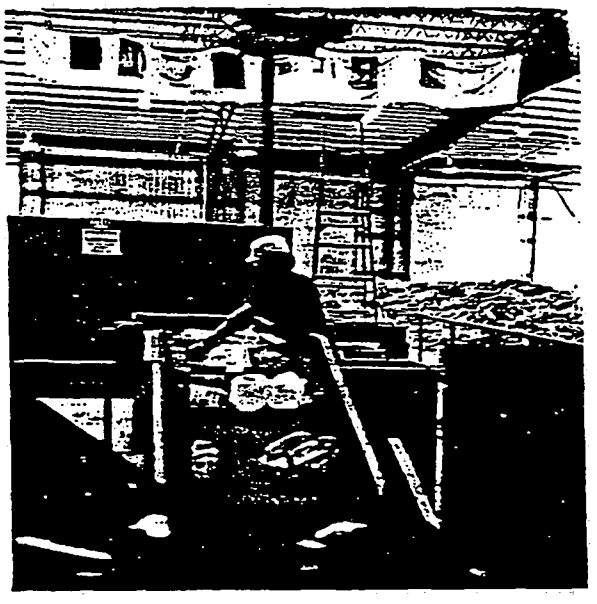
Separation is accomplished by the simple fact that glass is heavier than either plastic or aluminum. The bars "catch" the plastic and aluminum and move it to the left and right; there are two lines to process plastic and aluminum. The heavier glass either slides under the bars (the larger pieces) or simply tumbles through as if they were not there.

Note that as the glass slides downward, pulled by gravity and the movement of a shaker-screen, small pieces fall through 2-inch-wide holes in the screen onto the residue conveyor.

Plastic bottles and aluminum are run (on either side)

Plastics and aluminum, taken off the line by the chain curtains, are separated by a combination of eddy-current magnet and human sorting. Two workers (one on each side of the chain curtain) separate HDPE bottles from PET bottles.





through an eddy-current separator, which could be described as a "non-ferrous magnet." This pulls the aluminum cans off the line and onto another conveyor.

Plastic bottles of high-density polyethylene (HDPE) and polyethylene terephthalate (PET) are all that is fed to two separate conveyors, each of which is staffed by one picker. The picker's assignment is simple: Pull off any non-plastics that have made it through the process, and pull the HDPE milk and water bottles. The contaminants are placed in a hopper, the bottles the other way into another hopper (which feeds a conveyor devoted to HDPE). At the end of these two plastics conveyors all that is left are PET bottles, which again fall onto a dedicated conveyor.

As to the glass, it is conveyed by 4 or 5 pickers. These individuals again pick off any contaminants that may have been missed — including, perhaps, flattened plastics. But their main job is to pick off brown glass and green glass, which are placed, separately, into hoppers on either side of the conveyor. All that's left at the end of this final separation conveyor is clear glass, which falls off onto its own dedicated conveyor.

Most veteran recyclers know that clear glass pulls a higher price than the other colors, but CRInc underlines that by stationing one final worker on the conveyor feeding the clear glass to processing equipment. This "quality assurance" inspector's job — one of only 10 jobs directly on the MRF's processing line — is to pull any ceramics out of the clear stream. "In time, as the public education level increases even more, and as other towns and cities are brought on-line and *their* education level rises, we won't need this position," Katz claims.

Readying materials for markets

While it's being described separately here, the processing of materials for shipping to markets is integral to the process — although the machinery used for final preparation is not from Bezner. According to Katz, the material being sold from the MRF is (percentages of mixed bottles and cans): glass, 65%; steel, 12%; PET, 5%; HDPE, 3%; and aluminum, 3%.

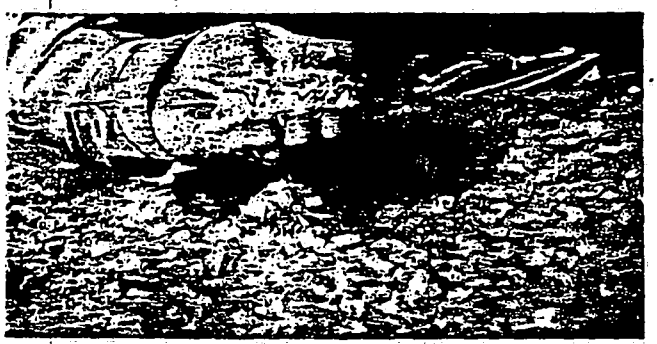
Cans made of steel and tin or of steel and aluminum (otherwise known as bi-metal) are conveyed from the top of the line to an AMG Cutler shredder. This unit, supplied by AMG (a major detinner of steel cans) flails at the cans and turns out small-sized, multifaceted steel "crumbs." In the process, the aluminum tops of the bi-metal beverage cans are separated out, giving AMG a clean product to buy and process. The steel crumbs are blown into a trailer.

Aluminum is fed to a can flattener, which also feeds a trailer.

Glass is fed to processing machinery which crushes it to the size required by markets: it's not furnace-ready cullet, but CRInc is getting experience with Grayson glass beneficiation machinery in California (in a two-MRF joint venture with Anchor Glass), and this may be added to CRInc MRFs in the future. In Johnston, the processed glass is fed to storage bins, which are unloaded into trailers when full.

Plastic bottles are processed in two ways. PET bottles are perforated and baled, in a Balemaster baler; while HDPE bottles are put through a granulator, which feeds Gaylord boxes. "The price we get for the granulated HDPE more than justifies the cost of the granulator," says Katz.

Newspaper is also processed, but lightly. It comes in separately from the cans and bottles, and is tipped on a separate tipping floor accessed through a different door into the MRF. CRInc is dedicated to providing de-inkable news, to maintain a steady demand for its product, so two workers take the paper out of grocery bags before it is fed to the Bollegraff baler.



One end-product of the Rhode Island MRF is ground high-density polyethylene (HDPE). Bottles made of polyethylene terephthalate (PET), on the other hand, are perforated and baled whole.

"This process has reduced our newspaper throughput somewhat, from an anticipated 8 tph down to about five," says Katz. "No one anticipated the present requirement for de-ink grade news. Remember, we bid this project to the RISWMC in 1986."

The bags are put in piles and baled later, for sale as recyclable kraft.

According to Katz, shakedown problems in the first few months of operation arose in the processing end. "The Bezner equipment has not been the source of problems for us," he claims.

Business arrangements

RISWMC pays CRInc on an operations and maintenance schedule, with varying revenue going to the company at graduated tonnage levels. CRInc also shares in the revenue; at a certain specified level, the company's share of the sales dollar declines, on a sliding scale, down to a minimum of 10%.

Katz says that the average cost to RISWMC — before revenue — of processing a ton of recyclables is in the $26 to $28 range. It might be possible to lower that cost in future MRFs, Katz says, by eliminating the plastics separation (including the two workers, the conveying equipment, and the two types of processing machines).

"Again, remember, this plant was designed, and our proposal accepted by the Corporation, in 1986," says Katz. "Since then, markets for mixed plastics recyclables, including rigid plastics that are not HDPE or PET, have developed."

In fact, CRInc experimented in producing mixed plastics products. Up until recently, the company had an ET/1 mixed plastics waste extruder at its North Billerica headquarters facility. "We wanted to further solidify our position as a full-service recycling company," says Katz. "With that machine, we were the only recycler that could take mixed post-consumer plastics.

"But since we began that project, which included research from Lowell University, the market has changed. Markets are emerging for mixed plastics now." That's one reason CRInc recently sold the ET/1 to another firm.

Additions to this plant

According to Katz, CRInc could lower its waste ratio to a figure significantly below the 9% now experienced with direct-delivered curbside material. The company may add an air classifier before the residue box, to separate paper from mineral residue. The paper and any plastics will be disposed: the mineral (glass, ceramics, etc.) CRInc thinks it will be able to market as low-quality cullet or for use in "glassphalt" road building.

Plans for the Johnston facility include pushing out one wall of the building. Now sized at 180 x 220, the building would then measure 180 x 270. This 9,000 sq. ft. of additional space would enable CRInc to enlarge the tipping floor and have more room to accommodate delivery of commingled material and storage of processed recyclables. "You learn all of the time in this business, and this is one lesson we've learned here," says Katz. "You just can't have enough space."

An interesting lesson CRInc learned from Bezner, before opening the plant, was to install wooden floors. "This is easier on the workers' legs," says Katz, "and their experience was that glass that may be thrown and not fall into the hoppers doesn't break as easily on wood."

Most immediately, the future for the $4.1 million Johnston plant includes accepting recyclables from the expansion of recycling programs in the major Rhode Island cities of Providence and Pawtucket. "This will keep our second shift busy long after the material in the backyard is gone," says Katz. ■

mrf of the month

NEW YORK'S LABORATORY IN HARLEM

This one-year-old unit has taught city officials — and the nation's most experienced MRF contractor — a thing or two.

Experimental. That's the label New York City has stuck on its only materials recovery facility (MRF), a 5,000-square-foot building situated on 1 acre of land in the East Harlem section of Manhattan. Strangely enough, the "experimental" intermediate processing facility has produced some surprises for city officials. And it has stimulated additional research and development by the privately owned firm that runs the place on a contract.

Don't be misled: That "experimental" tag doesn't mean the Harlem facility has MRF workers picking bottles and cans in laboratory coats and throwing samples of the contents into test tubes. It's a regular reclamation plant, with bottles and cans coming in just as random in cleanliness and condition as those in any other municipality.

What's been most unexpected, and exciting, is all the stuff coming in with the bottles and cans. "We tell the citizens to just put metal cans and glass bottles out for collection, but they are putting a lot of other materials as well," says Alison Blackman, project manager for the city's Department of Sanitation (DOS). "To tell the truth, most of us in the DOS didn't know what to expect one year ago when we began the various recycling programs. People from outside the city had told us New Yorkers would never recycle. They said we weren't going to get anything.

"Well, the exact opposite is true. What we've found is that New Yorkers are *enthusiastic recyclers*. In fact, they are almost too enthusiastic. They see us ask for metal and glass, and they give us chaise lounges and fish tanks and light bulbs. That's been the source of some problems. Actually, we see these problems as growing pains. And we're pretty excited about the solutions."

By JOE SALIMANDO

Expanding a fledgling program

New York is arriving at its solutions with the help of Resource Recovery Systems (RRS, Old Lyme, Conn.), which is running the plant on a two-year contract. RRS runs MRFs in Groton, Conn., and Camden County, N.J., and is involved in what will be the nation's largest MRF, a 240-tpd unit now under construction in Springfield, Mass.

"This isn't really a recycling facility," Peter Karter, president of RRS, says of the East Harlem plant. "It's really a waste diversion plant. At least, that's the way the people of New York who are giving us this material obviously see it. If you were to design a facility to recycle most efficiently, you'd just ask for clear glass and aluminum. That would be it; those are the highest-priced items."

As it is, the city has asked for just glass bottles and metal cans. But the enthused New Yorkers have disregarded limits.

"What we're getting is, well, everything," says Karter. "We get a lot of plastic. We get plastic bottles, both PET [polyethylene terephthalate] soda bottles and HDPE [high-density polyethylene] milk and water bottles. We get other plastics — like toys — soap and food containers, and other materials like aerosol cans. Plus, we are getting a lot of

Alison Blackman of New York's Department of Sanitation and Peter Karter of Resource Recovery Systems are working together to get the bugs out of the Harlem MRF.

crockery, a lot of kitchen ceramics. And we are getting pots and pans, and the like. We even get a good deal of aluminum beverage cans here, even though New York state has a bottle bill, which, by the way, also covers the PET bottles.

"We had not designed this facility for those materials. We had originally planned to process just glass, tin, and aluminum. And we were going to sell just the three colors of glass and mixed cullet. Now we are selling an aggregate product, because the material we receive has a lot of crockery in it. We are selling three types of aluminum — the cans, some scrap items (which the buyers call 'irony aluminum'), and foil.

"Besides tin cans, we are selling scrap metal; that's what we do with the garage doors and the like. We are recycling the plastics we get now and are expanding our capacity to handle much more in the future."

How it works, and who works there

In operation, the East Harlem MRF is much like that in Camden County, N.J. (see July, 1987, *Waste Age*, page 48):

- Commingled recyclables are dumped and pushed onto a conveyor.
- A worker stationed before the processing equipment picks out unrecyclables and breaks open plastic bags. The bags are put aside for disposal, as are the unrecyclables. This worker also picks out some plastic bottles, throwing them behind him into a plastic bag.
- As the materials enter the facility, they are air-separated. The plastics and aluminum are "blown off" for separate, automated processing.
- What remain are glass bottles, steel cans, and any unprocessables or plastics that have been missed. Workers at a moving conveyor belt separate the glass by color. Steel is pulled out magnetically.
- Near the end of the belt stands a worker with a hand scraper. When he sees broken glass or other aggregate-type material, he scrapes that off the belt into a hopper.
- Whatever that worker lets pass falls off the end of the conveyor into a roll-off destined for the landfill. This process is being automated, to provide for continuous processing of scrap glass remaining from the process.

Almost all of the staff of 14 running the plant as of mid-April were local residents; most walk to work. This area of relatively high unemployment supplies just the type of entry-level, trainable workers that RRS wants to use. "Many of these people were unemployed when they came here," says John Whitman, the RRS plant manager. Whitman specializes in RRS plant start-ups; he helped bring the Camden facility on-line.

"We've trained the people here to do every job in the plant, not only because we need this kind of backup, but also to relieve the boredom," says Whitman. "We've taught people to operate equipment, and we've even taught one worker to weld.

"We are constantly training new people, because we lose about two of our staff each month. Most of them go on to better jobs. We're proud of this, even though it's a headache, because it's a community service. Of the four women we have working here right now, two used to be on welfare. And of these 14, a few will advance to more important jobs when we expand to two shifts."

Adds Blackman: "For this type of job, a turnover of two persons out of 14 is not unusual in New York City. You can look at recycling as a job creation program. When we have several MRFs operating here, we will have created dozens of new jobs."

Leaving enthusiasm undiminished

One of the things these workers must cope with is a variety of recyclables that neither the city nor RRS planned to

handle. Interestingly, on the day of the *Waste Age* site visit, Karter's observations of the materials delivered to the MRF were proven. In one delivery, among the pile of metal cans and plastic bottles were:

- a metal folding garage door — the whole thing;
- the center frame of a bicycle;
- a metal garden hose wheel;
- a metal light fixture;
- untold amounts of plastic bottles and containers, including PET soda bottles;
- many small plastic bags, into which citizen-recyclers had gathered their recyclables; and
- sundry other materials that were clearly not called for by New York City's directions to its citizens, including plastic Tupperware-type items and many aerosol cans.

An initial market uncovered for plastic bottles required the materials to be supplied in large plastic bags. Here they are readied for shipping.

"Honestly, I didn't set this up," said Karter as the materials were being examined. "This is typical."

What will New York City officials do about this influx of unasked-for material? Says Blackman: "We really didn't expect the enthusiasm, and we certainly don't want to diminish it. We will not go back to our citizens and tell them not to put this stuff out for recycling if we can find a way to process and recycle it. The extra materials may cause some short-term problems, but our relationship with RRS has been very good, and together we're solving the problems. And the net result will be diverting more materials from the landfill."

In fact, the flow of plastic bottles has the city's recycling personnel working on expanding the program to target these as a recoverable, and actually *asking* citizens for them! The city wants residents to return PET soda bottles for the a nickel deposit. But other plastic containers will be targeted for collection.

From whence it comes

City officials admit that the East Harlem operation has been a money-loser in its first year. One reason is that, at 26 tpd, the plant is operating way below its design capacity; Karter claims the volume amounts to less than one shift.

Transportation and materials transfer is another cause of lost dollars. Recyclable materials collected in all of the city's five boroughs are brought to the plant, no matter what distance is involved. The transportation costs are high; but there was no other direction for the city to go in the short term, unless it considered opening a dozen MRFs or intermediate processing facilities (IPCs) simultaneously a viable option. The city didn't.

"Obviously, when we have many more IPCs spread out throughout the city, we will cut costs," says Blackman. "But right now we've got the collecting trucks unloading into other, larger trucks that make the trip here. There's a lot of time and expense. When we have a number of IPCs around the city, the route trucks will be able to dump directly, and that will cut the costs we're experiencing now."

Materials are brought to the East Harlem plant from several city programs. These include the curbside program, the Containerized Apartment House Recycling Program (CAHRP), institutional collections (such as those at the Riker's Island prison), and drop-off centers.

On the revenue side, the transportation problem causes yet another problem: The harvest of unbroken glass bottles is reduced. Items collected at curbside can be "triple-bounced," if you will, before reaching the processing line: once from curb into collection truck; once from that truck to a larger transport unit (typically, a roll-off); and again when the transport unit unloads at the East Harlem facility. And in the CAHRP, bottles are dropped (or thrown) once by residents into metal bins; again when the bins are emptied into front-loaders; and again when the front-loaders unload at the plant.

Find markets for materials

The 26 tpd of materials processed in April was the net reclaimed from the waste stream by volunteer participants among the 360,000 city households served in recycling programs. But in a process that began in April and will end this month, the city is expanding its curbside programs to reach 600,000 households.

"We shouldn't have a problem, in that the plant's capacity is about 40 tpd with one shift," Karter estimates. "We plan to go to two shifts when volume necessitates that move."

Strangely enough, under the city's contract, there is a limit on the profits to RRS for managing a higher volume of materials, selling for higher prices, or any other volume-based situation. Simply put, the company gets a fixed management fee plus an opportunity to earn an additional fixed fee based on volumes of materials sold. Certain expenses, such as salaries and maintenance, are paid by the city in a pass-through arrangement; but there is a cap on how high these expenses can run. On a monthly basis, if the expenses exceed the cap, RRS is out-of-pocket for the excess.

Funds from the sale of materials go straight to the city, which may pass on profits (up to a fixed amount) to RRS.

Although this arrangement seems to provide little incentive to the contractor to aggressively market the recyclables, that's not been the case. For one thing, as Blackman pointed out, "a lot of people have been skeptical of a New York City facility, and they are watching this plant"; RRS is aware of the positive exposure that can result from this. For another, this is only the first of the city's IPCs; with an eye to the future, RRS will not give anything less than its best effort.

Evidence of this dedication to marketing is abundant. Karter has instituted research and development (R&D) programs in a number of areas. Much of the R&D has been done at the company's facilities in Groton, Conn. (which has been operational with the same equipment in place since 1982) and Camden, N.J. (operational since 1986). When perfected, the ideas are moved to New York . . . and to other RRS plants.

One research effort centered on finding a use for the high volumes of broken glass, ceramics, and crockery that fall off the end of the MRF's conveyor belt. According to Karter, there is a higher percentage than seen elsewhere of broken glass (thanks to the triple-bouncing referenced above); the high percentage of non-glass breakables makes this material unsalable as mixed cullet. The market for mixed cullet is unreliable and uninspiring anyway.

What's the alternative? Before the plant opened, Karter and his staff worked with Harry Watson of the city's Department of Transportation to investigate how glasphalt and concrete producers can use an aggregate-type raw material. "What we've found is that these markets did not want a product with a spec of half-inch material. They wanted a blend — some half-inch; some quarter-inch; some very fine, almost like dust. We puzzled briefly over how to produce this, until we realized that our glass machines, fortuitously, are capable of producing this range of end-product size with just a little modification."

This R&D project, stimulated by New York's problem, is going to have a payoff for Camden County, N.J., and the Southeastern Connecticut Regional Resource Recovery Authority (which has funded RRS's upgrade of the Groton MRF), and other places. Karter says this new market for asphalt aggregate using mixed-color cullet blended with ceramics is big enough to absorb materials from other company MRFs.

Making the tin perfect

RRS has also been working on plastics. As of April, the workers were bagging plastics for recovery by a market that needed plastics in bags. But the company has worked with the city to locate markets (including nonprofit groups) for mixed plastic bottles of all kinds — HDPE, PET, and those of other materials (for example, motor oil bottles made of polyvinyl chloride). "For this effort," Karter says, "we'll have to buy a perforator and a baler."

Heavy ceramic contamination forced RRS to find new markets for mixed-color glass.

Yet another R&D project has involved solving a problem with the institutional tin cans sent to East Harlem. Many of them come to the plant partially filled with food (especially tomato sauce, peanut butter, and jelly). Because the process RRS uses now only crushes these cans, the detinner who buys the material has been unhappy.

"We are researching the use of a machine that would split the cans, cutting them up so that some of the food material would fall out," says Karter. "We've had close consultations with our buyer; this company wants the tin free of aluminum, paper, and food remains. We've examined this, and it looks like we would have to add two additional machines for the tin cans, beyond the one that we have, to meet this requirement. That's a big additional investment. We are looking around for alternatives.

"But we're pretty dedicated to the detinners as a market for these cans, rather than selling them directly to steel mills. We at RRS think the use of steel cans without first detinning them may cause contamination in the steel produced. We could be wrong, but if we're right, the market represented right now for these cans by steel mills will, over time, evaporate. That's why we want to stick with detinners.

"What we sell is this kind of expertise, the willingness to learn what the markets want, and giving them material of consistently high quality. That's what you have to do to make recycling work. For example, in talking with a representative of a glass manufacturer the other day, he told us the carbon content of our glass was .05% to .06%, and asked if we could get it down for a special use. That carbon is probably coming from food contents of glass jars and, perhaps, from paper. I told him that, if it was important to him, we would find a way to reduce the carbon content.

"Sure, if we add two more machines just to process tin, the costs will be a little higher. But while the city is in the refuse collection business, we are in the commodity business. And we are in it for the long term. That's why making the commitment that we would make in this case, and why making the investment in those additional machines, might be worth it." ■

NATION'S FIRST MERCHANT MRF

This New Jersey scrap dealer got into municipal recycling seven years ago. A materials recovery facility was a natural addition.

We saw it coming.

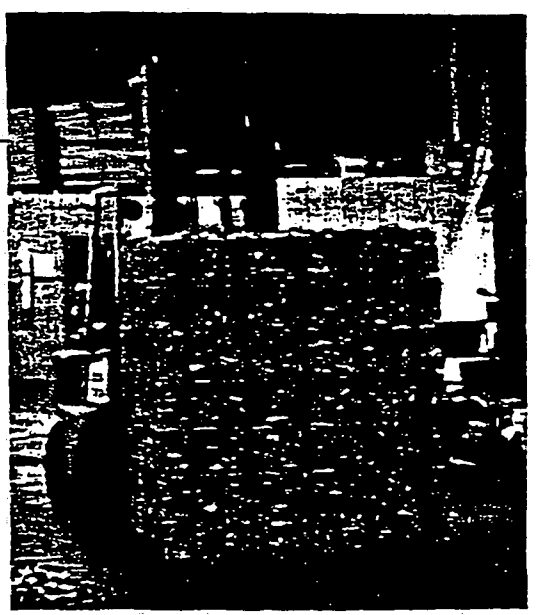
Rich Rosen and his partners in Monmouth Recycling (Long Branch, N.J.), a scrap company founded in 1977, have the satisfaction of saying that. They also are enjoying whatever profits can be derived from the operation since fall, 1987, of what may well be the first "merchant MRF" in the United States.

That's not to say profits rush like a tsunami from these recycling facilities. Then again, Monmouth Recycling's facility is one of only a handful of materials recovery facilities (MRFs) operating in the United States. A MRF is a place where recyclables from residential collection are taken; these facilities are also called IPCs (intermediate processing centers).

When Rosen calls his facility a "merchant MRF," he uses the term "merchant" to mean he opened the facility's doors without major long-term contracts for supply of the 50 to 60 tpd of materials he needs to keep the place operating efficiently every day.

"Not only are we a merchant facility, but we were 100% privately financed — and that means that my partners and I are responsible for a lot of debt," says Rosen. "We put more than $1 million into the equipment and construction that added the MRF to our existing scrap facility."

By JOE SALIMANDO



Aluminum is picked out of mixed loads and compacted into briquettes.

Most incoming material is commingled

Monmouth Recycling's MRF accepts bottles and cans — both separated and unseparated (commingled) — from

communities in and outside Monmouth County. The timing of its opening coincided with the Oct. 1, 1987, implementation of mandatory recycling in the county, which has 550,000 residents.

What's more, the company currently pays communities for the materials. Commingled materials bring $15 per ton; separated materials (glass by color, for instance) will bring more, depending on the going commodity price.

Rosen's facility is designed to handle commingled material, and the bulk of what the MRF handles is mixed. The recyclables are:

- pushed, via a Bobcat loader, into a vibratory feeder;
- run up a box conveyor past a magnetic separator; and
- run through the conveyor sorting area, where two workers pick aluminum out of the load; others then separate out glass by color.

Glass brings a much higher price when sorted into green, brown, and clear segments. The separated segments are crushed and screened; labels and bottle caps are screened out, leaving "cullet" useful to glass manufacturers. Glass that is not picked off the conveyor — typically, broken bottles — falls off the end of the conveyor belt and is tagged to be sold as mixed cullet.

Aluminum is run through a can flattener and blown into a trailer. Metals picked off the magnet are also flattened. Through use of a densifier from CP, these and other incoming aluminum volumes can also be handled by a Mosley briquetting machine that is part of the MRF.

An advocate of collecting commingled

Isn't this an awful lot of effort? Wouldn't it be better if materials came in separately from municipal recycling programs — in separate loads of green, clear, and brown glass; aluminum cans; and ferrous metal cans?

"We think commingled is the way to go," says Rosen. "If a community decides it wants to pick materials up separately, it must buy new trucks. If you decide to commingle, you can use your existing refuse trucks.

"Plus, in most programs of which I am aware, citizens are not asked to sort glass by color. There is one community here that has its citizens do that — they put out six buckets, one each for green, amber, and clear glass; aluminum; tin; and yard wastes. And there are other towns where the collection worker sorts the mixed materials at the side of the truck. That takes a lot of time.

"Asking people to set it out together makes sense, especially because most communities I've talked to want high participation rates. Compliance decreases with the amount of separation you ask people to do. When you ask them to do six sorts, or even three, you start to lose households and volume. If you commingle, you will win high compliance, and you'll do it without a big capital investment."

Some 40 communities — roughly 65% of the total using the Monmouth MRF — collect bottles and cans in ordinary refuse trucks, according to Rosen. "The only caveat we have for them is that they cannot compact the material," says Rosen. "We need those glass bottles whole."

Because of nearby summer resort towns, volumes received at the MRF vary with the seasons.

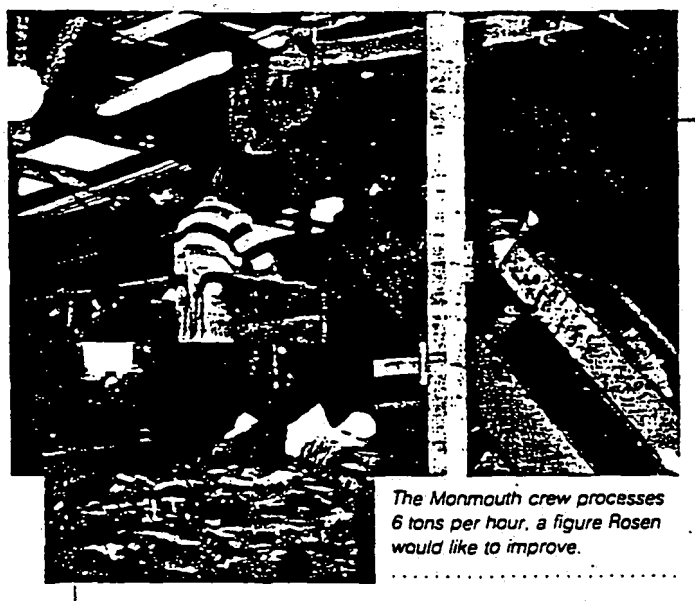
Helping municipalities since 1982

Monmouth Recycling was founded as a scrap dealer 12 years ago by Rosen and some partners. Rosen's career in the scrap industry dates to 1973. For the first four years, Monmouth dealt only in industrial scrap — specializing in aluminum alloys. This part of the business is still thriving.

Municipal waste recycling became part of the business in 1981-82, when Rosen began to encourage voluntary recycling programs that were springing up in the area. He worked with the Boy Scouts and other nonprofit groups, arranging to accommodate their needs for special services. "We had one of the first multimaterial recycling facilities in New Jersey," he says. By 1983-84, Monmouth Recycling was integrally involved in at least one community recycling program.

As the company's involvement in municipal recycling grew, so did New Jersey's trash crisis. Far from left out, Monmouth County was, in fact, *singled* out: it had to meet a year-earlier deadline (Oct. 1, 1987) than most counties for compliance with the state's mandatory recycling law. The county agreed to this deal in exchange from state regulators to vertically expand an existing, scheduled-to-close landfill.

"Recycling bottles and cans fits into the Monmouth County program, no matter what disposal decision is made in the future," says Rosen. "We're keeping this material out



The Monmouth crew processes 6 tons per hour, a figure Rosen would like to improve.

of the landfill right now. And if they decide to build a waste-to-energy plant, well, you can't do such a plant a better service than to take out all of the bottles and cans. "And best of all for the taxpayer, we did it without taxpayer dollars. There was no subsidy from the county or the state, no grant money. We funded it completely by ourselves."

An MRF operator's problems

Beyond the no-subsidy boast, Monmouth Recycling also provides income and savings for taxpayers by paying cold cash for unsorted recyclables. But this arrangement narrows the profitability of the operation, Rosen says.

"As a merchant facility, we've got to pay," he says. "We have some longer-term contracts with a few municipalities, but we have to make it our business to give them a good deal. That doesn't mean we're always going to pay for this material, though: it depends on how the markets for glass and metals fluctuate in the future.

"A big problem is contamination. Until we decide to process and sell plastics, PET (polyethylene terephthalate) and HDPE (high-density polyethylene) bottles are waste for us. But plastics are not the whole of it. A lot of citizens put in things like ceramics, paint buckets, aerosol cans, and coat hangers."

Rosen lists the following materials as wastes from his MRF:

- the various unprocessibles described above — plastics, paint cans, ceramics, china, dishware, light bulbs, stoneware, pottery, porcelain, opaque glass, leaded crystal;
- nonbottle glass (such as broken windows);
- labels from bottles and cans removed in the processing operation;
- bottle caps, can pop-tops and lids, and can rings; and,
- for the time being, mixed-color glass.

All together, Rosen says, the wastes equal 10% of what comes in to the MRF's front door. He claims that the figure is much better than that of a noted municipally owned New Jersey MRF: there, 25% to 30% of what comes in as "recyclables" leaves as waste.

And there would be less waste at Monmouth if the mixed-color glass could be recycled. "There are people out there who will tell you that there is a market for every bit of cullet, no matter whether it is sorted by color or not, but that hasn't been our experience," says Rosen.

"In our first year of operation, we did manage to sell 3,000 tons of mixed cullet. But we generated 5,000 tons. I don't blame the buyers. People who make bottles use mixed only sparingly. As a result, people who operate MRFs have to look to some innovative marketing.

"We've looked at glasphalt, and there are other ways to use glass — ideas that I don't want to talk about until we've actually done something with them. The key is that mixed glass is a cheap material. To find a market, it has to displace something that's more expensive."

Goal: higher daily throughput

Another problem that Rosen plans to tackle is his operation's efficiency. Right now, his crew of 25 processes 6 tons per hour. "I want to do 10 tons per hour, and I think we can," he says.

"In our first year, it's been a seasonal business. The amount coming in varies. We can get as much as 120 tpd on a summer day; the rest of the year it's an average of 70 to 80 tpd. The reason for the variance is our proximity to the summer resort towns.

"But obviously we want to put through more volume, because that's where the profit is. If we had a chance to do it all over again, I would change many things. You have to remember that we were the first: some other MRF operators have profited from our mistakes."

What would Rosen do differently? Here's a short list of nonconfidential plans he has for the next MRF he builds:

- Increase the amount of automation in his plant.
- Add machinery to aid in separating glass by color and in crushing and cleaning materials.
- Restructure the flow of materials inside the plant to eliminate bottlenecks that occur when higher volumes (closer to 10 tons per hour) are processed.

Rosen identifies MRF mistakes

What mistakes should others avoid? Again, Rosen has a short list:

1. Public entities should rely on private concerns such as Monmouth Recycling to get the job done. "This avoids

lengthy procurement processes and saves the taxpayers money," he says. "We are very proud of not having taken a dime to get this facility built. You can't compare the costs.

"A municipality has to hire consultants, engineers, and lawyers. There's a bid process. It can take years. We minimized our use of this kind of help. We've been in the scrap industry for years. We used our expertise, with the help of equipment suppliers, to design this facility. We got the site plan approved on May 5, 1987, and we had the building completed and equipment installed before the end of September."

2. Once built, the cost of labor is a key MRF profitability limit. Again, Rosen points out advantages his company has over a local government. "For this reason alone, even if a county or town insists on owning the MRF, it should hire a private operator. A company has some freedom of movement that's not given to a government. It's like trash collection, in that there are incentives and productivity-enhancing strategies that a company can use that a government cannot consider.

"I can guarantee a way for a MRF to lose a lot of money: Pay your help $10 per hour to pick glass. Yet, with benefits, that is what it might be in many New Jersey municipalities."

3. If you have a good idea, try it — but don't outsmart yourself. "We've been able to learn a lot here by making our own mistakes," Rosen says. "For instance, we tested a premise proposed to us — that we could make the operation more efficient through what the proposer called a 'negative' sort.

"Since 60% of the glass coming in here is clear, we decided to instruct our workers to pick out everything but clear. A negative sort. It should be easier, our theory went, because we would leave 60% of the material untouched. A good way to increase our throughput, right?

"Wrong. It doesn't work. Because of all of the breakage involved in our accepting commingled material, we were losing too much volume. Loads come in here with a range of 10% to 40% broken glass. That was too much to give up — we were ending up with too much mixed cullet, which, as I've said, doesn't move very quickly."

4. As more and more recyclables enter the market, quality is the most important concern for an MRF operator. "Let's say John is selling glass that's slightly off-color, and sells it right now. And then another seller comes on the market with glass that meets the buyer's specs more closely. If demand stays level, some of that supply will go begging. You can bet it will be John's material.

"With a potential glut on the market coming, prices are likely to be lower — unless demand can be built up. Quality is a big factor now, but it will be much more important in the future. Product quality can't be borderline."

5. Finally, don't assume that because material has been separated by color or any other specification, that it is pristine. "Believe it or not, we run the glass we buy pre-separated by our municipal and hauler customers through our facility anyway. Now, we run it by itself, so can we can push through a bigger volume in the shorter time. That's why it's worth it to us to pay a higher price — for higher throughput.

"But we have to run it by our pickers anyway, because there is missorted glass, nonglass contaminants, and even glass contamination in there. For instance, there is a beer from Holland that is, apparently, popular in this area. It's packaged in a bottle made of opaque glass. Also, we keep finding ceramic cups in there with the clear glass. The consumer wants to recycle the old, cracked coffee cup, so he or she puts it in with the clear glass. A white coffee mug looks a lot more like a clear beer bottle than it does a green or brown bottle.

"Fact is neither the coffee cup nor the opaque beer bottle is clear glass, but to the average consumer, what's the difference? For the MRF operator, these things are potential market-killers. If we want to maintain our reputation for product quality, we've got to pull the opaque bottle and the coffee cup out of the clear glass loads before they become cullet! ∎

What About Plastics?

While Rich Rosen has thought long and hard about accepting plastics at the Monmouth MRF, he's decided he has to think about it some more.

One problem he foresees is the temptation to compact. "Without plastics, using a truck with a 20-cubic-yard capacity, a community can get as much as 4 tons or more of bottles and cans before it fills up. This is without compaction.

"If you put plastics in a 20-yard truck and you don't compact, you're going to get just 2, maybe 2.5 tons, and the thing will be full," says Rosen.

"That's more trips to the MRF, and more cost for our towns."

Another problem is at the MRF's end of this arrangement. "First, when the truck dumps the commingled materials with plastics, it takes more time to feed. When you feed plastics to my conveyor line, you are feeding nothing but air.

"So what you are doing is taking a facility that can average processing 6 tons of recyclables per hour and push it down to, say, 3 tons per hour. Look what you've done to our profitability!"

Is this problem a permanent roadblock? Rosen thinks not, but then he's got to think it over. A solution he's toying with is recommending separation — a departure from his "commingled is best" philosophy.

"Yes, we think commingled is the best approach for bottles and cans without plastics," he says. "But what's the sense of mixing plastics in if you are only going to drive the MRF out of business? Perhaps separation makes sense in the case where you handle commingled plastics as a separate stream."

— J.A.S.

Cooperative marketing: a delicate balance

by Tom Watson
Resource Recycling

Cooperative marketing is on the rise, but setting up a successful program can be tricky.

Aggregation without aggravation.

That's the challenge for governmental cooperative marketing programs: Aggregate and market the recyclable materials from a number of municipalities, without aggravating the private sector. Often lauded as the wave of the future, cooperative marketing may prove more difficult than many realize. When government gets involved in an area that has been the domain of private business, it's like walking on a landfill without boots on. But despite the risks, cooperative marketing holds considerable promise. At their best, these programs can make things easier for both the public and private sectors.

The showcase for cooperative marketing is New Hampshire, where a program has operated for eight years. Right next door in Vermont, however, a similar effort never got off the ground. In the latest developments, New York State is providing funding for three new marketing cooperatives, including a large, ambitious program on Long Island for old newspapers. A proposed program in Tennessee, based on the New Hampshire model, has generated concern from the scrap metal industry.

Here comes Public Technology

These projects and others popping up across the country could all be dwarfed eventually by a major cooperative marketing effort recently announced by Public Technology, Incorporated (PTI). A nonprofit organization based in Washington, D.C., PTI is a research and development arm of the National League of Cities, the International City Management Association and the National Association of Counties. One of PTI's chief goals is to develop revenue opportunities for cities and countries.

PTI's new Recyclables Aggregation and Marketing Program has been established in conjunction with the environmental task force of the Urban Consortium, says program manager Matt Korot. The consortium consists of about 40 cities and counties, each with a population greater than 400,000.

Korot says PTI will serve as a broker, negotiating contracts based on an aggregate supply of materials from multiple jurisdictions. Though details are still being worked out, "We picture this as one umbrella program with some regionally specific activities," he says. Groups of municipalities in two separate states have expressed interest in the program, and PTI has begun to work with these groups. When interviewed in December, Korot declined to identify them, saying it was too early in the process. If all goes well with development of the effort in these two states, Korot says he hopes the program will be up and running by late spring of this year.

He emphasizes that PTI does not wish to compete with the private sector or state-sponsored programs, but wants to form partnerships with them if possible. Because PTI does not have the resources in-house to provide all the required services for the cooperative, these partnerships will be necessary for the success of the program, he adds. Asked about the issue of possible interference with private sector activities, Korot says, "To some extent, it's a big question mark." PTI introduced the cooperative marketing program at the request of members of the Urban Consortium's environmental task force, he points out.

San Diego and other Southern California municipalities would like to set up a marketing consortium and had originally hoped to participate in the PTI program. However, it now appears the Southern California project is at least a year or two away, says Yvonne Williams, deputy director of the services division in the City of San Diego's Waste Management Department. While Los Angeles city officials have expressed interest in the proposed Southern California marketing cooperative, no decision has been made on

1

Old newspaper from four large Long Island towns will be marketed jointly to achieve economies of scale (1 and 2).

2

whether Los Angeles would participate, according to Joan Edwards, director of the city's Integrated Solid Waste Management Office.

Old news, new revenues

While most programs try not to duplicate services provided by the private sector, sometimes cooperative marketing can be used as a tool "to keep the private sector a little more honest," as one recycling official puts it. On Long Island in New York, four large towns have been paying $20 to $40 per ton to have their unbaled old newspaper hauled away. Believing that these prices were excessive, the towns have joined forces to market their total annual volume of more than 60,000 tons of newspaper. As a result, contracts are expected to be negotiated soon so that the towns will now be paid $15 to $20 a ton for their old newspaper, says Evan Liblit, executive director of the new Long Island Regional Recycling Cooperative. Even with an estimated cost of $8 to $10 per ton to have the newspaper baled, the new contracts will still represent a healthy turnaround for the towns.

"The private sector, unfortunately, had demonstrated an inability to respond to our needs," says Liblit. "We had to go looking for a better deal." Liblit, former commissioner for the Department of Environmental Control for the Town of Babylon, started his new job as director of the cooperative in January. In addition to Babylon, the other towns in the cooperative are Huntington, Islip and Oyster Bay. The four communities have a total population of 1.1 million. Other Long Island towns have been invited to join, and some have expressed interest.

Liblit hopes to negotiate five-year contracts with four different companies to buy the newspaper. Several major firms have already submitted bids.

The Long Island cooperative has an estimated first-year budget of $416,000. New York State is providing $164,000 in grants, with cash and in-kind services from the four towns making up the rest. By July, the cooperative hopes to be operating out of a large, centrally located warehouse, which it will lease. Some baling may be contracted out to private firms.

Liblit says. In fact, the entire operation of the cooperative may be privatized eventually, he adds. Several companies have already inquired about taking it over. But Liblit says the towns want to keep the cooperative public, at least for a while, to see how it works out.

Although the first priority is marketing the old newspaper, the cooperative hopes to expand within two or three years into steel cans, glass bottles and plastic containers. Liblit would also like to add scrap tires, compost and demolition debris.

Anthony Maurino, deputy commissioner of environmental control for the Town of Oyster Bay, says he and officials with the other towns are quite enthusiastic about the new cooperative. "We want muscle in the recycled marketplace," Maurino says.

New York State has also provided grants to two other cooperative marketing programs: the Hudson Valley Regional Secondary Materials Marketing Cooperative, which includes Orange, Putnam and Ulster counties; and a program being developed by the three-county Montgomery-Otsego-Schoharie Solid Waste Management Authority.

Granddaddy in New England

The New Hampshire Resource Recovery Association (NHRRA), a not-for-profit membership coalition of municipalities and others, began cooperative marketing in 1983. Five towns marketed 386 tons of scrap paper through the program that first year.

It's been growing ever since. Marketing program manager Russell Allen gives these figures for the fiscal year ending in September 1990: 39 communities marketed 3,905 tons of paper, including newspaper, corrugated containers and high grade office paper; 17 communities marketed 1,268 tons of glass bottles; 13 communities marketed 138 tons of polyethylene terephthalate (PET) and high density polyethylene (HDPE) plastic containers; and 111 communities, plus 3 or 4 private sector haulers, marketed 12,250 tons of scrap metal, from appliances to high grade metals. The figure for scrap metal includes a small amount from a pilot program last year with several Vermont communities.

Materials that eventually may be added to the New Hampshire program include scrap tires, used oil, and demolition and construction debris. NHRRA executive director Gary Olson says the association is also considering a program to remove refrigerants and certain hazardous capacitors from appliances, to increase their market value and lessen the negative impact on the environment. If the program appears to be economically feasible, NHRRA will send a service person and a truck to municipal scrap metal collection sites, taking off the capacitors and using a machine that captures the refrigerant. The refrigerant, which contains pollutants, is itself recyclable.

The Concord-based NHRRA draws up one- to five-year contracts with buyers, handles all paperwork and arbitrates any disputes between buyers and suppliers. The association may combine loads from several municipalities to produce a full load for shipment. High-quality materials are a must, and the NHRRA may inspect loads before they are sent to market. (For more on the New Hampshire program, see "What's the future of cooperative marketing?" in the June 1990 issue.)

No go in Vermont

Although Vermont and New Hampshire are neighbors that are similar in many ways, an attempt to start a cooperative marketing program in Vermont was a flop. When the Association of Vermont Recyclers (AVR) ran a pilot program with the NHRRA in Vermont last year for the cooperative marketing of scrap metal, several private businesses and municipalities complained, says AVR director Glenn McRae. The program "appeared to be undercutting local vendors," he says.

As a result of this opposition, AVR has decided not to pursue cooperative marketing in Vermont. McRae says it's hard for a group such as AVR to coordinate a cooperative marketing program. AVR represents many different interests, including private recycling operators. NHRRA, on the other hand, is primarily geared towards municipalities.

"The reason it works for us," adds the NHRRA's Allen, "is because when we started, there wasn't anyone else here," buying materials. Now some additional alternatives for marketing in New Hampshire do exist, says Allen, and the NHRRA informs municipalities about those options when they're available.

Volunteer State debate

In Tennessee, a cooperative marketing program for rural areas has been included in the proposed solid waste management plan for the state. The Tennessee Legislature is expected to consider the plan this spring.

The proposed cooperative would probably be run "along the lines of the New Hampshire organization," says Peggy Douglas, a Knoxville economist who put together the recycling-related portion of the plan. Working for the University of Tennessee Waste Management Institute when she developed the plan, she is now a consultant with the Tennessee Valley Authority.

In 1990, the New Hampshire Resource Recovery Association marketed more than 17,000 tons of recyclables for its members.

As far as market demand, Tennessee is in a good location, she says, but the markets in the region want quality and quantity. Douglas has talked to potential buyers of materials who said they would agree to long-term contracts if they could be guaranteed significant volumes. Several major companies in the paper and plastics industries that buy recycled material support the cooperative marketing proposal, according to Douglas.

However, representatives of the scrap metal processing industry have reservations about the plan. Larry Cohen, president of M. Cohen Iron and Metal Co., a Nashville scrap processor, says he questions the idea of setting up a costly new agency or infrastructure when a great deal of marketing capability already exists. He says he realizes rural communities need help with marketing, and adds that he doesn't think the proposed program would hurt scrap metal dealers. Cohen serves as president of the Southeastern chapter

of the Institute of Scrap Recycling Industries (ISRI) and is also on the board of the Tennessee Recycling Coalition.

Steven Levetan, of Atlanta-based Resource Services, is a veteran recycling industry lobbyist who represents the Southeastern chapter of ISRI, among other clients. Levetan points out that an annual budget of $500,000 has been proposed for the Tennessee cooperative, but he feels that the specific problems that would be addressed by the cooperative have not really been identified. A deinked newsprint system under construction in Calhoun, Tennessee should consume the bulk of the state's collected old newspaper, he notes. Levetan estimates newspapers make up more than 60 percent of the post-consumer recyclable material collected in the state.

As far as other materials, he says many traditional scrap processors are now willing to get involved with new or different materials, such as plastics, "and they're not even being talked to."

Levetan compares the current fascination with cooperative marketing to the curbside recycling collection boom. Public officials hear about a "sexy" new approach and think it will solve all their problems, he says.

He believes the concept of cooperative marketing is not well understood. "Cooperative marketing has nothing to do with market development," Levetan asserts. It does not create new markets or new consumers, he adds. "It's a way to deal with marketing, not markets."

Minimizing headaches

Janice Walls, director of state government programs for ISRI who works out of the main office in Washington, D.C., says she believes many ISRI members would support cooperative marketing programs, as long as they did not duplicate existing private efforts.

If operated well, a cooperative marketing program "can be a convenient buffer for the private sector," says NHRRA executive director Olson. Private businesses can reduce their hassles by dealing with just one organization, rather than a number of municipalities.

Complaints have been heard in the scrap paper industry, primarily from packers, that cooperative marketing cuts into profits and results in a lower-quality product. But Glenn Clarke, president of Interstate Mill Supply, says he feels that some people in the private sector don't understand the changing needs of municipalities. Based in Laguna Niguel, California, south of Los Angeles, Interstate Mill Supply is a broker and exporter of scrap paper.

Clarke points out that communities are having enough problems working out the collection of recyclables; when it comes to marketing, they want to minimize their headaches. Ideally, cooperative marketing can accomplish this for both the public and private sectors. A supporter of the cooperative marketing concept, Clarke hopes to handle some of the newspaper from the Long Island program.

Cooperative marketing "is one of these things where you can either stand on the sidelines, or you can get involved with it," Clarke says. "I think it's better to try and change with the times than to fight it."

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For more information on PTI's new Recyclables Aggregation and Marketing Program, contact Matt Korot at Public Technology, Inc., 1301 Pennsylvania Ave., N.W., Washington, D.C. 20004; (202) 626-2455.

The latest European import: wet/dry collection systems

by Tom Watson
Resource Recycling

Two-stream and three-stream "wet/dry" collections head for the mainstream.

Scores of municipalities, states, provinces and even Canada's federal government have embraced ambitious recycling and waste reduction goals. Many of these goals call for solid waste diversion of 50 percent or more from disposal within 10 years. But when it comes to realistic proposals on exactly how to achieve this, the silence can be deafening.

What better time, then, for the arrival of a method capable of diverting well over 60 percent of residential solid waste? "Wet/dry" collection systems, fairly common in parts of Europe, have begun to attract a great deal of attention in the Canadian province of Ontario. Several major American cities, including New York and San Jose, have also been exploring the potential of wet/dry collection.

While many recycling leaders have high hopes for wet/dry, the method is so new to North America that its track record consists mostly of a few Canadian pilot programs. No one can say for sure that the public will accept it. Other big question marks are the quality of the materials and which composting process will work best for the wet portion. On this continent, wet/dry is still wet behind the ears.

A multitude of options

The essential, waste-gobbling element in wet/dry programs is the inclusion of food waste and yard waste. In its most basic form, wet/dry collection consists of two streams: One container (which could be a bag) is used for "wet" materials such as food waste, yard waste, disposable diapers and soiled paper; a second container holds everything else (the "dry" fraction). In most cases, two separate trucks make the collections. Recyclables are separated from the dry fraction at a sorting plant. The wet stream is composted.

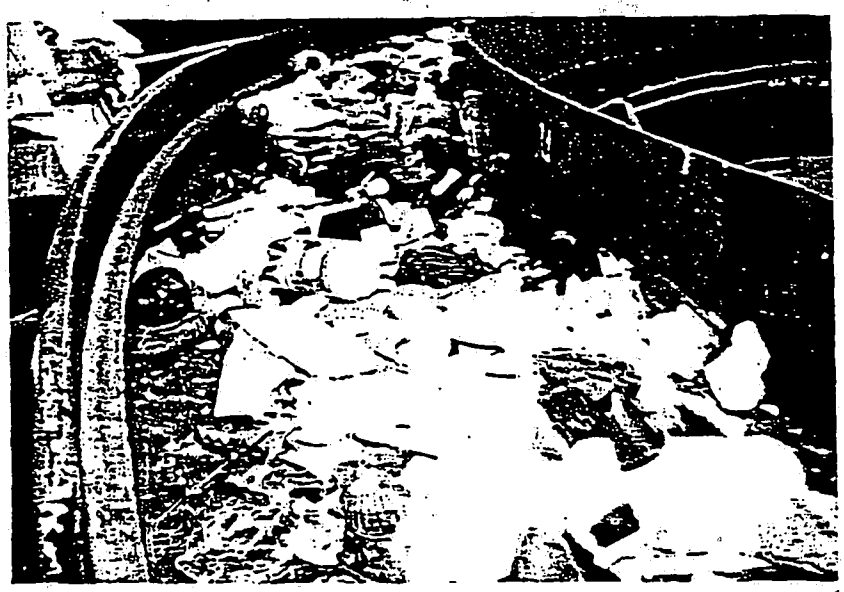
But the wet/dry concept encompasses many variations, including the three-stream method, which features one container for compostables, one for dry recyclables and one for the remaining garbage. For any community considering a wet/dry system, the question of whether to go two-stream or three-stream will likely be a major issue.

Several variations of two-bin and three-bin systems exist in Europe, says Reinhard Goeschl, president of a solid waste consulting firm based in Seebenstein, Austria. His firm also has offices in Germany, and Goeschl has assisted Canadian consulting firm Cave and Associates with its wet/dry pilot projects in Ontario.

One of Europe's largest wet/dry programs began last year in Munich, Germany, a city of 1.3 million residents. Munich employs a two-bin system. However, residents are asked to keep glass bottles out of the dry bin and take them to drop-off collection bins instead. Goeschl says this approach, which helps to reduce contamination of paper from pieces of broken glass, works well in Europe because most residents have convenient access to drop-off bins for glass containers.

A more elaborate wet/dry system that emphasizes a higher degree of source separation serves about 100,000 residents in Ludwigsburg, Germany. Residents have two large plastic bins. In the dry bin, householders place mixed scrap paper and plastic film; for a separate collection the following day, they use the same bin for glass, metal and rigid plastic containers. The other bin has two compartments, with one side for organics such as food waste and the other side for the remaining garbage.

In Europe, wet/dry systems with only two streams produce a low quality of compost, according to Goeschl. The reason, he says, is that many residents burn coal for heating or cooking, and the ash from coal — which ends up in the wet stream in two-bin systems — contains high levels of heavy metals. With three-stream sys-



1

Sorting plant in Neunkirchen, Austria use manual circular sorting line after a primar mechanical sort to separate dry mixed mate rials from a two-stream system (1). An em ployee removes recyclables in wet/dry twc stream collection system (2).

2

tems where the coal is discarded in the garbage stream, "you get a wonderful compost," he adds.

Because of stringent European standards for heavy metal content in compost, the trend has been toward more source separation. More than 25 facilities still process and compost mixed municipal solid waste in Germany and Austria, says Goeschl, but their only goal is to reduce the volume of the waste. The final product from these plants usually goes to landfills.

In another European trend, some nations and local governments have begun to ban or limit the dumping of food waste and other organic waste in landfills. A new law in Germany, for example, will limit the organic content of waste sent to landfills to 10 percent.

Guelph goes for it

Taking the lead from Europe, several Ontario municipalities hope to introduce wet/dry collection programs. However, a debate has erupted within the province's recycling community over which method is preferable, two-stream or three-stream. "It's very controversial," says John Hanson, executive director of the Toronto-based Recycling Council of Ontario.

So far, the only documented comparison of the two systems in Ontario has been done for a pilot program conducted by the City of Guelph. The program began in July 1989 with 600 households. Groups of residents use two-stream or three-stream systems with large, wheeled bins. Last July, 250 households were added to the program. Those residents use plastic bags, with half on a two-stream system and the rest three-stream. Full results are not yet in for the bag samples.

For the bin programs, results after one year show that the two-stream system recovers 12 percent more organic waste and 14 percent more dry recyclables than the three-stream system. Soiled recyclables deemed unmarketable are not included in the totals, notes Guelph waste management technician Jeff Kohl. Every group in the pilot project, including those using bags, has a waste diversion rate of more than 60 percent, he adds.

Guelph wants to have a citywide wet/dry program operating within two years, although it appears there may be delays in approval for its compost facility site. At this point, "we are leaning very heavily toward two-stream," says Kohl. City officials envision a system where one truck, with two compartments, picks up both streams.

In addition to the higher recovery rate, a recent report by the city listed other advantages a two-stream system has over a three-stream system:

- Greater flexibility. If markets make it uneconomical to recover a certain material, in a two-stream program that material could be dropped temporarily more easily than in a three-stream system (sorting plant employees would simply not pull the material out).
- Collection times and costs would be much lower with a two-stream program.
- A two-stream system would be easier to implement in multi-unit dwellings and most commercial settings. (Eventually, Guelph plans to establish the same collection system for single-family anc multi-family housing and businesses.)

The commercial-industrial sector in Guelph "has told us loud and clear: Two-stream is fine. Three-stream, forget it," says Dick Cave. He's president of Cave and Associates, the Oakville, Ontario-based consulting firm that designed Guelph's wet/dry pilot program.

Ontario scenario?

Discussing the controversy in Ontario over wet/dry, Cave notes that some government officials would like to have one system and use it throughout the province. Cave disagrees with that approach, saying the system should be tailored to the community. He advocates a two-stream system for Guelph, but points out

that a three-stream program might work better in certain other cities.

While the Guelph pilot project has generated support for the two-stream system, many in the recycling field remain firmly in favor of three-stream. Hanson, of the Ontario recycling council, believes three-stream systems "are superior as far as the end products" and also have a distinct advantage from a public education standpoint. With two-stream programs, residents don't gain a real sense of recycling because they throw recyclables in with dry garbage.

Hanson, Cave and other Ontario recycling leaders have toured wet/dry programs in Europe. After seeing sorting operations there, Hanson, says he decided he didn't like the two-stream system primarily because "it's basically subjugating people to poor working conditions." He describes the two-stream program sorting plants, where workers might come across hypodermic needles and other dangerous items, as "demeaning and dehumanizing."

Major Mississauga pilot project

In Mississauga, Ontario, a city of more than 400,000 residents located next to Toronto, a three-stream wet/dry pilot program serving 1,200 households has been running for more than a year. This summer, the wet/dry collection project will expand to cover a total of 8,000 homes. A two-stream system will be tested on a group of 1,100 of those residents, says Wes Vinter, the city's manager of waste collection and recycling.

For the existing pilot project, one group of residents received a 10-gallon plastic bin, one group received a 20-gallon plastic bin and one group received large plastic bags. These containers are for food waste, and some yard waste. Residents preferred the 20-gallon plastic bin, Vinter says. "They hated the bag," he adds. Additional plastic bags are provided to all households for overflow yard waste. Residents place dry recyclables in the household storage bins they had already been using in the city's curbside recycling collection program. Separate garbage collection continues as usual. All three collections are weekly.

First Brands Canada, maker of Glad bags, has provided plastic bags for the pilot program, including small plastic bags used for kitchen food waste collection by all participants. Residents received Glad brand "kitchen catchers," hard-plastic kitchen bins into which the small bags fit. First Brands has also assisted with other wet/dry pilot programs in Canada.

In addition to the two-stream component, the expanded test project will look at the collection of food and yard waste in special paper bags and will also test the effect of home composting on a wet/dry program. One group of 1,100 residents will receive yard waste composting bins, while another group of 1,100 will be given "Green Cone" food waste composting units.

Mississauga seeks to attain 50 percent waste diversion by 2000, which is the provincial and national goal. The city hopes to have some type of citywide wet/dry collection system in operation by early 1994, says Vinter.

More Toronto area action

The Metropolitan Toronto Department of Works plans to begin a three-stream wet/dry collection pilot program this fall. Designed by Cave and Associates, the 12,000-household test project will include sections of Etobicoke, North York and Toronto. Residents will use plastic bags for food and yard waste and their existing recycling bins for dry recyclables, says Bob Sawyer, chief engineer for the department's solid waste management division.

Similar to part of the Mississauga program, the wet stream will include "bags within bags," since many residents are expected to use small plastic bags for kitchen collection, Sawyer says. The processing system for the pilot project includes a debagger, he adds.

The Region of Halton, just southwest of Toronto, also has a pilot program in the works. Beginning early this summer, about 600 households in the town of Oakville will use a three-bin wet/dry system for six months. These same residents will then switch to a two-bin system for another six-month trial period. A 240-liter plastic container will be used for the dry stream, with a 120-liter plastic bin handling the wet stream. These wheeled containers are similar to those featured in Guelph's pilot program, notes John MacKay, director of waste management for the region.

Residents will be asked to keep their old newspapers (ONP) separate from other dry recyclables, either by placing them at the top of the bin or using their standard household recycling bin. The newspaper will be collected with the dry recyclables, but loaded into a separate compartment of the truck. This should reduce sorting costs, MacKay says, and should also result in a higher grade of ONP, since it will be free of contamination from broken glass shards.

On the other side of Canada, the small community of Powell River, British Columbia recently ran an eight-month pilot program for about 400 households. Although local officials have interest in a wet/dry system for the future, this project tested only the collection and composting of food and yard waste, and did not handle dry recyclables. The pilot project used the multi-bag, First Brands-sponsored system, which includes small plastic bags for kitchen waste and a large plastic bag for the set out at the curb. Residents reacted quite favorably to the pilot program, says Jim Greenwood, director of engineering services for the City of Powell River. A high quality compost was produced, adds Ian McCallum, of Airite Environmental Industries, the Richmond Hill, Ontario-based consulting firm that conducted the project.

Next stop, U.S.A.?

In the U.S., wet/dry collection is a blank page. But many in the recycling field are aware of wet/dry programs in Europe and the experiments in Canada, and the concept now garners serious discussion in high places.

Waste Management, Inc., the solid waste management giant based in Oak Brook, Illinois, has done some trial processing of material from the Guelph wet/dry pilot. Material from the dry stream was shipped to a Waste Management facility in Pinellas Park, Florida, and run through a new Brini sorting system. Bill Moore, then of Waste Management, says the diversity of the material received, including items that had been placed in the wrong bin, made processing difficult. Nevertheless, the company sees potential in wet/dry collection systems.

"We believe it's one of the only economical ways to get to the percentage of recycling that customers are demanding," Moore says. (Formerly the national director of recycling and waste reduction for Waste Management, Moore was recently named vice president for Paper Recycling International, a new joint venture of Waste Management and Stone Container Corp.)

New York ponders

In New York City, officials are taking a close look at wet/dry collection. However, hardly anyone in the city's Department of Sanitation wants to talk about it on the record. "It's a very sensitive issue here," says a source in the department. Planners for the agency are reportedly drawing up scenarios for various wet/dry systems, including a three-stream, a two-stream and a two-stream without glass bottles. The source says officials have concerns about glass contamination of newspaper. Some programs where glass containers are commingled with paper, such as the curbside collection operation serving the south side of Seattle, have trouble selling their paper to certain mills.

Martin Oestreicher, the department's assistant commissioner for operations planning, evaluation and control, says New York City has no current plans for a true wet/dry pilot project. However, an "intensive recycling" test program that just started for 6,100 households in Brooklyn is a variation on the wet/dry concept. Residents use one bucket for mixed scrap paper, one for other dry recyclables, one for kitchen waste and a separate container for garbage. Four different trucks collect the materials. The city's main goals with this pilot program are to determine participation levels and test the composting of food waste, Oestreicher says.

One consultant who has worked with New York City says he feels fairly certain the city will adopt some type of wet/dry system. The idea that the nation's largest city may be one of the first to try wet/dry collection is a sobering thought. "It scares the life out of me to think that New York is considering it," says Dick Cave.

San Jose not ready

America's eleventh largest city, San Jose, has also given serious consideration to wet/dry collection. However, in late February the city administration decided not to recommend implementing such a program. Gary Liss, environmental program manager for the city's integrated waste management program, says there are still too many unknowns about a wet/dry system for a city of San Jose's size to initiate it at this time.

In a test area of 200 households in Guelph, Ontario, one bin is used for wet collection and a separate container for other recyclable materials.

City officials had been especially interested in the idea because San Jose already has a type of wet/dry system for the commercial sector. The city makes a distinction between commercial garbage, which includes wet waste and putrescibles, and commercial rubbish, which is dry. A number of haulers handle commercial rubbish in San Jose, and some companies have made large investments in order to sort those materials for recycling. "Commercial rubbish is eminently more recyclable than commercial garbage," says Liss.

For a residential wet/dry system, the composting would be hard to justify financially, he says. San Jose will soon have an extensive windrow composting program for yard waste collected throughout the city, but adding food waste would require a much greater capital investment for an in-vessel system, he observes.

Some pilot projects and European program that compost food waste with yard waste do not use in-vessel systems, but odors are a common problem.

Dick Cave points out that other alternatives exist for processing food and yard waste, in addition to composting. "Possibly we should look at anaerobic digestion of the wet stream, to generate methane," he says.

Wet goes around, comes around

While wet/dry collection of residential waste can seem rather frightening to modern-day solid waste managers, it was once commonplace in American cities.

For example, in the 1940s and '50s, the City of Los Angeles made two separate collections, one for food waste and one for noncombustible rubbish, says Jack Kerkis, the retired superintendent of refuse collection for the city. The food waste was sold to hog farmers, and the dry stream went to a company that pulled out tin cans and sometimes glass bottles. The cans were shredded and delivered to copper mines in Arizona, where they were used in a leaching process. Residents burned combustible waste, such as paper and yard waste, in backyard barrels until that practice was outlawed in the late 1950s. At that time a third collection for combustible rubbish was added, and that material was land filled.

By the early '60s convenience was in, and residents clamored for a single garbage collection. In 1964, the City of Angels went to a single collection citywide, fulfilling a campaign promise by Mayor Sam Yorty.

"It was quite a political football," Kerkis recalls. **RR**

Appendix C

Articles on Financial Issues

Papers

Hornig, Constance "Introduction to Municipal Bond Financing of MRFs," September, 1991.

_____ "Considerations for Local Government MRF Development and Financing," September, 1991.

Rodde, Scott "Public Returns for Recycling Capital Investment Projects," September 9, 1991.

Articles

Binder, James A. "Getting to 'Yes' on Waste-to Energy", Waste Age (April 1990) p.148

Page, Abbie "Financing a Material Recovery Facility," BioCycle (August 1989) p. 50.

Salimando, Joe "Thar's Gold in Them Thar Tree Limbs," Waste Age (August 1988) p. 107.

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INTRODUCTION TO MUNICIPAL BOND FINANCING OF MRFS

I. Tax exemption

A. Spread between taxable and tax-exempt debt. When municipal governments want to borrow money to finance capital projects they can approach a bank for a loan (like a private individual or corporation might do), or they can issue their bonds: securities which evidence a municipality's obligation to repay the face amount of principal at stated interest on a specified date. Generally, if municipalities comply with rules set forth in the U.S. Internal Revenue Code and regulations, they can issue tax-exempt bonds. That is, the purchaser of a $5,000 bond bearing annual interest at 8% does not have to pay federal (or state) income tax on the interest he receives. If that purchaser is in a 50% tax bracket, then he would have to earn twice as much taxable interest to retain the same amount of interest earnings. The difference between the tax-exempt and taxable interest rates is "spread".

Because municipalities can issue tax-exempt bonds, they can generally access cheaper capital than private parties. As described below, municipalities can issue tax-exempt bonds to finance public or private solid waste disposal facilities. Consequently, even when a municipality has decided to enter into a service agreement with a private vendor to provide MRF services, it should consider whether to participate in a tax-exempt financing of the capital costs of the vendor's MRF, in order to reduce the capital cost component of the vendor's service fee bid. (A carefully constructed service fee will include a capital component to recover the vendor's capital investment in the MRF (including its interest payment on money borrowed at taxable rates to construct the MRF), an operating fee component to recover the vendor's projected cost of operating and maintaining the MRF, and the vendor's profit.) Capital cost savings represented by lower interest payments on tax-exempt borrowing, can be passed back to the municipality in lower service fees.

B. Legal basis for tax-exemption.

1. Tax exempt governmental bonds. Generally, interest on bonds issued by or on behalf of states or their political subdivisions (e.g. municipal governments with powers of eminent domain, taxation, police power) are exempt from federal income taxation. In California, municipalities often "issue" securities similar to bonds called Certificates of Participation ("COPs"), which evidence the holder's interest in a municipality's tax-exempt lease or installment purchase obligation.

Printed on Recycled Paper.

Sample Californian entities which can issue tax-exempt debt for publicly and/or privately owned MRFs include:

1. **California Pollution Control Financing Authority** ("CPCFA"; see the CPCFA Act, commencing with Section 44500 of the Public Resources Code)

2. **cities and counties** (pursuant to State constitution and enabling laws and/or charters, as applicable; Revenue Bond Act of 1941)

3. **Joint Power Agencies** (see Joint Exercise of Powers, commencing with Section 6500 of the Government Code)

4. assorted special districts: **garbage disposal districts** (commencing with Section 49000 of the Public Resources Code), **garbage and refuse disposal districts** (commencing with Section 49100 of the Public Resources Code), **community service districts** (commencing with Section 6100 of the Government Code), **County sanitation districts** (commencing with Section 4700 of the Government Code), **municipal utility districts** (commencing with Section 11501 of the Public Utility Code), including special districts for solid waste resource recovery (Section 13451 et seq.), and **sanitary districts** (commencing with Section 6400 of the Health & Safety Code).

2. Taxable private activity bonds. Because the federal Treasury views the interest that would otherwise have been paid on tax-exempt bonds, if the bonds were taxable, as lost income to the federal government, the Internal Revenue Code and regulations have developed complex rules to limit the ability of state and local governments to issue tax-exempt debt. In particular, bonds which finance privately owned projects or projects which substantially benefit the private sector, are taxable, even if issued by municipalities. Municipal bonds which meet the "private business use test" and the "private security or payment test", or the "private loan financing test", are private activity bonds. Interest on private activity bonds is <u>not</u> tax-exempt, so one wants to flunk these tests.

(1A) The **"private business use test"** is met if more than 10% of the municipal bond issue is be used for any private business use: use (directly or indirectly) in a trade or business of any person other than a governmental unit.

Example: privately owned facility/municipal service agreement. With respect to MRFs, if a municipality entering into a service agreement with a private hauler, scavenger or recycler considers issuing tax-exempt bonds to finance the private service provider's capital construction costs, the test would be met.

Example: publicly owned facility/private operating agreement. Similarly, if a municipality considers issuing bonds to finance its publicly owned MRF which is operated by a private vendor pursuant to a long term operating agreement, the test would also be met. The IRS reasons that private companies with long term operating agreements have a substantial economic stake in the facility, tantamount to private ownership. In order to flunk the private business use test, the management contract must have a term not less than five years (including renewal options); be terminable (without penalty) by the municipality at the end of any three year period; and provide at least 50% of the annual compensation to the manager on a periodic, fixed-fee bases, with no sharing of net profits. Municipalities may want longer term MRF operating contracts with fixed operating fees (subject to escalators) in order to achieve a measure of budgeting stability or predictability. They also may want to share recovered materials marketing risk with the private operator by sharing materials sales revenues. Both these objectives can be met, but bonds may be characterized as private activity bonds, with certain consequences described below.

(1B) The **"private security or payment test"** is met if the payment of the principal of, or the interest on, more than 10% of the proceeds of a bond issue is (directly or indirectly) <u>secured</u> by any interest in property used or to be used for a private business use or payments in respect of such property, or <u>derived from payments</u> in respect of property, or borrowed money, used or to be used in a private business use.

Example: privately owned MRF/municipal service agreement. With respect to MRFs, if a municipality considers issuing bonds to finance a private service provider's capital construction costs, the test would be met if the bonds are secured by a mortgage or security interest in the MRF and its equipment, or are paid from the MRF project revenues (e.g a project credit based on the municipality's service fee, other tip or processing fees, materials sales) or are a general obligation of the private service provider (a corporate credit). Since in this example, both the "business use test" and "private security or payment test" are met, the bonds would be private activity bonds.

Example: publicly owned MRF/private operating agreement. If a municipality considers issuing bonds to finance its publicly owned MRF which is operated by a private vendor pursuant to a long term operating agreement, the test would also be met if the bonds are project revenue bonds, secured by a mortgage or security interest in the MRF and payable solely from project revenues, not the municipality's general fund. Since in this example, both the "business use test" and "private security or payment test" are met, the bonds would be private activity bonds.

(2) The **"private loan financing test"** is met if the lesser of 5%

of the bond proceeds or five million dollars is to be used (directly or indirectly) to make or finance loans to persons other than governmental units. This is a more stringent subset of the use and payments tests.

3. Tax exempt private activity bonds: solid waste disposal facility. If bonds are characterized as private activity bonds, they are not tax-exempt, but certain exemptions may apply. The Internal Revenue Code provides that tax-exempt private activity bonds can be issued for certain "exempt facilities" which benefit the public, despite private ownership and/or operation. (IRC Section 142). One such exempt facility is a "solid waste disposal facility". (Internal Revenue Regulations Section 1.103-8(f)). A **solid waste disposal facility** means "any property or portion thereof used for the collection, storage, treatment, utilization, processing, or final disposal of solid waste". The Federal Tax Regulations further provide that "(a) facility which disposes of solid waste by reconstituting, converting, or otherwise recycling it into material which is not waste shall also qualify as a solid waste disposal facility if solid waste . . constitutes at least 65%, by weight or volume, of the total materials introduced into the recycling process".

The term "**solid waste**" is defined in the federal Solid Waste Disposal Act: ". . .garbage, refuse, and other discarded solid materials, including solid-waste materials resulting from industrial, commercial and agricultural operations, and from community activities. . ." In addition, material will not qualify as solid waste unless it is "property which is useless, unused, unwanted, or discarded solid material which has no market or other value at the place where it is located". Bond counsel which issue opinions that bonds are tax-exempt, will carefully scrutinize whether waste is truly without value <u>at the place where it is located</u>. In the case of a MRF, arguably the waste coming into the facility is valueless until further separated and processed. Only those portions of a MRF which turn the waste into marketable materials qualifies for tax-exempt financing under the "solid waste disposal facility" exception.

Private activity bonds issued to finance projects which meet this definition of "solid waste disposal facility", can qualify for tax exemption, if they meet additional criteria applied to private activity bonds.

4. Additional requirements for issuing tax exempt private activity bonds. If private activity bonds qualify for the solid waste disposal facility exception, they can be tax exempt if certain additional requirements are met.

Volume cap. In order to limit the amount of tax exempt private activity bonds which can be issued each year, the IRC imposes a unified volume limitation on each State. California

receives about $1.5 billion volume allocation. Priority in allocation is given to housing and mortgage subsidy bonds. Good news is that in the past year there has been sufficient remaining allocation to satisfy requests for other private activity bonds, like solid waste disposal facility issues. Bad news is that applications may have been down because of inability to get credit (discussed below) and consequent inability to access the bond market.

BONDS ISSUED FOR PUBLICLY OWNED SOLID WASTE DISPOSAL FACILITIES DO **NOT** REQUIRE VOLUME CAP ALLOCATION, EVEN IF THEY ARE PRIVATE ACTIVITY BONDS. This may be a compelling, even decisive, reason for opting for public MRF ownership, which does not, of course, preclude private operation.

Public approval. An applicable elected representative of the bond issuer and each governmental unit having jurisdiction over the financed facility site must approve the bond issue following published notice and a public hearing.

Issuance costs. Costs of issuing the bonds (e.g. underwriter's spread; fees of bond counsel, underwriter's counsel bond issuer's counsel, borrower's counsel; financial advisor fees; costs of engineering and feasibility studies necessary for the financing) cannot exceed 2% of the aggregate face amount of the issue. This is a practical limitation, especially for small issues where the issuance costs constitute a proportionately larger percentage of each issue. If issuance costs exceed 2%, the borrower must contribute the cash to make up the balance (an equity contribution). The CPCFA has developed a program to help subsidize issuance costs for small businesses.

Substantially all (95%) test. At least 95% of the net proceeds (net reserve funds, taking into account investment earnings) must be used for the exempt purpose of the issue e.g. solid waste disposal. Bond issuance costs must be taken into account within the 5% "insubstantial" portion, also called "bad money".

Limitations on maturity. The weighted average maturity of the issue cannot exceed 120% of the reasonably expected economic life of the facilities being financed with the bond proceeds.

II. Credit

Bonds may be issued publicly (underwriting syndicates buy the bonds and resell them pursuant to a public offering) or privately ("sophisticated" large investors, like insurance companies and investment funds buy the bonds). In either event, the bond purchaser pays interest commensurate in part with the relative risk of payment - or nonpayment- of the bonds. In a public offering,

rating agencies like Standard & Poor's or Moody's review the creditworthiness of the bonds and assign them a rating. In a private placement, the bond purchaser often makes that analysis itself.

A. Sources of credit. There are many sources of credit.

1. Municipal credit backs general obligation bonds, which evidence a municipal government's promise to levy taxes sufficient to repay bonds. Municipal credit also backs general fund obligations, like certificates of participation in lease/installment sale agreements, which evidence a municipal government's obligation to budget money sufficient to repay COPs.

2. Company credit backs some private activity bonds, which are payable from loan or lease payments by the private borrower, in amounts equal to bond payments. A difficulty in MRF financing is that, although there are some large corporate waste haulers which may be rated, there are also many smaller companies and non-profit organizations which do not have established credit records sufficient to obtain a rating on bonds. These bonds have often been called industrial development bonds (IDBs) or industrial revenue bonds.

3. Project credit can back private activity bonds, too, which are payable from project revenues. (If the bonds are payable solely from project revenues and not by the company, then they are non-recourse debt to the company.) MRF revenues would include the service fee or tip fees payable by municipalities and other haulers which bring waste or curbside-separated materials to the MRF, and recovered materials sales. Bonds payable from revenue sources are called revenue bonds. Rating agencies are loath to award a marketable rating to MRF project revenue bonds, because uncertainties in waste stream composition and recovered materials markets make for uncertain revenue projections. Economic feasibility on a project basis is uncertain.

Local governments which have chosen to enter into service agreements with private MRF owners may consider structuring service fees sufficient to repay the service provider's capital cost (i.e. debt service on solid waste disposal facility private activity bonds), projected O&M costs (with specified escalators for e.g., utilities, insurance premiums) and profit margin. The service agreement becomes the main source of project credit. (Arguably, in exchange the municipality should retain any recovered materials revenues.) Advantages to the municipality include potential service fee savings, by providing the service provider access to cheaper tax-exempt financing.

4. System credit can back revenue bonds. Particularly with respect to MRFs, which are difficult to finance on a project basis because of uncertain revenue projections, bonds paid from

waste disposal systems are the definite trend in waste financing. An integrated system might include collection service, landfill, transfer stations, a WTE facility, composting facility and MRF. Revenues charged for all services at all facilities, plus all other revenues (e.g. steam and electricity sales from a WTE plant, recovered materials sales from a MRF) are deposited in an "enterprise fund" for the system (not in the local government's general fund). Bonds are payable from system revenues, backed by a rate covenant: the promise to levy fees necessary to cover system operating and maintenance costs and repay system debt (perhaps by some coverage multiple, e.g. 1.5 times). System financing can provide a local government with flexibility, since as long as the system as a whole is generating sufficient income to meet the rate covenant, individual system components (like a MRF) can be subsidized. Fees from mixed waste collection and landfill disposal could help cover the cost of a curbside collection program and/or MRF, for example.

5. **Credit support.** Credit support, or credit enhancement, substitutes the credit of a municipal bond insurer or a bank providing a letter of credit for municipal, company, project or system credit. The issuer (or company) may seek to secure credit support when other sources of credit are insufficient to get a marketable rating on the bonds, or when the cost of obtaining credit support (the bond insurance premium or letter of credit fee) is cost-justified by the resulting improved interest rate payable on the bonds. Bonds are rated based on the credit rating of the bond insurer or bank, which promise to pay the bonds if municipal, company, project or system credit fails.

But in determining whether to provide credit support, credit providers assess the same credit risk factors as the rating agencies do in awarding bond ratings. A common difficulty which local governments and companies encounter, is that when they (or their bonds) have sufficiently strong credit to achieve a marketable rating, they can obtain credit support. But when they (or their bonds) are weak, then they cannot secure credit support, either. As described above, the inability to structure marketable deals may be one reason that the State had sufficient volume cap allocation for private activity bonds this past year.

B. Financial Aid. The CPCFA has developed a program to help small borrowers fund the cost of issuing CPCFA bonds. This could apply to private developers of MRFs seeking funding via the CPCFA. Issuance costs, as described above under "Additional requirements for issuing tax-exempt private activity bonds", can consume a large percentage of the principal amount of a small issue, and may have to be subsidized by the company's cash. THIS IS NOT CREDIT SUPPORT ON THE BONDS, or a guaranty of bond payment. But in some instances it may improve project economics enough to enable the bonds to achieve a marketable rating for a public offering, or to be privately placed.

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CONSIDERATIONS FOR LOCAL GOVERNMENT

MRF DEVELOPMENT AND FINANCING

INTRODUCTION. Local governments like yourself seeking to comply with AB 939 waste diversion mandates and responding to public pressures to recycle, increasingly are considering the development of materials recovery facilities ("**MRFs**"), where recyclable materials (e.g. paper, glass, cans, plastic) can be separated from mixed waste mechanically and by hand sorting. If you have already implemented or plan to implement curbside recycling, you may be considering the development of an intermediate processing center ("**IPC**"), where source separated materials are further separated and prepared for marketing.

This outline highlights considerations that you should weigh in developing a MRF or IPC processing facility which helps you meet your mandate at an acceptable price. The two questions, or goals, you should constantly assert are:

1. **How do I comply with AB 939 diversion mandates** of 25% by 1995 and 50% by 2000?

2. **What is a justifiable price to pay** for diversion compliance?

UNCERTAINTY. The greatest challenge both you and private service providers face in meeting timely compliance and reasonable cost goals, is uncertainty. With respect to an IPC, there is uncertainty regarding citizen participation in curbside programs. With respect to both IPCs and MRFs, there is uncertainty regarding waste composition and recovered materials markets.

Curbside Recycling Participation. You should consider:

(1) How will I enforce participation in my curbside program? What are incentives (e.g. variable can rates for mixed waste, free recyclable pickup)? What are penalties (e.g. service refusal, fines)?

(2) What will be the impact of AB 2020 container deposit law? How will I enforce an anti-scavenging law?

Waste Composition. California communities have advantages over many other American communities, since they have just

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completed waste characterization studies for their Source Reduction and Recycling Elements. However waste composition may affect the ability of MRF operators to make performance (e.g. separation) guaranties and the accuracy of economic feasibility projections (e.g. recovered materials revenues).

Recovered Materials Markets. At the State level, the CIWMB is grappling with the development of stable, preferably local, long term markets for recovered materials. The Recycling Development Zone program is one such effort, which provides incentives for local governments to develop industry which uses recovered materials in the manufacture of new products. At the local level, local governments are exploring how they can cooperate in mutual market development. The informal Recycling Roundtable in southern California is an example of such a forum.

Uncertainty in recovered materials markets makes it difficult for you and private service providers to project the cost of developing diversion facilities and providing diversion services. Like uncertainty in waste composition, it affects the accuracy of economic feasibility projections. Both public and private sector ask, what are revenue estimates? Can we rely on marketing revenues to offset capital (debt service) and operating costs?

And the corollary to uncertain revenues is the added cost of disposing of the unmarketed materials. What is the potential liability for additional disposal costs? How does that affect estimated operating costs and project economics?

Waste Stream Control. Waste stream control is not an uncertainty, but a complexity. Waste stream control - the ability to direct the destination of waste - lies within the authority of municipalities and counties (with respect to unincorporated areas). However at any given moment your ability to exercise your waste stream control power may be circumscribed by existing delegations or commitments: to Joint Powers Agencies, sanitation districts, franchised or licensed haulers. However, a franchise with a hauler to collect, transport and dispose of e.g. a local government's residential waste does not necessarily preclude your directing where that waste is taken. Existing programs should be examined to determine what constraints, if any, exist on your ability to direct waste to a processing facility. Waste stream control can be exercised through new or amended franchises or licenses, or ordinances.

In order to obtain financing for a public or private processing facility, or to ensure a profit in a private facility, rating agencies, credit providers, lenders and developers will scrutinize the facility's design capacity and the corresponding waste supply commitments, backed by waste stream control through ordinance or contract.

Capacity Commitments. However, you do not need to devote your entire waste stream to a processing facility in order to make the facility financeable/profitable. You need only commit to delivering through your municipal haulers, or causing to be delivered through your franchised or licensed haulers, sufficient waste to operate the facility at conservatively sized capacity. (Sizing, of course, is crucial to project economics.)

Alternative: Service Fee Commitment. As an alternative to committing a minimum portion of your waste stream, you may contract to pay a base service fee sufficient to cover capital and operating costs for an assumed minimum tonnage. Sizing the service fee to amortize debt and run the facility should satisfy rating agencies, credit providers, lenders and developers. (But see more on service fee sizing, below.) At least four sizeable advantages accrue to you by contracting to cover base costs rather than delivering actual tonnage:

(1) **Hedge Against Uncertainty.** You protect yourself from potential defaults for failure to deliver minimum tonnage due to poor recycling participation, scavenging etc..

(2) **Waste Planning Flexibility.** You preserve the ability to pursue flexible long-term waste planning. For example, you may wish to develop composting facilities. Or participate in a future joint diversion project with greater economies of scale and cheaper costs. Or in the LA area, after meeting your diversion requirements you might want to direct waste to the Commerce or Long Beach WTE facilities, if disposal costs are less than landfilling or diversion.

(3) **Cost Control.** You secure a (long-term) stable and predictable service fee. (See "SIZING THE SERVICE FEE" below.)

(4) **Service Fee Savings.** You indirectly provide the necessary credit for securing cheaper capital and consequent service fee savings. (See "ECONOMIC CONSIDERATIONS" below.)

PERFORMANCE GUARANTIES. With respect to your first goal, meeting diversion mandates, you should negotiate performance separation guaranties from private operators (of public facilities) and service providers. You should analyze to what degree diversion compliance is dependant on efficient MRF/IPC processing and consequently how much separation you need. Whether you solicit proposals through RFPs or respond to a private party's offer, you should demand minimum performance guaranties, including:

(1) **Throughput and capacity** guaranties (e.g. tonnage accepted at the facility daily/weekly/monthly/yearly). (Although the facility must accept the estimated amount of you commit to deliver, remember that it is separation of tonnage which furthers diversion

compliance.)

(2) **Facility availability** (e.g. operating hours, priority processing for your waste or recovered materials).

(3) **Materials separation** guaranties (weight is important for AB 939 compliance, but it is more typical to see percentage material recovery), x% recovery of glass, y% cans etc.. However, waste composition may affect the ability of a MRF processor to recover materials. For example, a waste stream with a high content of textiles might clog equipment; high cardboard content might obscure other recoverable materials on the conveyor; if 80% of the aluminum cans have already been recovered or scavenged before reaching the processing facility, it may be more difficult to meet a guarantied percentage recovery rate based on higher projected can content.

If a MRF processor cannot make meaningful unconditional separation guaranties, perhaps it can commit to more significant guaranties, preconditioned on corresponding assumptions of waste stream composition (i.e. specified percentages of recoverable materials). If the processing contract is relatively long-term, a mechanism can be provided for adjusting the guaranties based on re-characterization of the waste stream at fixed intervals.

(4) **Residue** guaranties, the converse of separation guaranties. Residue volume is important to operating economics, because the cost of transporting and disposing of residue- and its allocation to you (as a pass through cost) or the processor (as part of the processing fee)- can be considerable.

(5) **Storage capacity**, for both delivered waste/recyclables at the front end and recovered materials at the back end. Of course, sizing storage capacity for recovered materials relates to guess-timates on marketability.

(6) **Utility consumption.** Guaranties relating to utility consumption are especially important to a you, if you are paying their cost (e.g. as a pass through cost component of the service fee).

Damages for Nonperformance. The corollary of performance guaranties, is events of default and remedies (including specific performance, contract termination and liquidated damages). At a minimum, liquidated damages should include your cost of alternative transport and disposal or <u>processing</u>. If the cost of alternative processing is not covered, then your damages should arguably include any consequent fines you incur for failure to divert mandated percentages (up to $10,000 per day). In addition, depending on your agreement for revenue sharing, you should be made whole for lost revenue shares.

Processor's Creditworthiness. Performance guaranties and damages are only valuable if the processor can honor the guaranties and/or pay the damages. When considering contracting with either an RFP or self-initiated proposer, evaluate their creditworthiness. For example, ask them to demonstrate:

(1) their **net worth** (and compare it with e.g., their capital requirements for facility development);

(2) the amount of their **working capital** (and compare it with e.g., their annual projected operating costs);

(3) their **debt/equity ratio.**

If they (or a parent corporation or other guarantor) cannot meet your requirements (e.g. net worth equal to their estimated construction costs; working capital equal to at least half their annual estimated operating costs), then alternatively require them to secure an irrevocable letter of credit or loan commitment.

In addition, where the processor is proposing a fixed construction price and/or operating fee (described below), you might require **performance bonds** to back their proposals.

ECONOMIC CONSIDERATIONS. With respect to your second major goal, paying a justifiable price for diversion compliance, ask two broad questions:

(1) What are the **capital costs** for you or a private service provider, to develop a MRF or IPC?

(2) What are the **operating costs** for you or a private operator/service provider, to operate a MRF or IPC?

Focus on capital costs and operating costs, combined to equal a total diversion processing cost. Don't be distracted by statistics on disposal costs. If you need processing facilities to meet your waste diversion mandate, the cost of hauling to and disposal at a landfill is not relevant. <u>Comparing diversion processing costs to hauling and disposal costs is comparing apples and oranges.</u> The costs and economics are different.

(1) Capital Costs. Whether you are soliciting bids to construct your own facility or negotiating with a service provider which must construct or expand its processing facility to service your contract, analyze the capital costs. Average annual capital costs will depend on the amortization schedule and the cost of capital (internal or borrowed).

Amortization Schedule/Service Contract Term. One of your options is to contract for services with a private entity which

will provide processing services at its own facility. Naturally a proposer will want to recover any capital investment over the term of its service contract with you. In fact, its lender may require full capital cost recovery since your service fees may provide the major credit behind the project and security for loan repayment. So if you want to commit for a relatively short period (e.g. less than five years) because of uncertainties in waste composition, marketing etc., nevertheless be prepared to pay higher service fees, reflecting cost recovery loaded up front.

As an alternative to an expensive short term service contract, without committing to a long term contract, you might stipulate that the proposer assume long-term (e.g. ten year) amortization, and provide yourself the option to terminate the agreement or buy out the processor, at a shorter term (e.g. five years) upon your payment of the then present value of its remaining unamortized capital costs and/or pre-agreed residual value. You get the advantage of lower service fees in the early years, and can achieve present value savings.

Cost of Capital/Tax Exempt Financing. What is the proposer's cost of capital, whether internal or borrowed? Can you provide cheaper capital by issuing tax-exempt bonds secured either by your own or the private processor's credit? The savings realized by borrowing necessary capital at lower interest rates can by passed back to the you in lower service fees.

Local Government Credit. You can issue bonds (or certificates of participation) payable from your general fund, sanitation system revenues or special waste disposal/recycling fees, as the case may be, in amounts sufficient to cover capital costs. (I.e. you would substitute your debt service payments for the capital cost portion of the service fee you would otherwise pay - at an effectively higher interest rate- to the private service provider). This may be the simplest financing structure to implement mechanically (though not necessarily politically), because it is probably the strongest credit structure.

Project/Proposer Credit. Alternatively, you can issue conduit revenue bonds payable by the service provider. (I.e. the capital cost component of the service fee you pay the provider would be reduced to reflect the tax exempt borrowing rate it pays.) This may be a more difficult financing structure to implement, because (1) it is unlikely that waste diversion projects can receive a marketable rating based on a project credit (due to waste composition and market uncertainties), and (2) even if the debt is recourse to the service provider, the provider may not be a ratable credit. However your service contract covering base costs would provide strong credit support.

The possible borrowing structures and tax requirements for both credit structures should be further explored.

(2) Operating Costs. What are the proposer's projected operating costs? Get cost breakdowns to substantiate and justify the service fee, including labor, utilities, administration, insurance, taxes, supplies, equipment parts and maintenance, etc. Try to identify and quantify the hard costs and the profit component.

SIZING THE SERVICE FEE.

Fixed Capital and Operating Components. The exercise of scrutinizing capital and operating costs (including the proposer's profit margin) should end in aggregate fixed service fee commitments from the proposer, subject to a combination of agreed escalators on inflation-sensitive components and specified pass through costs (e.g. utilities, insurance, rejects disposal). To supplement fixed costs, a variable cost can be negotiated for tonnage in excess of the assumed minimum tonnage commitment which serves as the basis for facility sizing and calculation of the fixed service fee.

Revenue Sharing. But an important though elusive element in fee sizing remains to be considered: recovered materials revenues. Because of the uncertainty in waste composition and materials markets, it is difficult for both you and the private processor to project revenues. If you agree to pay a service fee sufficient to cover the proposer's capital investment and operating costs and provide a return on its investment, you should be rewarded by retaining the profits. As described above, you may be willing to commit to that service fee and bear the risk of recouping offsetting revenue credits, in order to secure a (long-term) stable and predictable service fee and provide the necessary credit for securing cheaper capital and consequent service fee savings. However sharing profits with the processor arguably gives the processor an incentive to maximize materials separation and recovery, which is your primary goal.

Alternatively, if you do not commit to pay a self-liquidating service fee and the service provider finances the facility based on its own credit (whether internally, on a taxable basis with a private lender, or with tax-exempt bonds), it should be rewarded by retaining the profits.

Obviously there is much room for negotiation in allocating risk and awarding revenue shares.

PRIVATE/PUBLIC OWNERSHIP.

Each local government must choose between developing and operating a diversion facility itself (or through a private contractor/operator), and contracting with a private entity for diversion services. Considerations include:

(1) **Operational Flexibility/Marketing Control.** Again, you must determine to what extent diversion compliance depends upon a MRF or IPC and consequently to what extent you need to be involved in materials separation and marketing decisions. The interest of you and the processor differ. Your fist priority is waste diversion; the processor's is naturally to make a profit. These differing interests are most evident when you want to recover a particular recyclable material in order to meet diversion requirements or to create/sustain a recovered materials market, even though recovery is not presently profitable to the processor. You might be willing to subsidize recovery of that material component, which makes financial sense on an avoided disposal cost basis or is cheaper than paying fines of $10,000 per day. You may conclude that public ownership gives you operational flexibility and marketing control which you need.

(2) **Waste Stream Control.** You may prefer to publicly own a diversion facility in order to preserve control over your waste stream, especially if you have a waste system comprising multiple disposal/diversion options.

(3) **Infectious Waste.** With respect to a MRF where mixed waste is separated by hand, liability for workers' illness or injury traced to infectious waste may become an issue. Workers compensation and /or insurance (if available) may not cover the risk. If you feel the risk is great, you might prefer private ownership.

(4) **Historical precedent.** You may not have a history of owning and operating waste disposal facilities. Traditionally you may have provided service by licenses or franchises with private haulers and disposal at private or other public entities' landfills. The decision to publicly own proposed diversion facilities would involve major expansion of staff and administrative functions.

(5) **Public Interest.** Some local governments believe that no one can better look out for the public's interest (especially its environmental health interest), than they can. It is their primary regulatory responsibility which should not be delegated. From this point of view, regulatory or contractual oversight is not sufficient assurance that the private sector will perform consonant with public needs, so the public sector should retain ownership.

(6) **Negotiating Leverage.** If an operator is not performing, you can replace it at your own facility; if a private service provider is not performing, you must find alternative service at another facility, which may be more difficult. For the same reasons, as a service agreement draws to the end of its term, a private owner may have greater leverage for negotiating new, higher service fees.

(7) **NIMBY.** You may have experienced difficulty siting waste disposal facilities, and prefer to shift the cost and time

commitment to the service provider.

(8) **Hazardous Waste Clean Up Liability.** Although you may never be able to fully eliminate your potential liability for hazardous waste cleanup, you may prefer to shift the risk, to the extent possible, to a private party, e.g. by contracting for services instead of owning your own facility.

(9) **Private Activity Bond Volume Allocation.** Privately owned and operated facilities which seek tax-exempt financing must receive an allocation from the municipal issuer (and ultimately, from the State) of a portion of the State's unified volume allocation equal to the aggregate principal amount of private activity bonds to be issued. The volume cap is limited, and competition for a portion can be fierce. Obtaining allocation can be time consuming. A local government which cannot get allocation for tax-exempt financing of a privately owned facility may find it cheaper to issue tax-exempt debt for a publicly owned facility. (Note that operation agreements with private operators may result in characterizing the tax-exempt bonds as private activity bonds, but private activity bonds issued to finance publicly-owned solid waste facilities do not require an allocation.)

(10) **Price.** Some commentators argue that public ownership provides better cost control: no profit margins need be built into the tip fees; service can be passed through to the citizen-waste generators at cost. If facilities are publicly owned and funded with tax-exempt debt, cheaper capital may result in debt service savings and a lower tip fee.

Contrariwise, others argue that precisely because the private sector is motivated by profit, it operates more efficiently (and cheaply) than the public sector.

9/9/91

MEMO RE: Public Returns For Recycling Capital Investment Projects

Using the example of Material Recycling Facilities (MRFs), it can be shown that a put or pay type of contract may, in financial terms, be the credit behind a project financing. As the credit in a project financing, the put or pay contract is the source of financing for the project.

The basic financial repayment structure is diagrammed as follows:

Municipality —Fees→ MRF —Debt Service→ Bond Holder

Fees may be based on:

1. Municipal general obligation
2. Sanitation system revenue
3. Project revenue

MRF/Bond Holders require a credit payor (1 is better than 3) contractually obligated through a put or pay contract to assure timely debt service payments.

Expected Public Returns

If a municipality is responsible for financing a MRF due to a pledge of its general obligation credit or the value of its put or pay contract, then the municipality is the credit in the project and as such is entitled to 50% to 60% of any profit[1] developed at the MRF.

If a sponsor is responsible for financing a MRF due to its credit through a guaranty or some other allocation of its credit, then the sponsor is the credit in the project, and as such is entitled to up to 80% of any profit developed at the MRF. The municipality is still entitled to at least 20% of the MRF project profit because of the value of its supply contract.

If a MRF sponsor is responsible for financing due to its credit and offers to take local waste on an as available basis, then the MRF sponsor is entitled to all of the MRF project profit.

[1]Profit includes cash flow, sale and refinance proceeds.

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Flow Control

Where the municipality is the source of financing, it can expect full recovered materials marketing control.

Where the municipality is responsible for supply but the project sponsor is the credit, the municipality can anticipate reasonable access to recovered materials at market prices.

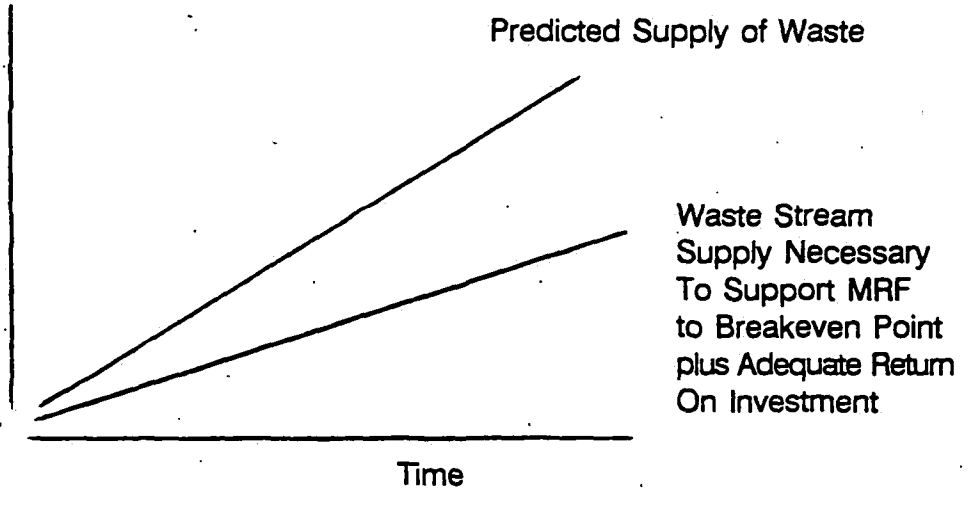
Where the municipality simply avails itself of an MRF, its ability to control recovered materials is limited.

Setting Service Fee Rates

In negotiating service fee rates, the following conceptual tools may prove helpful.

I. Service Fee Per Ton = $\frac{\text{Project Capital Cost X Financing Constant X Desired Return}}{\text{Breakeven Quantity (Tons)}}$

II. Quantity of Municipal Waste



The Municipality needs an adequate performance guaranty from the MRF to take waste above breakeven supply but at a reduced rate. This is because fixed costs are covered at breakeven and only variable costs need to be covered above that point.

III. MRF developers are entitled to adequate compensation depending on the role they serve.

If they are construction developers, they are entitled to up to 10% profit on development costs.

If they are investor developers, they are entitled to up to 12% return on invested cash.

All of the conceptual tools described in this memo imply a need for full project financial analysis starting with an analysis of the financial capacity of the MRF sponsor and project pro formas.

The National Development Council

By: _____
Scott Rodde

GETTING TO 'YES' ON WASTE-TO-ENERGY

A survey of equity adjustment practices for facilities in the Northeast uncovers how host communities are being brought around.

Acceptance of a waste-to-energy plant is an emotionally charged issue in potential "host" communities. Many projects have been delayed or rejected as a result of poor communication by project proponents — and also because the community has not been invited to participate in project siting decisions.

In many cases, the plant's impacts on the host community have not been adequately addressed. Also, the host community may not have been satisfactorily compensated for the impact of the facility on its environment, health, safety, public services, finances, property values, and self-image.

Measures discussed in this article can be used to mitigate a host community for a waste-to-energy facility's various risks and impacts.

Survey of host communities

Compensation of host communities by project sponsors does not have to come in the form of money. For example, public service payments may include road, water, and sewer system improvements. These conclusions, and the data appearing here, come from a 1988 literature and telephone survey of state agencies and host communities conducted for the Northeast Regional Biomass Program (which is administered by the Coalition of Northeast Governors Policy Research Center).

The purpose of the survey was to determine compensation measures available to communities that hosted waste-to-energy facilities. (The survey's focus was the Northeast.) It included state agencies responsible for solid waste management, and host communities and state agencies in areas with waste-to-energy plants in operation, construction, or an advanced planning stage. Fifty-one host communities with planned or operational resource recovery facilities were contacted.

Host-community measures for the mitigation of impacts and compensation for the risks of siting were classified as follows:

1. **Community participation and empowerment** (community participation beyond regulated permit hearings).
2. **Public service payments** (improvements to community infrastructure or public services).
3. **Payments in lieu of taxes** (referred to via the acronym PILOT).

Table One
State Regulatory Requirements For Host Community Compensation
(for waste-to-energy facilities only)

State	Compensation Type
Maine	Community participation and empowerment (1)
Massachusetts	Payments in lieu of taxes (3)
New Jersey	Monetary payments based on facility use (4)
Pennsylvania	Monetary payments based on facility use (4)
Rhode Island	Payments in lieu of taxes (3)

Notes: Results of a survey of Northeastern states. Connecticut, Delaware, Maryland, New Hampshire New York, and Vermont all do not have such regulatory requirements.

Numbers in parentheses refer to compensation types as listed in Table Two.

Data source: Coalition of Northeast Governors Policy Research Center

By JAMES A. BINDER
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Table Two

Survey Results: Current Practices (Actual/Proposed) For Host-Community Compensation In The Northeast For Resource Recovery Facilities

State	Community	Facility Name	Developer	Size (Tons/Day)	Facility Status *	Compensation Type **
Connecticut	Bridgeport	—	Wheelabrator [1]	2250	C	[NIR]
	Hartford	Mid-CT	Combustion Engineering	2000	C	2
	Wallingford	—	Vicon	420	C	1, 2, 3
Delaware	Pigeon Point	Delaware Reclamation	Raytheon	1000	O (1984)	None
Maine	Auburn	—	Consumat	200	O (1981)	1
	Biddeford	—	—	—	—	[NIR]
	Penobscott	—	—	—	—	[NIR]
	Portland	—	Dravo	500	C	1, 3 [2]
Massachusetts	Boston	—	American Ref-Fuel	1500	I	1, 2, 3
	Millbury	—	Wheelabrator [1]	1500	O (1987)	3
	Pittsfield	—	Vicon	240	O (1981)	3, 6
	Rochester	Semass	Energy Answers	1800	C	3, 6
	Springfield	—	Vicon	360	C	[NIR], 3
Maryland	Baltimore	Bresco	Wheelabrator [1]	2250	O (1985)	4
	—	Montgomery County	Not Selected	1800	P	2
New Hampshire	Claremont	—	Wheelabrator [1]	200	O (1987)	None
	Concord	—	Wheelabrator [1]	500	P	None
	Durham	Lamprey	Consumat	100	O	[NIR]
	Manchester	—	Vicon	560	P	[3]
New Jersey	Camden	—	Foster-Wheeler	600	P	[NIR]
	Kearney	Hudson County	Ogden Martin	1500	P	4 [4]
	Newark	Essex County	American Ref-Fuel	2300	P	[NIR]
	Oxford	Warren County	Blount	400	O (1988)	2, 4, 6
	Passaic	—	Foster-Wheeler	1300	P	[NIR], 4
	Pennsauken	—	Ogden	500	P	1
	Rahway	—	Ogden	1500	P	1, 4, 6, 8
	Salem	—	—	—	—	[NIR]
	W. Deptford	—	Wheelabrator [1]	575	C	4 [5]
	Woodbine	—	Not Selected	500	P	4, 6
New York	Albany	—	Energy Answers	600	O (1981)	None
	Cattaraugus	—	Enercan	108	O (1983)	None
	Dutchess County	—	Westinghouse	400	C	[NIR]
	Glen Cove	—	[NIR]	25	C	[NIR]
	Merrick	Hempstead	American Ref-Fuel	2250	C	1
	Hudson Falls	—	Foster-Wheeler	400	C	4
	Islip	—	Westinghouse	510	C	None
	New York City	Brooklyn	Wheelabrator [1]	3000	C	1
		Bronx	Not Selected	2000	P	1
		Manhattan	Not Selected	2000	P	1
		Queens	Not Selected	2000	P	1
		Staten Island	Not Selected	3000	P	1
	Oswego	—	Consumat	200	O (1985)	None
	Oyster Bay	—	—	—	—	[NIR]
	Peekskill	Westchester Cnty	Wheelabrator [1]	2250	O (1984)	2, 4, 6
	—	Washington Cnty	—	—	—	[NIR]
Pennsylvania	E. Stroudsburg	Monroe County	Not Selected	300	P	1, 2, 4, 5
	Bethlehem	Lehigh County	American Ref-Fuel	1000	I	1, 4
	Bushkill	Blue Mountain	Ogden	100	I	1, 4
	Erie	—	Conversion	850	P	3
	Manchester TWP	York County	Westinghouse	1300	C	2, 4, 6
	Plymouth TWP	Montogomery Cnty	Dravo	1200	P	[3]
Rhode Island	N. Kingstown	Quonset Point	Blount	750	P	1, 3, 6
Vermont	Rutland		Vicon	240	O (1987)	None

* *P - in planning; C - under construction; O - in operation (year initiated commercial operation); I - inactive*

** 1 - Community Participation and Empowerment
2 - Public Service Payments
3 - Payments in Lieu of Taxes (PILOT)
4 - Monetary Payments Based on Facility Funds
5 - Insurance and Trust Funds
6 - Special Services and Grants
7 - Property Value Guarantees
8 - Local Hiring and Procurement Policies
[NIR] - No Information Received

Notes:
1 - Formerly Signal Environmental Systems
2 - Ash landfill site also receives PILOT
3 - In discussion
4 - Amount in negotiation
5 - Negotiations not started

Data source: Coalition of Northeast Governors Policy Research Center

by a proposed facility. Monetary compensation to a host community based on facility use is perhaps the most widespread compensation measure. Most of those based on facility use are in the $1/ton to $2/ton range, with some having escalators.

The only case among survey participants of host community compensation in the area of insurance and trust funds was East Stroudsburg, Pa. The city, through negotiations, was established as a co-insured party with the Monroe County General Authority (the project developer) and was to be provided first-dollar coverage for defense of East Stroudsburg for any action against the city resulting from the plant's siting or operation.

Special services and grants compensate the host community for impacts related to the community's quality of life or other impacts of special concern. They can also be considered as incentives to the community to host the facility. Of the facilities surveyed, the most common special service granted to a community was a reduced disposal fee.

Although considered for siting hazardous waste facilities, regulated or negotiated property value guarantees are a relatively recent compensation development for waste-to-energy.

Of the facilities surveyed, property value guarantees have not yet been provided. The effect of siting a waste-to-energy plant on adjacent properties is difficult to assess; despite perceptions, facilities may have a neutral or positive effect on residential or industrial property values.

The only negotiated local hiring and procurement policy found among survey participants was in the agreement between Union County and Rahway, N.J. In that agreement, a plan for hiring and staffing (construction and operations) is to be prepared by the selected vendor who will, to the extent permitted by the law, grant preference to qualified residents. The vendor is also required to purchase materials from local businesses, whenever possible or practicable. ■

4. **Monetary payments based on facility use** (toll agreement).
5. **Insurance and trust funds.**
6. **Special services and grants.**
7. **Property value guarantees.**
8. **Local hiring and procurement policies.**

Summary of survey findings

Table One presents state regulatory requirements for host community compensation in Maine, Massachusetts, New Jersey, Pennsylvania and Rhode Island.

In each state, except Maine, regulatory requirements call for PILOT or a monetary payment based on the facility use (i.e., the number of tons of waste processed). Maine requires a plant developer to provide funds the community can use to review the proposed facility's design, operational specifications, and environmental impacts.

Table Two describes practices used in the Northeast to compensate host communities. Monetary payment based on facility use is the most prevalent measure. Other frequently used compensation practices are community participation, PILOT, provision of special services and grants, and public service payments. Property value guarantee policies were not used in any compensation package for the surveyed facilities.

To encourage an unwilling community's participation, Maine established a $50,000 fee (paid by the developer) for the community's use to review the project. In New York City, where several plants have been in the planning stages, the city provides funding to a Citizens Advisory Committee.

Host communities for five other facilities — East Stroudsburg, Pa; Rahway, N.J.; North Kingstown, R.I.; Boston, Mass.; and Wallingford, Conn. — had input on restricting truck access on certain routes through the community. Facility access for city/county health officials, and city examination of facility books and records, is provided for in the Rahway agreement. It also prohibits process discharge and outside storage of waste (to prevent leachate discharge) to the nearby river, and requires the building to be aesthetically attractive and present a non-industrial image.

In Boston, the agreement is incorporated into that proposed facility's Site Assignment — a local permit issued by a host municipality's Department of Health. The Site Assignment requires:

- semi-annual stack testing by an independent engineer;
- continuous emissions monitoring, with health department access to the monitoring data;
- automatic plant shutdown if emissions exceed limits more than once per quarter;
- design aimed at discouraging infestation of vermin and insects; and
- spare part and operation/maintenance log-keeping requirements.

Interveners (a local consumer and environmental group) will have direct access to the Hempstead, N.Y., facility emission data records. Through negotiations, this facility's developer agreed to install a baghouse (in lieu of the originally planned electrostatic precipitator); the agreement imposes a particulate emission limit lower than that in regulations.

No operating Northeastern facility surveyed has its emissions actively and continuously monitored by the community or its representatives. These precautions are being taken, however, at a Modesto, Calif. facility, and it was stipulated in the Boston Site Assignment.

A waste-to-energy plant may increase demands on the host community's roads, road maintenance, water supply systems, sewage treatment facilities, or other public services. To compensate for these impacts, public service payments may be negotiated.

Community infrastructure improvements by the developer — those beyond what the facility itself needs — can be deemed as having been made for the host community's benefit. Such improvements have included:

- construction of roads to provide facility access and minimize truck traffic on existing roads;
- upgrading of sewer lines near the facility site to accommodate potential community growth as well as the plant's demand; and
- provision of funding by the developer to construct additional water storage capacity for the community.

Monetary payments based on facility use may also be used to maintain or upgrade public services.

Payments in lieu of taxes (PILOT)

PILOT payments may be either annual lump sums or based on facility use. They can compensate the host community for removal of site property from the tax base.

Most PILOT payments, the survey found — either required by law or negotiated — are monetary payments based on facility use. Payments range from $1-2/ton of waste processed.

Two facilities make annual lump-sum PILOT payments. In Westchester County, N.Y., payments are made to the host community in an amount equal to the taxes that would be due if the property were not tax-exempt. The Portland, Me., facility also makes lump-sum payments. And in Erie, Pa., an amount equal to 25% of the taxes due is to be paid

FINANCING A MATERIAL RECOVERY FACILITY

An analysis of financing arrangements, how to evaluate the economics of recycling, and how to reduce the risks involved.

Abbie C. Page

CONSTRUCTION and equipment costs for a Material Recovery Facility (MRF) can range from about $100,000 to about $6,000,000, depending on the amount and type of material accepted and the extent of processing to be performed. A facility can be anything from a 1,000 ton-per-day tipping floor on which a mixed load of commercial trash is dumped, with manual recovery of cardboard and other recyclables; to a building accepting 10 tpd of highly source-separated residential waste with crushing or baling to prepare material for shipment. This report focuses on MRFs that accept source-separated household and light commercial waste, processing it into a marketable state. Financing issues will be analyzed from the standpoint of a municipality that has made the commitment to develop a recycling program but does not yet have its full system in place.

To date, almost all MRFs have been privately financed. Clearly, there are few "off-the-shelf" financing formulas to choose from, but MRFs should not be difficult to finance by a variety of means. The buildings and equipment are relatively simple and the overall cost is low, compared to other solid waste projects.

There are some risks associated with financing MRFs, but certainly no greater than the risks of financing any other garbage project. Perhaps the most serious risk is the market for the products. There was a similar risk in the waste-to-energy business when the price of oil dropped and electric revenues declined. However, there is no legal requirement for markets to accept recyclable materials as there is for utilities to accept electricity from a waste-to-energy facility. The important thing for a municipality to recognize (and this includes the politicians as well as the professionals) is that recycling, like incineration, is a waste disposal option and not a money-making opportunity. The municipality should be happy to pay a guaranteed tipping fee at the MRF, as long as it helps to lower the municipality's overall cost for waste disposal. This is true regardless of whether the MRF is public or private in ownership or operation.

FINANCING OPTIONS

Excluding grants, there are four basic categories of financing to be considered. All share the common feature that, unlike a grant, somebody has to be repaid. The four categories are:

1. General obligation (G.O.) bonds,
2. Revenue bonds,
3. Private financing, and
4. Leasebacks.

A G.O. bond is what a municipality typically uses to borrow money (from bond buyers). Such bonds can be taxable or tax exempt to the buyer. For a municipality that has an artificially low tipping fee at a cheap landfill but still wants to recycle, a G.O. bond is probably the easiest way to finance a MRF, unless, of course, the municipality is up against its debt limit. G.O. bonds also have the disadvantage of having to be paid back with larger amounts of money in the early years of a recycling program, when participation rates and material revenues may be low (but hopefully growing). It is politically cleaner to have the debt repayment more closely match the project's economic returns. This can be accomplished with a revenue bond.

Revenue Bonds can be paid back in larger installments over time. Another advantage is that they do not show up in the tally of outstanding G.O. debt, so they allow municipalities to borrow lots of money for essential services. Of course, they can be difficult to structure, and there are all sorts of legal and tax restrictions. The term "revenue bond"

means that there is a solid source of revenue to pay back the bondholder. In today's world, revenues from the sale of recyclables just are not secure enough. A guarantee by a icipality or group of municipalities to a fee to the MRF will do the trick, however the fee has to be high enough to pay the debt and the operating expenses plus a safety margin. Some financiers have quoted a safety margin or "debt coverage ratio" as high as 1.4, meaning that the municipal fee on an annual basis has to equal 140 percent of the annual capital and operating cost. Revenues from the sale of recyclables, however lucrative, are considered pure gravy. Obviously this kind of financing can be expensive, and the municipality will want to keep as much of the revenue from the sale of recyclables as possible. If a private company is operating the MRF and marketing the materials, you may want to give them a percentage of the "gravy" as an incentive.

The important thing for a municipality to recognize is that recycling is a waste disposal option and not a money-making opportunity.

Table 1: MRF Financing Options

General Obligation Bonds

- **Advantages**
  - —relatively easy to implement
  - —less need to prove efficacy
- **Disadvantages**
  - —all risk is public
  - —counts towards permissible debt limits
  - —inflexible, front-loaded repayment schedules

Revenue Bonds

- **Advantages**
  - —not included in permissible debt limits
  - —flexible repayment terms
- **Disadvantages**
  - —revenue must be secure, whether or not the MRF operates as planned
  - —put-or-pay tonnage guarantee may be required
  - —difficult to implement
  - —more costly than G O bonds

Private Financing

- **Advantages**
  - —reduces municipal risk
  - —easy to accomplish
  - —can bid out collection separate from processing/marketing
  - —tipping fee cheaper than landfilling, at least
- **Disadvantages**
  - —cost could be higher than for publicly-financed MRF
  - —uncertainty of service continuing
  - —less municipal control of sites and services

Leaseback

- **Advantages**
  - —avoids municipal debt
  - —municipality can operate the facility
  - —CDC/IDA could raise the $
- **Disadvantages**
  - —municipality must commit to make lease payments for the required length of time
  - —may not be possible in some states to lease land or buildings
  - —need to prove alternative use

Under the private financing option a municipality lets a private company finance and operate the MRF, and contracts with the company for services. This has been the most common approach to date. Municipalities do not have to be totally passive, however. They can issue requests-for-proposals (RFPs) for the services of a MRF alone, or curbside collection plus MRF, or collection separate from MRF. In almost all cases, the fee charged by the private MRF will be cheaper than the municipality would pay at the landfill or incinerator. If not, it will be difficult to sell the arrangement to political decision makers. Usually, a municipality will lose claim to the materials' revenues with this type of arrangement. And if the private company does not know what it is doing or is a victim of poor markets, the municipality could find itself on short notice without a recycling service. In addition, you might not admire what the private sector MRF looks like, or the working conditions the private sector seems to be able to tolerate in an effort to keep costs down. If you as a municipality are able and willing to select the best vendor without regard to lowest price, will give that vendor a long-term contract, *and* take on the risk of failed markets, you should have a comfortable working relationship with a happy private vendor and a very financeable project.

The fourth possible arrangement is a leaseback, wherein a community development corporation (CDC) or industrial development authority (IDA) raises the money, at least for the equipment, and possibly for the land and building as well. The community can, if it wishes, operate the facility with municipal employees, or it can contract out the operations to a private company. The municipality agrees to make lease payments until the debt is paid. The investor has to be convinced that a true government function is being performed, so that the municipality is most likely to make its lease payments. Another consideration in a leaseback arrangement is that the facility or equipment could be "repossessed" and leased to another party if the municipality defaults on payments, so the facility and equipment should not be so single-purpose that this would not be possible. Fortunately, most things associated with MRFs are fairly generic. This financing method has

The unique history of your municipality in financing other kinds of facilities clearly will be a factor in the selection of a MRF financing strategy.

been used a few times for MRF equipment and I am told in at least one instance for the entire facility.

FINANCING RISKS

Whatever option is chosen among these basic four, there is no need to feel constrained by the classic description. Hybrids are certainly possible. The unique history of your municipality in financing other kinds of facilities clearly will be a factor in the selection of a MRF financing strategy. But, whatever vehicle is chosen, those who are putting up the cash are going to ask you questions about the risks of the project.

The greatest risk areas associated with financing a MRF are: Unproven technology; underestimated construction cost; inexperienced operators; underestimated operating cost; overestimated revenues; insecure markets; high cost of landfilling residue; and possible future regulatory risk.

Some ways to deal with these risks include: *Unproven technology*—Technology is basically simple; Avoid the latest mechanical sorting/processing gadgets. *Underestimated construction cost*—Choose experienced full-service vendors; Do not separately contract for design, building, equipment. *Inexperienced operators*—Hire an experienced full-service vendor, or Contract with an experienced private firm for training. *Underestimated operating cost*—Have the firm that designs the MRF also be responsible for operations (guarantees); Use/train experienced operators; Create realistic cash flow models (including spare parts, cost of transport to market); Control quality of materials accepted. *Overestimated revenues*—Do not rely on market revenues for financial health; Require-put-or-pay contract; Tipping fees should cover operating expenses and debt. *Insecure markets*—In addition to above, hire experienced marketing agent; Be fanatical about product quality; Work for high, reliable volume; Have clear contingency plans. *High cost of landfilling residue*—Be clear about who takes responsibility for unsold materials; Arrange for stockpiling, on-site or elsewhere; Have a clear backup landfill arrangement. *Possible future regulatory risk*—Don't design a sweatshop!; Know the regulatory status of your markets.

TECHNOLOGY AND CONSTRUCTION

Your MRF technology is likely to be straightforward, unless you want to be the first to try some new laser-optical glass sorting device that can tell a green bottle from a brown one. To be financeable, keep the technology simple and proven.

Likewise, construction (including equipment) cost is not likely to be a problem, unless you are inexperienced. Choose people to do the design and cost estimate who have done work on a successful MRF in your size range. Start by looking among the ranks of the full-service vendors, since they have had to operate their own creations. Do not try to save money or reward some local firm for a political reason if it means contracting a critical item to an inexperienced party.

Operators: Even the most mechanized MRF is relatively labor-intensive, and municipal MRFs are frequently very labor-intensive for social reasons. But inexperi-

enced operators can sabotage efficiency and this affects cash flow, which affects the ability to pay investors. Lenders will want to be sure that these issues have been addressed. Again, the experienced full-service vendor ı help a lot, either by operating the MRF rigorously training the operators.

Estimating Costs: Operating costs can be higher than anticipated because of poor MRF design. This risk can be reduced by forcing the designer to be the operator and requiring a guarantee of efficient operations (for example, a throughput guarantee). Investors will also be favorably impressed if there are good operating cash flow models that take into account such items as the frequent replacement of conveyor belts and the cost of transporting materials to primary and alternate markets. Emphasize quality control on the front-end: it is difficult to produce a marketable product when you start out with "garbage."

Estimating Revenues: Do not try to fool investors by overestimating revenues. Do not overestimate participation rates, recovery rates, or unit prices you are likely to receive. At this point in MRF development, you probably should not rely on materials revenue for *any* kind of financing. The project should be able to survive politically and economically even if all you are doing is keeping materials out of the landfill. Be sure that you are able to guarantee a sufficient municipal revenue source to the project to cover operating and debt service costs. Of course, regardless of these cautions, investors will look actively on an experienced and aggressive material marketing program.

Securing Markets: You should plan for and emphasize quality control throughout your process, or you might not be able to meet market specifications. Some MRF vendors have been able to convince investors that they will never have a problem marketing all they process because they produce such a pure, high quality product that they can get long-term sales contracts. You should do likewise. However, the fact is that we do not know what the future holds for many materials, any more than we knew that oil prices would drop and drive down the expected energy revenues from incineration. Have a contingency plan for each of your markets.

There may come a time when some things just cannot be sold or given away. You can stockpile baled or crushed containers, if there is room. It's a little harder to stockpile news and mixed paper. Convince your investor that you are prepared for the worst-case market scenario, and also for unavoidable shut-downs caused by strikes, mechanical failures and regulatory sabotage.

Regulatory Risk: Recycling is not immune from "regulatory sabotage." Do not design a facility where you yourself would not work on the sorting line. Know whether the paper or the de-tinning operation or lead smelter accepting your materials is violating any environmental regulations and might be shut down. You should convince your investors that you know the sources of all the material entering the MRF, and that you would not, even inadvertently, accept any stolen goods.

> At this point in MRF development, you probably should not rely on materials revenue for any kind of financing.

By following all the above suggestions, you may have a sounder project but possibly a more expensive one than you had thought. That may be all right. Recycling does not have to make money for your town or city. We would all be much better off if we would eliminate the incredible economic confusion that surrounds recycling today. It's relatively easy to do if you always think of the total system-wide cost of municipal solid waste services.

After all, the total system cost is the economic "bottom line." We have come to this conclusion through a long computational struggle with the avoided landfill cost concept, which, if carefully considered, applies equally to an incineration project. In the context of total system cost, the economics become clarified. By contrast, the cost-per-ton of landfilling, incineration or recycling can be very misleading. To bolster either side of an argument, a convincing recycling cost of $200 per ton or $20 per ton can be calculated. The same is true for incineration. But the total system cost does not mislead you.

As an aside, there is an environmental or social "bottom line" which needs to be considered as well. Does your municipality want to do recycling even if it is not cheaper? Plenty of them apparently do, which represents a profound change in our national thinking.

The total net system cost is calculated by adding all the costs and subtracting all the revenues. In simplest terms, your municipal recycling effort breaks even if the total net system cost with recycling equals the total net system cost if you do not recycle.

In summary, financing a MRF should not be a problem, if the project is well thought through and if the municipality can accept the notion that the MRF is part of the solid waste disposal system which is ultimately a public responsibility. The big problem in the future as I see it is the marketing of the materials. We know how to collect and process a useful product; the question is, when will market demand catch up with the potential supply? Are we going to rely on overseas markets forever? ■

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THAR'S GOLD IN THEM THAR TREE LIMBS

. . . and leaves and grass, if you compost them. At least, it's gold for San Mateo, Calif., which needs the end product.

Can you make a yard waste composting project break even with a tip fee of $4.50 per cubic yard, if you don't market the stuff? That's the question Al Bergeron, maintenance manager for the Public Works Department in San Mateo, Calif., asked himself in 1982, when his city gave him the job.

Six years later, Bergeron has an answer: Yes . . . if you take a simple, low-tech approach and have plenty of land available. In fact, you may be able to do better than break even, depending on what value you place on your end product. How does a $3 million savings to the city budget thanks to an investment of perhaps $200,000 sound?

San Mateo's landfill, which had accepted a good deal of construction debris and very little household waste during its lifetime, closed in 1982. The city's plan for the 35-acre site, which is right by the shore of San Francisco Bay, is to turn it into a park with a variety of recreational uses.

Soon after site closure, Bergeron began the city's yard waste composting operation. Funded with a $75,000 California Waste Management Board grant, the project would be a service to city residents and commercial gardeners, who would save by avoiding the long trip to a landfill. At the same time, the composted yard waste would provide topsoil-like material, with which the site could be completely covered to a depth of one foot.

Maximizing worker & equipment productivity

The heart of the operation is a W.H.O. tub grinder, powered by a Cummins engine and serviced by two J I case front-end loaders. A loader feeds tree limbs, leaves, grass, and weeds to the grinder, which spits out a chopped-up, light-brown-and-green mixture. This is scooped up by a loader, which either pushes the material to the side or loads it into a dump truck for relocation to another part of the site.

To maximize the productivity of the four workers at the site, Bergeron has divided the work day there in two. Wastes are accepted at the site only in the afternoons — when most gardeners want to come in with a full load after a day of work. Workers can spend this time maintaining equipment — which is put to work each morning, chopping up the previous day's incoming batch.

"We originally planned to have just three people here, but we found we also needed a man at the gate," says Bergeron. "Most of our plans have worked out, though. We anticipated that we would have enough material to cover the site with one foot of compost within seven years of operation, and now, in year six, we are right on target."

Interestingly, during grinder-feeding times, one worker stands a short distance from the grinder with a push-button off switch in his hand. This worker's job, Bergeron says, is to quickly shut the machine down should something metallic inadvertently work its way toward the grinder's hammers.

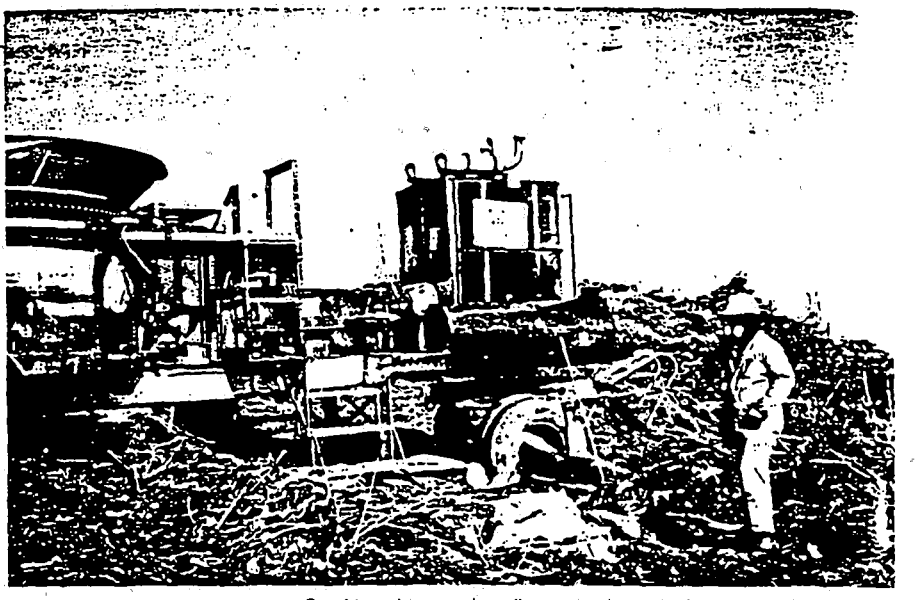
"We screen our material carefully when it is tipped here, but things like gardener's pick-axes can make it by us," he says. "We don't want that kind of item beating up on our hammers."

San Mateo used to position a dump truck beneath the

By JOE SALIMANDO

grinder's outfeed conveyor belt, but now just lets the material fall to the ground and pile up. Explains Bergeron: "With the truck beneath the belt, when the truck was full we had to stop everything and have the worker climb out from behind the loader, drive the truck to where we wanted the stuff unloaded, get the truck unloaded, and then drive back.

"It didn't take too much time, but it took time. It disrupted the operation. Now, the worker can stay in the loader cab. When the pile of shredded material gets large, he can push it out of the way with the loader, in between trips to feed the grinder. This way we've got a smooth operation, with no disruptions and no lost time."



San Mateo's operation allows a worker standing by the tub grinder to shut down the machine in case anything metallic makes its way toward the grinder's hammers.

Keeping the operation simple

Bergeron claims the tub grinder produces a 33% volume reduction in the amount of incoming yard waste. In fiscal 1986-87, the city says it turned 41,000 incoming yards of material into 27,000 yards of compost.

Note that these figures do not square with volume reduction claims of the equipment manufacturer, which promotes a much higher ratio of volume reduction. Bergeron thinks he knows the reason.

"Because we charge by the yard, and because we only accept material in the afternoons, it's to our customers' advantage to compact the material they are bringing in, so they can fit as much as possible into their trucks," he says. "When they drive in here, the limbs and grass and leaves are packed tight. The material 'grows' as it is dumped.

"Those 41,000 yards are what we charged for at the front gate. But it probably would be a much bigger figure if we measured the yardage by what it expanded to as it fell out of the truck."

Just as he's tried to maximize worker productivity to the city's benefit, Bergeron has taken advantage of the site's size to minimize the amount of equipment and work going into the composting effort.

"You may hear that you should turn compost piles frequently, and perhaps if we had a limited amount of space here, and were very concerned with developing a market, we would turn our piles more than twice a year," he says.

"But the fact is that the surest way I know of to turn compost into gold is to buy additional equipment and invest additional manpower in turning it frequently. Because we have 35 acres here, and because we don't have a time limit in which we have to move a given pile out of the site, we have the luxury of turning it less frequently. And that's enabled us to keep our costs way, way down."

So San Mateo basically leaves its composting yard waste alone. Twice a year it is turned; over time, it changes color

How To Avoid Compost Site Cash Flow Problems

Al Bergeron's keep-it-simple approach to compost site operations includes a key at the front gate: No cash changes hands on the property, and no invoices are created.

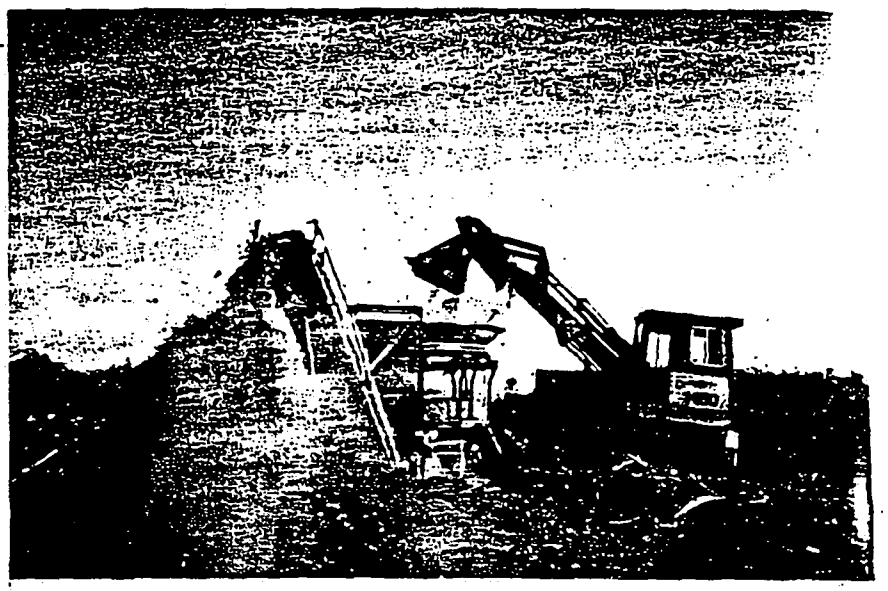
To avoid accounts receivable collection problems, Bergeron came up with an idea others have had: payment in advance for future capacity.

Gardeners from San Mateo and other areas who want to use the site must first purchase a ticket. The ticket entitles the holder to dump 100 yards at the site. The cost: $450.

When gardeners bring in loads, they present the tickets, which are punched by the site's gatekeeper. Even the ticket purchase is handled elsewhere, at city offices — reducing site transaction time for both customers and the city employee who mans the gate. It also allows the city to open the site to its customers only half the day and not face long lines.

—J.A.S

from that light-brown-and-green to a darker, blacker hue. Especially impressive is the five-year-old material that the city ran through a screen recently for experimental use on a city street divider. The material is as black and rich as anything that ever came out of a garden supply store's topsoil bag.



The high temperatures built up in a composting pile can produce steam.

Neighborly firefighting

San Mateo's main concern with its approach to composting is to stifle fires whenever they appear and to sop up any standing water. Bergeron wants the site to be a good neighbor, and smoldering piles or odiferous puddles are a sure way to alienate those living in houses less than a half mile away from the landfill.

"We found early on that you can get fires quite easily in a compost pile, especially if you pile it up too high," says Bergeron. "The temperature in these piles can be upwards of 170° F.

"If you pile the material up too high, you get what you might call a chimney effect. The heat rises, and the temperature builds, and then you get a breeze. Suddenly, part of the pile starts smoldering; it's a smoldering fire, somewhat like a peat fire you might see.

"So we keep a 3,000-gallon water wagon on the site at all times, to quench these fires whenever they occur." Bergeron adds that the city avoids adding water to the piles as an aid to composting, something it abandoned early in the project when he discovered there was enough rainfall to facilitate composting.

Note that there's not much odor generated by the now-closed landfill, credited to the fact that most of the material it accepted is not very likely to be decomposing.

Economics: how do you figure profit?

In fiscal 1986-87, the operation took in $150,000 in tip fees and spent $184,000. The cold hard net seems to be a loss of $34,000.

But that doesn't factor into the equation three elements:

- San Mateo's Parks Department hasn't purchased soil conditioner for four years;
- topsoil is not generally available in San Mateo County, and is imported; and
- the project's creation of as much as 200,000 cubic yards of top soil over its seven-year anticipated operating life means tremendous savings.

Since not one ounce of San Mateo's compost is marketed, it is tough to put a value on it. In discussing this, Al Bergeron mentions three figures:

- the going price for topsoil in San Mateo, he has been told by many of his gardener-customers, is $16 per yard;
- to be conservative and allow for perhaps a lesser quality, he used the figure of $10 per yard to value his operation's product in a recent report;
- but, he says, he's been told by one self-proclaimed expert from outside the county that the stuff is only worth $3 per yard.

To get to the worst of these scenarios: 1986-87 operations produced 27,000 cubic yards of compost. To make it even worse, allow 20% for shrinkage as the material continues to compost, and multiply that by $3 per yard. The result ($3.00 x 80% x 27,000) is a net value of $64,800 for topsoil product produced in the year . . . which nets out to a $30,000 profit for the city on this operation.

Or you can go to another scenario: By the end of 1989, Bergeron says, as much as 200,000 cubic yards of composted material will be covering the 35-acre site. If park planners had to include purchase of that much topsoil at $16 per yard, they would spend more than $3 million.

But they won't. The $3 million savings is quite a return on a $75,000 California Solid Waste Management Board grant and a few years of marginal net negative cash flow. ∎

Appendix D

Articles on Regulatory and Legal Issues

Papers

Solid Waste Association of North America "Upcoming California Legislation.

Articles

Glenn, Jim "Sorting the Mix at Materials Recovery Facilities," BioCycle (July 1991) p. 30.

Goldstein, Nora "How to Tackle a Siting Challenge", BioCycle (May 1990) p.38.

UPCOMING CALIFORNIA LEGISLATION

As Condensed by the Solid Waste Association of North America (SWANA)

Assembly Bills

AB 724 (Kelly)

This measure would permit the implementation of special assessments to cover delinquent charges for all or portions of county refuse collection bills without regard to whether the subject collection service is provided at the request of the property owner.

AB 750 (Margolin)

This measure would repeal exemptions in current law for wine, fortified wines, distilled spirits, and non-carbonated water from the California Beverage Container Recycling and Litter Act therefore, expanding the program to include these containers.

AB 1327 (Farr)

This measure would enact the California Solid Waste Reuse and Recycling Access Act of 1991 to require that, on and after July 1, 1992, any area in a development project used to transfer, receive, or store solid waste be designed to accommodate at least 4 receptacles for the purpose of separating, reusing, or recycling all solid waste materials generated by the project.

AB 1388 (Horcher)

Under existing law, the local enforcement agency must review changes for facilities which have solid waste facilities permits, to determine whether the changes are significant. If modifications are significant, then the permit must be revised and go through the environmental review process. This measure would in addition, establish a 2,000 foot buffer zone around solid waste facilities and prohibit expansion of the facility if a residence, hospital, school, or child care facility is within that buffer zone.

AB 1475

Existing law allows certain hazardous waste materials to be excluded from the Hazardous Waste Control Law when those materials are recycled. This measure would require that a person managing recyclable materials excluded from the hazardous waste control law to provide specified information to the department.

AB 1480 (Lee)

Existing law requires that used oil regulated by the Department of Heath Services be managed as a hazardous waste, in accordance with the hazardous waste control laws, until it has been recycled. Existing law also provides that any person who receives used oil from consumers or other used oil generators is exempt from hazardous waste facility permit requirements if certain conditions are met. This measure would include service stations within the provisions of current law.

AB 1515 (Sher)

Hearings are required under the California Integrated Waste Management Act of 1989 to be conducted by a panel appointed by the chairperson of the governing body of the local enforcement agency for certain enforcement activities for disposal sites. This measure requires the hearings conducted by the California Integrated Waste Management Board pursuant to statutory provisions relating to the administrative enforcement of requirements imposed upon a transfer or processing station or disposal site to be conducted by a hearing panel of three persons appointed by the chairperson of the board.

AB 1520 (Sher)

This measure would delay until January 1, 1993, the termination date of the statutory definition of "solid waste" for the purpose of determining the base amount of solid waste from which source reduction, recycling and composting levels are calculated.

AB 1696 (Filante)

This measure relates to provisions requiring that there be at least one certified recycling center within every convenience zone in the state and the Department of Conservation authorization to grant an exemption. AB 1696 would revise the condition to instead require that the exemption will prevent the creation of recycling opportunities.

AB 1707 (Becerra)

This measure provides that recyclable materials are the property of the authorized agent of the city or county from the time they are placed for collection and would eliminate the award of treble damages and would instead, provide that the authorized agent may be awarded a civil penalty of not more than $ 100 for each unauthorized removal.

AB 1760 (Eastin)

This measure would prohibit a solid waste landfill operator from accepting for disposal any white goods, vehicle or other metallic discard, as defined, which contains enough metal to be feasibly salvaged for commercial recycling and which is large enough to be easily separated from the waste stream, but would permit the landfill to accept them for recycling. Additionally, this bill would require the CIWMB to evaluate the use of recycling residue.

AB 1772 (Jones)

This measure would revise the reference to the regulations subjecting recyclable materials to the requirements of the hazardous waste control laws which the excluded recyclable materials are required to meet; would revise the provisions authorizing the management of recyclable materials, including deleting the provision exempting empty containers from classification as a waste; would allow certain RCRA hazardous wastes to be managed as recyclable material if the wastes meet specified requirements.

AB 2213 (Sher)

This measure would require the Integrated Waste Management Board to impose a recycling incentive fee on any packaging material made from paper, plastics, metal, glass or newspaper equal to the difference between the average scrap value paid by end-users for the materials and average cost of collecting and processing the material. Would require the Board to deposit all amounts paid as recycling incentive fees into the Recycling Incentive Account, which is created in the Integrated Waste Management Fund, and requires the funs to be made available for specified purposes, including the reduction or elimination of the tipping fee surcharge on each ton of solid waste disposed to fund the state's integrated waste management program.

SENATE BILLS

SB 235 (Hart)

This measure would require of rigid plastic packaging container manufacturers, as defined, sold or offered for sale in the state to meet specified criteria relating to the content of postconsumer materials used in the manufacturing process. This measure establishes a phased in approach starting with a 10% postconsumer recycled content requirement by January 1, 1993 to 25% on or after January 1, 1995. Additionally this measure would authorize the DOC to exempt a manufacturer from these requirements upon specified certifications. This measure would require a manufacturer to submit an annual certification to the Department of compliance of these provisions.

SB 543 (Calderon)

This measure would require the Department of Conservation to report the volumes of materials collected by each certified recycling center in a convenient zone and would prohibit the Department from withholding any information reported on the basis that withholding the information serves the public interest, unless it is proprietary information.

SB 576 (Royce)

This measure would permit cities and/or counties to include an implementation schedule for specified goals for diversion of solid waste from landfill or transportation facilities and to count towards those diversion goals the total weight of any cover material other than clean soil, if the alternative cover material is made of recycled solid wastes or compost, and the solid wastes from which the alternative cover material are made were normally disposed in solid waste landfills on January 1, 1990.

SB 752 (Hill)

This measure relates to the California Beverage Container Recycling and Litter Reduction Act under which the Department of Conservation is require to calculate a processing fee for each beverage container with a specified scrap value, which is required to be applied by beverage manufacturers. This measure would extend the prohibition concerning the use of a higher recycling cost when establishing a processing fee from January 1, 1991 to January 1, 1994.

SB 1051 (Vuich)

This measure would impose an excise tax on the sale of every disposable diaper sold in this state by a distributor, to a dealer, at rate of .005 cents per diaper. The measure would require that the moneys from the tax be deposited in the Disposable Diaper Fund, which is created in which would be used for specified purposes.

SB 1066 (Dills)

This measure would require the California Integrated Waste Management Board to conduct a study of the feasibility of requiring that all telephone directories which are issued or sold in this state, be made of materials which makes them acceptable to most recycling operations.

SB 1197 (Royce)

This measure would provide that it is a misdemeanor for any person to interfere with, scatter, or disturb the contents of any receptacle containing ashes, garbage, household wastes, or rubbish, punishable by not more than 1 year in jail or a fine of not less than $ 50 nor more than $ 300, or both.

SB 1238 (Royce)

This measure would require every city, county and special district or the public agency, which sets or approves waste collection rates, to establish, by July 1, 1992, or the next scheduled rate modification, whichever occurs first, variable can rates for all waste collection service is provided by public or private entities to residential, commercial, industrial, agricultural, or other waste generators.

SORTING THE MIX AT MATERIALS RECOVERY FACILITIES

ONE FACTION of recyclers believes in relying on the householder to separate materials. Another group says no, have the residents set out mixed recyclables and let the collector separate them at the curb. Still another faction believes in collecting the material commingled and sorting it at a central processing facility.

How recyclables should be collected and processed will continue to be debated for years. And while it is, other approaches will emerge. Already some solid waste managers have bought into the idea that sorting mixed waste for recyclables is the way to go, saying it is the only way to ensure 100 percent participation. And then there is the idea of wet/dry systems, which is gaining favor in some corners. Here, compostables are separated, while the remaining fraction is sorted to pull out the recyclables.

While collection approaches go off in a variety of directions, it's a fairly safe bet that commingled collections have become one of the most dominant methods. That's quite a statement to make considering that before 1988 there were only a half dozen materials recovery facilities available to process the commingled materials into marketable products.

Before getting too deeply into this discussion, let me explain that in this article a Materials Recovery Facility (MRF) is defined as a central operation where commingled recyclables, at least a portion of which come from the residential sector, are sorted and processed for market. It does not include facilities that process source separated materials or facilities that sort mixed waste if they also process commingled materials.

This report is based on *BioCycle*'s third annual survey of existing and planned MRFs in the United States. It is intended to give the reader a basic understanding of the MRF industry — where facilities are being developed, who is developing them, how they are financed, their size, capital and operating costs, and how many people it takes to keep them running.

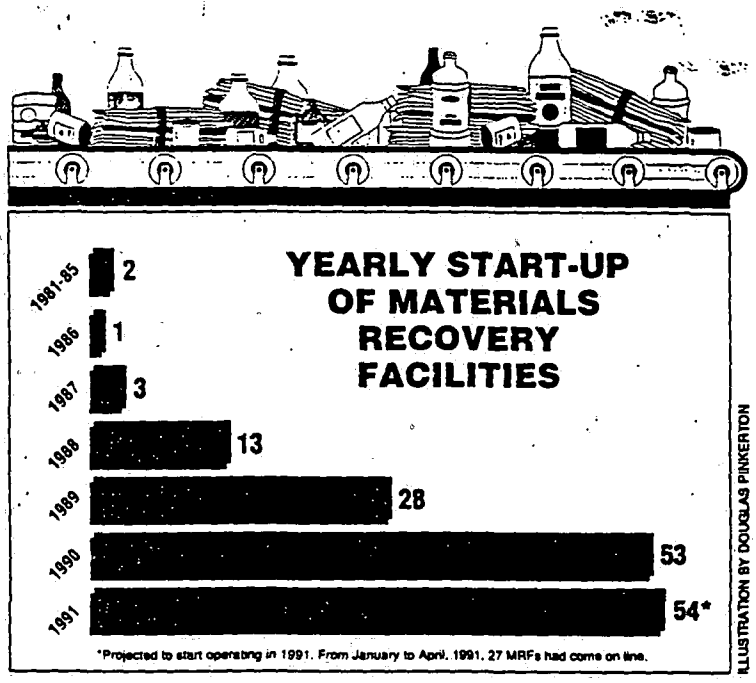


ILLUSTRATION BY DOUGLAS PINKERTON

Facilities that process commingled recyclables are springing up all over the country. This third annual BioCycle *survey takes a look at the industry and how it has changed in its brief history.*

Jim Glenn

THEY'RE EVERYWHERE!

Last year's survey identified 47 operational MRFs, while another 11 were under construction. Forty more were on the drawing board. This year's survey identified 126 operational facilities, a jump of 168 percent over last year. (At the end of 1989 there were only 19 in operation). Another 18 facilities are currently under construction.

While the overall number of facilities continues to grow, so too does the commitment solid waste managers have in developing more reliable and efficient processing capabilities. A case in point is the opening last year of a new MRF in Islip, New York (see *BioCycle*, March 1991) which replaced what is believed to be the first fully operational facility in the country. Another instance is in Atlantic County, New Jersey, where the Utilities Authority is going through a procurement to develop a 58,000 square foot facility capable of handling more than three times the amount of material processed at its current plant.

In all, between 25 and 30 operating MRFs have plans to upgrade their existing plants. One operator, Omni Recycling of Westbury, New York, is constructing a new facility capable of handling 300 tons/day (tpd) of material. Its current plant will be used as a backup in case of problems or overload at the new MRF.

Even MRFs that run into financial difficulty can be reborn. After Monmouth Recycling in Long Branch, New Jersey closed its doors in 1990, it was purchased by Auto-

mated Recycling Technologies and upgraded. When the plant reopened in August 1990, Automated Recycling mothballed its other mixed container processing facility in Ocean, New Jersey and now uses that plant exclusively to process paper.

As always, not all planned facilities see the light of day. Several projects reported last year have either been put in the freezer or abandoned entirely. For instance, when recycling was initiated in Lyon County, Minnesota, it was decided that private haulers would be given the responsibility to market materials instead of the county developing a MRF as originally planned. Orange County, New York has put its MRF on hold for at least two years, opting instead to start out by utilizing an existing private facility. A project in the Knoxville, Tennessee area was shelved when the authority proposing it went under and the city balked at spending $3,500,000 to build the plant.

In the late 1980s, MRFs were largely a Northeast phenomenon. And while there is still a large concentration of operating projects in that region — 48 in New Jersey, New York and Pennsylvania alone — MRFs are springing up everywhere. In fact, 28 states have at least one, up from 16 states identified in last year's survey. About the only part of the country not well represented are the Rocky Mountain states.

Currently, California has more operating MRFs (22) than any other state. It is followed closely by Pennsylvania (21) and New York (17). Other states with substantial numbers of facilities include New Jersey (10), Florida (8), and Minnesota (6).

While it is difficult to track the number of planned facilities (the last two surveys have underestimated those in development), this year's survey shows that New York stands head and shoulders above the other states, with at least 16 MRFs either being constructed, procured or designed. About 10 MRFs are being planned in Illinois, including up to six to handle Chicago's recyclables alone. Other states where numerous MRFs are on the drawing board include Wisconsin (7) and Maryland (6).

OWNER/OPERATOR ARRANGEMENTS

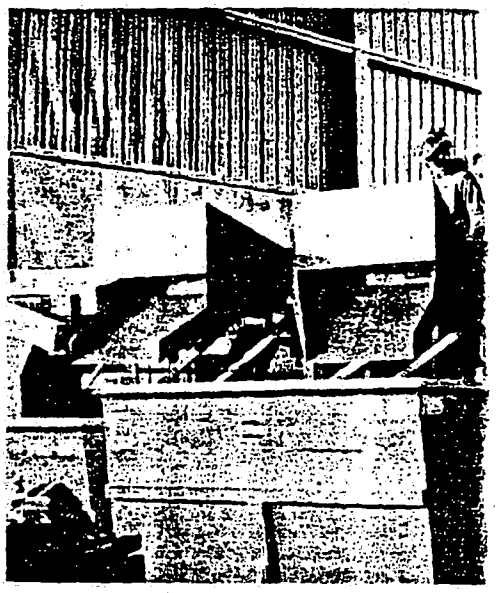
As most people are aware, the drive to develop recycling programs, including collection, has largely come from the public sector. On the other hand, the public sector is not so dominant in terms of being responsible for the development of MRFs.

MATERIALS RECOVERY FACILITIES IN THE UNITED STATES

LOCATION SPONSOR	STATUS OWNER	OPERATOR	THROUGHPUT (TPD)
ALABAMA			
Dotham Wiregrass Rehab Recyc	Operational same	same	2 (a)
Mobile City of Mobile	Operational Goodwill	Goodwill	4 (a)
Montgomery City of Montgomery	Operational McGinnis Ctr	McGinnis Ctr	10 (a)
ARIZONA			
Phoenix Why Waste America	Operational same	same	12 (a)
Phoenix City of Phoenix	Operational same	same	20 (a)
Tuscon Waste Mgmt. of Tuscon	Operational same	same	25 (a)
CALIFORNIA			
Anaheim Taormina Industries	Operational same	same	300 (a)[1]
Anaheim Taormina Industries	Construction same	same	600 (d)[1]
Chino Western Waste Ind.	Operational same	same	30 (a); 100 (d)
Concord Concord Disposal	Operational same	same	N/A
Fremont Oakland Scavenger/WMI	Operational same	same	50 (d)
Fresno City of Fresno	Operational WMI	WMI	55 (a); 200 (d)[1]
Lemon Grove San Diego Recycling	Operational same	same	120 (a); 300 (d)[1]
Monterey Monterey City Disposal	Operational same	same	20 (a)
Napa Napa Garbage Sevice	Operational same	same	20 (a)
Pacheco Pleasant Hill Bayshore Disposal/BFI	Operational same	same	12 (a)
Redondo Beach Western Waste Ind.	Operational same	same	50 (a); 75 (d)
Richmond Richmond Disposal	Operational same	same	30 (a); 50 (d)
San Francisco City of San Francisco	Operational Norcal	Norcal	185 (a)[1]; 200 (d)[1]
San Jose BFI	Operational same	same	125(a);1600(d)[1,2]
San Jose Norcal - South Bay	Operational same	same	20 (a); 20 (d)
San Martin South Valley Refuse Disposal	Operational same	same	20 (a)
Santa Cruz County Santa Cruz County	Design n/a	n/a	500 (d)[2]
Santa Helena Upper Valley Disposal	Operational same	same	2 (a)

MATERIALS RECOVERY FACILITIES IN THE UNITED STATES
(Continued)

LOCATION SPONSOR	STATUS OWNER	OPERATOR	THROUGHPUT (TPD)
Simi Valley G.I. Industries	Operational same	same	45 (a)
Southgate Bestway Recycling	Design same	same	160 (d)
Stanton CR&R	Operational same	same	150 (a); 150 (d)
Venicia Pacific Rim Recycling	Operational same	same	2 (a)
Ventura City of Ventura	Operational Gold Coast	Gold Coast	125 (a); 400 (d)
Walnut Creek Pacific Rim Recycling	Operational same	same	8 (a)
CONNECTICUT			
Berlin Tunxis Recycling Operating Comm.	Procurement ACR/RRS	ACR/RRS	100 (d)
Danbury Housatonic RRA	Operational RTI	RTI	90 (d)
Groton SE CT RRRA	Operational Groton	Resource Recovery Systems	35 (a); 40 (d)
Hartford Connecticut RRA	Procurement RRT/C.R. of CT	RRT/C.R. of CT	400 (d)
New Haven S.Central Reg. COG	Procurement n/a	n/a	160 (d)
Strafford SW CT RRRA	Operational CRRA	Fairfield Co. Recycling	50 (a); 250 (d)
DISTRICT OF COLUMBIA			
Washington Washington DPW	Procurement n/a	n/a	500 (d)
FLORIDA			
Broward County Broward County	Procurement n/a	n/a	150 (d)
Hialeah Dade County	Operational Attwoods	Attwoods	200 (a)
Jacksonville City of Jacksonville	Operational BFI	BFI	100 (d)
Lee County Lee County	Operational County	Goodwill	40 (a); 200 (d)
Orlando Orange County	Operational WMI of Florida	WMI of Florida	85 (a); 300 (d)
Pinellas County WMI	Operational same	same	150 (d)
Pinellas Park BFI	Operational same	same	120 (a); 160 (d)
Tallahassee Tallahassee-Leon Cty.	Operational Capitol Recy.	Capitol Recycling	25 (a)
West Palm Beach Palm Beach Co. SWA	Construction RRT	RRT	500 (d)
West Palm Beach Palm Beach County SWA	Operational same	same	220 (d)
GEORGIA			
Atlanta Recycle America - WMI	Operational same	same	50 (a); 100 (d)



King of Prussia, Pennsylvania is equipped to handle mixed containers.

Of the 126 in operation, 69, or 55 percent, were sponsored by the private sector. This is a reversal of the situation last year when 26 of the 47 operating facilities, or 55 percent, were publicly sponsored.

In terms of ownership, the private sector owns approximately 73 percent of all operating facilities and operates 82 percent. Both figures are up slightly from last year when 66 percent of operating facilities were privately owned and 79 percent were privately operated. There are 23 operating facilities both owned and operated by the public sector, a 130 percent increase over last year.

Evidence gathered in the survey on planned MRFs seems to indicate that the shift toward private ownership and/or operation will continue. Of the 49 projects that have determined such arrangements, nearly 90 percent will be operated by the private sector and slightly more than half will be privately owned.

DESIGN CAPACITY AND THROUGHPUT

You may have heard this one before: "In order to support a MRF an area has to generate at least 100 tpd of recyclables." If that's true, then why are facilities capable of handling as little as eight and 10 tpd cropping up all over the place? One of the principal reasons so many plants are operating is the explosion of small MRFs (SMRFs). The demand is so great that several equipment companies have begun targeting this lower end of the market.

The simplicity of most MRF designs makes them easily adaptable to any number of situations. Data from this year's survey illustrates that companies and municipalities are building facilities with a wide range

Table 1. Status of MRF Development

	Number
Operational	126
Construction	18
Procurement	27
Design	21
Total	192

Table 2. Owner/Operator Arrangements (Operating MRFs)

	Number	%
Full Public	23	18
Public/Private	11	9
Full Private	92	73

of capacities. Of the 76 identifying their design capacity on a per shift basis, 24 had single shift capacities of 50 tons or less, 25 had capacities of between 50 and 100 tons, and 27 were over 100 tons. Of those larger facilities, five had capacities of 200 tons or more.

Design capacities are one thing, but actual throughput is quite another. Of the 103 facilities that could estimate actual throughput on a per shift basis, 42 were processing 25 tons or less, and 21 were handling between 25 and 50 tons. Another 24 processed between 50 and 100 tons, 16 handled between 100 and 200 tons, and one reported processing over 200 tons.

Before jumping to the conclusion that MRFs aren't living up to their design standards, remember that many of these facilities opened only recently. While some can't reach their design capacities, it is more likely that these MRFs are processing all that comes in the front door — and that the collection programs aren't up to full speed.

The easiest way to increase throughput at these facilities is to add a second shift. This doesn't necessarily result in doubling throughput, but does add substantially to it. At least 13 operating MRFs are working two shifts and another two are working a shift and a half. Use of increased shifts has allowed at least five facilities to reach throughput of 200 tpd, and three others to hit 300 tpd.

Based on information in the survey, it appears that larger facilities are being planned. Of 57 on the drawing board, 13, or 23 percent, will have capacities of more than 200 tons per shift. Another 22 will be between 100 and 200 tons per shift. The remaining 22 will be below that figure.

Table 3. Owner/Operator Arrangements (Planned MRFs)*

	Construction	Procurement	Design	Total
Full Public	3 (18%)	1 (5%)	2 (15%)	6 (12%)
Public/Private	6 (35%)	9 (47%)	3 (23%)	18 (37%)
Full Private	8 (47%)	9 (47%)	8 (62%)	25 (51%)

Information on planned, privately sponsored MRFs, often known as Merchant Facilities, is not as easily tracked as Public Facilities and thus they are usually underreported.

Table 4. Design Capacity and Throughput (Operating MRFs)

Tons per Shift	Design Capacity	Throughput
25 and less	10	42
25+ to 50	14	21
50+ to 100	25	24
100+ to 200	22	16
200+	5	1

TYPES OF INPUT

There are generally three types of input for facilities handling commingled recyclables picked up separately from trash. In the early years of MRFs, most handled only the mixed container stream. Whatever paper collected was processed at a separate facility. While several of these types of facilities are in the planning stage, MRFs have now evolved to the point where nearly three quarters of all operating facilities handle two streams — paper and mixed containers.

The final approach is to collect all recyclables, paper and mixed containers alike, in one receptacle. This type of system is clearly in the minority, but with interest in bag-based collections growing, new totally commingled MRFs may well take an increasing share of the market.

Another issue is source of the inputs. At least three-quarters of the operational and planned MRFs are geared either exclusively or primarily to residential recyclables. Increasingly, however, MRFs are beginning to handle greater quantities of commercial recyclables. For example, one of the principal reasons the Atlantic County (NJ) Utilities Authority is developing a new system is so it can expand its commercial program.

In other instances, facilities are being developed primarily to capture commercial recyclables, with processing of residential materials as an adjunct to the operation. The recently opened BFI plant in San Jose, California dramatically illustrates this approach. The facility is designed to handle 1,600 tpd of material. Only about 10 percent of the input will be residential, with the majority comprised of commercial material.

A large scale facility planned for Babylon, New York also will concentrate on commercial materials. In that instance, only about 10 percent of the plant's 1,000 tpd of capacity will be used to process residential materials. In some cases, a MRF simply wouldn't be built were it not for the availability of large volumes of recyclables from the commercial sector. Last October, Waste Management installed a MRF in Kingsport, Tennessee because it had a contract in hand to collect and process recyclables from a large Eastman Chemical plant — not because that part of Tennessee is a hotbed of recycling.

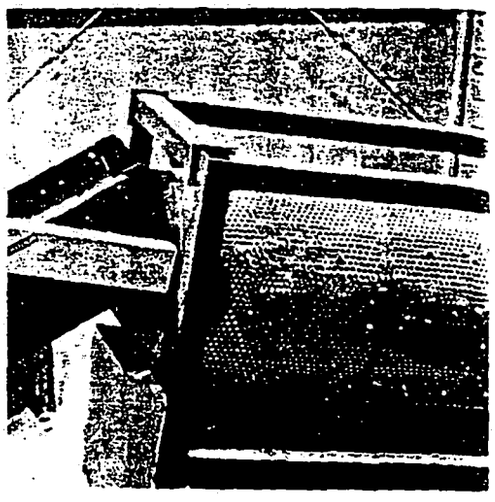
WHAT'S BEING PROCESSED

Remember when curbside recycling was limited to newspaper, glass containers, aluminum cans, and occasionally tin cans? For the most part, those days have gone the way of trailers with steel drums being used to collect recyclables. Curbside in the 1990s has expanded to include those materials plus a variety of paper and plastic products. This expansion beyond collecting three or four materials in large part explains why commingled collections, and thus MRFs, have become so popular.

Today, it's not uncommon for corrugated cardboard (OCC) and office paper (OP) to be included. And some programs are even go-

MATERIALS RECOVERY FACILITIES IN THE UNITED STATES
(Continued)

LOCATION SPONSOR	STATUS OWNER	OPERATOR	THROUGHPUT (TPD)
ILLINOIS			
Batavia Fox Val.Disp. - WMI	Operational same	same	N/A
Carol Stream Dupage County	Construction county	150 (d) n/a	
Champaign Intergovernmental SWDA	Procurement same	same	40 (d)[1]
Chicago City of Chicago	Procurement n/a	n/a	n/a[1]
Chicago Ridge Meyer Bros - WMI	Operational same	same	10 (a)
Dupage County Dupage County	Design county	N/A	150 (d)
Elgin Elgin Disposal - WMI	Operational same	N/A same	
McCook Waste Watchers/ Crown Disposal	Operational same	same	25 (d)
Romeoville Land & Lakes Co.	Design same	same	450 (d)[1]
Schamberg Laidlaw Waste Systems	Construction same	same	n/a
Wheeling Buffalo Grove/ Wheeling Disposal-WMI	Operational same	same	10 (a); 15 (d)
IOWA			
Carroll Carroll County SWMC	Operational same	same	7 (a); 30 (d)
Ottumwa Ottumwa-Wapello Co. Landfill Commission	Design same	same	35 (d)
Sheldon NW Iowa SWA	Operational same	same	6 (a); 8 (d)
LOUISIANA			
Baton Rouge City of Baton Rouge	Operational WMI	WMI	50 (a); 150 (d)
New Orleans City of New Orleans	Operational WMI	WMI	20 (a)
MAINE			
Bowdoinham Town of Bowdoinham	Operational same	same	5 (a)
MARYLAND			
Anne Arundel Co. Anne Arundel County	Operational county	BFI	34 (a)
Capitol Heights Prince Georges Co.	Operational Eagle Mgmt.	Eagle Mgmt.	30 (a)
Carroll County Carroll County	Design county	n/a	50 (d)
Derwood Montgomery County	Construction county	CRInc	240 (d)
Elk Ridge BFI	Design same	same	150 (d)
Finksburg Phoenix Reycling	Operational same	same	100 (a); 300 (d)



Cape May County, New Jersey's MRF processes 190 tons of commingled recyclables per day.

Table 5. Design Capacity (Operating and Planned MRFs)

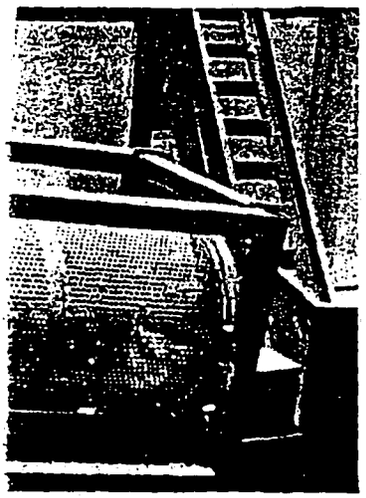
Tons per Shift	*Operational*	*Construction*	*Procurement*	*Design*
25 and less	10	1	1	1
25+ to 50	14	2	5	3
50+ to 100	25	3	1	6
100+ to 200	22	7	9	6
200+	5	4	6	3

ing beyond those into mixed paper and magazines (OMG). With plastics, the standard now is for collection of PET and HDPE bottles, but it is moving rapidly into all rigid containers and may eventually include film plastics as well.

Two years ago, it was hard to find a MRF that sorted and processed plastics. That has changed. The 1991 survey found that of all operational MRFs, 120 process at least one type of plastic. About 110 handle PET and all HDPE bottles, at a minimum. Currently, 11 facilities handle all bottles and another 10 are accepting all rigid containers. Four more are taking anything made of plastic.

The situation is similar for planned facilities. Of the 62 identified in the survey, only two do not have plans to handle any plastic. And 57 of the 62 will be processing at least PET and all HDPE bottles. Six more have plans to take all bottles; another two will handle rigid containers and two will have the task of dealing with all plastics.

The range of paper products being handled by MRFs as a matter of course also continues to expand. There are 18 facilities in operation that are not processing any paper products currently; five others in the planning stage will not include paper either. Most MRFs, however, are even moving beyond ONP into other grades, with 85 handling OCC, 47 processing OP, 27 handling



mixed paper and four accepting OMG. For planned facilities, 50 of 62 include OCC, 24 will handle OP, 13 will process mixed and another nine include OMG.

RESIDUE LEVELS

One of the biggest criticisms of commingled collection is that it leads to a lot of good recyclables being put into landfills because they were unfit to be marketed. In some earlier facilities, residue levels were well above 20 percent of the incoming materials. Through a great deal of effort, particularly on finding markets for mixed cullet (mixed colors of broken glass), today's operating MRFs are reporting residue levels far below those in the past. Indeed, 60 MRFs report residue of five percent and below, while another 11 estimate residue at between five and 10 percent. An additional 11 have levels in the range of 11 to 20 percent.

While some of these levels aren't what they could be, most managers are quick to point out that much of the residue is nonrecyclable trash that is collected along with the recyclables. To them it's an educational problem more than a flaw in the processing system.

Project planners have picked up on the fact that operators can achieve lower residue rates and are specifying appropriate levels. Very few allow operators even 10 percent, while most opt for five to 10 percent. A few even specify levels below that.

DOLLARS AND SENSE

The capital costs of MRFs span a range about as big as the Kansas prairie. Down in the valley, facilities that process 50 tpd or less can often be constructed and equipped for $1 million or less. On the high plateau, there are some facilities, such as those in Cape May County, New Jersey, and Islip and Utica, New York, that cost anywhere from $5 million to $8 million.

The average cost per ton of daily capacity (based on a single shift) for operating MRFs is $27,767. The range in cost per ton is from $11,250 to $53,325.

Based on information from the survey, smaller facilities are generally less capital intensive. MRFs with design capacities of 25 tpd and less have average capital costs of $20,525/ton of daily capacity. Facilities between 25 and 50 tpd and those over 100 tpd are about $7,000 more per ton. Those between 50 and 100 tpd are over $10,000/ton more costly. While this flies in the face of general economic wisdom, one possible explanation is that smaller facilities tend to use less sophisticated and less costly equipment.

Table 6. Type of Input for MRFs

	Operational	Construction	Procurement	Design
Mixed Cont	18 (15%)	3 (17%)	0 (0%)	1 (5%)
Paper/ Mixed Cont.	92 (73%)	13 (72%)	23 (96%)	18 (95%)
Total Commingled	16 (12%)	2 (11%)	1 (4%)	0 (0%)
Total	126	18	24	19

Table 7. Operational and Planned MRFs Handling Plastics

	Operational	Planned
All MRFs	126	62
One or more Plastics	120	60
PET & HDPE Bottles	110	57
All Bottles	11	6
All Rigid Containers	10	2
All Plastics	4	2

Table 8. Operational and Planned MRFs Handling Paper Products

	Operational	Planned
No. of MRFs	126	62
Any Paper Grade	108	58
ONP	106	57
OCC	85	50
OP	47	24
Mixed	27	1
OMG	4	9

Table 9. Effects of Capacity on the Capital Cost of Operating MRFs (Based on one shift/day)

Capacity	Cost/Ton of Daily Capacity	
	Average Capital Cost	Range of Capital Costs
25 tpd & less	$20,525	$11,250 - $30,000
25 tpd to 50 tpd	$27,421	$11,875 - $37,500
50 tpd to 100 tpd	$30,996	$15,000 - $37,500
100 tpd & more	$27,728	$13,325 - $53,325
All	$27,767	$11,250 - $53,325

Table 10. Effects of Size on the Estimated Capital Cost of Planned MRFs (Based on one shift/day)

Capacity	Cost/Ton of Daily Capacity	
	Average Capital Cost	Range of Capital Costs
50 tpd & less	$36,000	$21,429 - $70,000
50 tpd to 100 tpd	$32,462	$16,500 - $57,143
100 tpd to 200 tpd	$39,494	$18,500 - $66,667
200 tpd & more	$29,940	$20,000 - $61,538
All	$35,510	$16,500 - $70,000

MATERIALS RECOVERY FACILITIES IN THE UNITED STATES
(Continued)

LOCATION SPONSOR	STATUS OWNER	OPERATOR	THROUGHPUT (TPD)
Halethorpe EWI/Attwoods	Design same	same	400 (d)
Landover Prince Georges Co.	Procurement county	CRInc	210 (d)
Northeast Cecil County	Design same	same	60 (d)
MASSACHUSETTS			
Boston Area Millis Consortium	Procurement n/a	N/A	120 (d)
Milbury Central MA RRC	Design n/a	N/A	n/a
Roxbury Jet-A-Way	Operational same	same	60 (a)
Springfield State of MA	Operational state	Resource Recovery Systems	210 (a); 240 (d)
MICHIGAN			
Ann Arbor City of Ann Arbor	Operational city	Recycle Ann Arbor	100 (d)
Auburn Hills Oakland County	Procurement county	WMI	260 (d)
Battle Creek Waste Mgmt. of Michigan - Southwest	Construction same	same	35 (d)
Whitmore Lake Mr. Rubbish	Operational same	same	n/a
MINNESOTA			
Benson Swift County	Operational same	same	6.5 (a); 10 (d)
Jackson Jackson County	Operational Fallenstein Recyc.	Fallenstein Recyc.	1 (a)
Preston Fillmore County	Operational same	same	3 (a)
Saginaw South St. Louis SWC	Operational same	same	0.5 (d)
St. Louis Park WMI	Operational same	same	90 (a); 150 (d)
Wothington Schaap Sanitation & Recycling	Operational same	same	4 (a); 8 (d)
NEW HAMPSHIRE			
Hookset Resource Conservation Services	Operational same	same	100 (d)
Rochester WMI of New Hampshire	Operational same	same	25 (a); 50 (d)
NEW JERSEY			
Atlantic County Atlantic County Utilities Authority	Procurement same	same	300 (d)
Boundbrook Somerset County	Operational same	same	125 (a)
Boundbrook Somerset County	Construction same	200 (d) same	
Camden Camden County	Operational county	RRS	70 (a)

Approximately half of Grand Central Sanitation's 20,000 square foot private facility in Pen Argyl, Pennsylvania is devoted to paper and cardboard.

Table 11. MRF Operating Costs (Based on 250 workdays/year)

	Cost/Ton	
Capacity	*Operating*	*Proposed*
100 tpd & less	$52.85	$43.82
Over 100 tpd	$39.69	$40.23
All	$45.67	$42.03

Planned facilities have an estimated capital cost of just under $8,000/ton of daily capacity more than the operating facilities (or $35,510/ton of daily capacity). In other words, it appears MRFs are becoming more expensive. There are several good reasons why this is occurring. First, MRFs are being designed to deal with an ever increasing number of materials. For instance, a paper system used to process mixed paper simply costs more than one that is only required to inspect and bale newspaper. Another reason is that, on the whole, processing systems are becoming more sophisticated. Finally, more attention is being paid to worker comfort and safety. All this adds up to increased costs.

OPERATING COSTS

Based on the information provided in the survey, the gross operational and maintenance costs of operating MRFs averages $45.67/ton, with facilities having under 100 tpd of throughput roughly one-third more expensive than those over 100 tpd. In terms of planned facilities, the average O & M costs are $42.03/ton. MRFs with design capacities of under 100 tpd are estimated to be approximately $2.50/ton more expensive than those over 100 tpd.

PERSONNEL ISSUES

When comparing facilities based on their costs, oftentimes what is actually compared are the wage rates and other costs in different regions of the country — and not the efficiency of the plants. Another means of measuring the efficacy of MRFs is to analyze the amount of material that can be processed by each worker.

Based on information from the survey, there is a significant difference in the amount of materials workers in various size plants process on a daily basis. On average, MRFs process 3.57 tons/worker/day (t/w/d). Facilities with throughput of 50 tpd or less average 2.31 t/w/d, which is 2.00 t/w/d less than facilities in the 50 to 100 tpd range, and more than four t/w/d less than facilities with over 100 tpd throughput. Private facilities more than double the productivity of publicly operated MRFs — 4.00 t/w/d versus 1.80 t/w/d.

The figures above are based on a comparison of all workers in a plant. Worker productivity statistics increase when just the sorters are compared, but roughly the same relationships exist. One exception is the comparison between publicly and privately operated MRFs. Sorters at private facilities process just under 6 t/w/d, only 1.5 t/w/d more than the public facilities average. When looking at these numbers, therefore, perhaps it isn't that public employees are so much less productive, but rather that there are more "nonprocessing" personnel in public plants.

CONCLUSION

Materials recovery facilities clearly have taken a strong position as processors of recyclables over the past several years. Increasingly, MRFs are being called on to process longer and longer lists of materials. While most are still relatively unsophisticated, several firms have begun to offer systems that aid in sorting the material, increasing productivity. This is an evolutionary process, with many mistakes to be made along the way. Clearly, however, the industry is learning and improving. ■

MATERIALS RECOVERY FACILITIES IN THE UNITED STATES
(Continued)

LOCATION SPONSOR	STATUS OWNER	OPERATOR	THROUGHPUT (TPD)
Deerfield Twp. Cumberland County Improvement Authority	Operational same	same	20 (a); 80 (d)
Lakewood Twp. Ocean County Ocean County	Construction county	RRT-Empire Returns	300 (d)[1]
Long Branch Automated Recycling Technologies	Operational same	same	165 (a); 200 (d)
Newark REI	Operational same	same	200(a)[1];600(d)[1]
Pleasantville Atlantic County Utilities Authority	Operational same	same	80 (a)
Toms River Rosetto Recycling	Operational same	same	125 (a)[1];150 (d)[1]
Toms River Rosetto Recycling	Construction same	same	150 (d)
West Patterson W.P.A.R.	Operational same	same	150 (a)[1]
Woodbine Cape May Co. MUA	Operational authority	RRT	190 (a)[1];225 (d)[1]
Woodbridge Woodbridge Township, Middlesex County	Operational same	same	20 (a); 50 (d)
NEW YORK			
Babylon Town of Babylon	Procurement Solar Int'l Trading Corp.		1000 (d)[1,2] Solar/RRT
Brookhaven Town of Brookhaven	Operational town	CRInc.	125 (a); 300 (d)[1]
Brooklyn Waste Management Recycling	Operational same	same	100 (d)[1]
Broome County Broome County	Procurement n/a	n/a	50
Buffalo City of Buffalo	Operational Integrated Waste Systems (IWS)	IWS	60 (a); 300 (d)[1]
Columbia County Columbia County	Design n/a	n/a	80 (d)
Depew Northern Recycling Council	Procurement NOREC	n/a	400 (d)[1]
Elmira Chumung Co. SWMD	Construction same	same	75 (d)
Hudson Columbia County	Operational same	same	4 (a)
Islip Town of Islip	Operational same	same	125 (a); 300 (d)
Ithaca Tompkins County	Procurement county	n/a	102 (d)
Lincoln Madison County	Operational ARC	ARC	25 (a); 95 (d)
Lowville Lewis County	Operational same	same	4 (a); 25 (d)
NYC-Brooklyn New York City	Construction city	n/a	50 (a)

(Continued on page 74)

HOW TO TACKLE A SITING CHALLENGE

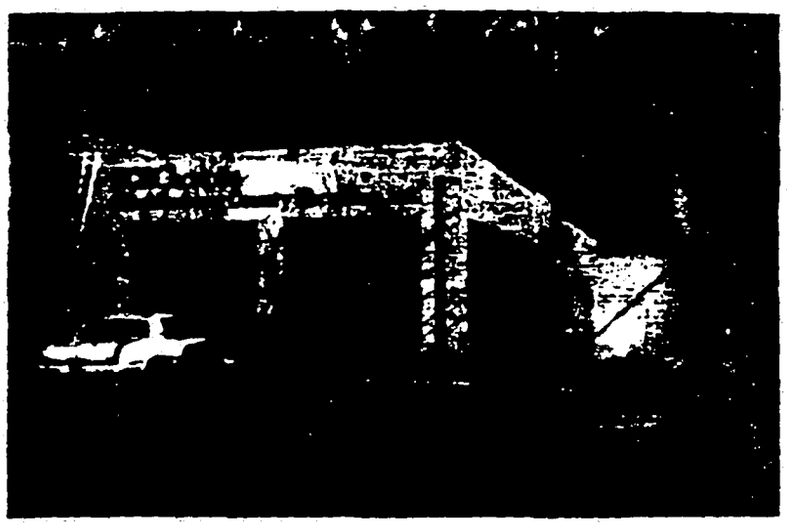
FOR THE most part, recycling projects have been able to easily win support of the public. Siting facilities like dropoff or processing centers, therefore, is fairly straightforward and met with minimal public opposition. And in places where citizens have successfully battled an incinerator or a new landfill, recycling and support for it are viewed as a necessity by the public.

As recycling programs expand, especially with community-wide curbside collection, it is becoming necessary to site materials recovery facilities or MRFs. To the public at large, these facilities can appear on the outside to be just another unwanted waste management facility in a neighborhood. So far, there hasn't been a great deal of public opposition. But a siting experience in Mecklenberg County, North Carolina provides some valuable pointers on how it is critical to let the public know what you are doing — even with what are perceived to be "benign" solid waste projects.

Several years ago, Mecklenberg County and the City of Charlotte were going to build a combined transfer station/MRF. The facility was to service Charlotte's curbside collection program. The county felt it had found an ideal site for the transfer station/MRF. It was in an industrial zone and had easy access to an interstate highway. Citizens surrounding the site, on the other hand, had a different perception.

"The community felt it was in their neighborhood, and residents did not want the project sited there," recalls Betsy Dorn, formerly a recycling coordinator for the county, and now a consultant with Hazen & Sawyer in Raleigh. "Eventually, the city decided they didn't want the transfer station but would proceed, with the county, to site the MRF at the same location. But the citizens were still opposed — the battle lines were drawn, and the project never got sited there."

In the meantime, the county had been operating a pilot curbside recycling program and was actively involved in public education. "The county wanted to proceed with multi-material curbside service, and the public wanted and supported it, but it couldn't be done without a MRF," says Dorn.



An unexpected neighborhood challenge to a combined MRF/transfer station led to a change in plans and eventually a successfully sited MRF.

Eventually, the county decided to privatize the project and selected Fairfield County Recycling, Inc. of Stratford, Connecticut to build and operate the MRF. The vendor and the county selected a different site, also in an industrial zone. The group of citizens opposed to the first transfer station/MRF proposal offered its assistance to neighbors surrounding the second proposed site.

"At first, we had some opposition," says Louise Dixon of Epley Associates in Charlotte, a public communications firm hired by the county to work on the recycling/MRF projects. "The neighborhood leader contacted some county commissioners and city council representatives and said they didn't want a garbage project stinking up their neighborhood. One fundamental problem we had was that these people did not clearly understand what the project was."

The city and county, working with Epley Associates, utilized a two-pronged approach to build and maintain public acceptance for the MRF, a 33,000 sq. ft. plant designed to process an average of 100 tons/day of recyclables, including glass, aluminum, newspaper and PET. First, they worked with the

news media to get the message across about the MRF. "We said it was a clean operation where all the processing would be done inside so there wouldn't be garbage all around," explains Dixon. "We emphasized that a MRF was essential to a successful recycling program. This helped to educate the community at large about the project, as well as citizens in the affected neighborhood."

The second step in the strategy was to work directly with neighbors, to further explain the role of the facility and how it would operate. The county and vendor also expressed their willingness to work with citizens to design a facility that would fit into the neighborhood, e.g. landscaping it to suit the site.

A public meeting was held to give citizens an opportunity to talk with city and county officials and the president of Fairfield County Recycling. "We addressed issues such as the volume of truck traffic and generally explained what the daily impact would be on the neighborhood," says Dixon. "Soon after, Fairfield Recycling flew the neighborhood leaders to Connecticut to tour a MRF they operate there — to give them a first-hand view of what the project entails."

There was another meeting with the neighbors to follow up on the facility tour and address any additional concerns. At the next county commissioner's meeting, representatives of the neighborhood group said they believed in the MRF concept and would work with the county to help the project move forward. The public education/acceptance process for the second site took about two months, and the MRF became operational in early January 1990.

> It is critical to handle the process so that if one site doesn't work out, you still have the community's overall support for the project.

Looking back, Dixon says the experience in Mecklenberg County taught them some important lessons. First, they had to pay attention to what people saw and heard about the project, and to understand citizens' concerns and address them. Second, they needed to make sure that people knew what a MRF was and what it did. Finally, the message had to get out to the community at large, which required working with the media.

"We had to let people know that the MRF is an essential part of the program," says Dixon. "There was a lot of support for the pilot curbside project and recycling was the preferred solid waste management method — and the MRF is a working part of that. We needed to get people to take a pragmatic look at the situation . . . that they just can't put recyclables on the curb, but that they have to be processed as well."

The new MRF houses a community educational center to teach school children and others about recycling. In addition, the MRF has the potential to provide jobs to neighborhood residents. Looking back, Dorn emphasizes that a key lesson to be learned from the initial defeat and subsequent success is that the county continued to involve citizens as a whole in the recycling effort. "We didn't lose the support of the rest of the community and we maintained our credibility. That's why it is critical to properly handle the siting process so that if one site doesn't work out, you still have the community's overall support for the project." N.G. ■

Appendix E

Glossary of Solid Waste, Materials Recovery and Recycling Terms

GLOSSARY OF SOLID WASTE, MATERIALS RECOVERY, AND RECYCLING TERMS

A

Aeration
The process of exposing bulk material such as compost to air, or of charging a liquid with a gas or a mixture of gases.

Aerobic Bacteria
Bacteria requiring free oxygen for the metabolic breakdown of materials.

Aerobic Treatment
Any kind of waste treatment that utilizes air to break down organic substances into simple substances.

Air Classifier
A resource recovery separation device in which mixed material is injected into a forced air stream and separated according to the air-drag-to-weight ratio density of each piece.

Air Pollutant
A substance that, when present in the atmosphere in large enough concentrations, adversely affects the environment.

Air Pollution
An impaired condition of the atmosphere that results because certain substances present in it are too numerous or are of a noxious character or both.

Air Winnowing
Separation of materials according to mass and size by means of a flow of air.

Anaerobic
Able to live and grow in the absence of free oxygen.

Anaerobic Biological Waste Treatment
Any kind of waste treatment that functions without the presence of oxygen.

Anaerobic Digester
A closed vessel with a controlled environment in which anaerobic fermentation takes place.

Anti-scavenge ordinance
A governmental regulation prohibiting the unauthorized collection of secondary materials set out for pick up by a designated collector.

Back-End Recovery
Recovery of materials from urban waste after shredding, incineration, or other treatment; for example, recovery of organic materials by composting or anaerobic digestion, inorganic materials such as iron and glass after incineration.

Backyard composting
The controlled biodegradation of leaves, grass clippings and/or other yard wastes on the site where they were generated.

Bacteria
Single-cell, microscopic organisms with rigid cell walls. They may be aerobic, anaerobic, or facultative; they can cause disease; and some are important in the stabilization and conversion of solid wastes.

Baler
A machine used to compress and bind solid waste or other materials.

Baling
A waste volume reduction technique where refuse material is mechanically compacted into cubes or bricks and may be held by wire or steel straps.

Ballistic Separation
A type of air classification system where mixed refuse material is ejected with horizontal velocity, and segregated by the respective ballistic path or arc of each component according to its air-drag-to-weight ratio. (See Separator, Ballistic.)

Beverage Container
The individual, separate bottle, can, jar, carton, or other receptacle, however denominated, in which a beverage is sold, and which is constructed of metal, glass, or plastic, or other material, or any combination of these materials. It does not include cups or other similar open or loosely sealed receptacles (effective January 1, 1990).

Biodegradable
The breaking down by microorganisms of the physical or chemical structure of a compound.

Broker
One who acts as an agent or intermediary buying and selling recyclable materials.

Buy-Back Recycling Center
A facility where citizens sell specific recyclable materials.

Citizen Participation
The involvement of citizens in a wide range of administrative and policy-making activities.

Classification
Sorting materials by physical characteristic(s).

Co-composting
Simultaneous composting of two or more diverse waste streams.

Co-disposal
A process designed for the simultaneous disposal of two or more waste products. This term is frequently employed to describe incinerator processes which handle both municipal refuse and sewage sludge.

Collection
The act of removing solid waste from the central storage point of a primary source.

Collection,

Alley
The picking up of solid waste from containers placed adjacent to an alley.

Carryout
Crew collection of solid waste from an on-premise storage area using a carrying container, carrycloth, or a mechanical method.

Contract
The collection of solid waste performed in accordance with a written agreement between cooperating parties, usually a municipality and private haulers.

Curbside
Collection of solid waste from containers placed adjacent to a thoroughfare.

Franchise
Collection made by a private firm that is given exclusive right to collect for a fee paid by customers in specific territory or from specific types of customers.

Municipal
The collection of solid waste by public employees and equipment under the supervision and direction of a municipal department or official.

Private
The collection of solid waste by individuals or companies from residential, commercial, or industrial premises; the arrangements for the service are made directly between the owner or occupier of the premises and the collector.

Setout/Setback
The removal of full and the return of empty containers between the on-premise storage point and the curb by a collection crew.

Collection Frequency
The number of times collection is provided in a given period of time.

Collection Method,

Daily Route
A method in which each collection crew is assigned a weekly route that is divided into daily routes.

Definite Working Day
A variation of the large-route method in which definite routes are laid out and a crew assigned to each. Collection proceeds along a route for the length of time adopted for a working day. The next day, collection begins where the crew stopped the day before. This procedure continues until the whole route is covered, whereupon the crew returns to the beginning of the route.

Group Task
A method in which the responsibility for collecting on assigned routes is shared by more than one crew. Any crew that finishes a particular route works on another until all are completed.

Inter-Route Relief
A method in which regular crews help collect on other routes when they finish their own.

Large Route
A method in which each crew is assigned a weekly route. The crew works each day without a fixed stopping point or work time, but it completes the route within the working week.

Reservoir Route
A method in which several crews are used to pick up on a centrally located route after having collected on peripheral routes.

Single Load
A variation of the daily route method in which areas or routes are laid out that normally provide a full load of solid waste. Each crew usually has at least two such routes for a day's work. The crew quits for the day when the assigned number of routes is completed.

Swing Crew
A method in which one or more reserve work crews go anywhere help is needed.

Variable-Size Crew
A method in which a variable number of collectors is provided for individual crews, depending on the amount and conditions or work on particular routes.

Collection Stop
A stop made by a vehicle and crew to collect solid waste from one or more service sites.

Collection Systems
Collectors and equipment used for the collection of solid wastes. Solid waste collection systems may be classified from several points of view, such as the mode of operation, the equipment used, and the types of wastes collected. In this text, collection systems have been classified according to their mode of operation into two categories: hauled container systems and stationary container systems.

Commingle
A mix of empty beverage containers and other containers of the same material type. Any broken glass empty beverage container(s) shall be deemed commingled. Commingled rates shall be determined by DOC Division of Recycling pursuant to subsections 2750 and 2770 of Chapter 5 of Divis8ion 2 of Title 14.

Compactor Collection Vehicle
A large vehicle with an enclosed body having special power-driven equipment for loading, compressing, and distributing wastes within the body.

Compaction Pit Transfer System
A transfer system in which solid waste is compacted in a storage pit by a crawler tractor before being pushed into an open-top transfer trailer.

Compactor.

Mobile
A vehicle with an enclosed body containing mechanical devices that convey solid waste into the main compartment of the body and compress it.

Sanitary Landfill
A vehicle equipped with a blade and with rubber tires sheathed in steel or hollow steel cores; both types of wheels are equipped with load concentrations to provide compaction and a crushing effect.

Stationary
A machine that reduces the volume of solid waste by forcing it into a container.

Component Separation
The arranging or sorting of wastes into components or classes.

Compost
Relatively stable decomposed organic material.

Composting
A controlled process of degrading organic matter through the use of microorganisms.

Composting,

Mechanical
A method in which the compost is continuously and mechanically mixed and aerated.

Ventilated Cell
A composting method in which the compost is mixed and aerated by being dropped through a vertical series of ventilated cells.

Windrow
An open-air method in which compostable material is placed in windrows, piles, or ventilated bins or pits and is occasionally turned or mixed. The process may be anaerobic or aerobic. (See Windrowing.)

Container
A receptacle used for the storage of solid wastes until they are collected.

Contracting
The legal process by which the local government enters into relationships with other public organizations or firms in the private sector to administer programs or projects, or to provide goods and services.

Conveyors
Devices for moving materials between points. Conveyor systems vary in size and construction depending on the character and quantity of material to be transported. The conveying platform may incorporate interlocking metal plates, rubber belts, tilting seats, revolving screws, or other specialized mechanisms. To prevent compressible materials (such as ground glass or metal) from packing, some conveyors may vibrate or oscillate.

Cooperative Agreement
An agreement designed to implement certain projects such as resource recovery in partnership or joint venture relationships with cooperating political subdivisions.

Cullet
Clean, color-sorted, crushed glass that is used in glassmaking to speed up the melting of silica sand.

Cut and Cover (Cut and Fill)
An infrequently and incorrectly used term referring to the trench method of sanitary landfilling.

Cyclone Unit
A mechanical separator which uses a swirling air flow to sort materials according to weight.

D

Density,
Solid Waste
The number obtained by dividing the weight of solid waste by its volume.

Destructive Distillation
The airless heating of organic matter that results in the evolution of volatile substances and produces a solid char consisting of fixed carbon and ash. (See Pyrolysis.)

Digester
Specially designed equipment in which waste materials are softened or decomposed, usually for further processing.

Direct Dump Transfer System
The unloading of solid waste directly from a collection vehicle into an open-top transfer trailer or container.

Disc screen
A waste-separating device using meshing, revolving discs.

Disposal or Deposition
The discharge, deposit, injection, dumping, leaking, or placing of any solid waste into or on any land or water.

Disposal,

Ocean
The deposition of waste into an ocean or estuarine body of water.

On-Site
The utilization of methods or processes to eliminate or reduce the volume or weight of solid waste on the property of the generator.

Waste
The orderly process of discarding useless or unwanted material.

Disposal Savings
The cost savings realized through waste reduction and recycling as a result of avoiding landfill or other final disposal process. Sometimes referred to as Avoided Cost in Waste Disposal.

Disposal Site
The location where any final treatment, utilization, processing, or deposition of solid waste occurs.

Dribble Chute
A funneling device that collects and transfers separated materials to conveyors or storage areas.

Drop Box Facility
A facility used for placement of a detachable container including the area adjacent for necessary entrance and exit roads, unloading and turn-around areas. Drop box facilities normally serve the general public with loose loads and receive waste from off-site. Also called Drop Box.

Drop-Off Depot
A facility where citizens voluntarily deposit recyclable materials. Also referred to as Drop-Off Center or Drop-Off Site.

Drum Mill
A long, inclined steel drum that rotates and grinds solid wastes in its rough interior; smaller ground material falls through holes near the end of the drum and larger material drops out of the sand. The drum mill is used in some composting operations.

Dump and Pick
The manual separation of recyclables in a materials recovery facility.

E

Ecology
The science that deals with the interrelationships of organisms and their living and non-living surroundings.

Ecosystem
The interdependence of organisms and their surroundings.

Emissions
Material that is released into the air either by a discrete source (primary emission) or as the result of a photo-chemical reaction or chain of reactions (secondary emission).

Emission Standard
A rule or measurement established to regulate or control the amount of a given pollutant that may be discharged into the outdoor atmosphere from it source.

Environment
The conditions, circumstances, and influence surrounding and affecting the development of an organism or group of organisms.

Environmental System
The interreaction of an organism or group of organisms with its natural and manmade surroundings.

F

Ferrous Metals
composed predominantly of iron. In the waste materials stream, these metals usually include cans, automobiles, refrigerators, stoves, etc.

Flailmills
A type of hammermill used for shredding refuse. Two sets of articulated flails on parallel shafts are rotated in opposite directions. The flails tear the refuse as it passes through the rotors. This equipment can process large quantities of refuse at low power levels.

Front End Loader
A collection vehicle with arms that engages a detachable container, move it up over the cab, empty it into the vehicle's body, and return it to the ground.

Front End Resource Recovery
A combination of mechanical processes that recover the valuable material in solid waste by a combination of shredding, grinding, screening, flotation, magnetic, air, and other processes which reduce in size and separate the different types of materials, passing on the organic material for further treatment or disposition.

Front End System
Those processes used for the recovery of materials from solid wastes and the preparation of individual components for subsequent conversion using rear-end systems.

G

Garbage
Unwanted animal or vegetable wastes and animal and vegetable wastes resulting from the handling, preparation, cooking, and consumption of food, swill, carcasses of dead animals, and of such a character and proportion as to be capable of attracting or providing food for vectors, except sewage and sewage sludge.

Gravity Separation (Flotation, Heavy Media)
The collection of any substance usually immersed in a liquid by taking advantage of differences in specific gravities enabling the separation, for example, of various non-ferrous metals from other heavy materials (does not always require a liquid medium).

Grinding
The mechanical pulverization of solid waste.

H

Hammermill
A broad category of high-speed equipment that uses pivoted or fixed hammers or cutters to crush, grind, chip, or shred solid wastes.

Haul Distance

1. The distance a collection vehicle travels from its last pickup stop to the solid waste transfer station, processing facility, or sanitary landfill.

2. The distance a vehicle travels from a solid waste transfer station or processing facility to a point of final disposal.

3. The distance that cover material must be transported from an excavation or stockpile to the working face of a sanitary landfill.

Haul Time
The elapsed or cumulative time spent transporting solid waste between two specific locations.

Hazardous Waste
See Waste, Hazardous.

Humus
Decomposed organic material.

I

Impact Mill
A machine that grinds waste material by throwing it against heavy metal projections rigidly attached to a rapidly rotating shaft.

Intermediate Processing Center
A facility for processing recyclable materials into a form marketable to industry. (See Materials Recovery Facility)

J

Junk
Unprocessed materials suitable for reuse or recycling.

L

Landfill
A disposal facility or part of a facility at which solid waste is permanently placed in or on land and which is not a landspreading disposal facility.

Mandatory Recycling
Legislation that prohibits generators of waste from disposing of designated materials. Such legislation may include rules mandating separation of designated materials for separate collection for recycling, composting, or re-use. Sometimes referred to as "source separation" legislation.

Manual Separation
The separation of wastes by hand. Sometimes called "hand-picking" or "hand sorting," manual separation is done in the home or office by keeping food wastes separate from newspaper, or in a recovery plant by picking out large cardboard or metal objects.

Materials Recovery
A concept of resource recovery emphasizing separating and processing waste materials to be sold for various purposes.

Materials Recovery Facility (MRF)
A facility that receives, processes and markets mixed recyclable materials that have been source-separated from commercial waste streams. Also called Intermediate Processing Center (IPC) or Materials Recovery Center (MRC).

Mechanical Separation
The separation of waste into various components by mechanical means.

Metals
In the secondary materials industry, metals include all ferrous, non-ferrous, and alloy materials.

Mobile Recycling Unit
An automobile, truck, trailer, or van licensed by the California Department of Motor Vehicles which is used for the collection of recyclable material such as aluminum, glass, plastic, and paper. Also, bins, boxes, or containers used for the collection of recyclable material such as aluminum, glass, plastic, and paper, which are transported by trucks, trailers, or vans licensed by the California Department of Motor Vehicles.

Municipal Waste
See Waste, Municipal.

N

Non-ferrous
Metals not including iron or its alloys or compounds.

O

Odor Threshold
The lowest concentration of an airborne odor that a human can detect.

On-Site Handling, Storage, and Processing
The activities associated with the handling, storage, and processing of solid wastes at the source of generation before they are collected.

Organic
Comprised of chemical compounds containing carbon rings of chains combined with hydrogen, and also with oxygen, nitrogen, and other elements.

Organic Content
Synonymous with volatile solids, except for small traces of some inorganic materials such as calcium carbonate, that lose weight at temperatures used in determining volatile solids.

Organic Fraction
That portion of the solid waste stream consisting of organic matter which has been separated out through a waste processing facility (such as an RDF facility).

Organism
Any living thing.

P

Processing
Any method, system, or other treatment designed to change the physical form or chemical content of solid waste.

R

RDF (Refuse-Derived Fuel)
A variety of solid, liquid, and gaseous fuels obtained from solid waste materials.

RDF.

Densified
Cubetted or pelletized RDF fluff.

RDF Fluff
Finely ground organic fraction of the refuse.

RDF Powder
RDF fluff ground to a fine powder.

Rear End System
Those chemical, thermal, and biological systems and related ancillary facilities used for the conversion of processed solid wastes into various products.

Reclamation Site
A location used for the processing or the storage of recycled waste.

Recoverable Resources
Materials that still have useful physical or chemical properties after serving a specific purpose and can, therefore, be reused or recycled for the same or other purposes.

Recovery
The process of obtaining materials or energy resources from solid waste. (See also Energy Recovery, Reclamation, Salvage.)

Recycling.

Waste
See Waste Recycling.

Redemption
The return to a recycling center or location of an empty beverage container for a refund of at least the redemption value and any applicable redemption bonus. (Effective January 1, 1990)

Redemption Value
The minimum refundable value established for each type of beverage container pursuant to Section 14560 (AB 2020). (Effective January 1, 1990)

Reduction.

Waste
See Waste Reduction.

Refuse
Term generally used to describe solid waste material.

Refuse-Derived Fuel
See RDF.

Regional Planning Agency
An agency, regional planning district, or joint planning area commission established by legislative act and performing general environmental and resources planning for any region of a state.

Resource Recovery
Resource recovery is a general term used to describe the extraction of economically usable materials or energy from wastes. The concept may involve recycling or conversion into different and sometimes unrelated uses. (See also Energy Recovery and Front End Resource Recovery.)

Reuse
The reintroduction of a commodity into the economic stream without any changes.

Reverse Vending Machine
A mechanical device which accepts one or more types of empty beverage containers and issues a cash refund or a redeemable credit slip with a value not less than the container's redemption value and applicable redemption bonus, if any. The bonus payments may be aggregated over more than one container and then paid. (Effective January 1, 1990)

Rubbish
A general term for solid waste--excluding wood waste and ashes--taken from residences, commercial establishments, and institutions.

Rubble
Broken pieces of masonry and concrete.

S

Salvage
The utilization of waste materials.

Salvaging
The controlled removal of waste materials for utilization.

Sanitary Landfill
A site where solid waste is disposed using sanitary landfill techniques.

Sanitary Landfilling
An engineered method of disposing of solid waste on land in a manner that protects the environment, by spreading the waste in thin layers, compacting it to the smallest practical volume, and covering it with soil by the end of each working day.

Scavenger
One who participates in the uncontrolled removal of materials at any point in the solid waste stream.

Scrap
Discarded or rejected material or parts of material that result from manufacturing or fabricating operations and are suitable for reprocessing.

Scrap,

Home
Scrap that never leaves the manufacturing plant and is reprocessed there. Also known as Revert Scrap.

Obsolete
Scrap that results when material becomes worn or otherwise unusable for its original purpose.

Prompt Industrial
Scrap that is left over from the fabrication of iron and steel products.

Screen,

Rotary
An inclined, meshed cylinder that rotates on its axis and screens material placed in its upper end. (See Trommel.)

Vibrating
An inclined screen that is vibrated mechanically and screens material placed on it.

Secondary Material
A material that is utilized in place of a primary or raw material in manufacturing a product.

Separation
The systematic division of solid waste into designated categories.

Separation Techniques
Refers to various processing systems for waste recovery, e.g., air classification, gravity separation, hydrapulping, magnetic separation, manual separation, etc.

Separator,

Ballistic
A device that drops mixed materials having different physical characteristics onto a high-speed rotary impeller; they are hurled off at different velocities and land in separate collecting bins.

Inertial
A material separation device that relies on ballistic or gravity separation of materials having different physical characteristics.

Magnetic
Any device that removes ferrous metals by means of magnets.

Shear Shredder

A machine that reduces discarded automobiles and other low-grade sheet and coated metal in a continuous operation to fist-size pieces. (See Hammermill.)

Shredding

Mechanical operations used to reduce the size of solid wastes. (See also Size Reduction (Mechanical).)

Size Reduction (Mechanical)

The mechanical conversion of solid wastes into small pieces. In practice, the terms shredding, grinding, and milling are used interchangeably to describe mechanical size-reduction operations.

Solid Waste

All putrescible and nonputrescible solid and semisolid wastes, including but not limited to garbage, rubbish, ashes, industrial wastes, swill, demolition and construction wastes, abandoned vehicles or parts thereof, and discarded commodities. This includes all liquid, solid, and semisolid materials which are not the primary products of public, private, industrial, commercial, mining, and agricultural operations. Solid waste includes but is not limited to sludge from wastewater treatment plants and septage, from septic tanks, wood waste, dangerous waste, and problem wastes.

Solid Waste Handling

The management, storage, collection, transportation, treatment, utilization, processing, or final disposal of solid wastes, including the recovery of energy resources from such wastes or the conversion of energy in such wastes to more useful forms or combinations thereof.

Solid Waste Management

The systematic administration of activities which provide for the collection, source separation, storage, transportation, transfer, processing, treatment, and disposal of solid waste.

Solid Waste Management Plan

Plans developed to define and establish solid waste management objectives and policies, and deal with problems at any level--city or county, subregional or regional, state, or federal. Typically, a local plan encompasses one or more functional elements and one or more program areas.

Solid Waste Management Program

All the activities associated with the development of a solution to a problem or problems within a functional element of a solid waste management system.

Solid Waste Management System

The assemblage of one or more of the functional elements to achieve a given objective or goal.

Special Waste
See Waste, Special.

Storage
The holding of solid waste materials for a temporary period.

T

Tipping Fee
The charge imposed for taking waste at a disposal site. The tipping fee normally determined in dollars per ton is levied on the hauler for the quantity of waste deposits on the receiving or tipping floor at the waste disposal site.

Tipping Floor
Unloading area for vehicles that are delivering solid waste to an incinerator or other processing plant.

Transfer Station
A permanent, fixed, supplemental collection and transportation facility, used by persons and route collection vehicles to deposit collected solid waste from off-site into a larger transfer vehicle for transport to a solid waste handling facility. Transfer stations may also include recycling facilities.

Transport
The movement of solid waste subsequent to collection.

Trash
Waste materials that do not include putrescible garbage but may include such organic materials as yard waste.

Trommel
A large revolving cylindrical screen used as a waste separation technique.

Tub Grinder
A mechanical device used to process solid waste by grinding.

Turn Key
One of the more popular contractual methods used by a community for the construction of its resource recovery facility. In the turn key process, the contractor is responsible for the design, engineering, construction, and shake-down operation of the facility. Once the facility has passed all the stipulated operation requirements, the key is turned over to the community which then assumes responsibility for its operation.

Waste.

Bulky
Items whose large size precludes or complicates their handling by normal collection, processing, or disposal methods (includes furniture, tree branches, stoves, refrigerators, etc.).

Commercial Solid
Wastes that originate in wholesale, retail, or service establishments, such as office buildings, stores, markets, theaters, hotels, and warehouses.

Construction
Building materials and rubber resulting from construction operations.

Demolition
Solid waste, largely inert waste, resulting from the demolition or razing of buildings, roads, and other man-made structures. Demolition waste consists of, but is not limited to, concrete, brick, bituminous concrete, wood and masonry, composition roofing and roofing paper, steel, and minor amounts of other metals such as copper. Plaster (i.e., sheet rock or plaster board) or any other material, other than wood, that is likely to produce gases or a leachate during the decomposition process and asbestos wastes are not considered to be demolition waste.

Food
Animal or vegetable wastes resulting from the handling, storage, sale, preparation, cooking, and serving of foods; commonly called garbage.

Hazardous
Those wastes that require special handling to avoid illness or injury to persons or damage to property.

Inert
Noncombustible, nondangerous solid wastes that are likely to retain their physical and chemical structure under expected conditions of disposal, including resistance to biological attack and chemical attack from acid rainwater.

Residential
Wastes generated in houses and apartments, including paper, cardboard, beverage and food cans, plastics, food wastes, glass containers, and garden wastes.

Special
Those wastes that require extraordinary management.

Wood
Solid waste consisting of wood pieces or particles generated as a byproduct or waste from the manufacturing of wood products, handling and storage of raw materials and trees and stumps. This includes, but is not limited to, sawdust, chips, shavings, bark, pulp, hog fuel, and log sort yard waste, but does not include wood pieces or particles containing chemical preservatives such as creosote, pentachlorophenol, or copper-chrome-arsenate.

Wood Pulp
Wood or paper fiber residue resulting from a manufacturing process.

Urban
A general term used to describe the waste stream originating from within an urban area.

Yard
Plant clippings, prunings, and other discarded material from yards and gardens. Also known as yard rubbish.

Waste Processing
An operation such as shredding, compaction, composting, and incineration, in which the physical or chemical properties of wastes are changed.

Waste Recycling
Reusing solid waste materials and extracting valuable materials from a waste stream.

Waste Reduction
Reducing the amount or type of waste generated.

Waste Sources
Agricultural, residential, commercial, industrial, tech., activities that generate wastes.

Waste Stream
A term used to denote the waste material output, transport, and disposal of an area, location, or facility.

White Goods
Discarded kitchen and other large, enameled appliances.

Windrowing
A composting procedure of placing sorted and shredded refuse in rows, usually five or six feet deep, and turning the piles for natural aeration. (See Composting, Windrow.)

Wood Waste
See Waste, Wood.

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Certain other terms have been reproduced from the Resource Recycling, Inc. Glossary of Recycling Terms and Acronyms and the National Recycling Coalition, Inc. (Ferrand Associates) Measurement Standards and Guidelines.

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