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0129 Progress Report on: Solid Waste Disposal

Colorado Legislative Council

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SOLID WASTE DISPOSAL

Legislative Council

Report To The

Colorado General Assembly

Research Publication No. 129
December, 1967

COLORADO GENERAL ASSEMBLY

LEGISLATIVE COUNCIL
ROOM 341, STATE CAPITOL
DENVER, COLORADO 80203
222-9911 — EXTENSION 2285
AREA CODE 303

November 30, 1967

To Members of the Forty-sixth Colorado General Assembly:

In accordance with the provisions of Senate Joint Resolution No. 42, 1967 session, the Legislative Council submits the accompanying progress report relating to Solid Waste Disposal in Colorado.

The committee appointed by the Legislative Council to conduct the study reported its findings and recommendations to the Council on November 27, 1967. At that time, the progress report was adopted by the Legislative Council for transmission to the Second Regular Session of the Forty-sixth General Assembly.

Respectfully submitted,

Representative C. P. (Doc) Lamb,
Chairman

CPL/mp

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ROOM 341, STATE CAPITOL
DENVER, COLORADO 80203
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November 24, 1967

Representative C. P. (Doc) Lamb, Chairman
Colorado Legislative Council
Room 341 State Capitol
Denver, Colorado 80203

Dear Mr. Chairman:

Your Committee on Solid Waste Disposal submits herewith its progress report on problems of solid waste disposal and junkyard control in Colorado.

The committee requests that the Legislative Council give consideration to the committee's recommendation that the General Assembly memorialize the Congress of the United States of America, requesting that the "Highway Beautification Act of 1965" -- P.L. 89-285, be amended to permit the use of federal funds for financing the actual removal and disposal of solid wastes in junkyards adjacent to the Federal-aid Interstate and Primary Highways.

Respectfully submitted,

Representative Don Friedman,
Chairman
Committee on Solid Waste Disposal

DF/mp

FOREWORD

Pursuant to Senate Joint Resolution No. 42, 1967 Session, the Legislative Council appointed the following committee to conduct a study of the problems connected with the collection and disposal of trash, junked automobiles, and other solid wastes:

Rep. Don Friedman, Chairman
Sen. Ed. Scott, Vice Chairman
Sen. John Bermingham
Sen. Allegra Saunders
Sen. Ruth Stockton
Sen. Allen Williams
Sen. Lloyd Hodges
Rep. Barbara Frank
Rep. Leigh Norgren
Rep. Les Fowler
Rep. Robert Jackson
Rep. Roy Shore
Rep. R. O. Woodfin

During the course of the study the Legislative Council's Committee on Solid Waste Disposal held a total of six meetings. Representatives of city and county governments met with the committee to consider problems in connection with refuse disposal sites under Colorado's Solid Waste Disposal Act of 1967 -- Senate Bill 225, 1967 session; a hearing was held with steel producers and the scrap processing industries concerning disposal of junked automobiles and other metalic scrap; and a meeting was devoted to the implementation of both the federal "Highway Beautification Act of 1965," -- P.L. 89-285, and Colorado's "Junkyard Control Act of 1966" -- Chapter 7, Session Laws of Colorado, 1967. In addition, the committee conducted a field trip in the Denver Metropolitan area to view sanitary landfills, scrap metal processing, composting, a transfer station and an experiment auto body shredding machine.

Special assistance was given the committee by: The Colorado State Association of County Commissioners; State of Colorado, Division of Local Government; John A. Schwarz, Colorado Fuel and Iron Steel Corporation; Mel Bemel, President, Colorado Auto and Truck Wreckers Association; Fred Merton, Assistant Chief Engineer, Colorado State Department of Highways; Hank Tiediemann, Regional Chief, Recreation and Development, U.S. Forest Service; William Gahr, Director Engineering and Sanitation, Colorado State Department of Public Health; and Jim Wilson, Assistant Attorney General, Legislative Reference Office. Dave Morrissey, Principal Analyst of the Legislative Council staff, had the primary responsibility for the research connected with the committee's study, aided by Wallace Pulliam, Research Assistant.

December, 1967

Lyle C. Kyle
Director

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Committee Findings and Recommendations

Pursuant to S.J.R. No. 42, 1967 session, the Colorado Legislative Council appointed a committee to study present and future problems concerning the collection and disposition of solid wastes. The committee appointed to conduct the study was concerned with defining the state's role in solid waste disposal, including the need to remove any impediments to the development of economic methods of waste disposal.

Disposal of Junk Automobiles

For the most part, the majority of wrecked and obsolete automobiles provide a source of auto parts for the auto salvage operator, as well as scrap metal for steel producers. Wrecking firms are particularly interested in late model vehicles because of the demand for used parts from these automobiles. Parts obtained from older motor cars, on the other hand, are of little value to the wrecker. In fact, many wreckers, with limited storage space, will not accept an automobile ten years of age or older because of the limited market for parts from these vehicles. In testimony before the committee, the auto wreckers agreed that a stripped auto hulk is a liability, especially since costs of current methods of disposal exceed the scrap value of the vehicle. This also places a burden on the owner of an obsolete automobile, because a wrecker may refuse to accept an older model vehicle even if the owner is willing to pay a few dollars toward disposition costs.

Supply and Demand

The auto wrecker must salvage parts from auto hulks to stay in business and make a profit. Following parts salvage, the wrecker wants to dispose of the auto hulk in the most economical manner possible. Unfortunately, the auto scrap market in Colorado is in a depressed condition, and many wreckers are faced with mounting inventories of auto bodies. One reason for the depressed auto scrap market is that auto wreckers or scrap collectors are prohibited from utilizing traditional means of removing contaminants (to steelmaking process) from auto hulks. In the past, plastics, rubber, dirt, etc., were removed by open burning. However, under Colorado's "Air Pollution Control Act" (Chapter 45, Session Laws of Colorado 1966), open burning is prohibited in the air pollution basins of the state. Because of a lack of new innovations in methods of processing auto bodies in Colorado, collectors or wreckers must resort to hand stripping of contaminants before scrap processors and steel mills are willing to accept a hulk.

The cost of hand stripping an auto hulk ranges from $15 to $20, while the amount paid for a stripped hulk by the processor is limited to $13 per ton (roughly one vehicle). Under these price conditions, the urban auto wrecker will not process a hulk for use in the scrap market unless he is forced to move a hulk in order to make room in his yard to salvage parts from other vehicles. It is interesting to note that prices paid for scrap by the steel industry are fairly uniform throughout the country, and the steel industry is willing to pay only about $21 per ton for so-called "No. 2 Bundles" -- auto scrap. Thus the scrap processor has a margin of only $8 per ton for baling, transportation, and other overhead expenses.

Roughly 60 percent of the scrap utilized in the production of iron and steel is "home scrap," that is, scrap generated in the actual steel making process. The second most important source of scrap steel is that obtained from waste by-products of the steel fabricating industries -- 16 percent. The remaining 24 percent of scrap metal consumed by the steel industry includes high quality heavy melting steel, as well as the less desirable grades of scrap metal such as Number 2 Bundles (auto scrap).

The long term demand for auto scrap appears to be declining, because the steel industry is gradually utilizing a greater proportion of iron ore to scrap metal in the production of iron and steel. For instance, the steel industry is in the process of converting from Open Hearth production to Basic Oxygen Furnace (BOF) systems. The BOF can produce up to 12 times the amount of steel made in an Open Hearth. The change in steel production methods is significant to the scrap industry, because the amount of scrap utilized in an Open Hearth usually ranges from 50 to 80 percent of the raw material supplied to a furnace, while the BOF scrap charge is limited to only 30 percent of the raw material fired in a furnace. By 1975, the BOF probably will produce over 50 percent of the total steel made in the United States, compared to 12 percent of total steel production in 1954.

Another new development in the production of iron and steel could reverse the present trend of declining demand for scrap metal. Greater use of scrap metal could be achieved if Colorado's steel industry would convert to electric furnaces. Scrap metal can make up 98 percent of the total raw material used in an electric furnace. However, even with a substantial increase in demand for scrap metal, auto hulks probably would comprise less than 50 percent of the scrap tonnage because of the availability of other types of high grade scrap steel.

Even in the event the use of auto scrap continues at demand levels of past years, the committee is concerned with the problem of the so-called "scrap gap." That is, the Council staff estimates that about 26 percent of obsolete or wrecked automobiles in Colorado

never enter the scrap cycle (roughly 22,300 vehicles per year). Although some of these vehicles are used for riprap to support stream banks or disposed in landfills, the committee believes that the scrap gap is accounting for an ever increasing inventory of junked vehicles, not only in auto graveyards but scattered throughout Colorado's landscape.

Federal Highway Beautification Act

Rapid population growth in the urban areas of the nation is making it increasingly difficult for people to live in decent surroundings. There is a need for communities to preserve some aspect of our natural environment -- streams, trees, and meadows. With increased leisure time, higher levels of educational attainment, plus a general growth in prosperity, recognition of the need to improve our urban environment and preserve natural habitat is growing. Congress attempted to translate some of these general concepts into legislation through enactment of the "Highway Beautification Act of 1965" -- P.L. 89-285. In part, the "Highway Beautification Act" provides funds to the states to assist in screening and removing junkyards located within 1,000 feet of Interstate and Primary highways. Unfortunately, the federal act only applies to about 30 percent of the junkyards in Colorado, because the vast majority of junkyards are located within industrial areas of municipalities, zoned industrial sites of unincorporated communities, or in sites other than those adjacent to Primary or Interstate highways. The federal junkyard control act does not apply to junkyards in these latter categories. Failure of a state to participate in the federal program may result in forfeiture of ten percent of federal highway assistance monies. To meet the conditions imposed by the federal act, the General Assembly adopted a junkyard control bill in 1966 -- Senate Bill No. 9.1

The "Highway Beautification Act" permits the federal government to pay 75 percent of the cost of screening or moving junkyards from within 1,000 feet of Interstate and Primary highways. To date, however, the federal government has not participated in costs of actually disposing of auto hulks and other junk materials. The highway department of the state of Wyoming expressed interest in a proposal to utilize a portable baler to prepare auto hulks for entry into the scrap market. The Federal Bureau of Public Roads, however, would not agree to participate in funding this program. Therefore, a choice must then be made by state government to: 1) simply participate in moving or screening junkyards and face the possibility of paying cost of disposal at a later date; or 2) pay

1. Chapter 7, Session Laws of Colorado 1966.

100 percent of the added cost of disposal of junkyards at the time federal requirements are met.

Committee Recommendations. The committee recommends that steps be taken to provide more flexibility in the federal-state junkyard control program. For instance, the committee believes that present programs for screening the contents of junkyards located within 1,000 feet of a federally-aided Interstate or Primary highway have not proved satisfactory. Although screening may be successful in hiding the contents of a junkyard from view at a given point on a highway, in many instances the junked materials are plainly visible at further distances. Therefore, the committee suggests that the General Assembly consider a memorial requesting Congress to amend the "Highway Beautification Act of 1965" to permit the use of federal funds for financing the actual removal and disposal of solid wastes in junkyards adjacent to Interstate and Primary highways (Appendix A).

Since 70 percent of the junkyards in Colorado are not covered by the federal act or Colorado's junkyard control law (S.B. No. 9, 1966 session), the committee considered the possibility of amending S.B. No. 9 to encourage local governments to assume responsibility in reducing the proliferation of junkyards, as well as to screen or enclose the yards from public view. The committee did not recommend such a proposal for four reasons:

1) adequate authority already exists for restricting the location of junkyards under local zoning ordinances;

2) local governments probably would be unwilling to enforce junkyard control in areas in which little or no interest has been expressed in planning and zoning;

3) the committee does not believe that screening of junkyards has solved the problem of increasing inventories of auto hulks; and

4) systems for the disposal of junked vehicles need to be developed prior to the development of restrictions on the proliferation of junkyards.

Alternate Proposal for Disposal of Auto Hulks

In view of the high costs of hand-stripping vehicles, the committee considered the feasibility of recommending a program to simply dispose of vehicle hulks, in the cheapest manner possible, without regard to conservation of scrap metal. Under this proposal, an auto body could be baled and placed in a landfill without the need to remove contaminants. This system would eliminate processing costs currently required to prepare a vehicle for the scrap cycle. To meet expenses of disposal either an annual fee (attached to the registration) or a fee paid at the time a vehicle is purchased could be instituted.

Prior to implementing a program for disposal of obsolete and wrecked automobiles, the committee believes that consideration needs to be given to the following factors:

1) The auto scrap industry requested time to solve its own problems. The processing of vehicle hulks for consumption in the scrap cycle is going through a period of transition in which hand labor is being replaced by machines. Although restrictions on open burning are making it more difficult for an auto wrecker or collector to function, changes in the production of steel probably would have forced the auto scrap industry to mechanize anyway. For example, the removal of contaminants by open burning, and the compression of an auto hulk into a bundle, never has provided a quality product that could compete with better grades of iron and steel scrap or iron ore. However, new methods of shredding auto hulks, currently employed in some of the larger metropolitan areas, reduce car bodies to small pieces in which copper, rubber, dirt, and other contaminants are easily segregated. These machines are capable of producing high quality scrap at low costs.

2) The development of shredders or fragmentizers is proceeding at a rapid rate nationally. Thus it appears that high quality auto scrap will be readily available to most of the nation's steel industry in the years ahead. Since scrap prices are fairly uniform throughout the country, an abundant supply of high quality scrap may encourage the steel industry to develop new procedures to permit greater use of scrap, particularly in Basic Oxygen Furnaces. Scrap processors also are hopeful that world markets for low-cost high-quality scrap may develop. In any event, it is possible that a future shortage of auto hulks could develop in the larger metropolitan areas, rather than an overabundance of wrecked and obsolete vehicles.

3) A vehicle hulk may retain its value as scrap metal for a number of years. Any "crash program" to dispose of vehicles in landfills could waste this valuable resource. Scrap metal is an important raw material in the production of iron and steel. Utilization of scrap metal reduces the steel industry's dependency on iron ore, thus conserving the nation's dwindling iron ore deposits. Furthermore, in periods of national emergency, scrap metal has played an important role in fulfilling demands for raw materials for iron and steel production.

4) Nationally, 85 percent of the automotive hulks in the United States are consumed in the scrap cycle.2 Roughly three-fourths of Colorado's wrecked and obsolete cars are also being

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2. Iron and Steel Scrap Consumption Problems, U.S. Department of Commerce, Business and Defense Services Administration.

processed for the steel industry. A subsidy system to move the remaining scrap vehicles (the "scrap gap") either into the scrap market or to some other disposal site could disrupt the present scrap system. Making more vehicles available for the scrap cycle could drive scrap prices lower, for example. Furthermore, there are a number of administrative difficulties in establishing a subsidy. Who is to be subsidized? How would vehicles be disposed of? If costs of disposal were greater in one county than another, would consideration need to be given to meet cost differences? What impact would the variation in a subsidy, if allowed, have on the scrap market? What kind of standards would be established for disposal? Finally, would a subsidy tend to discourage industry from investing monies to solve a scrap disposal problem?

In other words, if each municipality and county in a metropolitan area were provided with funds for disposal of vehicles, the supply of vehicles to the auto scrap market might fluctuate to a large degree. Private investors contemplating large scale methods of processing vehicles for scrap could be placed in an adverse position if a dependable supply of vehicles were not made available. In conclusion, a subsidy designed to dispose of as little as 15 percent of the obsolete and wrecked automobiles would appear to be premature, especially at a time when private industry may be able to solve its own problems.

In conclusion, the committee was hampered by a lack of technical information on an economically practical method of disposing of the excess auto bodies within Colorado. Therefore, the committee is considering recommending that independent researchers be employed to assist the committee and the Legislative Council in obtaining the needed data. The committee may make a specific recommendation in this regard for consideration by the 1968 General Assembly.

Refuse Disposal

The committee emphasized problems of refuse disposal rather than refuse collection. Refuse collection is considered to be a matter of local concern. For example, refuse collection usually is handled on a door to door basis, regardless of the type of disposal system utilized in a given area, and even in the event a disposal system is designed on a regional basis. With changes in technology, refuse collection procedures could eventually encompass transportation systems similar to that currently employed for liquid waste disposal. However, until the time individual trash pickup service is no longer needed, competition by local governments to provide for efficient trash collection services needs to be encouraged.

Refuse Disposal -- Matter of Public Health and Safety. Disposal of refuse, on the other hand, is concerned with public health and safety. Excessive competition in refuse disposal pro-

The problem of meeting health standards in the operation of landfills probably will not be as acute in the urban areas. The large volume of refuse to be disposed of lowers the per ton operating costs of urban fills. The heavily populated areas, however, will be faced with problems of diminishing availability of landfill sites in close proximity to central cities.

Metropolitan Problems

The volume of solid waste that must be disposed of in the urban areas of Colorado is expected to increase dramatically in the next few years. Although some of the increase may be attributed to population growth and changing methods of packaging of foods and other commodities, the bulk of additional waste matter that must be handled by community disposal systems previously was disposed of by means of backyard incineration or open burning at local dumps. Under Colorado's "Air Pollution Control Act," as amended,[3] backyard burning in the air pollution basins of the state is prohibited after January 1, 1970. This prohibition is significant because of of the volume of domestic trash that has been handled by backyard incinerators. For example, a pilot study of a selected group of Denver residents revealed that when a prohibition on backyard incineration was imposed on a voluntary basis, a 35 percent increase in the volume of trash handled by the city refuse crews was reported. The 35 percent figure is a minimum figure, because the study was conducted on a voluntary basis. Denver officials contemplate a possible increase of up to 50 percent in the volume of domestic trash at the time backyard incineration is prohibited. This increase in the volume of domestic trash is particularly critical to Denver officials, because Denver is in the unique position of providing a domestic trash collection service. Since domestic trash collection is supported from general revenues, any increase in trash collection expenditures compounds the budgetary problems of the City and County. A ban on backyard burning in adjacent counties, however, in no way affected the operating expenses of these counties.

The prohibition on open burning also prevents a reduction in the volume of waste after it has been delivered to a landfill. Therefore, the expected life of landfills is far less than that of open dumps of the past.

Solid waste disposal costs are dependent on two factors: 1) the cost of actually operating a disposal system; and 2) the expenses of transporting wastes from collection points to disposal sites. The second factor poses a major problem to urban centers.

3. Chapter 45, Session Laws of Colorado 1966, as amended.

The City and County of Denver, for example, is utilizing disposal sites in adjacent counties to meet its refuse problems. As haulage distances between collection points and landfill sites increase, however, transportation costs may exceed costs of the more elaborate methods of disposal of wastes such as composting, rail transit, or incineration, all of which may be located within the confines of the city. Thus a delicate balance exists between costs of transporting refuse and costs of disposal.

In an attempt to reduce transportation costs to the Lowry Bombing Range Landfill, the City and County of Denver established a transfer station in Southeast Denver. Refuse is shifted from collection trucks to large haulers at the transfer station, and, in turn, the haulers make a 14 mile trip to Lowry disposal site. Costs of the Lowry site are roughly 25 cents per yard. Unfortunately, transfer station costs and haulage costs to the Lowry site total about 55 cents per yard. In any event, the present transfer system has not proved to be a satisfactory answer to Denver's disposal problems.

Factors Influencing Development of Alternate Disposal Systems

Constant Supply of Refuse. An important factor to be considered in construction of incinerators, compost plants, or other sophisticated methods of waste disposal is a steady supply of refuse. In order to keep per unit costs of waste disposal to a minimum, a plant must operate at, or near, design capacity. If a plant is constructed to handle 1,000 tons of refuse per day, but only 500 tons of trash are processed per day, assuming that the same numbers of men and equipment are employed, operating costs will be far higher on a unit basis.

With this in mind, if trash pickup services are continued on a competitive basis, haulers will utilize the new plant only if it reduces their over-all costs or if the haulers are prohibited from disposing of wastes at other locations. The need for a new system of disposal may be obvious in the central area of a core city, i.e., haulage costs to suburban disposal sites are greater than the estimated disposal costs of the proposed plant. Unfortunately, in order for a plant to be economically feasible, a service area larger than that benefiting individual trash haulers may be required. For example, a situation could exist in which trash haulers operating well within the confines of a service area are content to deliver refuse to a proposed incineration plant. Lower transit charges offset higher disposal costs for these haulers. However, haulers on the outer limits of the defined area may find that their over-all costs are greater if the proposed plant is used. If the haulers in the latter situation do not dispose of refuse at the new plant, operating costs for all the haulers will increase. If the new plant is forced to increase dumping fees to meet expenses, the savings in transit charges to haulers in the central area also may be lost.

The committee believes that Senate Bill 225 gives local governments sufficient authority to provide a stable supply of refuse to disposal sites under their respective jurisdictions. Municipal officials may designate disposal sites while county commissioners are provided authority to limit the number of authorized sites in unincorporated areas of their counties. There is no provision, however, in Senate Bill 225 for the development of a regional approach to solid waste disposal. For this reason, local governments within metropolitan areas should cooperate in the planning of disposal sites in order that the method of disposal in one community may complement, rather than conflict, with the disposal system of another community.

Financing Disposal Systems. One of the problems private industry is faced with in attempting to obtain long-term financing for construction of solid waste disposal systems is the inability to obtain contracts with municipalities for periods longer than the term of office of the governing body. A contract negotiated with one city council, for instance, is not binding on a council elected at a later time. For this reason, industry cannot obtain a contract for handling a community's waste problem for more than a few years. Without a guaranteed supply of refuse to a firm, lending institutions are discouraged from financing disposal sites on a long-term basis. Of course, Senate Bill 225 permits a municipality to designate specific disposal sites; however, a succeeding council also could change the site designation. Thus, Senate Bill 225 does not provide a total answer.

The "Economic Development Revenue Bond Act," House Bill 1503, 1967 session,4 may offer local communities a means to assist private industry in the development of incineration or compost plants. Under this act, revenue bonds may be issued by local communites for the purpose of developing industrial or commercial enterprises. Long-term financing would be available since the maturity date of the bonds may be for a period up to forty years. Under the provisions of this act, private industry could lease a facility from local governments and also exercise an option to purchase the plant at a future date.

Local Government Authority

In addition to the powers provided under Senate Bill 225 and House Bill 1503, 1967 session, local governments are vested with authority to cooperate in the development of solid waste disposal systems. Article 2 of Chapter 88, C.R.S. 1963, permits local governments to contract with one another for a variety of purposes,

4. Chapter 330, Session Laws of Colorado 1967.

including the development of solid waste disposal sites. Concern has been expressed that counties are not including solid waste disposal, particularly the establishment of landfill sites, in the long-range county planning programs. The lack of planning may contribute to resistance on the part of some landowners to the location of landfills in close proximity to urban areas. Representatives of local governments reported that zoning authorities have approached the problem of designating dump sites or landfills through the use of temporary permits. Since the average landfill may be utilized for a few years only, local government officials believe there is no need for inclusion of sites in the long-range planning process. Furthermore, the opposition of property owners to the location of sanitary landfills in their respective jurisdictions may stem from a belief that the odious unsanitary dumps of the past are sanitary landfills. Public acceptance of sanitary landfills probably will improve with the adoption of modern sanitary practices.

Regional Solid Waste Disposal

The need for a regional program of refuse disposal for the Denver Metropolitan Area is not as critical as in other metropolitan communities in the United States because of the availability of landfill sites in the suburbs of Denver. Furthermore, the capacity of proposed disposal plants is limited by the economic necessity to keep haulage distances from collection points to disposal sites to a minimum, suggesting that the service areas required to maintain plants at maximum capacity need not encompass more than a portion of any one county in the Denver Metropolitan Area. Nevertheless, the committee believes that as the Denver Metropolitan Area continues to expand, the need for a regional approach to solid waste disposal will become more urgent. Therefore the committee recommends that the General Assembly consider the inclusion of solid waste disposal in any future proposal to amend the Colorado Constitution to permit regional or metropolitan governmental services.

SOLID WASTE

Solid waste may be described as firm or rigid material which is worthless to the owner. Solid waste includes garbage, refuse, and other non-liquid materials generated by industrial, commercial, and agricultural activities, as well as by individual homeowners. Junk cars, refrigerators, and other discarded metals come under the category of solid waste. With the mounting problems of solid waste disposal, perhaps the definition of solid waste needs to be expanded to include material that is not only worthless to the owner, but may hinder the owner from functioning effectively in his environment. For example, an auto salvage operator who strips and sells useable parts of wrecked automobiles for a living, is faced with the problem of disposing of the auto hulk once the parts have been obtained. Disposal of the hulk often is an unwanted expense to the auto salvage operator. Since salvage operators, particularly in metropolitan areas, must work within the confines of a limited area, the bulky auto bodies pose a handicap to the operation of their businesses.

Although solid waste may be classed into numerous categories such as domestic refuse, commercial and industrial refuse, junk cars, etc., for purposes of this report, the solid waste problem is treated in two parts: 1) automobile body disposal and 2) refuse disposal.

Automobile Body Disposal

Historically, automobile bodies have been a major source of scrap metal for use in the production of iron and steel. Disposition of auto hulks in the scrap cycle also has been the prime means of auto body disposal. Of course, auto bodies are used for riprap to support stream banks or simply deposited in dumps or landfills. Both of the latter methods of disposal pose problems. Needless to say the use of auto bodies as riprap is unsightly, particularly in the more desirable recreational regions of the state in which the mountain streams are an attraction. The bulkiness of auto bodies reduces the life of landfills unless compacted, and, even then, the density of an auto body complicates normal operating procedures.

In general, disposal of an auto body in the scrap cycle has a number of advantages. The use of scrap provides a cheap resource for the production of steel and reduces the drain on iron ore resources. Auto bodies are the second largest source of scrap steel, and with the growth in domestic use of automobiles, a steady market is assured.

Auto Scrappage in Colorado

The main receiver of scrap auto bodies in Colorado is the Colorado Fuel and Iron Steel Corporation, Pueblo, Colorado. CF&I receives scrapped auto bodies from collectors and auto wreckers

operating within a 400 mile radius of Pueblo. Automotive scrap used by CF&I comes from as far away as South Dakota, Wyoming, Western Kansas, Northern New Mexico, as well as Eastern Colorado. In view of the fact that CF&I serves such a large area, the supply of auto scrap generated far exceeds that needed by the CF&I plant. For instance, the amount of auto scrap used by the Colorado Fuel and Iron Steel Corporation amounted to about 210,000 net tons in the past five years, or roughly 280,000 vehicles. Nationally the average number of vehicles scrapped is about seven percent of total vehicle registrations; therefore, as many as 378,000 cars may have been scrapped in Colorado during this period. The number of auto bodies used by CF&I is estimated to be about 74 percent of the auto scrap generated in the state.

Scrap processors also reported that the high cost of transportation of auto scrap precludes shipment to other consumers of auto scrap in Kansas City and Provo, Utah. According to scrap processors the types of furnaces used in the Denver area also cannot handle auto bundles. Thus 100 percent of the auto scrap generated in Eastern Colorado, that finds its way into the scrap cycle, is sold to CF&I. The cost of shipping a baled auto body from Denver to Pueblo is $2.70 per ton.[1]

Problem

For the country, 1965 factory sales of motor vehicles exceeded 11,000,000 vehicles, and vehicle registrations climbed to over 50,000,000.[2] In comparison, vehicle registrations in the United States amounted to less than 50 million in 1950. Although automobile production varies from year to year, over-all growth in annual vehicle sales has increased by about 4,000,000 cars since 1950. Not only is the increased car production accounting for the tremendous volume of autos that must be disposed of, but the average car life of only ten to eleven years enhances the magnitude of the number of vehicles that must be disposed. In any event, an estimated total of 6,833,000 vehicles were scrapped in 1965. On the average, the number of vehicles scrapped is about seven percent of total vehicle registration.

The following summarizes the major factors handicapping the entry of junked vehicles into the scrap cycle:

1) The auto industry has increased the use of glass, rubber, plastics, and non-ferrous metals in the production of automobiles.

1. "Summary of Field Trip," Committee on Solid Waste, Colorado Legislative Council, July 18, 1967.
2. Automobile Body Disposal, A National Problem, U. S. Bureau of Mines, page 21.

These contaminants, to the steel making process, often are built into the structure of the vehicles, increasing the difficulty of removal. The cost of the conventional process of hand stripping contaminants now exceeds the value of a motor vehicle as scrap metal, especially since contaminants may no longer be removed by open burning in many sections of Colorado. Air pollution laws now restrict this cheap method of removing rubber, plastics, and other materials from the auto body.

2) New means of producing steel is resulting in a relative decrease in the demand for scrap metal. For instance, in 1963, only eight percent of the steel produced in the United States was made in Basic Oxygen Furnaces (BOF). By 1975, it is estimated that the amount of steel produced by the BOF process may exceed 50 percent of the total steel production. Since the amount of scrap used in the BOF process is limited to about 30 percent of the total raw material charged in the furnaces as opposed to an open hearth furnace which may use from 40 to 80 percent scrap,[3] the relative volume of scrap utilized in steel production probably will decline.

3) Reduced demand for scrap, in turn, drives the price of metal scrap lower, making economical preparation of auto scrap more and more difficult.

Again, traditional means for preparation and processing auto bodies for use by the scrap industry no longer provides an adequate solution for disposal of the nation's junked cars.

The Auto Hulk and the Scrap Cycle

The auto wrecker is the initial receiver of older obsolete automobiles, as well as the wrecked late model vehicles. The auto wrecker's primary business is salvaging parts for resale. A late model automobile may have a parts value of up to $700, while vehicles ten years of age and over have little parts value to the wrecker.[4] Once saleable parts have been removed from the vehicle, the wrecker or a scrap collector prepares the auto hulk for the scrap market. All contaminants, including glass, plastics, rubber, copper and other materials must be removed from the auto body. In the past, contaminants have been removed either by hand stripping or burning, usually by a combination of both methods. Technically, the auto wrecker is not considered a part of the scrap industry since his interest is in the value of used auto parts.

3. Iron and Steel Scrap Consumption Problems, U. S. Department of Commerce, Business and Defense Services Administration, page 13.
4. "Minutes of Meeting," June 15, 1967, Committee on Solid Waste Disposal, Colorado Legislative Council.

The auto hulk first enters the scrap stream when the wrecker delivers the auto hulk to a collector or to a processor. For instance, prior to the ban on open burning, auto wreckers often were able to sell an auto hulk to a collector who hand stripped or burned contaminants from the vehicle for delivery to a central location. In many instances, however, the auto wrecker acts in the capacity of a collector and is responsible for removing contaminants from the hulks. In general, a collector may be a small operator that scours an area for all saleable objects or a large firm that processes scrap for the steel maker.

From the collector the scrap moves to the "processor" who takes the auto hulks or other unprocessed ferrous scrap and prepares it to meet specified size, form, and quality demands of the so-called "consumer" (steel mills and foundries). There are approximately 1,800 processors in the United States.

The prepared ferrous scrap moves from the processor to the steel mills through the hands of a "broker." A broker acts as a middleman between the processor and the consumer of ferrous scrap. Of the approximately 200 brokers in the United States, roughly 150 of them also operate processing yards. In addition to the function of middleman -- distributing orders for scrap metal among the processors for the shipment of the scrap to the steel mills -- the brokers frequently arrange for the shipment of prompt industrial scrap directly from the fabricators to the consumer of the scrap metal. Table I graphically illustrates the flow of ferrous metals in the scrap market.

Types of Scrap by Source

There are two basic classifications of scrap: (1) home scrap, or scrap that originates in the iron-steel industry, and tends to be used there; and (2) purchased scrap. Purchased scrap can be further subdivided into prompt industrial scrap, which is produced as a waste by-product in the metal fabricating industries, and obsolete scrap which is the primary business of the scrap metal industry. Auto hulks, of course, fall in the category of obsolete scrap. During recent years home scrap has accounted for around sixty percent of the total scrap consumed; prompt industrial scrap has accounted for about sixteen percent and obsolete scrap for about twenty-four percent.

Grades of Scrap. In order to meet the needs of the scrap consumer, purchased scrap is separated into different types, or grades. Of the many grades of ferrous scrap metal (1961 specifications of the Institute of Scrap Iron and Steel list forty-three grades of alloy-free scrap), the following are the most commonly used categories:5

5. Iron and Steel Scrap Consumption Problems, U. S. Department of Commerce, Business and Defense Administration, pages 5 and 6.

Table I

FLOW OF FERROUS SCRAP IN THE SCRAP METAL CYCLE

	(1)	(2)	(3)	(4)	(5)
Scrap Metal (A)1	Originated Scrap---- (includes auto bodies)	Collector---- (this group may include the auto wrecker)	Processor---- (prepares the scrap for the steel mill)	Broker---- (acts as middle-man in the sale of processed scrap)	Steel Industry: (melts the scrap to produce steel)
	(1)	(2)	(3)	(4)	(5)
Wrecked Auto (B)2	Automobile-----	Auto wrecker---- (Here the auto is stripped of all contaminating materials)	Processor---- (The auto is cut, compressed, shredded, or processed in an acceptable manner for the steel mill)	Broker---- (same as above)	Steel Industry: (same as above)

1. Line A, shows the processes that all scrap metals usually follow as they move through the scrap cycle.

2. Line B, for purposes of illustration and comparison, follows the path that is normally taken by a wrecked or abandoned automobile in the scrap cycle.

"(1) No. 1 Heavy Melting Steel. This may be not larger than 5 feet by 2 feet by at least one-quarter inch thick. This type of purchased scrap, usually of obsolete material, is obtained from heavy capital goods such as structural shapes, tank plates, ship sides, boilers, and bars.

"(2) No. 2 Heavy Melting Steel. This is essentially the same as No. 1 except that it can be as thin as one-eighth inch. This class is subdivided into two size groups, one up to 5 feet by 2 feet, the other up to 3 feet by 1 1/2 feet. Automotive slab (see item 7 below), a recently developed form into which old automobiles are processed, is often classified in this category.

"(3) No. 1 Busheling. This consists of loose light material, mostly new but including some obsolete (except old auto body and fender stock), which may not exceed 1 foot in any dimension.

"(4) No. 1 Bundles. These are made up principally of prompt industrial scrap, and consist of sheet clippings compressed mechanically into bales or bundles weighing not less than 75 pounds per cubic foot. This is a premium scrap because it is made up of new material of known composition, free from contaminants and usually free of rust.

"(5) No. 2 Bundles. These constitute a less expensive item and are made up of old black and galvanized material, often auto bodies, compressed to a density of not less than 75 pounds per cubic foot. Tin or lead coated material or enameled stock may not be included. Although the auto body sheet material is of good quality steel, a problem arises from contamination resulting from incomplete removal of parts in which nonferrous metals or nonmetallic materials are present.

"(6) Bundle No. 2 Steel. This is comparatively new and growing type of steel scrap, a variant of the No. 2 bundle. It is an automobile bundle including the frame. As compared with the No. 2 bundle, it tends to be higher in metallic return and lower in contaminants, because the frame is lower in contaminants than the body.

"(7) No. 2 Automotive Slab. This is another comparatively new type of steel scrap -- often classified as a form of No. 2 heavy melting steel scrap -- into which old automobiles are increasingly being processed. The method of processing is to partially compress the stripped automobile, and then to slice it with a shear into a number of slabs. In contrast with No. 2 bundles, much of the nonmetallic dirt is eliminated by this process. Furthermore, the smaller size of the pieces makes it physically more acceptable for use in electric furnaces than No. 2 bundles.

"(8) Shredded (or Fragmented) Scrap. This is a new type of scrap which has not yet been included in the commonly used specification lists. It consists of small pieces of chopped up automobile bodies and similar materials, from which dirt, other nonmetallic materials, and nonferrous metals have been largely removed. These

pieces generally range from one-half inch up to 8 inches in length or width, although a small proportion (less than 10 percent) may range up to 12 inches. The thickness is dependent on the nature of the part of the car from which cut.

Qualitywise, shredded scrap is much superior to most No. 2 bundles, bundled No. 2 steel, or automotive slab, the other forms in which this type of scrap material is processed. As yet it is produced by only a few companies, and consumed by only a few iron and steel producers. The annual production of shredded scrap is well over 1 million tons, most of which is accounted for by one large producer. It is particularly well adapted for use in electric furnaces, where virtually all of the current supply is utilized.

"(9) Steel Turnings and Iron Borings. These are the residue from various machining and fabricating operations in converting iron and steel into capital and consumer goods. They are primarily used in blast furnaces. However, sometimes borings are briquetted for charging into gray iron foundry cupolas. A method was recently developed for using borings in sintering.

"(10) Several Grades of Steel and Cast Iron Used Primarily by Iron and Steel Foundries: Crops (ends) from billets, blooms, bars, and forged material; structural shapes and plates; cast steel (includes broken car wheels); hard steel (auto rear ends, crankshafts, front axles, springs, and gears); cupola cast (broken motor blocks and similar cast iron material); charging box scrap; and heavy breakable cast."

Scrap Use by Types of Steel Making Operations

There are essentially two basic classifications of steel producing companies: 1) the integrated company, and 2) the nonintegrated company.

The nonintegrated producer, (one that does not have blast furnaces for the production of pig iron from iron ore) who must buy cold pig iron at prices far above those of scrap metal, consequently uses a high proportion of scrap to the total metalic output (70 percent or more). However, the quantative importance of the nonintegrated producer has decreased in recent years and now represents only a small proportion of the total steel production today -- about eight percent.

Integrated producers are companies that generally produce their own pig iron, (hot metal) in their own blast furnaces, often obtaining the ore from their own mines. Because the integrated companies are capable of producing their own pig iron, they normally use considerably lower proportions of scrap than the nonintegrated companies. For example, in 1963, the proportions of scrap used in the open hearth furnaces of the integrated companies was thirty-nine percent (roughly three-fourths of this is home scrap), compared with an eighty percent use of scrap in the open hearth furnaces of the

nonintegrated producers. The primary reason for the lower scrap proportion used by the integrated companies is that their pig iron costs are far lower than the nonintegrated companies. The lower costs to the integrated producers stems partially from the fact that they can use the pig iron in its molten state (hot metal) thus saving on the cost of "casting the pigs" as well as the costs of the fuel and heat that would be necessary to raise the cold metal to melting temperatures.6

Basic Oxygen Furnace. Of major importance to the use of auto hulks and other scrap metal has been the introduction of the Basic Oxygen Furnace in 1954. According to CF&I officials, the BOF furnace can produce the same amount of steel in one hour that the open hearth furnaces can produce in from 12 to 15 hours.7 Nationally, steel production in the BOF furnaces accounted for 12 percent of the nation's steel production in 1964.8 By 1975, production of steel in BOF furnaces may exceed 50 percent of the total steel production in the United States.

This technological change is important to auto body disposal because, according to CF&I officials, Open Hearth Furnaces often are charged completely with scrap metal. Auto scrap is mixed, on approximately a 50-50 basis, with other higher grades of scrap to reduce the impurities contained in the auto scrap or No. 2 Bundles. The BOF furnace, on the other hand, utilizes 70 percent iron ore and only 30 percent scrap. Not only is there a substantial reduction in the amount of scrap used in the BOF, but a reduction in scrap use tends to lower the price of scrap as well as increasing the supply of quality scrap (grades other than bundled auto bodies).

Electric Furnaces. Another new development in the production of steel is the Electric Furnace. The Electric Furnace makes a positive contribution to the scrap metal industry because of the high percentage of scrap used in the process. Approximately 98 percent of the charge is scrap metal. Unfortunately, Electric Furnaces are not the total answer for the scrap industry. For instance, the amount of steel to be produced by Electric Furnaces by 1975 is expected to be only 15 percent of the total steel produced in the United States. Also, the quality of scrap demanded by Electric Furnaces is such that bundled automobile bodies presently do not meet quality standards demanded by users of Electric Furnaces.

6. Ibid. page 10.
7. "Minutes of Meeting," September 6, 1967, Committee on Solid Waste Disposal, Colorado Legislative Council.
8. Automobile Body Disposal, prepared for the Inter-county Regional Planning Commission by Thomas B. Garland, Denver, Colorado.

Impurities in Steel Scrap

One of the prime reasons for classifying steel scrap is to segregated scrap bundles with a large amount of contaminants. Unfortunately, Number 2 Bundles (auto bodies) often contain substantial amounts of copper and sulphur. The problem arises, not from the quality of the body steel which is excellent, but from various accessories, trimmings, wire, etc. Auto wreckers or collectors attempt to remove contaminants, but the extent of removal varies considerably from dealer to dealer. As previously mentioned, the removal of impurities often involves considerable hand labor which discourages the wrecker from delivering a completely stripped hulk to the scrap processor. In turn, the processor is unwilling to further clean the hulk, and the end result is a low classification of the quality of a Number 2 Bundle.

Another important reason for the reluctance on the part of steel mills to accept the Number 2 Bundles is the difficulty in determining the quality of the scrap contained in a Number 2 Bundle. This has tended to make the consumer unwilling to pay a higher price for better quality bundles of Number 2 Scrap, and, as a result, the processor is unwilling to put more effort in producing higher quality bundles.

Furthermore, the use of contaminated scrap tend to cumulatively raise the impurity level in the basic steel stock. If all other conditions remain the same, increased use of scrap in basic steel production today might lower the proportion of scrap which could be used in the future. As a result, the raising of the contamination level in the basic steel stock ultimately operates to the disadvantage of the scrap metal industry. This situation was well summarized in a recent industrial publication:

> For many years, traces of copper in scrap steel were quite acceptable to steel mills. But these trace amounts kept increasing in a progressive manner. This is because the cycle of scrap-to-ore-to-finished product led to more residual copper in an almost never-ending cycle. On top of that, the increasing electrical nature of our civilization placed more pure copper in the scrap bundles..."[9]

Some steelmakers make use of Number 2 Bundles because of the low price, but they do not use enough to risk the danger of contamination rising above acceptable levels. A relatively large proportion of Number 2 Bundles can be used in the making of such items as concrete reinforcing bars, small shapes and angles, floor plate, etc., because in the making of these products greater tolerance of impurities is allowable.

9. Machine Design, July 7, 1966, page 116.

Volume of Auto Body Scrap Utilized

The Colorado Fuel and Iron Steel Corporation reports that for the past two years approximately 300,000 net tons of scrap metal was purchased. Of this amount, 50,000 tons was made up of bundled auto bodies, or 16.67 percent of the total scrap purchased. For the most part, however, bundled auto bodies may be used only in the Open Hearth Furnace. For instance, the Basic Oxygen Furnace's thermal requirements limit the use of scrap metal to about 30 percent of the total charge. Of the scrap metal used in the BOF, only a small fraction is bundled auto bodies, because a bundled auto body is not suited physically to be consumed in a BOF. On the other hand, Number 2 Bundles account for as much as 25 percent of the scrap charge of an Open Hearth Furnace. For example, a typical charge to the open hearth might be as follows:

100,000 lbs. of No. 2 Bundles;

100,000 lbs. of mill generated scrap; and

200,000 lbs. of No. 2 heavy melting scrap.

Technically Feasible Variations in the Proportion of Scrap Used in Steelmaking [10]

Technically feasible use of scrap means the amount of scrap that could be physically introduced into the steel making process. The fact that a higher proportion of scrap would increase operating costs, production time, amounts of fuel used, etc., is ignored.

Open Hearth Furnaces that use hot metal for a portion of the metal fired (called the "charge"), in the furnace, could increase the proportion of scrap now used from forty percent to around eighty percent. (See Table II.) Open Hearth Furnaces that use essentially a cold charge, however, could not practically increase the percentage of scrap metal beyond the present eighty percent. The Basic Oxygen Furnaces could, under present technology, theoretically increase the percentage of scrap metal now used from twenty-eight percent to nearly fifty percent and this could be pushed as high as one hundred percent if certain modifications were made. In all cases, the increase in the percentage of scrap used would depend on the type and quality of the steel being made. Electric Furnaces, both in the steel mills and in the castings industry, cannot increase the scrap proportion, since they are already using nearly one hundred percent scrap.

10. Iron and Steel Scrap Consumption Problems, U. S. Department of Commerce, Business and Defense Services Administration, page 13.

Table II

TECHNICALLY FEASIBLE MAXIMUMS IN THE SCRAP PROPORTION OF TOTAL METALLICS[a] USED IN THE MAKING OF IRON AND STEEL IN THE UNITED STATES[a]

Type of furnace	Scrap as percentage of total metallics used[b]: Actual in 1963	Scrap as percentage of total metallics used[b]: Technically feasible[b] maximum
Steelmaking (all types)	46 %	79 %
Open hearth	41	80[c]
Hot metal shops	39	80[c]
Cold melt shops	80	80[c]
Electric	98	98
B.O.F.	28	50 (or more)[d]
Bessemer	10	20
Castings production (all types)	75[e]	---
Cupola	77[e]	100[g]
Electric and other	98[e]	98
Pig iron production (blast furnace)	15[f]	100

a. Although technically feasible, it will often be impractical to radically change customary scrap proportions, because steelmaking time is likely to be increased or particular specifications may be difficult or impossible to meet. Estimates of maximum proportions are based on judgment of BDSA industry specialists, based both on published materials and their own experience.

b. Total metallics in this table includes only pig iron and scrap, except for pig iron production, for which the iron content of iron ore is included.

c. The maximum could literally be pushed to 100 percent scrap, but the cost and quality control problems introduced would make it impractical. For cold melt shops, the 80 percent scrap proportion requires a substantial proportion of cast iron scrap; the proportion would be 70 percent if only steel scrap were used.

d. The maximum proportion would rise to about 60 percent if scrap were preheated to 1250°, and 100 percent if oxygen fuel lances were used. These techniques, however, have not yet been used commercially.

e. Total based on castings production only, but separate figures for cupola and electric and other include the noncastings production of these furnaces as well.

f. Castings output is measured by shipments rather than production figures.

g. Most cupolas can use 100 percent scrap only if a substantial proportion of the scrap is cast iron.

Source: Iron and Steel Scrap Consumption Problems, U. S. Department of Commerce, Business and Defense Service Administration, March, 1966, page 14.

Cost of Preparation of Auto Scrap

Table III lists the relative cost for preparation of auto hulks and the amount paid by scrap consumers in Colorado for vehicles processed into scrap. The initial cost of an auto hulk to a wrecker is roughly $4.00 per ton -- the approximate weight of an average auto body including chassis and engine block. Hand-stripping costs range from $15 to $20 per vehicle, bringing the total cost to the collector to $24. The processor, in turn, pays about $13 per ton for an auto hulk delivered to the processing plant, thus the collector or auto wrecker's loss is roughly $6 to $11 per vehicle. Present steel scrap prices for Number 2 Bundles also are insufficient for a processor to make a fair return. The costs of bundling or compressing the auto hulk ranges from $8 to $10. This amount, plus the initial purchase cost of $13, raises the processor's costs from $21 to $23 per ton. Present scrap prices paid by the steel industry are about $21 per ton.[11]

Table III

Comparison of the Costs and the Prices at Different Points in the Wrecking and Disposal of an Automobile

Price Paid for the Automobile	Costs to the Person Handling the Wrecked Automobile
CF&I -- $20 to $21 per ton for usable auto scrap	
Processor -- $13 per ton for the auto hulk delivered at their plant	$8 to $10 per hulk for processing
Wrecker -- $4 per ton, at the salvage yard	$15 to $20 per hulk to hand-strip the automobile for the processor

11. "Minutes of June 15 Meeting," Committee on Solid Waste Disposal, Colorado Legislative Council, page 5.

New Programs to Improve Quality of Auto Scrap

In general, following removal of contaminants by a collector or auto wrecker, the traditional method of handling auto bodies is to compress or bale the hulks to a uniform size commonly referred to as a Number 2 Bundle. The baling of an auto body is accomplished in the following manner. The automobile hulk, minus the frame, engine block, and axles, is placed in a bin and other "loose" scrap metal is added to produce a final bundle of a fairly uniform size and weight (1,500 pounds). On two sides of the crushing bin are hydraulic presses (rams). The face of one ram covers the width of the bin. This ram is used to compress the steel scrap toward one end of the bin, and once the first ram has been fully extended the second ram compresses the scrap steel into a bundle approximately five feet long and two feet square. The larger hydraulic pressing arm has a compressing capacity of 500 tons, while the smaller ram compresses at a pressure of 700 tons. The heavier capacity of the second pressing arm is due to the fact that it must compress the steel scrap that has already been partically compressed by the first pressing arm. All that is accomplished by compression of the hulk into a Number 2 Bundle is a reduction of vehicle bulk to a size that can be handled in the production of steel. The quality of the product is not improved at this time.

With this in mind, two basic steps are needed to improve the marketability of auto scrap: 1) a higher quality of metal needs to be produced by reducing contaminants; and 2) cost of preparation must be reduced to improve the desirability of the product.

Guillotine Shears. To improve the condition of the auto scrap market, industry's first step after the development of the "baler" was the development of a "hydraulic guillotine shear." The shear reduces auto hulks to small pieces, and metals and nonferrous materials are separated by magnetic and vacuum systems. Advantages of the guillotine shear is its large capacity, adaptability to mechanized feeding, and speed of operations.[12] Slab shears also are a relatively new development. An auto hulk is compressed to two-foot widths, six inches thick, and then sheared off into 18 inch lengths weighing roughly 150 pounds. The advantage of a slab shear is that it allows visual inspection of contamination and the consumer is willing to pay more for a quality product.

Shredding. Perhaps the major breakthrough in the processing of automotive scrap is the development of shredders or fragmentizers. Cost of these machines range from $300,000 to $3,000,000 with capacities of 1,000 cars per day. Large capacity shredders (200,000 tons per year and over) currently are operating in Everett, Massa-

12. Automobile Disposal, A National Problem, U. S. Bureau of Mines, page 43.

chussetts; Chicago, Illinois; Bellville, Michigan; Kansas City, Missouri; Houston, Texas; and Los Angeles. Similar fragmentizers are scheduled for operation in 1967 in Danbury, Connecticut; Baltimore; San Francisco; Jersey City; Newark; Philadelphia (two); Detroit; and Cleveland.[13]

The high construction and maintenance costs of fragmentizers suggest that a minimum supply of 500 automobiles per day is needed to economically sustain these operations. The large metropolitan areas of the United States are providing a volume of auto scrap that will support the development of huge fragmentizers. Since only about 32,000 cars are scrapped in the Denver area each year, a smaller shredder could handle the needs of Metropolitan Denver. Smaller capacity fragmentizers may be obtained at a cost of upwards of $300,000 that would provide a capacity of 20,000 tons or more of scrap per year. Scheduled for 1967 alone, fragmentizers with capacities under 200,000 tons are suppose to be built in eleven cities -- Buffalo, New York; Syracuse, New York; Saginaw, Michigan; Toledo, Ohio; New Orleans, Louisiana; Albuquerque, New Mexico; and Beaumont, Texas. Plans are also in the offering for developing fragmentizers in many other localities. No doubt, the impact of air pollution restrictions and the federal "Highway Beautification Act" have acted as catalysts for these new developments in the scrap industry.

According to a survey by Steel magazine, small and medium size shredders may meet the needs of communities outside of the large metropolitan areas; however, the smaller machines probably could not compete directly with the larger operations. In any event it is possible that in order for the multi-million dollar investments to be made for shredding machines, industry must be sure of a market, suggesting that steel mills and foundries may become more involved in the scrap business.[14]

Shredding Reduces Contaminants. Shredding of contaminated scrap seems to offer a satisfactory solution to the problem of contaminated Number 2 Bundles and similar materials. This process, essentially, reduces such scrap materials as automobile bodies, refrigerators, washing machines, etc., into small pieces generally ranging from one-half inch to twelve inches in length or width. The thickness of the pieces depends upon the size of the material from which they are cut. Shredding operations allow the magnetic separation of nonferrous metals. (The valuable nonferrous metals can then be sorted and sold.) After shredding is completed the ferrous scrap is heated in order to melt or burn off as much of the remaining nonferrous contaminants as is economically feasible. Temperatures sufficient to melt off all nonferrous metals except copper,

13. Steel, December 12, 1966, pages 65, 67 and 68.
14. Steel, December 12, 1966, page 68.

which melts at around 2,000 degrees Fahrenheit, are standard for this process. The hot metal is then moved through some form of a rolling or tumbling process to break loose the remaining contaminants. One important accomplishment of the shredder is the reduction of dirt which may make up to ten percent of the weight of a baled auto body.

According to Steel magazine, the Newell Manufacturing Company (Texas firm) is considering the construction of a shredding machine in Denver, Colorado. This machine would have a capacity in the neighborhood of 35,000 to 40,000 tons of scrap annually.

Proposed Machine -- Denver Auto Wreckers. The Committee on Solid Waste Disposal visited a working prototype model of a shredding machine at the Wassinger Auto Wrecking Company in Denver. The machine would provide a three stage operation. (1) The entire, unstripped auto, minus the engine and axles, is placed in a shearing device which cuts the automobile into pieces roughly eighteen inches square. (2) These small pieces are then moved by conveyor to an oil fired, afterburner type incinerator. The pieces of scrap metal move through the incinerator on a continuous belt. In the incinerator, temperatures in the neighborhood of 2,000 degrees fahrenheit, will purportedly burn all contaminants from the scrap metal and hopefully will be hot enough to melt away such unwanted metal as copper. Large quantities of copper, of course, will have to be removed by hand, but the value of the copper may cover the cost of this operation. In addition, with the afterburner, the incinerator is supposed to meet air pollution standards. (3) From the incinerator the burned scrap is moved, by conveyor, to a shaker that shakes loose all ash, dirt, and other materials that are left. The finished scrap steel is loaded, by a continuous conveyor, into a truck for delivery to the steel mill. Eventually, it is hoped that when the larger machine is placed in operation between 350 and 450 cars per day can be processed.

Taconite Process. The U. S. Bureau of Mines is producing 95 percent pure iron from a low grade iron ore (taconite) by roasting auto scrap and taconite in a rotary kiln. This process has the dual advantage of meeting the growing problem of junked automobiles, as well as tapping sources of hitherto unused taconite. Consideration is being given to a combined operation in which an incinerator plant for disposal of refuse would generate the heat needed to upgrade taconite ore for use in the production of iron and steel.[15]

15. "Minutes of Meeting," September 6, 1967, Committee on Solid Waste Disposal, Colorado Legislative Council.

Junkyard Control In Colorado

The incapacity of the auto wrecking industry to minimize inventories of junk cars, as well as the economic inability or unwillingness on the part of the wreckers to improve so-called "environmental standards," is resulting in increased concern over the unsightliness of auto wrecking yards or junkyards adjacent to the nation's highways. With over 6,800,000 vehicles junked each year, and with the rather slow turnover or disposition of the vehicles once they are no longer operating, volume of junked vehicles appears to be growing. For example, a survey of Pueblo County auto wrecking yards reveals that the ratio of disposals to number of vehicles on hand indicates that 31 months elapse during the time a vehicle passes through the average wrecking yard in the Pueblo area.[16] In order to limit junkyards adjacent to the nation's highways, as well as to improve the sightliness of the yards, the federal government is encouraging the states to take steps for junkyard control.

Title II of the "Highway Beautification Act of 1965" (P.L. 89-285) calls for the control of junkyards adjacent to the Interstate and Primary federal highway systems in order to protect the public investment in the highway program, to promote safety, to improve the recreational value of the highways, and to preserve the natural beauty of the landscape. To foster the purposes of the act, states must control junkyards within 1,000 feet of Primary or Interstate systems or face the possibility of loss of ten percent of federal aid for highway construction. For fiscal year 1966-67, a ten percent loss in federal highway construction funds would reduce the Highway Department's revenues by an estimated $5,090,000.

According to subsection (c) of section 201 of the "Highway Beautification Act," effective control of junkyards may be achieved by screening or removal. Screening may be accomplished by planting, fencing, or other appropriate means of hiding junkyards from the motorist's view.

Colorado Law

To implement the federal Highway Beautification Act, the General Assembly enacted Senate Bill No. 9, 1966 session, which requires that a permit must be obtained from the Department of Highways prior to operating a junkyard within 1,000 feet of the federal Interstate or Primary systems.[17] Furthermore Section 9 of the act provides:

16. Automobile Disposal, A National Problem, U.S. Bureau of Mines, page 128.
17. Chapter 7, Session Laws of Colorado 1966.

Section 9. -- Screening, removal of existing junkyards. -- Any junkyard in existence on the effective date of this act which is not in compliance with this act, shall, at the expense of the department, be screened, as provided by regulations, by natural objects, plantings, fences or other appropriate means so as not to be visible from the main-traveled way of the highway or, at the expense of the department, shall be removed from sight. The department is hereby authorized to acquire, move, or relocate property, real or personal, or interests therein, by purchase, donation, condemnation, or by exchange of other property owned by the state to accomplish such objectives, and to dispose of any property, real or personal, acquired thereby.

Colorado law delegates specific authority to the department to permit the purchase of junked vehicles.

Federal Regulations

The control of junkyards adjacent to the Interstate and Primary systems is basically a federal program. With this in mind, the Highway Department's approach to the control of junkyards is largely dependent on federal regulations and on the extent and availability of federal funds for alternate methods of control. In general, federal regulations appear to give the states wide latitude in developing procedures for screening or removing junkyards.

Federal regulations for the control of junkyards are outlined in the Policy and Procedures Memorandum (PPM 80-9), March 31, 1967, published by the Bureau of Public Roads. Section 6 of this memorandum "Control of Junkyards," is contained in Appendix B. In brief, these regulations provide:

1) that junkyards adjacent to Primary or Interstate highways must be controlled except for junkyards in legally zoned industrial areas or in unzoned industrial areas approved by the secretary;

2) the federal administrator may approve federal participation in costs of meeting more stringent state standards;

3) if only a portion of a junkyard lies within a control area, only that portion in the control area may be screened at federal expense;

4) federal reimbursement is on the basis of 75 percent of costs of screening or removal;

5) federal participation in the costs of removal of junkyards is based on the costs of a) acquiring minimum real property interests necessary, plus the cost of removal of the personal property including junk; or b) the removal and land rehabilitation of garbage dumps and sanitary landfills; and

6) the state may select alternate methods of disposing of junk; however, federal participation is based on a cost-to-cure amount.

The latter regulation is particularly important, because the federal government will participate in the cost of disposal of junk vehicles only to a minimum degree. For instance, if the cost of screening a junkyard is less than the cost of moving the junked vehicles to a new area, the federal government will only contribute funds sufficient to cover the cost of screening. Section 4e -- "Guidelines for Cost Estimates" -- of PPM 80-9 also permits limited federal reimbursement in the event a state elects to move junk vehicles into the scrap cycle. For instance, section 4e states:

"Maximum distance of a move of junk shall be determined on the basis of a relocation site that would serve the same general community or metropolitan area, or a move to the nearest market point for processing or reuse, if no more costly, or a move to a disposal point by the state..." (Emphasis added)

In any event, according to Art Libby, Regional Right-of-Way Engineer, Region Nine, Federal Highway Administration, the federal government is interested in controlling junkyards adjacent to the Interstate and Primary systems in the most economic manner possible. Under present federal regulations, the federal government participates in junkyard control only to the extent necessary to screen or remove from view junkyards adjacent to the aforementioned highway systems. Although the federal government is not particularly interested in the manner in which the state eliminates junkyards adjacent to Interstate and Primary highways, federal funds are restricted to the most economical method (based on federal purposes of control).

Mr. Libby also points out that the allocation of costs for junkyard control is determined on the basis of each individual yard that must be screened or moved. In the event the state elected to utilize a portable crusher to handle the disposal of auto hulks, federal participation, if allowed, would still have to be based on the minimum projected costs of screening and moving individual yards.

Problems of Purchasing Junkyards

Colorado law permits the purchase of junkyards by the Highway Department. A problem exists, however, with respect to determining the parts value of junked material. In other words, the value of an auto hulk to be used for scrap depends on the market value of iron and steel scrap. Auto parts, on the other hand, which may be sold to many individual customers fluctuate in value, usually based on the model of a vehicle. For instance, a wrecked late-model automobile may have a parts value of as high as $700. In other words, because of the difficulty of placing an acceptable average price on salvaged parts, the purchase of auto junkyards is made more difficult.

Junkyards Adjacent to Interstate and Primary Systems in Colorado

A survey by the Department of Highways reveals that a total of 134 auto junkyards are located adjacent to Interstate and Primary highways in Colorado. These junkyards, of course, are located outside of municipalities or unzoned industrial areas which are not covered by the federal and state laws.[18] On the interstate system, eight junkyards are located in a manner that screening is not feasible, and control of these yards can only be accomplished by removal. Seventeen other junkyards adjacent to the Interstate could be screened. The total estimated cost for the screening and removal of the 25 junkyards adjacent to the Interstate is $277,000.

On the Federal-aid Primary Highway System there is a total of 109 junkyards which must be moved or screened. Of this number, 81 yards could be effectively screened, while the remaining 28 must be moved. The estimated cost for moving and screening the junkyards on the Federal-aid Primary Highway System is approximately $1,500,000. The entire cost for the screening and removal of junkyards on the Interstate and Primary highways within Colorado is estimated at $1,750,000. Again, these cost estimates do not include junkyards along toll roads; junkyards entirely on the right-of-way; and junkyards in zoned and unzoned industrial areas, which are excluded under the "Highway Beautification Act of 1967."

According to Robert Musgrave, Supervising Engineer, Colorado Department of Highways, confusion exists as to what constitutes unzoned industrial properties, as provided under the federal act. Upon the recommendation of state officials, the Secretary of Transportation may designate an area as an unzoned industrial site, which would permit a junkyard to be excluded from the provisions of the federal act. However, Colorado law, section 3 of chapter 7, Session Laws of Colorado 1966, makes no provision for unzoned industrial areas. For instance, section 3 provides, in part: "...No permit shall be required...within areas adjacent to said highways which are within one thousand feet of the nearest edge of the right-of-way which are zoned industrial under authority of state law, or any of its political subdivisions." Again, no mention is made of unzoned industrial property in the state act.

Junkyard Control to Date. In fiscal 1966, the federal government allotted in excess of $88,000 to Colorado for the screening or removal of junkyards. (The "Highway Beautification Act" -- PL 89-285 -- permits 75 percent federal financing of the cost of removal or screening junkyards.) The state share amounted to over $32,500 for a total of over $120,500 available to the Colorado Highway Department for junkyard control in 1966. As of July 31, 1966, the department actually spent almost $22,000 on screening or removal

18. Section 3 of Chapter 7, Session Laws of Colorado 1966.

projects. According to Fred Merton, Assistant Chief Engineer, Colorado Highway Department, any funds allocated for junkyards control carry over at the end of each fiscal year as long as the monies are earmarked for specific projects.

In September of 1967, roughly $150,000 was available for junkyard control in Colorado -- $112,500 in federal monies and $37,500 in state monies. To date, $105,000 has been allocated for specific project agreements, while about $9,000 has been allocated for preliminary surveys and engineering. Unobligated junkyard control monies total $35,000.

Removal Costs. As of August 11, 1967, the department had either let bids or made agreements to remove or screen eleven yards at a total estimated cost of $133,000. Agreements have been reached with owners as to compensation for damages and moving bids have been approved for six junkyards. The total actual cost for moving the six yards from within 1,000 feet of highway rights-of-way is $65,870, for an average moving cost of $10,978 for each yard (see Table IV). Moving costs cover not only the actual amount of money necessary to remove them from sight but also to compensate the owners for damages.

Screening Costs. The Highway Department agrees to screen three junkyards at a total cost of $34,953. This is an average of $11,651 per yard. At first glance, the cost to the Highway Department for screening three junkyards exceeded, on the average, the cost of removing eight junkyards. Information in the Denver Office of the Highway Department does not show whether or not the average costs that can be computed from present junkyard removal or screening operations represent an average cost for the screening or removal of all the junkyards on the Interstate or Federal-aid Primary Highways in Colorado.

Cost of Purchasing and Disposal by the State. According to Mr. Merton there is no way for the Highway Department to estimate, with the present information available, just what it would cost if the present policy of screening and moving were changed to one of purchasing junkyards and actually disposing of them. The department did try to purchase one junkyard because of particular problems with respect to size and location. The junkyard covered a large area of a steep slope near Pagosa Springs, Colorado, and because of the hillside location, the yard could not be screened. To complicate matters, there were no other suitable sites in the immediate area to which this yard could be moved, making the relocation extremely difficult. For these reasons, the department attempted to buy the yard, for a price exceeding $75,000 (the owner paid about $75,000 for the yard); however, the federal government would not participate, over and above the cost of moving the junkyard. The federal government apparently believed that the junkyard could be moved for a much lower cost than the purchase and disposal price; however, it is unclear as to where the federal government would have the yard moved.

Table IV

SUMMARY OF JUNKYARD CONTROL ACTIVITIES
IN COLORADO -- 1967

Junkyard Removal

Location of Junkyard	Appraisal Value		Purchase Price (Bid Price)
2.25 Mi. E. of Rifle	$13,000		$14,000
2.0 Mi. E. of Rifle	22,800		26,000
North edge of Delta	4,300		------
N.W. of Montrose	15,500		14,000
East of Cortez	11,100		------
East of Mesa Verde	5,500		5,290
East of Durango	9,500		5,000
North of Wiggins	2,300		1,480
Total Estimated Cost	$84,000	Total Costs	$65,870
Average Estimated Cost*	$10,500	Average Total Cost	$10,978

Junkyard Screening

Location of Junkyard	Appraisal Value		Bid Price
1.3 Mi. S. of Montrose	$15,750.00		$10,999.00
5 Mi. N.W. of Cortez	16,550.00		14,070.00
1 Mi. S. of Jct. State Highway 52	16,989.80		9,884.20
Total Estimated Cost	$49,289.80	Total Costs	$34,953.20
Average Estimated Cost	$16,430.00	Average Total Cost	$11,651.00

* All averages are approximate, because they have been rounded off to the nearest whole number.

Summary of Auto Body Disposal

Both the auto scrap industry and the steel industry currently are going through a rapid process of change involving new techniques in the production of iron and steel, as well as in the preparation of scrap for use by steel producers. The development of the BOF furnace may tend to reduce the demand for scrap metal, because the maximum use of scrap in a BOF currently is limited to about 30 percent of the total charge. However, with a reduction of contaminants in scrap metal and improved technology in the use of scrap, a higher percentage of scrap metal may be used in these furnaces. At the same time, increased use of electric furnaces, utilizing almost a 100 percent scrap charge, also may improve the availability of markets for scrap metal.

Governmental legislation, in the areas of highway beautification (action is being taken by governments to minimize the proliferation of junked vehicles) and air pollution, is acting as a catalyst to encourage new approaches for preparation of scrap metal for use by steel makers. With this in mind, traditional means of preparing auto hulks by hand stripping and open burning no longer are feasible because of high labor costs and air pollution restrictions. Construction of massive fragmentizers and shearing machines, coupled with heating processes and other means for separating contaminants, appears to be meeting the auto body disposal problems of the large metropolitan areas. Rapid expansion of the use of these machines, particularly the adaptation of the shredders to smaller metropolitan communities may provide a means whereby auto hulks could be processed in metropolitan areas the size of Denver. Portable equipment, will, however, be needed to process auto hulks generated in the rural parts of the state.

The Colorado General Assembly elected to participate in the federal program to control junkyards within 1,000 feet of Interstate and Primary highways. This legislation affects only a small portion of all auto wrecking yards located in Colorado since yards that are located in areas zoned industrial are excluded. Control of junkyards within the confines of municipalities are regulated through planning and zoning processes. In general, junkyards come under the category of industrial zoning. Perhaps local communities could exercise more stringent control of junkyards by providing a special classification for wrecking yards, rather than simply including the yards in a broad industrial classification.

Refuse Disposal

Nationally, more than 800 million pounds of solid waste are produced each day -- an average annual production per person of 1,420 pounds. Not only is the volume of waste material generated staggering, but the annual cost of solid waste disposal is only exceeded by expenditures for public schools and roads.[19] In Colorado, the State Department of Public Health estimates that over 1.6 million tons of domestic (home and apartment) wastes are generated each year, at a disposal cost of 14.5 million dollars annually. In ten years, the department believes that domestic waste production will double and disposal costs will increase by 70 percent (based on today's expenditures). Current monthly costs to Colorado homeowners for disposal of domestic waste range from $1.50 to $4.85 per month, or an average monthly cost of $2.25.[20]

Major Types of Refuse

Although there are many specific categories of refuse, including putrescible wastes, combustible rubbish (paper, rubber, cloth, synthetics), noncombustible items (tin cans, plastics, glass, masonry), street sweepings, hospital wastes, animal carcasses, over sized materials, chemical by-products, and other industrial refuse, refuse haulers deal with four basic classes of disposal items: 1) obsolete or unwanted household goods (domestic trash); 2) trash generated by retail activities such as resturaunts, stores, and other offices (commercial refuse); 3) residue from manufacturing processes (industrial wastes); and 4) disposable materials collected from parks, streets, and sewage plants (public refuse).[21]

Suggested Criteria for Solid Waste Disposal Systems

A system of solid waste disposal probably should accomplish the following basic objectives:

1) serve the needs of the entire community in the most economical fashion possible;

19. Today's Health, March 1966, published by the American Medical Association.
20. Interim Progress Report, Solid Waste Disposal Planning, State of Colorado, Prepared by the State Department of Public Health, Denver, Colorado.
21. Cameron and Jones, Inc., Refuse Disposal Study for the Inter-County Regional Planning Commission, Denver, Colorado, 1966, pages 2-3.

2) eliminate any condition which would foster the breeding of rats, mice, flies, mosquitos, and other vermin which could menace public health;

3) minimize infringements on the sensibilities of the community, that is, the design, construction, operation, and location of the disposal system must prevent odors, noise, dust, etc., from disturbing the local community; and

4) in the processing of solid wastes, emissions from the disposal system must not be permitted to pollute the air and water resources of the community.

Of the aforementioned criteria, perhaps the most difficult standard to achieve in urban areas is keeping costs of disposal from becoming prohibitive, while in the rural areas, health standards (elimination of breeding grounds for rodents and insects) may be the most difficult to attain. In the latter situation, small communities often have neither the desire nor ability to maintain disposal systems in a sanitary condition, simply because relative costs prohibit daily operation of the disposal site.

Sanitary Landfills

Since time immemorial man has been solving problems of waste disposal by dumping refuse on vacant land. These disposal sites are usually known as dumps. Only recently, however, have dumps been operated in a sanitary, pollution-free manner, commonly called a "sanitary landfill." Briefly, a sanitary landfill involves compacting and confining refuse to as small an area possible, and at the end of each days operation the compacted refuse is covered with a layer of inert material. In this manner, sanitary landfills eliminate traditional problems posed by open dumps, i.e., 1) rodent and vermin breeding is reduced; and 2) air pollution contaminants caused by open burning are eliminated. Selection of sanitary landfill sites is based, at least partly, on the need to prevent ground water pollution. In general, credit is given to the United States Army for developing procedures for operation of landfills. The Army experimented with sanitary landfills during World War II, and the success of these experiments resulted in rapid acceptance of the sanitary landfill concept by local governments. Unfortunately, over half of the cities in the United States with populations exceeding 2,500 still lack sanitary nuisance-free facilities.[22] With this in mind, a major step, for controlling improperly administered dumps or landfills, was taken by the Colorado General Assembly in 1967, with the passage of Senate Bill 225.

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22. Nation's Cities, December, 1966, published by National League of Cities.

Methods of Operation. Sanitary landfills often are located in areas in which there is a depression, eliminating the need for excavation of the ground to provide space for depositing refuse. Adjacent higher ground usually is graded to provide dirt cover needed at the end of each day's operation. Of course, if cover dirt is not available, the dirt must be hauled in from some other source. In relatively flat terrain, landfills often are developed on a trenching basis, in which a ditch is dug to permit the deposit of refuse. Needless to say, in trenching operations, there is no problem with respect to adequate cover.[23]

Conditions to be Considered in Developing a Landfill. In general, disposal of refuse in a landfill requires approximately one acre of land per year per 10,000 people.[24] This estimate is based on average compaction of an eight foot deep landfill.[25] There is increased concern over the placement of sanitary landfills in sand-pits and other excavations adjacent to streams and drainage areas, because of possible pollution of ground water. Landfills need to be located above water tables or at least, where contaminated ground water is not likely to be used.

> State law charges the Water Pollution Control Commission with responsibility for pollution control, not only as to surface water, but also ground water, both public and private. Requests have been received to use old gravel pits along Clear Creek as dump sites. Some of these requests have been refused because there is ten to fifteen feet of water in some of the pits. There has also been a proposal from Public Service to discharge ash and fly ash into the gravel pits. However, the ash is high in phosphates and there is concern that if it leaches into the river, it will enhance the growth of algae. Regardless of whether a contract is entered into between the private owner of a gravel pit and a firm that wishes to dispose of waste materials, if there is resulting water pollution the Commission can control the situation.[26]

The availability of cover material is particularly important to the economic operation of a sanitary landfill. In the event that

23. Solid Waste Disposal Study, Phase I, Tri-County Regional Planning Commission, Lansing, Michigan, page 4.
24. Refuse and Garbage Disposal in Milwaukee County, Refuse and Garbage Disposal Committee, Metropolitan Study Commission, Milwaukee, Wisconsin.
25. Ibid, page 6.
26. "Minutes of Meeting," Committee on Solid Waste Disposal, Colorado Legislative Council, May 24, 1967, page 5.

earth or other inert material is not available for cover, such material must be hauled in from another location, often doubling the cost of operations. For instance, cover material for the Adams County Sanitary Land Fill (60th Avenue and Federal Blvd.) is obtained from Public Service Company steam generating plants. This cover material consists of ash produced by burning coal at the steam plants. A question exists as to whether the ash is providing a satisfactory means of cover. In the event this material is no longer acceptable, dirt cover would have to be hauled in at an additional cost of 25 cents per yard (roughly five cents for the dirt and 20 cents for transportation charges).

Location of the landfill site to the community is another extremely important economic consideration, i.e., haulage costs are a critical factor in determining the feasibility of landfill operations. In the mountain communities adverse weather or heavy snowfalls may also prevent or hinder daily use of disposal sites.

Advantages of a Sanitary Landfill. First-of-all, properly operated sanitary landfills meet the conditions or standards outlined on pages 23-24, with respect to public health, acceptability, and economical operation. Secondly, the principle advantage of a sanitary landfill is that it provides final distribution for all types of waste material, regardless of whether the material is flammable, putrescible, etc. Refuse need not be sorted prior to disposal in a landfill. The third most important advantage of a sanitary landfill is that there is little capital outlay with respect to operation of a facility. Equipment necessary to operate a landfill includes bulldozers, tractor-type front-end loaders (bullclam), road graders and other highway machines which are available in most counties. In smaller communities, the landfills do not have to operate each day and the equipment can be utilized for other county or municipal purposes.

The cost of operating Denver's Lowry Bombing Range Landfill is estimated at 26 cents per yard. Since there is approximately four cubic yards to the ton, the Lowry Bombing Range Landfill currently is maintained for a little over $1.00 per ton (excluding haulage costs). Nationally, landfill costs range from $1.25 to $2.25 per ton.[27] An Adams County landfill which is currently operating for 23 cents per yard, utilizing fly ash as cover material, would have its maintenance costs doubled if the State Department of Health regulations reject the use of fly ash as suitable cover and dirt must be hauled to the site. In any event, landfill operating costs compare favorably with other major methods of disposal -- composting and incineration (minimum cost estimates $3.50 per ton).

27. Denver Metropolitan Area Solid Waste Disposal. Prepared by Colorado State Department of Public Health, Denver, Colorado, page 2.

Disadvantages of Landfills. One disadvantage of a sanitary landfill is the inability or unwillingness of communities to maintain fills in a proper manner. Thus, although a given site may be classed as a sanitary land fill, without daily maintenance the site simply becomes a dump. This is a problem particularly in smaller communities. For example, if a site is open only two days per week, residents may choose to throw refuse over the fence, if it has a fence, or dump materials on the roadway next to the operation. Landfill operations also require more space than other means of disposal which is a serious handicap in the metropolitan communities. For example, there is insufficient land within the City and County of Denver for development of a landfill and, as disposal sites are located further and further from the core city, the cost of transportation of the refuse begins to offset the economic advantages of landfills. Although properly operated sanitary landfills are not a health menace, there is little acceptance on the part of the public to locate landfills within or adjacent to populated areas. Again, public antagonism toward landfills may tend to push sites further and further from areas served. Perhaps, the negative reaction on the part of the general public toward landfills is due to a belief that sanitary landfills and open dumps are the same thing.

Once a sanitary landfill has been completed, care needs to be exercised in use of the land. Usually, the more desirable uses include parks and golf courses rather than building sites. This recommendation is made because landfills tend to settle, and decomposition of waste materials, particularly in dry climates such as Denver, takes up to ten years.

Composting

Composting is a two stage process in which useable scrap (paper, cardboard, tin cans, and other metals) is salvaged from refuse, while the remaining organic matter is finely ground and allowed to decompose, producing a humus material similar to peat moss. Theoretically, composting transforms the bulk of refuse materials into saleable products, hence, conserving in some manner, the resources of a community. The utilization of waste traditionally has had world-wide appeal, and even though in many instances compost operations have failed economically, new compost plants are being constructed in many areas.

The Colorado Composting Company built a plant in Boulder at a cost of approximately $250,000. Plant officials estimate operating costs of the Boulder plant range from $4.00 to $4.25 per ton. Under the present contracts with trash haulers, a fee of sixty cents per yard is charged; however, with the use of compaction trucks, the sixty cents per cubic yard fee yields only $3.10 per ton in revenue, far below the cost of operation of the plant.

Operation of Boulder Compost Plant. When the refuse collection trucks arrive at the plant, the refuse is dumped into a receiving bin. The floor of the bin consists of an agitating metal belt

that slowly moves the refuse inside the plant to a sorting conveyor. Men are stationed along the conveyor to pick out plastic, cardboard, metal, glass bottles, rags, aluminum, etc. The remaining material is moved to a grinder. The grinder is powered by a 200 horsepower motor, revolving at 1,800 revolutions per minute. The grinder reduces the refuse in volume by a ratio of four or five to one. Moisture also is added in the grinding process. From the grinder, the material is taken outside and placed in windrows. In the windrows a machine aerates and adds additional moisture to the ground refuse, aiding in the biological digestion of putrescible materials (garbage is an example) which produce offensive odors and attract flies and rodents. While the prepared refuse is in the windrows, heat generates from within the materials, and the temperature climbs to a high of 72 degrees centigrade. (Water boils at 100 degrees centigrade.) The increase in temperature destroys most of the bacteria. After fourteen days the compost is taken out of the windrows and placed in curing bins where it is allowed to stand for about 30 days to achieve final decomposition. Finally, the material is removed from the curing bins, broken into fine particles, and placed in bags for distribution and sale.[28]

Advantages of Composting. In addition to the conservation of matter, there are a number of advantages to compost operations. Of course, composting meets the standards for solid waste disposal with respect to public health matters. In particular, composting eliminates the air and/or water pollution problems that often are associated with incinerators and landfills. Furthermore, if the compost operation is carefully conducted, odors generated in the biological digestion of putrescible materials may be kept to a minimum. Since not all refuse, particularly plastics, is acceptable for salvage or for the final organic product, some material must be deposited in a landfill. However, for communities which are in short supply of landfill sites, composting reduces the amount of landfill space by at least 50 percent, and even more, depending on markets for salvage operations.[29] Nationally, the humus end product of composting accounts for about 30 percent of the total weight of unprocessed refuse.[30]

Disadvantages of Composting. To date, composting has not proven to be economically feasible. It has not been substantiated that adequate markets exist for either salvage materials or the

28. "Summary of Field Trip," July 18, 1967, Committee on Solid Waste Disposal, Colorado Legislative Council.
29. Cameron and Jones, Inc., Refuse Disposal Study for the Inter-County Regional Planning Commission, Denver, Colorado, 1966, page 74.
30. "Composting Around the World, Obstacles to Success," 1967 Sanitation Industry Year Book, page 39.

humas product. For this reason, compost plants must depend on charging sufficient dumping fees to cover all operating costs. Barring haulage considerations, composting simply cannot compete with landfills on a cost basis.

"Dr. George J. Kupchick studied municipal refuse composting in Europe and Israel in 1965 and came up with these sober findings, after evaluating 14 installations.

"The average gross cost to process one ton of raw refuse was $4.45. Amortization, interest and rent accounted for an average of $1.76 and operating costs $2.79 (note that these figures are based on comparative costs. Capital and operating costs in the United States would be substantially higher.)

"The average income from compost sales averaged $2.73 per ton of compost, or 90¢ per ton of raw refuse. Income from salvage -- only significant in Britain -- averaged about 20 cents per ton of raw refuse.

"None of the operations visited by Dr. Kupchick was able to cover its capital service expenses and operating costs from compost and salvage sales. Deficits ranged from $0.32 to $5.32, with an average net cost per ton of refuse of $3.38. Only in Israel was a substantial price for compost obtained, and even there local governments must subsidize the operations."[31]

The relative success of some European composting operations is due, in part, to a high content of putrescible materials, especially in comparison with refuse generated in the United States. In other words, the prepackaging of foods, as well as the use of garbage disposals, in the United States has reduced the garbage content of refuse. In turn, the percentage of paper and plastics, which have little salvage value, amount to from 50 to 60 percent of the waste or refuse generated in the United States. The nutrient quality of compost in the United States may be improved, however, by mixing sewage sludge with compost.

Integration of Liquid and Solid Waste Disposal. John R. Snell, a consulting engineer, has recommended to officials of the City of Boulder that a new fully enclosed high-rate compost plant be constructed at the site of the new sewage treatment plant. Snell points out that federal demonstration monies are available under the "Solid Waste Disposal Act"[32] and probably would be made available to Boulder in view of the relatively new integrated concept proposed by Snell. Under the Snell plan, following sorting and salvaging, the

31. Ibid.
32. Public Law 89-272, 89th Congress.

refuse is deposited into a so-called "pug-mill". At this point, sewage solids from thickening tanks are mixed with the refuse. After the sludge is thoroughly mixed, the material is conveyed to a digester. According to the Snell report, the compost material could be digested in about eight days. Finally the humus product is conveyed to a regrinding, screening, and bagging facility. Snell believes that an initial plant capacity of about 200 tons per day is sufficient to meet the needs of the Boulder Area.[33]

Although coupling the compost and sewer disposal systems together provides a more efficient integrated system, sewer sludge may pose problems. For instance, raw sludge contains harmful germs which must be guarded against. Also, the nutrient value of sludge may not be sufficient to improve the marketability of the compost. Nevertheless, integration of composting and sewer sludge disposal plans are being formulated or undertaken in Altoona, Pennsylvania, Miami, Florida, and Boulder, Colorado.

Incineration

Incineration reduces the volume of refuse to be disposed of by as much as 87 percent. The remaining 13 percent of waste material is composed of metalics or other noncombustible items, as well as the ash residue from the incineration process. Basically, incineration is a method by which solid waste is transformed into gaseous waste. Needless to say, without adequate controls, the gaseous vapor poses an air pollution problem. Afterburners or other types of measures must be employed to insure complete burning and reduction of air contaminants. Refuse in the United States is made up of high percentage of combustible materials: paper products (54 percent); food waste (8 percent); wood, leaves, grass (9 percent); metal (7 percent); glass ceramics and ash (8 percent); plastics, leather, rags (5 percent); and moisture (9 percent);[34] suggesting that incineration in this country has an advantage over similar facilities in other parts of the world.

European Incineration Facilities. Several European cities are using highly sophisticated gas-fired incinerators to dispose of their refuse. The steam produced, by the incineration of refuse, is used to provide heat for city buildings and/or generate electricity. The largest of these plants, now in operation, is located in Issy-les-Moulineaux, France, a suburb of Paris. This facility has a nominal capacity of 400,000 tons of refuse per year, but this can, if necessary, be raised to one-half million tons -- nearly 57 tons an hour. Altogether there are four gas-fired incinerators in operation

33. Report of John R. Snell Engineers, Inc., to City of Boulder.
34. "Incineration," published by the Ohio Municipal League, Cities and Villages, April, 1967, page 18.

near Paris. A fifth plant should be in operation by 1969, which will use two forty-ton per hour incinerators capable of handling over 700,000 tons annually. In late 1966, Paris was sending one million tons of refuse a year to the four existing plants and the suburbs were sending about 600,000 tons to the same facilities.[35] Other major European cities using incinerators for refuse disposal include Dusseldorf, Germany; Rotterdam, Netherlands; and Vienna, Austria.

According to the July, 1967, issue of Public Works magazine, each of these plants present characteristics more typical of conventional power plants than incinerators as they are customarily seen in the United States. The fact that they are located in relatively densely populated areas and their presence does not seem to be objectionable, may be attributed, in part, to their sophisticted layout and design of facilities. The trend is, for example, to keep the storage bins totally enclosed, with sectionally designed dumping or tipping areas so that only a small part is exposed to the outside at any one time. Due to intake systems, which draw the air used for combustion into the furnaces from the storage bins the area around these plants and the facilities are free of odors.[36]

In general, the plants are located with steam production in mind. Of course, central location of these plants in the populated areas is essential to keep refuse delivery costs to a minimum.

Plant Design. European incinerator designers have approached the problem of refuse burning by putting emphasis on new trash stoker designs which seem to operate efficiently and effect a high "burn-out" rate with practically complete burning of all combustibles in the refuse. The general pattern is to use a forced air system with constant speed induced draft, and manually controlled inlet or outlet dampers to regulate air and gas flows.

Air pollution problems are handled by electrostatic precipitators that appear to rather effectively remove the fly ash. As a result, the smoke stack emissions are practically invisible.[37] For example, in the precipitator units at the Rotterdam plant each collector accumulates approximately fifteen (15) metric tons of fly ash every 24 hours; this represents almost eighteen (18) percent of the total residue.

It is interesting to note that these precipitators, compared to those commonly in use in the United States, operate on relatively low voltages and the gasses travel through them at lower velocities,

35. Rene J. Bender, "Incineration Plant-Plus," Power, Jan., 1967, page 64.
36. Miro Dvirka and A. B. Zanft, "Another Look at European Incinerator Practices," Public Works, July, 1967, page 99.
37. Ibid., page 100.

with practically no maintenance. The precipatators are larger in size than comparable units in the United States, but the inherently higher initial costs are probably offset by the absence of maintenance.[38] There is, however, no data available that gives a laboratory analysis of the gases that are emitted from the stacks, i.e., sulfur dioxide, etc. Nor is there information on the quantity or size of particle matter that is discharged through the stack into the atmosphere.

Power and Steam Generation. At the Vienna plant, only steam is sold and the revenue from this source exceeded the operation and maintenance costs of the plant last year.[39] The Paris plant uses the steam to drive a 9,000-KW generator all year around. In the winter, steam from the Paris plant is, in addition to powering the generator, put through a super heater and used for city heating. In the summer, the excess steam is used to drive an additional 15,000-KW generator. Water condensate from the steam is returned to the plant, demineralized, deaerated and returned to the boilers.[40]

At the Dusseldorf plant, in addition to power generated, the residue from the burning is also utilized. Metals are separated from the residue and cleaned by means of vibrating screens. This metal is then baled and sold to steel mills at a price which "exceeds any expectations for the sale of scrap iron in the United States."[41] The rest of the residue is moved over a series of sieves where it is collected in storage bins according to size. This residue is sold as aggregate for road construction at a relatively high price.[42]

Problems of Incineration. Several problems have developed in the operation of various European incinerators, but none of them appear extreme or unsolvable. For example: In a few instances air intake vents were improperly located resulting in dust, paper, etc., occasionally clogging the vents. At the Dusseldorf plant in particular, combustion takes place in the boiler section high above the fire grates causing corrosion in the steam tubes. Also, the Dusseldorf and Rotterdam plants have experienced a high percentage of "down" (repair) time, causing as much as 25 percent of the plant to stand idle. Mr. Dvirka and Mr. Zanft suggest, however, that this may be caused by the failure of the persons responsible for the operation of the incinerating plants to consider the primary purpose of the plant as refuse disposal and instead place too much emphasis on electrical production. The plants need to be capable of performing refuse disposal, independent of any other production.[43] The

38. Ibid.
39. Ibid., page 99.
40. Bender, Op cit., page 62.
41. Dvirka and Zanft, Op cit., page 100.
42. Ibid., page 100.
43. Ibid.

disposal of large amounts of packaging material, largely plastics, has, in the Paris facility, had a corrosive effect on the lower parts of the furnace walls. This has been corrected by using a special method of treating the lower parts of the sidewalls.

Advantages. Incineration offers a satisfactory means of reducing solid waste, at least as far as public health standards are concerned. Air pollution poses the major menace to public health, but evidence indicates that incinerators can be constructed and maintained to reduce this problem. Since incinerators can be operated within the confines of populated communities, haulage costs are minimized. Incineration also lends itself to conservation, in that the heat generated from the burning of refuse may be put to a productive use, and noncumbustible materials may be salvaged. In other words, an incinerator could supplement steam production of coal-fired power plants for the generation of electric power. A salvage operation could be instituted to reclaim materials both before and after incineration. Finally, the ash residue is easily disposed of in a landfill and does not provide a breeding ground for rodents or insects.

Disadvantages. In comparison to landfill operations, construction and operation of incinerators is far more expensive. A survey of 295 cities adopting incinerators and having populations less than 1,000,000 reveals that from 30 to 40 percent of these communities abandoned incineration in favor of landfills because of excessive operating costs.[44] Since the incinerator merely transforms the waste material to ash and gas, landfills are needed to meet the problem of disposal of ashes and noncombustibles. Incinerators also are limited in the type of refuse that can be handled; highly flamable materials, for example, present an explosive problem. Finally, maintenance and "down-time" are problems to be coped with in operating an incinerator.

Refuse Grinding[45]

The home garbage grinder has met with considerable success and is an integral part of solid waste disposal in many communities of Colorado. It has been suggested that perhaps grindable refuse, other than kitchen wastes, could be handled in a similar fashion. In other words, an improved grinding system for individual homes or apartments would be developed to handle nonmetalic refuse, or a collection system could be employed which would deliver grindable materials to grinding stations located at main trunk lines of sewer

44. California Waste Management Study, a report to the State of California Department of Public Health, Aerojet General Corporation, page III-22.
45. Ibid., page III-20 and III-23.

systems. In a sense, refuse grinding simply directs solid waste into the liquid waste disposal systems, i.e., the solid wastes are reduced to fine particles and transported through the sewers to the treatment plant for actual disposal. The advantage of this system is that existing sewer lines may be used for the transportation of refuse, reducing haulage costs. However, an increased load on sewer facilities could mean that existing sewer lines would have to be rebuilt and enlarged. Needless to say, revision of the sewer system could reduce any possible economic gains resulting from the integration of the two disposal systems. In any event, considerable technological investigation is needed prior to implementing a refuse grinding system.

Rio Grande Plan

The Denver and Rio Grande Western Railroad Company proposes a system of shredding and rail transfer of rubbish for City of Denver, costing about $4.50 per ton. Basically, the system employs the landfill concept but attempts to meet Denver's problems with respect to hauling refuse to landfill sites. Cost estimates exceed present costs of the Lowry Bombing Range disposal program but is competitive with proposals for composting and incineration. The cost estimate is based on a minimum tonnage of 875 tons per day. Briefly, collection trucks would deposit refuse at two transfer stations. The trucks would unload refuse materials into large storage bins. A conveyor then would take the material to a shredding machine. The shredder reduces the bulk of the material to about one-tenth the original volume, whereupon another conveyor deposits the refuse in rail cars. The rail cars then transfer the refuse to a disposal site.46

Refuse Disposal in Colorado

Historically, public and private dumps have been the most common method of refuse disposal in Colorado. Although the dumps often were referred to as sanitary landfills this simply was not the case. Open burning was permitted and few restrictions were enforced by local governments to prevent dumps from becoming a habitat for insects and rodents. To meet the aforementioned problems, two basic steps were taken by the General Assembly: 1) the "Air Pollution Control Act" (Chapter 45, Session Laws of 1966), which prohibits open burning in the air pollution basins of the state, was enacted; and 2) S.B. 225, 1967 session, was adopted providing standards for the operation of landfills. In other words, by July 1, 1968, all

46. The GRANDE Plan for Refuse Disposal for the City and County of Denver, Denver and Rio Grande Western Railroad, September, 1966.

dumps must be operated in a sanitary condition, and at the end of each day's operation, refuse must be covered by at least six inches of inert material. A permanent cover of two feet of earth or inert material must be used when a section of a site or facility is completed.

Disposal Sites in Denver Area. In Metropolitan Denver (including Douglas and Boulder Counties), there are over 50 landfills, serving a population in excess of 1,104,000 persons. Since the restrictions imposed by recent legislation undoubtedly will result in increased costs in the operation of these landfills, a question exists as to whether there is enough refuse generated in the Denver area to justify continued operation of over 50 landfills. For instance, three large scale landfills serve the needs of over 57 cities and 3,000,000 people in the Los Angeles Area. A 12-inch layer of soil is compacted over the refuse each day at the Los Angeles landfills.[47]

Increased operating costs of landfills coupled with diminishing availability of readily accessible dump sites may increase the economic justification for development of other solid waste disposal systems. In other words, the cost of incineration and composting is more competitive with a properly operated sanitary landfill than an open dump. One reason incineration may compete economically is that plant sites may be located within populated areas, thus providing a reduction in refuse hauling costs.

The relatively higher costs of community services in core cities in relation to surrounding suburbs is amply illustrated in the problem of solid waste disposal. Although the Denver Metropolitan community is a comparatively small metropolitan complex, the City and County of Denver has exhausted dump sites within the corporate city limits, and Denver has turned to the suburbs for landfill space. The Lowry Bombing Range landfill (Arapahoe County), operated by the city at a cost of 25 cents per cubic yard, is a relatively efficient and economical operation. Unfortunately, in order for Denver to haul refuse out to the Lowry dump site, a transfer station is utilized to reduce the number of trips made by refuse collection trucks. The costs of operating the transfer station exceeds the costs for operating the landfill; transfer station costs approximately 30 cents per yard. Furthermore, an additional cost of 25 cents per yard is incurred by hauling refuse from the transfer station to the Lowry Bombing Range -- a total distance of 14 miles. Thus the costs of transferring rubbish after collection to the bombing range is 55 cents per yard. The total cost of disposal, excluding collection is $3.20 per ton. Thus, the lack of open land within the core City of Denver, raises the cost of solid waste disposal beyond that of its neighbors. However, unless steps are taken now

47. "Sanitary Landfill: Decision for Small Towns," Missouri Municipal Review, April, 1967.

to insure that landfill sites are reserved in close proximity to existing suburban communities, the suburban communities also will be faced with increased trash haulage costs.

According to a Connecticut study, savings of up to 15 percent of total costs could be achieved by regionwide disposal services. In other words, there are economic advantages in elimination of duplication of investments for disposal equipment.[48]

Need for Stablized Supply of Refuse. In order for an incinerator, compost plant, or sanitary landfill to operate economically, a given amount of refuse must be delivered each operating day. Regardless of the type of disposal employed, daily overhead costs can only be reduced through maximum utilzation of equipment. In other words, if a plant operates at fifty percent of capacity costs of disposal are far greater than if the plant is operating at 100 percent of capacity. If a private firm invests in an incinerator plant, compost operation, or landfill and refuse haulers are in a position to exercise a choice with respect to a disposal site, the firm must provide a competitive price or be forced out of business.

Powers of County Commissioners. Senate Bill 225 does provide county commissioners with authority to limit landfill activities in unincorporated portions of respective counties. A person desiring to operate a landfill must obtain a certificate of designation from the board of county commissioners of the county in which the landfill is to be located. In considering the certificate, the statute requires that the following factors must be taken into account:[49]

> (b) The effect that the site or facility will have on the surrounding property, taking into consideration the types of processing to be used, surrounding property uses and values, and wind and climatic conditions:
>
> (c) The convenience and accessibility of the site or facility to potential users:
>
> (d) The ability of the applicant to comply with the health standards and operating procedures provided for in the act, and such rules and regulations as may be prescribed by the department or by local health agencies.

Rulings of the commissioners, of course, are subject to appeal to the district court.

48. Solid Waste Handling in Metropolitan Areas, United States Department of Health, Education, and Welfare, page 28.
49. Section 3 of Chapter 358, Session Laws of Colorado 1967.

Perhaps item (d) above, provides the commissioners with the authority to prevent too many landfill operations to be initiated in a county. For instance, if there is insufficient business to justify the creation of another landfill, the economic basis upon which all the landfills in the county are operating could be weakened, and, as a result, sanitary conditions may not be met. However, a question exists as to whether S.B. 225 meets the needs of the metropolitan area for control of disposal sites. The decisions of the commissioners of one county may have an adverse effect on the decisions made in another county.

Rural Communities. Testimony at the September 6 meeting of the committee reveals that small communities, particularly mountain towns, may encounter some difficulty in meeting the provisions of Senate Bill 225, 1967 session. For instance, the amount of refuse processed in rural areas certainly does not justify maintaining heavy equipment at dump sites on a daily basis. However, restricting dump operations to one day per week or less also may discourage residents from using the landfill with the result that waste tends to accumulate. For instance, a health department study of Summit County revealed a lack of ordinances governing storage of waste material in individual yards or premises. The health department pointed out that with putrescible matter in refuse, the garbage needs to be taken to a dump site at least one day per week; however, this does not appear to be the case in Summit County. Roaming dogs add to the problem of sanitation by pilfering garbage containers and scattering refuse in the community. In addition, adverse weather conditions restrict access to dump sites, and a question exists as to whether the extreme cold and heavy snows of Summit County may prevent the community from meeting the requirements of S.B. 225 with respect to dirt cover on waste material deposited at the dump sites.

Problems of Refuse Disposal in Lands Under the Jurisdiction of the United States Government. Forest Service officials pointed out that serious consideration is being given to expanding the use of incinerators to handle trash generated in camp grounds. The following reasons were given: 1) In the national forest areas where recreation demands are the heaviest (the Eastern Slope), there is a definite shortage of suitable landfill sites; 2) water pollution problems are avoided by incineration; and 3) the air pollution laws of Colorado no longer allow open burning in the five designated pollution basins within the state, and this restriction may be extended in the future. (The incinerators are relatively pollution free.) At least one of the incinerators, now being operated by the Forest Service, is capable of handling the refuse that is created by approximately 1,200 daily visitors, based on an eight-hour per day operation.

Operation and Costs of Stationary Incinerators. Permanent incinerators cost between $10,000 and $12,000 and are capable of burning around 800 pounds of refuse per hour. In most areas, the forest service operates incinerators twice a week only (in one area it is necessary to burn three times a week), burning on Friday and

again on Monday. In the intervals between the days that the Forest Service burns the refuse, collected trash is stored in a metal bin specifically designed for this purpose. As the amount of refuse increases the incinerator facilities will be used more often.

A Forest Service incinerator located at Woodland Park, Colorado, burns about 28 gallons of fuel for each hour of operation. Based on a six hour burning day, a total of 160 gallons per day or 320 gallons per week (two burning days a week) are burned, at an average estimated weekly fuel cost of $50. (The Forest Service, because of the relatively isolated incinerator locations, must use bottle gas as fuel.) The incinerators, are used, for the most part, during the "tourist season," (a minimum of fourteen weeks). Based on a fourteen-week period, the Woodland Park incinerator's fuel cost averages roughly $700 per season. Compared with open dumping, the Forest Service estimates that the total man hours required for waste removal, at least in one area, increased under the incineration program. At Manitou Park the estimated total man hours required for solid waste removal increased from 630 man hours per season (open dumping) to 798 man hours per season (incineration); for a total increase of 168 man hours or $344.40 figured at the U.S. Civil Service GS-3 rate of pay. A comparison of incineration costs with open dumping does not provide a true picture of prospective costs, however, open dumps are not covered daily and do not require the additional grading equipment that will be necessary to properly operate a refuse dump, under Colorado's 1967 Solid Waste Disposal Act (S.B. 225). The dumps that are used in this cost comparison simply were pits that the Forest Service excavated, at a cost of about $80, and filled with refuse over a period of time prior to covering them with earth. What the cost comparison would be if a proper sanitary landfill method were used is not at the present known. The Forest Service hopes to be able to develop a properly operated landfill for the purpose of comparing costs, efficiency, convenience, etc., with the incinerators. In any event, recreation values of some national forest areas may preclude use of sanitary landfills.

Projected Incineration Costs for a Small Community. Assuming fuel costs of roughly $8.30 per day for a natural-gas-fired incinerator, plus labor costs of $24 per day, the total daily costs of operation for an incinerator for a mountain community is estimated at $32 per day. If the amount of refuse generated in a community averages six pounds per person, and the total population of the town is 1,000, the amount of refuse generated would average about 6,000 pounds or three-tons per day. If the incinerators were operated on a daily basis, maintenance costs would amount to at least $10.75 per ton of refuse processed. In order for the community to reduce operating costs, the community would have to invest more money for the construction of larger incinerators to permit part-time operation. Needless to say, cost of incineration on a small scale far exceeds current costs of maintaining open dumps.

Municipal Landfills on Forest Service Land. The location and establishment of refuse disposal areas by small municipalities that are surrounded by National Forests are as follows: 1) The U.S. Forest Service and town officials jointly review possible dumping sites and mutually select an area that will not present any nuisance factor, fire danger, air or water pollution, and that will allow for compliance with proper landfill practices. The Forest Service then draws up a use agreement with the town. The use agreement contains provisions establishing specific standards under which the dump must be operated, i.e., proper cover, fire protection, screening, etc.

The major problem is that many municipalities in the National Forests do not have enough private land available to provide for landfills. Also, the value of land around the towns may be so high that the cost of obtaining private land is too great and consequently the towns seek the use of public land. On the other hand, the Forest Service does not want the lands it governs to become public dumping grounds. Also the land that a town desires may have too high a recreation potential for the Forest Service to allow it to be used as a landfill. For example, most of the forest land, around Dillon, Colorado, has a high recreation potential and the Forest Service does not intend to permit the establishment of landfills in this area. The final result may be that the Forest Service may, someday, curtail the use of national forest lands as landfill sites.

Many of the counties and towns in the National Forests are going to have to recognize that present dumping methods and procedures often do not meet the requirements of the Solid Waste Disposal Act of 1967 (S.B. 225). And, unless the dumps are operated according to state laws, the Forest Service, under the terms of the use agreements, may have to refuse landfill permits on Forest Service lands. One of the problems confronting many of the small towns is that the volume of refuse produced is too small to make a proper landfill operation economically feasible. (The National Academy of Sciences, in a study entitled "Waste Management and Control" estimates the capital cost of a sanitary landfill, excluding the cost of land, to be between $1,000 and $2,000 per ton, per day.)

The Forest Service is willing, and in fact has tried on one occasion, to enter into a use agreement or lease arrangements with small towns and resort areas, to allow them to take advantage of the incinerators that the Forest Service has constructed and is operating. The Forest Service attempted to work out a use agreement with the town of Woodland Park, Colorado, but no agreement was reached. According to Hank Tiediemann, Chief Recreation and Development, Region 2, U. S. Forest Service, the Forest Service would prefer to contract for refuse disposal rather than collect and dispose of the refuse themselves.

The Forest Service, due in part to Colorado's Solid Waste Disposal Act of 1967, is experimenting in many areas of the state with various waste disposal methods. Cooperative planning is needed between the communities and the Forest Service to determine

just what the disposal needs of a particular area are, projecting increased needs over a long term (say twenty years). On the basis of these projections perhaps cooperative waste disposal programs could be worked out. Also, incinerator companies may be willing to lease incinerators, reducing the need for the communities to raise comparatively large initial sums of money for construction. In conclusion, the Forest Service would prefer that communities build the incinerators and contract with the Forest Service for disposal of waste generated in national forest areas rather than for the Forest Service to develop a disposal program.

One of the major problems, with the existing county and community dumps located within the national forest lands, is that the Forest Service has not really insisted that the localities properly maintain dumping areas. The Forest Service has been more concerned with fire prevention and litter (they require that the dumps be fenced to prevent refuse from blowing out of the area) than with proper cover and sanitation. However, under the Forest Service agreements, dumps must be maintained in accordance with state laws. What effect the solid waste act will have on many of the existing dumps has not been determined, but Mr. Tiediemann believes that many areas may not be able to afford to handle the refuse fills properly and the Forest Service and/or the State Health Department may have to close these dumps. At the present time, the Forest Service exercises control of landfills by refusal to issue use permits. On a few occasions, however, the Forest Service has prosecuted persons under the Colorado Litter Law, but this has been rare. The federal regulations as per indiscriminate dumping on Forest Service lands are being clarified and once these are compiled offenders may be taken before a United States Commissioner. This probably will reduce the present amount of random dumping that occurs.

Bureau of Land Management. Similar to the Forest Service, the Bureau of Land Management (BLM) enters into use agreements with counties and municipalities to provide federal land for refuse disposal. The federal "Recreation and Public Purposes Act" (68 Stat 173-43 U.S. Code 869) gives the town or municipality legal ability to acquire lands for landfill purposes. The use agreements provide that dumps must be properly maintained. However, Mr. J. Elliott Hall, Land Office Manager, Denver Office, Bureau of Land Management, stated that periodic checks by the BLM, of landfill areas, reveal that with few exceptions local communities do not live up to the provisions in the agreements on care and maintenance of dumps.

The BLM does not have the problem the Forest Service does of a lack of available land for the purpose of refuse disposal. The reason for this is that the lands administered by the BLM are generally of a lower quality than the lands administered by the Forest Service.

According to Mr. Hall, the BLM will assist the communities in their search for suitable dumping areas. Application for a refuse disposal site is made by a municipality to a BLM district office (there are five district offices in Colorado). At the district

office BLM personnel review available lands with the municipal authorities. Often, according to Mr. Hall, the towns request more land than the BLM believes is needed, and as a result, the amount of land made available by the BLM often is less than requested. As a condition for obtaining land for a refuse fill, the community must enter into an agreement to meet specific conditions outlined by BLM and agree to meet all state requirements. (These agreements normally contain a reversion clause that will return the land to the BLM if it is found that the municipality is not properly fulfilling the terms of the agreement.) After the application has been submitted and agreed upon by BLM all that remains is the processing of the application. Mr. Hall implied that, if this procedure is followed, approval of the application, while it may be time-consuming, is usually automatic.

National Park Service. According to Fred Novak, Superintendent, Rocky Mountain National Park, the National Parks in Colorado, at the present time, are experiencing no problems with refuse disposal; nor does the Park Service expect any serious problems to develop in the near future. At the present time all the areas under the jurisdiction of the National Park Service use some form of dumping grounds, landfills, etc. At the present time there are no incinerators in use nor are there any that are being planned. There are two methods commonly used by the Park Service for waste disposal. Where it is possible the Park Service tries to obtain dumping agreements with communities outside the park area. For example, Rocky Mountain National Park utilizes the dump at Estes Park, Colorado. In contrast, the National Park areas at Mesa Verde, Great Sand Dunes, and Bent's Fort all maintain dump pits within their own respective areas.

Questions to be Resolved

In general, the new prohibitions on landfill operations probably will force dump operators to up-grade their activities or cease operation. The demand for disposal sites probably will continue to determine the number of dumps that are needed in the Denver Metropolitan Area. A basic question to be answered is whether the present competitive system of trash disposal, in the Denver Metropolitan Area, actually tends to meet the interests of the community as a whole, or whether the end result may be higher overall costs for trash disposal. For instance, persons residing on the outer fringes of the Denver Metropolitan Area, particularly eastern areas, may be within easy access of landfill sites, and their costs of disposal may be quite low. However, because of costs involved in transportation of solid wastes, other systems or methods of waste disposal might reduce waste disposal costs for persons or firms located substantial distances from landfill sites. Continued study and review of the following questions may be needed:

1) Is the cost of solid waste disposal in the Denver Metropolitan Area reaching a point that there is need for an integrated program in which refuse haulers would be limited to only a

few disposal sites? In other words, is there a need for centrally located incinerator plants, transfer stations, or other means of reducing the distance trash is to be hauled? Even though the Lowry Bombing Range permits free dumping, trash haulers utilize other sites in the metropolitan area, which is an indication that haulage distances, not disposal fees, may be the most critical factor in trash disposal costs.

2) If there is need for providing large-scale disposal sites, could such operations be initiated under existing framework of state law and be economically feasible? Some powers are given to the county commissioners for control of landfill sites within their respective jurisdictions under S.B. 225; however, control is based on health and sanitation factors rather than economic conditions. Also, S.B. 225 empowers cities and towns with authority to designate disposal sites to be used for dumping waste materials collected in the city. The act does not provide similar authority to county commissioners for unincorporated areas. In view of Gerbitz, Rubbish Removal, Inc. v. the City of Boulder, (1966) Civil Action No. 20301, and in spite of S.B. 225, a question exists as to whether local communities, particularly in the metropolitan area, can require that contractors dispose of materials at given sites. Section 7, S.B. 225, specifically provides for site designation by towns and cities. However, would the courts uphold such site designation as a reasonable exercise of police power? At the September 6 meeting of the Committee on Solid Waste Disposal it was pointed out that, in the western parts of the United States the local courts are generally unwilling to view the regulation of solid waste disposal as a necessary police function in the same manner that sewage disposal is treated. This is exemplified by the recent court decision in Boulder, Colorado, where the city was denied the power to designate, under its police power, the disposal sites trash haulers could use. With respect to the metropolitan community, limitation of sites might not be in the interests of all sections of the metropolitan community and a refuse hauler might prefer to take his trash into another county.

APPENDIX A

HOUSE JOINT MEMORIAL NO. ____

MEMORIALIZING THE CONGRESS OF THE UNITED STATES TO AMEND THE "HIGHWAY BEAUTIFICATION ACT OF 1965", TO PERMIT THE USE OF FEDERAL FUNDS TO ASSIST THE STATES IN THE ACTUAL REMOVAL AND DISPOSAL OF SOLID WASTES IN JUNKYARDS ALONG THE INTERSTATE AND FEDERAL-AID PRIMARY HIGHWAY SYSTEMS.

WHEREAS, In many sections of Colorado and other parts of the Western United States, due to the geographical terrain, the content of junkyards may be seen from the main-traveled way of highways for great distances, suggesting that distance is an inadequate criterion for junkyard control; and

WHEREAS, The control of junkyards along the Interstate System and the Federal-aid Primary Highway System is basically a federal program designed to protect the public investment in such highways, to preserve the beauty of the nation's highways, and to promote the safety and recreational value of public travel; and

WHEREAS, Colorado has enacted legislation to implement the "Highway Beautification Act of 1965" in order to remain eligible for its full and fair share of Federal-aid highway funds apportioned after July 1, 1968; and

WHEREAS, Federal government participation in the disposal of junk or solid waste is limited to an amount sufficient to cover seventy-five percent of the cost of screening or relocating junkyards located within one thousand feet of Interstate and Primary highways; and

WHEREAS, Moving or screening junkyards within one thousand feet of the main-traveled way of the federally-aided highways of Colorado

in nonindustrial zones affects only 30 percent of the junkyards in the state of Colorado and has proven to be expensive, ineffective, and does not actually solve the problems of disposal of junked vehicles and other solid wastes; and

WHEREAS, The federal government is spending considerable monies for junkyard control without accomplishing the objectives of the federal act; now therefore,

Be It Resolved by the House of Representatives of the Forty-sixth General Assembly of the State of Colorado, the Senate concurring herein.

That the Congress of the United States be hereby respectfully requested to amend the "Highway Beautification Act of 1965", to permit the use of federal funds to assist the states in financing the actual removal and disposal of solid wastes in junkyards affected by the "Highway Beautification Act".

Be It Further Resolved, That a copy of this Memorial be transmitted to the President and Vice President of the United States, the Speaker of the House of Representatives of the United States, and the members of Congress from the State of Colorado.

Appendix B

6. CONTROL OF JUNKYARDS*

a. General

(1) Each State shall make provision on or before January 1, 1968, for effective control of establishment and maintenance of junkyards within 1,000 feet of the right-of-way and visible from the main traveled way of the Interstate and Federal-aid primary highway systems.

(2) All junkyards, except those in legally zoned industrial areas and in unzoned industrial areas as determined by the several States and approved by the Secretary, are to be controlled by appropriate screening or removed from sight.

(3) Where junkyard control standards imposed by State law are more stringent than Federal control requirements the Administrator may approve Federal participation in costs of applying the State standards on a Statewide basis.

(4) Where only a portion of a junkyard lies within the controlled area, only that portion within the controlled area need be screened or removed from sight. Screening and removal may be performed as part of the same project.

(5) Federal funds may participate in the costs necessary to determine the practicality of screening or removal or combinations thereof.

(6) Federal reimbursement will be made on the basis of 75 percent of the eligible costs paid by the State for the screening or removal of junkyards which (1) were lawfully in existence on October 22, 1965; and (2) lawfully along any highway made a part of the Interstate of Federal-aid primary systems on or after October 22, 1965, and before January 1, 1968; and (3) those lawfully established on or after January 1, 1968, which subsequently become nonconforming.

(7) Any junkyard in existence on October 22, 1965, which does not conform to the requirements set out above and which cannot, as a practical matter be screened, is not required to be removed until July 1, 1970; however, the State may, at its option, accomplish such removal or relocation at an earlier date and Federal funds may participate in such removal or relocation.

Any junkyard lawfully established on or after January 1, 1968, which later becomes nonconforming, and which as a practical matter cannot be screened must be removed within a reasonable time but not later than two years after the date it becomes nonconforming.

It shall be the responsibility of the State to remove any junkyard established in nonconforming manner after October 22, 1965, with no Federal-aid participation in the costs thereof.

(8) Where a junkyard which was lawfully in existence on October 22, 1965, cannot, as a practical matter be screened, the junkyard may be considered unscreenable and may remain in place until no later than July 1, 1970. When a State considers that the topography of the land will not permit adequate screening of the junkyard or the screening would not be economically feasible, such finding, along with supporting data and justification, shall be submitted to the division engineer on a parcel-by-parcel basis for review and determination as to the practicality of the proposed action.

(9) In order to remove junkyards, Federal participation will be based on the costs of acquiring only the minimum real property interests necessary plus the cost of removal of personal property including junk, or the removal and land rehabilitation costs for garbage dump and sanitary fills. Such costs will be supported by appraisals, value findings, or cost estimates or combinations thereof....

(10) The State may, at its option, select alternate methods of removal and disposal and Federal funds may participate in the actual costs incurred on a cost-to-cure basis....

(11) When the State, after a thorough study, considers that removal is the most economical method of disposing of abandoned or valueless junk, Federal funds may participate in the actual cost of moving and in the net cost of a site for disposal. Prior approval of the division engineer in the site location and estimated cost thereof must be obtained.

b. Acquisition

Federal funds may not participate in the acquisition cost of interests or rights as a measure for prohibition or control of the establishment of future junkyards.

* Policy and Procedure Memorandum, 80-9.