



3

DEPARTMENT OF
PUBLIC WORKS

SOLID WASTE DIVISION

CITY OF SACRAMENTO
CALIFORNIA

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DAVID A. PELSER
SOLID WASTE
DIVISION MANAGER

March 13, 1990

Transportation and Community Development/
Budget and Finance Committees
Sacramento, California

Honorable Members in Session:

SUBJECT: COMPOSTING YARD AND GARDEN WASTE

SUMMARY

City staff has studied the potential for composting yard waste instead of disposal by landfilling. A report was submitted to the Joint Committees on November 14, 1989 (copy attached) with a recommendation that the report be distributed for public comment. The November 14 report was presented at two public educational workshops.

The City's consultant has completed a report on yard waste composting. All separately collected yard waste can be composted. This represents approximately 28% of the waste stream currently being disposed at the 28th Street Landfill. If the existing landfill site is used for a full scale, long term compost program, the total cost for composting is estimated by the consultant to be \$1,700,000 annually, or about \$0.97 per month per household. Revenues from compost sales are expected to offset some of the costs. After the City landfill closes, the alternatives for landfill disposal are the County landfill and L&D Landfill. Depending on the revenue received and the alternative landfill used for comparison, the net fiscal impact of a full scale yard waste compost program ranges from a savings of \$0.69 to a cost increase of \$0.14 per month per household, according to the consultant. Based on the City's previous experience with operating the vegetal waste facility, we expect the actual operating costs of a compost program may be higher than estimated by the consultant.

BACKGROUND

City staff has studied the potential for composting yard waste instead of disposal by landfilling. A report was submitted to the Joint Committees on November 14, 1989 (copy attached) with a recommendation that the report be distributed for public comment.

The November 14 report was presented at two public educational workshops. Several people expressed interest in the current composting operations and proposed backyard composting. Generally, there was support for the possibility of large scale composting as a way to reduce the quantity of material being landfilled. Individuals who visited the compost table at the workshops included Denise Delmatier, Burns McCalman, Dave Manhart, Jim Paterson, D. J. Long, John Mayor, Karolyn Simon, Carl Hauge, and R. H. Townley.

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Budget and Finance Committees
March 13, 1990
Page 2

During the week of February 12, 1990 staff attended an international recycling conference in Seattle, Washington. Included in the conference was a tour of two large active compost programs. Seeing these programs in operation, along with continuing our literature review is helping staff to determine specific equipment and process design needs for the most effective composting of Sacramento's yard waste.

For additional information, see the attached copy of the November 14, 1989 staff report and consultant report.

FINANCIAL DATA

See attached report.

POLICY MATTERS

See attached report.

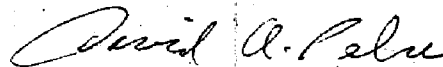
MBE/WBE

See attached report.

RECOMMENDATION

Pursuing a major compost program may be necessary as the greatest single impact on the waste stream towards achieving City recycling and landfill avoidance goals. However, the City is currently requesting proposals from private firms for alternatives to directly hauling the City's waste to the County's landfill (see the February 13, 1990 staff report to the joint committees on this subject). The Statements of Qualifications already received indicate that some of the firms would include yard waste processing in their overall waste processing strategies. Therefore, any decision at this time to initiate a large compost program should be considered tentative until the alternatives review process is completed. **Staff recommends continuing the current small scale composting operation and delaying consideration of large scale expansion until after the alternatives review process is complete. Then, if the alternatives process does not conflict with a City compost program, staff recommends pursuing full scale composting of yard waste by including the necessary funding in future budget requests.**

Respectfully submitted,



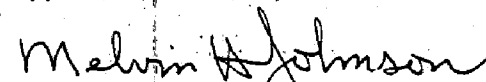
DAVID A. PELSER
Solid Waste Division Manager

Recommendation Approved:



For SOLON WISHAM, JR.
Assistant City Manager

Approved:



MELVIN H. JOHNSON
Director of Public Works

Contact Person to
Answer Questions:
DAVID A. PELSER, SOLID WASTE DIVISION MANAGER
449-2043

March 13, 1990
All Districts



**DEPARTMENT OF
PUBLIC WORKS**

SOLID WASTE DIVISION

**CITY OF SACRAMENTO
CALIFORNIA**

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SUITE 103
SACRAMENTO, CA
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November 14, 1989

Transportation and Community Development/
Budget and Finance Committees
Sacramento, California

Honorable Members in Session:

SUBJECT: COMPOSTING YARD AND GARDEN WASTE

SUMMARY

The City's consultant has completed a report on yard waste composting. All separately collected yard waste can be composted. This represents approximately 28% of the waste stream currently being disposed at the 28th Street Landfill. If the existing landfill site is used for a full scale, long term compost program, the total cost for composting is estimated by the consultant to be \$1,700,000 annually, or about \$0.97 per month per household. Revenues from compost sales are expected to offset some of the costs. After the City landfill closes, the alternatives for landfill disposal are the County landfill and L&D Landfill. Depending on the revenue received and the alternative landfill used for comparison, the net fiscal impact of a full scale yard waste compost program ranges from a savings of \$0.69 to a cost increase of \$0.14 per month per household, according to the consultant. Based on the City's previous experience with operating the vegetal waste facility, we expect the actual operating costs of a compost program may be higher than estimated by the consultant.

It is recommended that the Joint Committees direct City staff to transmit this report to the City's Solid Waste Advisory Committee and other interested public agencies for a review and comment period along with other recycling reports presented this day.

BACKGROUND

With the closure of the City's 28th Street landfill (currently estimated at the end of 1991 or early 1992), and the City's recycling goals, City staff recommended in the 1988-89 fiscal year proposed budget that composting the yard waste be studied. The first phase of the compost studies was to experiment with a rented tub grinder and mechanical screen to determine production rates, quality of material produced, and costs. Staff presented in August, 1989 an information report on the first phase. The information report was heard by the joint committees of Transportation and Community Development/Budget and Finance and by the City Council.

The second phase of the compost studies was to hire a consultant to recommend a specific operational and process design for a compost program which will divert from landfilling as much yard waste as possible. The Department of Public Works engaged the services of R. W. Beck Associates (the firm conducting the major recycling study for the County). Specifically, the consultant was requested to review the data developed by City staff, evaluate the markets for selling compost, and recommend a specific compost program operation to make maximum use of the available land at the City landfill site.

Subsequent to the initiation by the Department of Public Works of the second phase of compost studies, the City/County Solid Waste Advisory Committee (SWAC) recommended the City compost as much yard waste as possible. In Resolution 89-685 adopted on September 11, 1989 the City Council adopted a goal of composting as much yard waste as feasible.

Submitted with this staff report is the final report by R. W. Beck, "Yard Waste Composting Options for Yard Waste Recycling in the City of Sacramento". R. W. Beck is recommending the City implement a high-tech compost program capable of processing up to 85,000 tons per year of yard waste. If all City yard waste is processed, the recommended system could produce approximately 177,000 cubic yards per year (70,000 tons per year) of finished compost product. The consultant recommends the program be implemented over five years to allow for market development. Capital costs for equipment are \$3,100,000 and could be debt financed with an estimated annual cost of \$500,000 according to the consultant. Gross operating costs are approximately \$1,200,000 per year at full capacity. Avoided landfill costs are estimated to range from \$ 915,000 per year to \$ 1,778,000 per year depending on whether the L&D Landfill or County landfill would be used for landfill disposal of yard waste. It is estimated that the local market could absorb 108,000 cubic yards per year (43,000 tons per year) of finished compost product with the revenue ranging from \$88,000 to \$215,000 per year depending on the quality of compost produced and local market prices. The total cost per month per resident over the life of the program at full capacity is estimated at \$0.97/mo. The avoided cost of landfilling per month per resident is from \$0.76 to \$1.48 considering the L&D Landfill and the County Landfill respectively. Revenues are projected to range from \$0.07 to \$0.18 per month per household. If all yard waste is processed into compost, approximately 28% of the City's total waste stream could be diverted from landfill disposal. However, 60,000 cubic yards (27,000 tons) per year of finished product may not be immediately marketable. Therefore, alternative disposal methods may be necessary.

The R. W. Beck report is based on use of about 20 acres of the existing City owned land west of 28th Street at the City Landfill site where the current compost program is operated. This property is shown on the City General Plan as Parks/Open Space/Recreation. Currently under study in an Environmental Impact Report is the proposed riverfront park and Richards Boulevard connector. The alignment of the proposed connector and the extent of park development of the site could impact the long term use of this property for a compost program. Once the alignment of the Richards Blvd. connector is determined the compost program could be located in the vicinity to avoid a conflict. The proposed riverfront park is unlikely to be developed immediately due to landfill post-closure constraints and insufficient park development funding. Equipment and personnel needed for the recommended compost program could be used to assist with the landfill post-closure maintenance. Then, at such time that a park is developed and landfill maintenance efforts are reduced, consideration could be given to relocating the compost program to a new site.

It should be noted that the cost estimates reported herein are all from the City's consultant. Based on past City experience with operating the vegetal waste shredder facility, staff expects that actual operating costs may exceed those reported by the consultant. The more yard waste that is diverted from landfilling to composting, the less selective operators can be about the quality of material accepted for composting. If all of the yard waste is composted, additional personnel may be needed to screen incoming material. Also, higher maintenance costs for processing equipment may be incurred due to the substantial quantity of problem material in the yard waste piles collected from City streets.

FINANCIAL DATA

Cost estimates included in the attached consultant's report, and summarized above, assume the existing landfill site with minimum improvements will be used for an expanded compost program. Also, costs identified are to provide a basis for comparing options and for providing rough order of magnitude projections for preliminary budget consideration. Additional staff review will be necessary to prepare specific budget estimates for any approved program. With these qualifications and assumptions in mind, the consultant's recommended program costs and revenue projections are shown in Tables 1-3 and 1-4 of the attached report.

POLICY MATTERS

Pursuing a major compost program may be necessary as the greatest single impact on the waste stream towards achieving City recycling and landfill avoidance goals. That is the conclusion of the County's recycling program report by R. W. Beck with respect to County-wide recycling goals. However, the City is currently requesting proposals from private firms for alternatives to directly hauling the City's waste to the County's landfill. It is conceivable, although unlikely, that diverting the yard waste to a compost program might eliminate other waste management alternatives that involve some other processing of the total waste stream. Therefore, any decision at this time to initiate a large compost program should be considered tentative until the alternatives review process can settle the issue of other waste management strategies that may include yard waste.

Initiating a major compost program as recommended by the consultant will require a significant initial investment of funds, including debt financing of capital costs and high operational costs in the first few years of the program. A decision must be made to site the program at the existing landfill site, or immediately search for an alternate location.

MBE/WBE

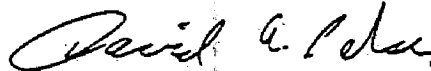
Not applicable.

RECOMMENDATION

It is recommended that the Joint Committees direct City staff to transmit this report to the City's Solid Waste Advisory Committee and other interested public agencies for a review and comment period along with other recycling reports presented this day.

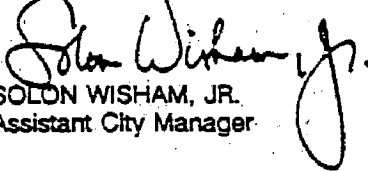
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Respectfully submitted,



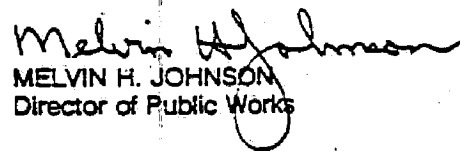
DAVID A. PELSER
Solid Waste Division Manager

Recommendation Approved:



SOLOM WISHAM, JR.
Assistant City Manager

Approved:



MELVIN H. JOHNSON
Director of Public Works

Contact Person to
Answer Questions:

DAVID A. PELSER, SOLID WASTE DIVISION MANAGER
449-2043

November 14, 1989
All Districts

Yard Waste Composting Options

for

Yard Waste Recycling

in the

CITY OF SACRAMENTO California



Final Report

October, 1989

**R.W. BECK
AND ASSOCIATES**

Sacramento, California

This Document is printed on 100% Recycled Paper

R.W. BECK
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WK-1893-AA1-AA

October 19, 1989

Mr. David Pelser
Manager, Solid Waste Division
City of Sacramento
1231 I Street, Suite 103
Sacramento, CA 95814


Dear Mr. Pelser:

Attached is the Final Report for the City's compost evaluation. I would like to thank you and your staff for your constructive comments and input for the Final Report. Because of time constraints, I will be providing information on pathogen standards for composting sewage sludge under separate cover.

If you need assistance in developing the City's comprehensive recycling plan, or implementation plans for any of the proposed recycling programs, please feel free to contact me or Richard Gertman.

Very truly yours,

R. W. BECK AND ASSOCIATES


Richard Tagore-Erwin
Solid Waste Management Specialist

Yard Waste Composting Options

for

Yard Waste Recycling

in the

CITY OF SACRAMENTO

California



Final Report

October, 1989

R.W. BECK
AND ASSOCIATES

Sacramento, California

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SECTION I

EXECUTIVE SUMMARY

A. INTRODUCTION

The City of Sacramento disposed of approximately 251,842 tons of solid waste in the City landfill in 1988. Of this, approximately 65,000 tons of yard waste was separately collected. In August 1989, the City of Sacramento adopted Resolution Number 89-685 which states that "by January 1, 1992, the City shall endeavor to recycle or reduce all solid waste disposed of in the City by 30% by weight;"... and "the City shall compost or utilize alternative disposal to landfilling of the maximum amount of yard and garden waste that is feasible."

In June 1989, the City contracted with R. W. Beck and Associates to develop a compost program which could compost all separately collected yard waste. As a result of this, eight alternative compost designs were evaluated, each of which could achieve the desired result.

The recommended compost program is a "high tech" option with a design capacity of 85,000 unprocessed tons per year (Section V-3) which could accommodate seasonal fluctuations in the amount of yard waste collected. If all City yard waste is processed, the recommended system could produce approximately 177,000 cubic yards, or 70,000 tons, per year of a finished compost product. Such a program should be implemented over a five (5) year period to allow for market development.

For the recommended option, total capital costs for equipment would be \$3,100,000 and could be debt financed with an annual cost of \$500,000. Gross operating costs would be approximately \$1,200,000 per year at full capacity. Depending on whether the City would use L & D landfill or the County landfill to dispose of its solid waste after the City landfill closes in late 1991, by implementing such a program the City could realize savings between \$915,000 to \$1,778,000 per year through avoided landfill costs. Local markets could absorb approximately 108,000 cubic yards, or 43,000 tons, per year of finished compost. This represents projected revenue ranging from \$88,000 to \$215,000 per year depending on the quality of compost produced and local market prices.

When the cost for the recommended compost program is applied to the 100,000 residential households serviced by the City's yard waste collection program, the additional cost per month per household with the system operating at full capacity would be \$0.97. However, this cost may be partially offset by revenue generated through the sale of compost and through avoided landfill costs. Revenues are projected

to range from \$0.07 to \$0.18 per month per household, and avoided landfill costs would range from \$0.76 to \$1.48 per month per household depending on which landfill the City would use.

If all yard waste would be processed, approximately 28.2 percent of the City's total waste stream could be diverted from landfill disposal. However, 27,000 tons, or 69,000 cubic yards, of finished product may not be immediately marketable. Accordingly, until strong local and state-wide markets are developed, alternative disposal methods such as requiring that City produced compost be used when new parks and recreation areas are developed. In addition, Assembly Bill 4, which was signed into law in September 1989, most likely will increase state-wide markets for compost because it provides for procurement preferences for compost products.

The evaluation was assisted by use of a spreadsheet computer model developed by R. W. Beck in cooperation with GroCo, Inc. The model performs mass balance calculations, checks the suitability of the initial mix against several compostability criteria, estimates area requirements, estimates labor, power and fuel requirements, estimates operation, capital, and present worth costs, and calculates the cost per unit of material processed. The program has the flexibility to evaluate windrow, aerated static pile, and large static pile composting systems. Sludge and yard waste composting and de-composting have also been evaluated using the program, but are not included in this evaluation. The spreadsheet format also allows adaption of the program to reflect specific needs of a particular community, such as seasonal composting of a separate leaf compost product. The program allows rapid evaluation of changed conditions and assumptions including the effect of seasonal rainfall. The program provides a useful tool for evaluation and preliminary design of compost facilities.

The Consultant has identified the system parameters for aspects of the model described above to assist City officials in determining the most viable plan for its yard waste compost program. This evaluation is intended to provide options that the City may pursue in expanding its compost program, and is not intended to prescribe the degree of yard waste processing or the marketing strategy for the end-products. However, given the critical role of ensuring long-term markets for the processed yard debris, a focus of this report is how the City can begin to optimize the value of the finished compost while minimizing overall costs to the City.

B. COMPOST FEEDSTOCK

Section II discusses compost feedstock in terms of the amount of City collected yard waste available for processing and the characteristics of yard waste. Because yard waste is the largest component of the City's waste stream, composting yard waste is a logical approach in achieving Sacramento City's goal of reducing the amount of solid waste disposed of in landfills. Based on programs operating in Davis, CA, Portland, OR, Hennepin, MN, and Seattle, WA, the reasons are:

- Yard waste is the largest component of City's waste stream.
- It is collected separately from residential generators.

Table I-1		
Sources and Tons of Yard Waste Collected in Sacramento		
Source	Tons/Year Solid Waste Disposed	Percent Vegetal Waste Sector
Garden Refuse	64,763.9	91%
Parks & Recreation	4,435.8	6%
Tree Trimming Contracts	628.8	1%
Vegetal Waste Accepted for Compost	1,264.8	2%
TOTAL	71,093	

- If properly composted, it can be reduced in volume and weight by more than half without producing undesirable by-products.
- It is usable as a valuable mulch and soil conditioner.

Approximately 251,842 tons of solid waste was disposed of at the City landfill in 1988. 58,921 tons were commercial and 192,920 tons were residential. Of this, 71,093 tons of vegetal waste was separately collected. This represents approximately 37 percent of the residential waste collected. In comparison, a waste composition study conducted by the Consultant in April 1989 for Sacramento County estimated that approximately 41 percent of the countywide residential waste stream is composed of leaves and grass, and yard waste. Table I-1 shows the sources of yard waste collected by the City.

C. YARD WASTE PROCESSING

Processing of yard waste is an essential step in producing a usable compost product. Section III outlines backyard composting, neighborhood composting, and municipal scale composting, then discusses several methods of processing yard waste into marketable compost materials.

Backyard composting and mulching of grass clippings are methods that can help reduce the solid waste stream. Backyard composting of leaves and grass can also reduce the amount of material requiring disposal.

Although yard wastes comprise approximately 37% of the residential waste stream in Sacramento, programs operating in Davis, CA., Portland OR. and Hennepin, MN., have shown that probably only 2% of the public will participate in such a program. This 2% may cover as much as 75% of their yard waste materials. Although only four-tenths of one percent (0.4%) of the solid waste stream in Sacramento might be reduced by back yard composting, encouraging such efforts should be viewed as part of any promotional program to assist those who might be interested.

Neighborhood composting is an organized effort for backyard composting of yard wastes by groups of up to ten householders. Typically, there is a paid staff person and grant to initiate the program and guide the participants. An added help would be at least one volunteer who is eager and involved, lives near the site, and is prepared to manage the program after the grant period ends.

Shredding and screening of compostables and finished compost serves several functions. Shredding and screening of the feedstock provides opportunities to aerate and to separate out too large, noncompostable, and contaminating material. Reducing particle size increases surface area and accelerates decomposition. However, if particle size gets too small, compaction can result, decreasing aeration of the feedstock and also deteriorating the soil conditioning properties of the finished compost. Screening of the compost can remove pieces of glass, metal, ceramics, stone and plastic that did not decompose, mix it to improve homogeneity, and make a more marketable product.

D. COMPOST MARKETS AND USES

Section IV presents an assessment of potential compost markets. The market analysis also includes a review of factors that could reduce sales or impede distribution. The purpose of this analysis is to compare the amount of finished compost that could be produced annually from Sacramento vegetal waste feedstock materials with the capacity of secondary markets to absorb it.

Generally, soil amendment purchasers are looking for a product that provides some nutrients, aids soil tilth and water holding capacity, possesses a nearly neutral pH character, is easy to spread, and that looks like fertile soil. There are a number of organic soil amendment products which would compete with compost or humus made from Sacramento's yard waste due to their similar properties. However, no additional nutrients would need to be added to compost produced by the City.

In the Sacramento area (includes Sacramento County, Yolo County, El Dorado County and Placer County), there is not a clear hierarchical structure for bulk soil amendment distribution. Accordingly, when ordered in large quantities, some is shipped directly from lumber mills, some from sludge compost marketers or from other generators. The largest share, however, goes through about a half dozen brokers that are local or are relatively close to Sacramento. These include Redi-Grow, Neilson-Ferrar, Sun-up Forest Products, Mallard Creek Industries, and Wilbur Ellis Company. Some of these are potential processors or marketers as well as consumers of yard waste compost.

There are a variety of consumers who buy soil amendments having the attributes of compost. These consumers normally purchase soil amendments such as topsoil, manure, sawdust, or peat moss. Compost, as discussed in this report, has qualities of each of the above materials, which enhances its position in the soil amendment marketplace.

The majority of larger compost suppliers in the Sacramento area import wood scrap from lumber mills in Northern California. The scrap is processed and marketed for many different uses, such as sod production, topsoil enhancement, landscaping, etc. Other imported compost products sold in the area include mushroom compost from Santa Cruz and a variety of organic products from companies in southern California, the Bay Area, and San Joaquin County.

The Consultant conducted a survey which indicated that there is a significant demand for a variety of compost products in the Sacramento area. This demand is due to a number of factors, including:

- Rapid development of new housing and businesses in the County Region
- Long transportation distances from existing suppliers
- Growing popularity of organic farming in the area
- Local topsoil in the urban areas of Sacramento County is poor and often needs soil amendments

Putting together the fragmented estimates of demand from the relatively different sectors, total known demand of bulk soil amendments excluding fertilizer and wood bark is 210,000-270,000 cu. yd./yr. This would be equivalent to 80,000-105,000 tons of unprocessed yard waste per year.

The companies contacted in the survey quoted retail prices between \$13.56 and \$18.55 per cubic yard, with "Superblend" and other similar mixes being the most expensive. Many claimed that they offer a reduced price or free delivery for larger purchases. Of those who sell compost wholesale, the price was around \$5.00 per cubic yard and \$7.00 per cubic yard delivered.

As noted previously, the existing supply does not meet the great demand for compost and compostable materials in the Sacramento area. Currently, transportation of materials affects the cost and availability of compost substantially. The City's product could add stability to the existing market and possibly even reduce the cost of compost to the local residents, though its effect would probably be moderate. If properly marketed, the City could avoid competition with local compost distributors while offering them a new source of materials for processing and sales.

Table I-2			
Projected Cost Per Ton For Processed Compost For the City of Sacramento			
Option	Debt Service	Processing	Gross Cost
High Tech			
Option 1	\$ 5.90	\$ 7.66	\$13.56
Option 2	\$ 8.00	\$ 7.66	\$15.66
Medium Tech			
Option 3	\$ 6.16	\$ 9.88	\$16.04
Option 4	\$ 6.91	\$ 9.88	\$16.79
Option 5	\$ 6.16	\$ 9.88	\$16.04
Option 6	\$ 6.91	\$ 9.88	\$16.79
Low Tech			
Option 7	\$ 6.93	\$10.86	\$17.79
Option 8	\$ 7.69	\$10.86	\$18.55

E. SYSTEM ECONOMICS

In order to keep disposal costs relatively constant after the City's landfill is closed, the City may choose to reduce the amount of solid waste disposed of in landfills by implementing an aggressive yard waste composting program. Section V presents eight options which have three distinct processing approaches: high technology, medium technology, and low technology.

Operation and maintenance cost for processing range from \$7.66 to \$10.86 per ton depending on the degree of processing done and the final quality of the compost materials. Debt service for capital costs ranges from \$5.90 to \$ 7.69 per ton depending on the type of equipment used and the amount of site improvements made. Projected revenue from the sale of compost ranges from \$1.94 to \$10.37 per ton depending on the quality of the compost produced.

On the aggregate, gross costs range from \$3.02 to \$16.47 per ton depending on equipment, site improvements and projected revenues. Table I-2 compares the differences in gross costs between the eight options presented in Section V.

The options presented in Section V were developed from a computer simulated economic model which estimates area requirements, labor, power and fuel requirements, estimates operation, capital, and present worth costs, and calculates the cost per unit of material processed. In all the options presented in Section V, the model was based on operating at full capacity of 85,330 unprocessed tons per year. Revenue calculations were based on selling 50% of the compost produced (approximately 35,000 tons of unprocessed yard waste). Therefore, actual operating costs and revenue generated may change according to the level of production and the marketing strategy the City pursues.

In Section VI, Option 1 was modified to reflect a phased implementation of the program over a four year period by increasing the level of processing from 25 percent for the first year to processing all yard waste collected by the City during the fourth year of operation.

F. RECOMMENDATIONS AND IMPLEMENTATION PLAN

Section VI presents recommendations and an implementation plan for the City's Yard Waste Composting Program. Based on the overall cost effectiveness, both in terms of cost to the City and flexibility of the compost program, the Consultant recommends that the City consider selecting Option 1 (High-Tech).

1. Processing Recommendations

The Consultant recommends that all processing equipment, with the exception of front-end loaders, be purchased during the first year of operation. This should be done in order for the City to avoid purchasing downsized equipment to match lower processing levels during the initial years of operation, then having to make addition equipment purchases to accommodate increased processing levels. After the first year of operation, the only additional equipment requirements would be for additional front-end loaders.

The Consultant does not anticipate the program to generate any revenue through the sale of compost during the first year of operation. This is based on a six month lead time necessary to order and set up processing equipment, to make the necessary site improvements prior to any processing occurring, and to secure markets for the finished product. We estimate that an additional six months will be necessary for yard waste to be processed into marketable compost material.

The Consultant recommends that approximately 17,500 tons, or 25 percent, of all separately collected yard waste be processed during the first year of operation. This would be increased to approximately 35,000 tons, or 50 percent, during the second year of operation. The tonnage could be increased to 52,500 tons, or 75 percent during the third year of operation if either viable markets are located, or if alternative forms of disposal are deemed feasible. Likewise, during the fourth year of operation, and there after, the program could process all yard waste separately collected by the City, or approximately 70,000 tons. The actual amount of yard waste available for processing may be reduced by up to 13 percent to account for material

TABLE I-3					
COMPARISON OF ANNUAL OPERATING COSTS					
	First Year (25% capacity)	Second Year (50% capacity)	Thlrd Year (75% capacity)	Fourth Year (100% capacity)	Fifth Year (100% capacity)
Quantity Processed	17,500 tons	35,000 tons	52,500 tons	70,000 tons	70,000 tons
Quantity Produced	44,236 CY	88,473 CY	132,709 CY	176,945 CY	176,945 CY
Annual Debt Service	\$503,496	\$503,496	\$503,496	\$503,496	\$503,496
Operation and Maintenance	\$303,121	\$432,769	\$562,416	\$663,746	\$663,746
Gross Operating Cost	\$806,667	\$936,265	\$1,065,912	\$1,167,242	\$1,167,242
Gross Cost Per Ton	\$46.10	\$26.75	\$20.30	\$16.67	\$16.67
Gross Cost Per Household Per Month	\$.67	\$.78	\$.89	\$.97	\$.97
Avoided Landfill Cost (\$25.50/ton) *	(\$445,000)	(\$889,000)	(\$1,333,500)	(\$1,778,000)	(\$1,778,000)
Avoided Landfill Cost Per Household (\$25.25/ton)	(\$0.37)	(\$0.74)	(\$1.11)	(\$1.48)	(\$1.48)
Avoided Landfill Cost (\$13.08/ton) **	(\$228,900)	(\$457,800)	(\$686,700)	(\$915,600)	(\$915,600)
Avoided Landfill ** Cost Per Household (\$13.08/ton)	(\$0.19)	(\$0.38)	(\$0.57)	(\$0.76)	(\$0.76)
* Cost for transport and disposal at the County landfill					
** Cost for transport and disposal at L&D landfill					
Cost per household is based on 100,000 households					

not suitable for processing. Because the system is designed to process up to 85,330 tons of yard waste per year to account for seasonal variations, the main factor in deciding how much yard waste to process is the viability of markets.

TABLE I - 4					
PROJECTED REVENUE					
Quantity Produced		Price per Cubic Yard			
Cu. Yards	Tons	\$2.00	\$3.00	\$4.00	\$5.00
15,000	6,000	\$30,000	\$45,000	\$60,000	\$75,000
30,000	12,000	\$60,000	\$90,000	\$120,000	\$150,000
45,000	18,000	\$90,000	\$135,000	\$180,000	\$225,000
60,000	24,000	\$120,000	\$180,000	\$240,000	\$300,000
75,000	30,000	\$150,000	\$225,000	\$300,000	\$375,000
90,000	36,000	\$180,000	\$270,000	\$360,000	\$450,000
105,000	42,000	\$210,000	\$315,000	\$420,000	\$525,000

Table I-3 is a summary of gross costs for the first five years of operation. Revenue projections are listed in Table I-4. In order to project net operating costs, the City will have to make a policy decision on the level of production to determine revenue projections, and if unprocessed yard waste will be disposed of at either the County landfill or L&D landfill.

The yard waste should be processed into end products based on size and quality standards negotiated with end users or brokers. All material should be shredded and screened, then formed into windrows and composted. The screen size used will depend on the moisture content in the uprocessed yard waste and the quality of compost desired. As the seasonal types of yard waste are shredded and screened, samples should be analyzed by City staff to ensure marketability of the compost product being produced. This should be continued for as long as the program is in operation.

Monies should be provided for site improvements at the City landfill, for purchasing equipment for processing yard waste into a compost product, and for annual operating costs.

2. Marketing Recommendations

Because of the developing nature of the compost marketplace, the City should utilize a large portion of the compost produced during the first several years of the program to stabilize the soil amendment market while aggressively pursuing local and regional markets. In addition, the City should actively investigate the use of compost as a cover for the City's landfill as well as for the County of Sacramento's landfill.

Some short term market displacement may occur if during the third or forth year of operation the City were to market all compost that was produced. For example, if the City were to operate the program

TABLE I - 5	
MARKETS FOR COMPOST	
USER	TONS/YEAR
North Highlands Rock	18,000
Redi-Grow	30,000
Other companies	20,000
City Parks and Recreation	20,000
City Weekend Sales	20,000
TOTAL	108,000

Source: Table IV-5

at 50 percent capacity, approximately 75,000 cubic yards of compost would be produced. This represents between 25 percent to 31 percent of the known commercial soil amendment market in the Sacramento Region. Although the Consultant estimates that some market displacement will occur, however, most of the displacement will be for compost producers located outside of the Sacramento Region. Table I-5 summarizes potential markets for compost.

SECTION II

COMPOST FEEDSTOCK

A. INTRODUCTION

Yard waste compost options presented in this evaluation assumes that the creative management of solid wastes offers the City an opportunity to significantly reduce the amount of solid waste the City disposes of in a landfill, while providing local and regional businesses which use vegetal waste or process compost as a feedstock with a stable supply. This section discusses yard waste collected by the City that is available for processing into compost and the characteristics of yard waste.

B. COMPOST FEEDSTOCK

Composting yard waste is a logical approach in Sacramento City's goal of reducing the amount of solid waste disposed of in landfills. Based on programs operating in Davis, CA, Portland, OR, Hennepin, MN, and Seattle, WA, the reasons are:

- Yard waste is the single largest component of the City's waste stream.
- It is collected separately from residential generators.
- If properly composted, it can be reduced in volume and weight by more than half without highly technical processing and without producing undesirable by-products.
- It is usable as a valuable mulch and soil conditioner.

Composting is the biological decomposition of organic materials under controlled conditions to a state where the materials can be handled and stored, and applied to land as a valuable organic soil amendment. The biological mechanism of all aerobic (i.e., with oxygen present) composting technologies requires that micro-organisms be supplied with oxygen, water, and a balanced diet of carbohydrates and protein. When these micro-organisms are provided with their basic needs, they consume 70% of the volume of yard waste and other organic wastes in a matter of 3-6 months.

The primary feedstock evaluated in this report is yard waste which is high in carbon or carbohydrates. Other feedstocks considered in this study are wastes high in protein and/or water that will assist in the rapid

decomposition of yard waste. Nitrogen is an important building block in proteins, and therefore aids the decomposition process.

C. MUNICIPAL SOLID WASTE CHARACTERISTICS

Approximately 251,842 tons of solid waste was disposed of at the City landfill in 1988. 58,921 tons were commercial and 192,920 tons were residential. Of this, 71,093 tons of vegetal waste was separately collected. This represents approximately 37 percent of the residential yard waste collected. In comparison, a waste composition study conducted by the consultant in April 1989 for Sacramento County estimated that approximately 41 percent of the countywide residential waste stream is composed of leaves and grass, and yard waste.

Table II-1 shows estimates of the percentage of residential waste disposed in the City landfill. Waste generated by residential users accounted for the majority of yard waste disposed of in landfills.

Table II-1	
Residential Waste Disposed by the City of Sacramento	
Organics	50.9%
Paper	24.9%
Plastic	5.0%
Metal	3.2%
Glass	4.1%
Wood	1.3%
Hazardous Materials	0.6%
Rubber	0.5%
Other Waste	9.6%
* Total may not add to 100% because of recycling. Source: Solid waste Composition Study for Sacramento County Division of Solid Waste Management, August 1989.	

D. YARD WASTE VOLUMES & CHARACTERISTICS

Knowing the weight and volume (i.e., density) and general properties of the yard waste is significant in planning the collection containers, collection vehicles, and processing site capacities and design. Section III discuss density-related issues in terms of marketing and alternative disposal costs. Yard waste generation varies considerably across the United States. Table II-2 compares tree and landscape waste generation estimates for all regions of the U.S.

Table II-2	
Tree and Landscape Waste Generation Estimates	
Region In U.S.	Average Waste Rate (lbs/capita/day)
Pacific Coast	0.34
New England	0.21
Southeast	0.81
Southwest	0.40
Great Lakes	0.13
Sacramento	0.99

(Source: Neissen, W. R., 1988. Estimation of Solid Waste Production Rates: Handbook of Solid Waste Management, D. G. Wilson, editor, Van Nostrand Reinhold Publishing Company, New York, and Composition of Solid Waste in Sacramento County, April 1989.)

Table II-3 estimates the sources and quantities of vegetal waste that was disposed of in the Sacramento City Landfill in 1988.

Table II-3		
Sources and Tons of Yard Waste Collected in Sacramento		
Source	Tons/Year Solid Waste Disposed	Percent Vegetal Waste Sector
Garden Refuse	64,763.9	91%
Parks & Recreation	4,435.8	6%
Tree Trimming Contracts	628.8	1%
Vegetal Waste Accepted for Compost	1,264.8	2%
TOTAL	71,093	

The density of yard waste and compost varies with the waste source by moisture content, texture, particle size, degree of compaction and other factors. Uncompacted waste largely made up of brush and dry leaves may be as light as 93 pounds/cubic yard (Davis, CA). On the other hand, loose dry leaves picked up in a dump truck or dropped off at a compost site is typically 200-260 pounds/cubic yard, while mulched leaves are 250-450 lbs./cu. yd. Green grass is generally more moist and ranges from 300-500 lbs./cu.

yd. A 30-gallon plastic bag of yard waste weighs 20-50 pounds. The higher figure (usually wet grass) sometimes creates lifting problems for collectors.

A load of yard waste filling a compactor truck varies from about 300 lbs./cu. yd. for dry leaves which may not be very compactable, to 1550 lbs./cu. yd. for wet, finely chopped green grass. Average figures for compacted yard waste for a whole season varied from 325 to 929 lbs./cu. yd. Densities for yard waste and other soil amendments are listed in Table II-4.

Table II-4		
Density of Organic Materials		
Material	Condition	Typical Density (lbs/cu. yd.)
Brush & Dry Leaves	Loose and Dry	100
Leaves	Loose and Dry	200-260
Leaves	Shredded and Dry	250-450
Leaves	Compacted	300
Green Grass	Loose and Moist	350-500
Green Grass	Wet & Compacted	1550
Yard Waste	As Collected, Whole Season	350-929
Yard Waste	Shredded	450-600
Yard Waste	Composted	500-650
Redwood Sawdust	As Shipped to Market	300-350
"Organic" Compost	Chicken Manure, Rice Hulls Mix	400-450
"Tillo," Zanker Humus	Sludge and Wood Waste Composts	
Lab analysis on a Dry Basis		412-427
"Tillo"	As Marketed-("too wet for bagging")	1000-1200

Shredding or grinding reduced the volume of the loose yard waste material by 84% in Davis and increased the density to 600 pounds/cubic yard. Composting further reduced the volume by 55%, for a total volume reduction of 93%. Also, composting reduced the weight by 54% through volatilization, so that final density was comparable to the raw, ground material.

Commercial alternatives to yard waste compost vary in density from 300-500 lbs./cu. yd. for "Organic Compost" produced from a mixture primarily of chicken manure and rice hulls, to 1000-1200 lbs./cu. yd. for Tillo Sludge compost and "mushroom" compost. Zanker Humus (A San Jose mulch from wood wastes) and Tillo sludge compost were measured on a dry basis, and density was 415-427 lbs./cu. yd. However, according to Soil and Plant Laboratory, located in Santa Clara, CA, moisture content was 40.2 and 53.7%, respectively, as received for testing.

E. MUNICIPAL YARD WASTE COLLECTION PROGRAMS

There are a variety of methods to collect yard waste, including loose and containerized systems. One can expect to recover 50-90% of yard waste generated, provided the approach is flexible and adapted to local conditions.

The following section contains a brief synopsis of municipal yard waste collection programs throughout the United States.

1. Yard Waste Collection in Sacramento, California: Sacramento's program operates year around and provides service to 100,000 homes with annual collection of about 64,763 tons. In 1988, monthly collection ranged from 4,024 tons in July to 7,015 tons in December. The program utilizes front-end loaders with "claw" attachments for collection and rear loaders for transportation. The budget for 1988-89 is approximately \$5,300,000, or approximately \$81.84 per ton collected.
2. Yard Waste Collection and Composting in Davis, California: This year-round program includes just over 10,000 homes with annual collection at about 5,000 tons, varying from 1,000 tons/month in the Fall to 250 tons/month thereafter, though Spring brings a fairly constant 400 tons/month. The program uses a front-end loader with "Claw" attachment and a retrofitted rear loader for collection and a "beefed-up" W.H.O. tub grinder for composting.
3. Vacuum Leaf Collection in Roseville, Minnesota: This Fall program operates for four weeks and collected 12,879 cubic yards in 1986 at a cost of \$55,000, or \$4.28/cubic yard. The program uses two "Super-Vacs" and one "Vac-All", and realized a 60% participation rate, or approximately 9,000 homes.
4. Street Sweeping in Minneapolis, Minnesota: This program includes a Fall sweeping and a street and alley sweeping in the Spring, and collected 8,500 tons of material (90% leaves), or approximately 53,300 cubic yards, at a cost of \$600,000, or \$11.30/cubic yard. The equipment used includes a flusher truck, front-end loader and a tandem dump truck.
5. Yard Waste Collection and Composting in Madison, Wisconsin: This yard waste collection and composting program collected 4,136 tons in 1986, or approximately 25,850 cubic yards, primarily leaves. The equipment used includes a water truck, jeeps with broom attachments, retrofitted rear loader packer trucks and small vacuum trucks. Total cost for the collection and composting operation in 1986 was \$183,700, or approximately \$7.11/cubic yard.
6. Separate Wet Waste Collection in Amersfoot, Holland: This program services 50,000 households with weekly curbside collection with 85% participation. Approximately 3,000 tons per year is collected, made up of 70% wet putrescibles and 30% yard waste.

7. Separate Wet Waste Collection in Portland, Oregon: This relatively small operation services 1,200 homes or about 1% of total, and includes wet waste and yard waste collection, at a cost of about \$34/cu. yd.

8. Yard Waste Collection Using Paper and Biodegradable Plastic Bag Collection in Woodbury, Minnesota: The program recovered 3,068 tons in 1987 from 6,530 homes with a collection cost of \$131,924, or about \$7.00/cu. yd.

SECTION III

YARD WASTE PROCESSING

A. INTRODUCTION

Processing of yard waste is an essential step in producing a usable compost product. This section will outline processing with regard to backyard composting, neighborhood composting, and municipal scale composting. This will be followed by discussion of several methods of processing yard waste into marketable compost material.

B. BACKYARD COMPOSTING

Backyard composting and mulching of grass clippings are methods that can help reduce the solid waste stream. In Plano, Texas, a public education program has been used to encourage lawn maintenance methods that reduce waste generation. If lawns are cut weekly, the clippings can be left on the lawn with little change in aesthetics but with a substantial reduction in the generation of grass clippings. Backyard composting of leaves and grass can also reduce the amount of material requiring disposal.

Although yard wastes comprise approximately 37% of the residential waste stream in Sacramento, programs operating in Davis, CA, Portland, OR, and Hennepin, MN, have shown that probably only 2% of the public will participate in such a program. This 2% may cover as much as 75% of their yard waste materials. Although only four-tenths of one percent (0.4%) of the solid waste stream in Sacramento might be reduced by backyard composting, encouraging such efforts should be viewed as part of any promotional program to assist those who might be interested.

C. NEIGHBORHOOD COMPOSTING

Neighborhood composting is an organized effort for backyard composting of yard wastes by groups of up to ten householders. Typically, there is a paid staff person and grant to initiate the program and guide the participants. An added help would be at least one volunteer who is eager and involved, lives near the site, and is prepared to manage the program after the grant period ends.

The site may be on nearby City property, or may be in the backyard of a participant, but should be reasonably centrally located. The group may be neighbors, people with a common interest, members of a housing complex, etc. Guidance in organizing the program involves constructing a bin, education on use of water, aeration and appropriate mixtures of compostables for a 21-day pile, and suggestions for work rotation plans. The 21-day compost-making system is rapid and efficient, but requires understanding and adherence to certain procedures. A meeting is held to bring the participants together, decide on a site, and agree to work schedules and a system for distribution of the finished compost. The group meets again to build the compost bin and make the first batch.

The Seattle model uses a three-compartment bin made of recycled wood pallets where possible. The design includes removable inner slats for easy turning of the compost and air ventilation screens for oxygen circulation. Each compartment is typically one cubic yard in volume. This minimum size is needed for sufficient heat generation to kill pathogens. Additional holding bins may be needed to presentably store new material until it is turned into the compost pile. Once all three compartments have compostable materials, it takes about two hours of turning each week to keep the piles appropriately aerated. Special tools which cost about \$15 are available which simplify the turning-aerating process.

D. MUNICIPAL SCALE COMPOSTING PROGRAMS

This section summarizes programs located in Davis, California, Hennepin and Ramsey Counties, Minnesota; New Brighton, Minnesota; and Seattle, Washington.

1. Davis, California

Davis' contractor for collection of refuse, recyclables and yard waste, the Davis Waste Removal Company, uses a W.H.O. Forage Grinder to process the yard wastes. The unit was purchased in 1981 using grant funds from the California Waste Management Board (CWMB). Staff from the Company and the State found this grinder most appropriate and economical for Davis' variable yard wastes, which includes substantial quantities of woody branches from pruning of deciduous fruit trees. The grinder is a modified version of one designed to grind row crops into animal feed and has a tub-shaped container which rotates to bring materials to a hammermill. The grinder performed satisfactorily during the five-year compost program commitment made to the CWMB.

For the 1981-1986 period, the program processed 10,500 tons of yard wastes with an estimated original volume of 225,000 cubic yards. The total operating budget was \$155,746 or about \$15 per ton of material collected. About 25% of the compost was sold for \$13,000 to landscapers and nurseries, while the balance was given away to residents for lawn and garden use. As a result of the program, avoided tipping fees at the Yolo County landfill totaled over \$37,000. Taking these savings into account, the overall cost of production was \$21.75 per ton of compost produced, or \$10 per ton of waste processed. Further, if the grinder cost was amortized over its full life, and all of the compost was sold, this cost could be further reduced.

2. Hennepin County, Minnesota

Hennepin County's yard waste program serves approximately 1,000,000 people, including Minneapolis and its western suburbs. Yard waste is processed at four sites, each of which receives material from municipalities, private haulers, private landscapers and the general public. Some participating cities which offer weekly separate collection programs are Robbinsdale and St. Louis Park. Total annual yard waste

generation is estimated at 90,000 tons, though when the program is fully implemented, 150,000 tons are anticipated. The County has also distributed a brochure to homeowners promoting backyard composting, further reducing volumes destined for disposal. These efforts are particularly important since the Minnesota Waste Management Act has required all urbanized areas in the County to implement weekly separate collection programs by 1990.

Hennepin County's recycling and yard waste compost programs will be funded via a \$7.00 per ton surcharge added to the regular tipping fee that will be assessed on wastes processed at the Hennepin County waste-to-energy facility.

Marketing the County's compost has only been partially successful due to inadequate quality control measures during processing. Nevertheless, the County anticipates demand for its compost from many sectors, including the State Department of Transportation, farmers and reclaimers of abandoned gravel pits.

3. Ramsey County, Minnesota

This county has been conducting a documented multi-site yard waste composting program for the past five years. The program is a voluntary, resident drop-off system. Finished compost is available at established times on a first-come-first served basis, and a substantial share of the compost has been taken by homeowners. About 20-25% of the waste is collected in the Spring with the remainder in the Fall.

4. New Brighton, Minnesota

This suburb of Minneapolis began its program in 1981 as a result of a grant from the State Pollution Control Agency. Initially, small groups interested in landfill abatement and compost developed neighborhood compost sites. Later that year, the focus expanded from the neighborhood to the community level, and included development of a site in the center of the City to accept all of the City's leaves collected by four private haulers. The following year, a new site, maintained by Ramsey County, was established outside New Brighton, and was shared with the community of Arden Hills, where the site was located. Separate leaf collection by haulers was discontinued, but citizen drop-off was expanded.

5. Seattle, Washington

Seattle's comprehensive and integrated training program for home composting uses a private non-profit organization, the Seattle Tilth Association to promote urban agriculture. The Association has held compost workshops, generated compost since 1980, and promoted use of compost as a garden soil amendment, using compost contributed by Association members at its demonstration garden. In addition, the Association developed a "Master Composter" Program to train people to compost at home with the intent that these people would train others. The Association has conducted workshops at a variety of sites, and brochures and slide shows have been developed.

E. PROCESSING EQUIPMENT

Shredding and screening of compostables and finished compost serves several functions. Shredding and screening of the feedstock provides opportunities to aerate and to separate out too large, noncompostable, and contaminating material. Reducing particle size increases surface area and accelerates decomposition. However, if particle size gets too small, compaction can result, decreasing aeration of the feedstock and also

deteriorating the soil conditioning properties of the finished compost. Screening of the compost can remove pieces of glass, metal, ceramics, stone and plastic that did not decompose, mix it to improve homogeneity, and make a uniform product.

It is not uncommon for those working with waste materials to adapt shredders and grinders designed for other uses to suit their particular needs. A list of some equipment manufacturers for shredding, screening, leaf pickup and composting is included in Appendix D.

Screening, such as that used by greenhouses to separate roots from black dirt, requires moisture to be less than 30% to prevent plugging up of the screens. A small rotary screen costs about \$22-24,000, and can process 15 cubic yards per hour. Vibrating or oscillating screens are one-quarter as expensive, but may require a two-step process; screening after initial shredding and after compost stabilization. Royer Shredder-Mixers are specifically marketed for leaf composting. It is a comprehensive system, which mixes, shreds, breaks material down into uniform particle size, aerates before and after processing, and separates out non-shreddable material. Capacities range from 15 to 250 cubic yards per hour. The manufacturer claims these particular advantages over hammermills: separates rather than crushes non-compostables; handles moist materials and aerates more efficiently; and is transportable. Larger models have variable flow control, so the unit can run continuously even with varying conditions of input materials. Royer has been marketing this equipment for a long time, and refers to successful programs in Scarsdale, NY, Wellesley, MA, Tenafly, NJ and Westfield, NJ. They did not, however, have references for mixed yard waste programs. In the past few years, Royer has built sludge compost processing systems for Columbus, OH, Philadelphia, PA, Scranton, PA, Myrtle Beach, VA. Costs in 1989 ranged from \$18,000-\$100,000, with about \$16,000 in options on the largest model. The Royer 2600 chipper converts brush, branch trimmings and stalks less than 4" in diameter into uniform small chips. The Price is approximately \$7,000. It is designed for use with a tractor.

The Universal Refiner Corporation is described as a "comminuter" of wood residue, paper products and municipal garbage. It uses "centrifugal force and rolling penetration action" rather than "hammers, knives or anvils". Users are primarily wood and wood products companies. One user told us that their machine has a rated capacity of 1,000 T.P.D., has not performed for wet bark, and has had bearing problems. Lindig makes the L15 to the LR200 Shredder/Screeners. The former is oriented towards the needs of nurseries and golf courses; the latter for earth or compost processing for public works departments. They are designed for feeding with large loaders. They process 15 to 200 cu. yds/hr. Self-cleaning rotary screeners are available in a variety of sizes and screen meshes.

The Shredding Systems, Inc. Mobile Shredding Service (MS-2) is a heavier duty rotary shear type shredder that can handle 25-35 tons/hr of municipal solid wastes (MSW), steel drums, tires, etc. Marketing is geared toward materials recovery programs or MSW volume reduction.

In 1980, Davis, CA investigated stationary and rotary/tub grinders and shredder/mulchers for handling its municipal yard wastes. They found that the first two types could not properly handle the compacted brush as collected, and were generally more expensive. The Medallion Model 1010 and the W.H.O. Model P12-56 were found to be comparable overall when considering operation, production, maintenance, accessibility, parts, service and cost. The W.H.O. was chosen because it cost \$65,000 (at the time) compared to a minimum of \$95,000 for the Medallion. It was determined that hard materials cause

excessive wear of the hammers and fibrous materials can clog the screens and jam up the mill. (The Medallion is no longer available.)

Fuel Harvester Equipment (present owner of W.H.O.) markets a tub grinder geared specifically for waste wood. The promotional materials are a balanced account of advantages and potential obstacles to smooth operation. The current cost for a portable unit with power is \$120,000, with production cost just for machine depreciation, repair, spare parts and fuel estimated at \$5-\$7/ton. This does not include labor, secondary processing or other operations. This is used by Palo Alto for its dropped-off yard waste. Branches up to 6" in diameter are accepted and the loose volume should be reduced by 66%. Capacity is 10-25 tons/hour. The northern California location of the company is convenient.

Numerous other tub grinders are available including the 6650 Hammermill grinder from Farmhand Inc. (once owned by Medallion), with a rated capacity of 100 cu. yds./hour (20 tons) when powered by a 150 horsepower unit and grinding bark, wood chips, leaves, branches up to 3" diameter and 4' long. Manure, and hay are among other acceptable materials. Excluding the power unit, the cost is about \$26,000.

F. PROCESSING REQUIREMENTS

Two general processing requirements are critical in commercial handling and processing of yard waste:

1. Fire Safety Procedures

When managing yard wastes that contain brush and green grass, it is important to process the two as quickly as possible after the material arrives at the processing site. Grass begins composting more rapidly and spontaneous combustion is possible if too much grass is clumped together and, a source of fuel, such as brush, is available. Adequate planning will have to be made to ensure the availability of water and water pressure in case there are any problems with spontaneous combustion.

Brush and tree limb drying piles usually only need storage for 30 days to reduce moisture content for optimal shredding conditions. Further storage of these materials beyond 30 days increases the risk of fires. Drying brush and tree limbs should be stacked in numerous piles that are spaced with fire breaks so that the size of any fire will be minimized, as smaller piles are less likely to reach combustion temperatures.

2. Federal and State Sludge Requirements

Although the City does not anticipate using sewage sludge in its composting program, a brief discussion of Federal and State sludge requirements may provide City staff useful information in developing a testing program for yard waste compost.

If any sewage sludge is used to high-grade the yard waste, then U.S. Environmental Protection Agency (EPA) standards must be followed. To be able to use this compost without restriction, it will be necessary for the compost to meet standards for maximum heavy metals and PCB's. Whether or not sludges are used to "high-grade" the compost, these standards should be specified for compost produced in Sacramento.

The Federal standards also require that sludge-derived composts which might be used to raise root crops or leafy vegetables must prescribe to the "Process to Further Reduce Pathogens." Although not required for yard waste compost, as there is not a similar problem, it would be valuable for processors of high-graded compost to meet the pathogen standard. The "Process" requires that temperatures in the compost piles be maintained at a level which will destroy most weed seeds (i.e., 100 consecutive hours above 140 degrees). In high-grade soil amendment markets, having a material free of weed seeds is critical.

High grade sludge composts are assumed to:

1. have been fully composted so that weed seeds are killed.
2. have met pathogen standards if sewage sludge is used.
3. have been screened to at least 1/4 inch.
4. have blended yard waste feedstock with higher nitrogen materials so that the compost is dark in appearance and has a cake-like texture. Low grade compost is assumed to be greater than 1/2 inch, but less than 1-inch particle size, brown in color and light texture.

SECTION IV

COMPOST MARKETS & USES

A. INTRODUCTION

This section presents an assessment of potential compost markets. The market analysis also includes a review of factors that could reduce sales or impede distribution. The purpose of this analysis is to compare the amount of finished compost that could be produced annually from Sacramento vegetal waste feedstock materials with the capacity of secondary markets to absorb it. This analysis will examine the marketplace for a yard waste compost product.

The overall objectives of this section are:

- To provide an overview of the biological properties of compost as they relate to the needs of end-users.
- Describe the various soil amendments available, their properties, quantities sold, and cost.
- Describe the various end-users of soil amendments, quantities used, and their potential interest in compost.

B. COMPOST PROPERTIES

1. General Properties

Humus consists primarily of organic materials which have been thoroughly decomposed into an earthy, sweet-smelling, soil-like substance. However, in common usage, the term "humus" describes any soil amendments containing organic matter which may or may not have been thoroughly decomposed. Technically, humus is best described as organic materials which are thoroughly decomposed into a group of substances, most of which are visibly unrecognizable and of unknown parentage.

Nearly all soils contain some humus, or decomposed organic matter, although the actual percentage can vary depending upon the particular soil type, climate, cropping patterns and other factors. Most soils contain between 1.5% and 4.0% organic matter. Soils with adequate levels of organic matter (2.5% to 4.0%) generally have the following characteristics:

- increased water retention and resistance to evaporation by wind or heat.
- improved resistance to wind and water erosion;
- enhanced soil tilth and "pore space;"

- consistent soil temperatures;
- serves as buffer in making minerals available to plants and;
- ensures faster and more extensive root development of plants; and
- exhibits higher populations of "friendly" soil biota

The final nutrient analysis and marketability of the humus end product from a composting facility will depend on the type of feedstock inputs and processing steps used to "finish" the compost. For example, using sludge enhances the final compost product because sludge adds primary plant foods in small quantities.

2. Laboratory Analyses

Although this evaluation does not include a laboratory analysis of compost produced at the City's existing facility, a brief discussion of a typical laboratory analysis should provide the City with useful comparative data. In addition, the City should consider performing a laboratory analysis of their compost after the program is underway.

Apart from the physical characteristics of the compost and its soil-conditioning benefits, plant food nutrients are the basis upon which a probable end-user value can be developed at this time. The primary plant food nutrients are nitrogen (N), phosphorus (P) and potassium (K), and are normally represented as "N-P-K." Table IV-1 shows a representative breakdown of the constituents of sludge-free compost from lab tests at the University of Minnesota on a sampling from a variety of sites in Minnesota.

Table IV-1	
Representative Analysis of Yard Waste Compost	
Nitrogen	0.57 - 2.14%
Carbon	4.4 - 39.3%
Phosphorus	average 0.2%
Potassium	average 0.3%
Lead	100ppm*
Moisture	4 - 60%
pH	7-8

*Highest average at one site

The pH reflects a slight alkalinity, which means that this compost reduces need for lime on acid soils, but is recommended for acid-loving plants such as azaleas and strawberries.

The N (nitrogen), P (phosphorus) and K (potassium) figures, are in the range of a rich topsoil rather than fertilizer, and make these elements accessible to plants slowly. They are not lost from the soil as readily as soluble inorganic fertilizers. For example, the most popular form of inorganic nitrogen, anhydrous

ammonia (NH₄) is less efficiently used by the growing crop due to its tendency to either leach below or volatilize (disperse into the atmosphere) away from the plant's "root zone" in soil. The carbon-nitrogen (C:N) ratio is variable but was never greater than 20:1, assuring that nitrogen would be usable. Higher ratios occur in composts that are not fully decomposed, with carbon oxidizing to carbon dioxide, and turning nitrogen into a form which is unavailable to plants.

The source of some lead in compost is automobile exhausts from leaded gas. Higher figures, in more urban areas and in prior years when leaded gas was more common, confirm this theory and predict a decreasing trend. While no laboratory analysis has been performed in Sacramento, it is generally considered safe to use garden produce grown in soils with lead measuring 500ppm. Soil typically is 2-200ppm lead.

Essential plant nutrients, including iron, sodium, manganese, zinc, copper and boron are found in yard waste compost in useful concentrations, many fold less than toxic levels. The Minnesota Pollution Control Agency has proposed maximum levels of these elements, as well as cadmium (10ppm), nickel (100ppm), chromium (1000ppm), and lead (1000ppm). Analysis showed virtually all samples well below these figures; often less than 1/100th of the concentrates. While no laboratory analysis has been performed for the City's yard waste, concentrations of these elements should be similar to those in Minnesota.

Just as with many other natural materials, compost acts as a buffer -- it can save extra precipitation for drier times; it can bind up or leach minerals and nutrients making them accessible or inaccessible to plants over time. Analysis may indicate a particular quantity of cadmium, for example, but not indicate the chemical forms of the cadmium, and the rate at which it is changing to other forms, given the pH, temperature and other qualities of the medium in which it is found. Plant growth experiments are a very important adjunct to laboratory analysis because they vividly demonstrate the life-supporting qualities of soil amendments.

3. Contaminants

Compost contains biological nutrients but may also contain bio-toxic (harmful to life) substances. The source of biological nutrients is organic waste from plants which contain nutrients from soil (minerals), air (as carbon from CO₂) and water (as hydrogen and oxygen from H₂O). Bio-toxic substances found in sludge are from industrial and residential discharges into sewer systems. Discharges into sewer water by manufacturers from processing equipment and plant washdowns are examples. Household chemicals such as solvents and other chemical compounds normally found in the home are other examples.

Toxics are less of a problem in yard waste than in sludge. While there are pesticide and herbicide residues, most of these and other organic chemicals found in feedstocks for compost are initially in low concentration and will be further reduced by decomposition in the compost process.

Other possible contaminants, such as lead, are more likely to remain as a residue, but as mentioned above, in less than toxic concentrations.

During the composting process, carbon dioxide, water, nitrogen and other gases are released from the composting mixture. Some minerals may also be leached out of this mixture depending upon the technology used.

If glass, metals and plastics are present in the collected yard waste, there will probably be bits of glass, plastics and perhaps metal in the final compost product. The inclusion of these foreign substances in the final compost product should not significantly affect its marketability in most high volume markets, though effective screening to remove the majority of these foreign materials can upgrade the compost and raise the market value.

4. Particle Size

There will be different grades of compost, based upon the final screening to maintain uniform particle size. Ideally, the screening process should be designed to separate "finished" compost into a particle size that can be easily applied through any standard push-type dry fertilizer spreader. The particles must be small enough so that the compost will not be visible when applied to grass. This size is ideal for nearly any compost market.

C. SOIL AMENDMENT MARKETS

Generally, soil amendment purchasers are looking for a product that provides some nutrients, aids soil tilth and water holding capacity, possesses a nearly neutral pH character, is easy to spread, and that looks like fertile soil. There are a number of organic soil amendment products which would compete with compost or humus made from Sacramento's yard waste due to their similar properties.

Table IV-2 compares some of these soil amendment properties and cost at the wholesale and retail level. Wholesale costs are for quantity orders. With no minimum order, the price doubles in some cases.

Table IV-2					
Soil Amendments in the Sacramento Area					
Product	% Organic by Weight	pH	Salinity	Wholesale price/cubic yard	Retail price/cubic ft.
Peat	100	3.6	.3	NA	\$1.50
Steer Manure	50	8-8.6	12-14	NA	2.50-3.50
Chicken Manure	30-40	3.9-8.5	17-23	NA	4.80-5.90
Redwood Compost	100	7.8	1.8	\$6-12	2.00-2.50
R/C. mix w/sand	65	4.7	.2	NA	2.00-2.50
"Organic" Compost	57-93	2.9	2.0	11	3.00-4.00
"Organic" Compost	69	7.6	1.0	11	3.00-4.00
Mushroom Compost	44	7.9	6.5	7-10	3.30

(Technical data provided by the University of California Extension and Soil & Plant Laboratory, Inc. Price data obtained by telephone Survey conducted in June 1989)

1. Brokers for Bulk Soil Amendments:

In the Sacramento area (includes Sacramento, Yolo, El Dorado and Placer Counties), there is not a clear hierarchical structure for bulk soil amendment distribution. Accordingly, when ordered in large quantities, some is shipped directly from lumber mills, some from sludge compost marketers or from other generators. The largest share, however, goes through about a half dozen brokers that are local or are relatively close to Sacramento. These include Redi-Grow, Neilson-Ferrar, Sun-up Forest Products, Mallard Creek Industries, and Wilbur Ellis Company. Some of these are potential processors or marketers as well as consumers of yard waste compost.

Bagged soil amendments are sold in a great variety of businesses, ranging from nurseries whose primary business is growing and selling potted plants, to discount stores such as Woolworth and K-Mart. Typical retail prices for a variety of bagged amendments are described in Table IV-3. Though we indicate a savings for large quantity purchases, however, the majority of bagged amendment sales were for small quantities.

Table IV-3			
Bagged Compost Market Value			
Product	Bag or Bale Size In Cu. Ft.	Retail Price	Comparative Price (\$/cy)
Peat Moss	1	\$4 .79	\$129.00
4 (250 @ a time)		8.40	\$56.70
Steer Manure	2	3.19	\$43.00
2 (75 @ a time)		2.05	\$28.00
Redwood Compost	2	3.50-7.00	\$47-94.00
Fertilizer 18-6-12	20 lbs.		\$37-87.00
Bone Meal	5 lbs.		\$3-7.00
	20 lbs.		\$16.99
• Org. Plant Food 5-3-1	4 lbs.		\$3.98
Vermiculite	2.5	3.29	\$35.50
	4	12.00	\$81.00
Planter Mix	1.5	3.99-5.25	\$80.00
Org. Compost Plant Mix	0.5	2.99	\$162.00
Potting Soil-"Supersoil"	1	3.99	\$108.00
Potting Soil-"Greenhouse"1		2.99	\$81.00

These prices indicate the substantial markup per cubic yard for bagged amendments. Those listed are only a sampling from a telephone survey conducted by the Consultant during June-July 1989 which found a wide variation in prices for just about every product.

A detailed discussion of soil amendments and their retail and wholesale markets can be found in Appendix C, which includes peat moss, chemical fertilizer, redwood compost, manure, mushroom compost, organic compost and sludge compost.

2. Soil Amendment Additives

Many other variables affect choice of soil amendment. These include release time of mineral, affect on pH, texture, and color. Processing and treating compost to improve the universally desirable qualities, and/or to meet the specifications for a particular end use is referred to as "high-grading." Briefly they include:

- (a) Ammonium sulfate is often added to sawdust and other nutrient-low soil conditioners to boost nitrogen content.
- (b) Blood meal is an easily soluble supplement, stimulates microbial activity, and is a concentrated source of nitrogen.
- (c) Bone meal is a supplement high in phosphorus and tends to alkalize soil.

(d) Coca bean hulls are similar to compost in that they can serve as a soil conditioner or a mulch. In addition, hulls are aesthetically pleasing as a mulch, thereby adding to its value.

(e) Dolomite and lime are used to increase pH, but are not much needed in Sacramento where soils tend to be more alkaline.

(f) Food wastes, such as grape pomice, and lignin (pulp mill waste) can increase nitrogen and trace element content when composted with yard waste.

(g) Ferric sulfate adds iron and dark color (to look fertile) and acidifies, but can stain when used in contact with concrete, such as water runoff from lawns.

(h) Gypsum purportedly replaces sodium in alkaline soils with calcium, helps slow the volatilization of ammonia from compost piles, and helps loosen clay soils. Often added to mixes in San Jose landscapers specifications.

(i) Kelp meal is a soil conditioner and mulch, and is especially high in potassium and trace elements.

(j) Perlite is puffed volcanic ash, and Vermiculite, a puffed mined mineral, are used especially for planting mixes for aeration and water holding capacity, and drainage.

(k) Sand increases workability and porosity, and is needed for clay soils. It does not provide nutrients.

(l) Sulfur is used to gradually lower soil salinity.

(m) Worm castings are "digested" soil after passing through earth worms. According to the ninth edition of The Nature and Properties of Soils, they have: lower bulk density, highly improved structural stability, four times the cation exchange capacity and exchangeable calcium, three times the exchangeable potassium and soluble phosphorus and total percent nitrogen when compared to "undigested" soils. Of course the activity of the live worms themselves would provide aeration.

D. MARKETING STRATEGIES

Based on experiences all over the country, it can be conclusively stated that a product which becomes familiar to the public is the key factor in successful mass marketing of compost. A trade name is needed that connects the product to the area, or a popular area feature. For compost sold in any form, developing a history of reliability and customer satisfaction is critical. For example Milorganite, a sludge compost, was used on the Candlestick Park field in the 1970's, when heavy metal content was higher than today. When several football players coincidentally came down with ALS (Lou Gehrig's disease), the finger was pointed at Milorganite. Though it was exonerated, the connection remains in many minds years later.

High grading to improve nitrogen content and custom mixing with other materials to appeal to specific markets can increase market price many fold. Ensuring homogeneity of the product by screening for non-compostables and for size uniformity is also important. A reasonable range of moisture, mineral and metals content should be adhered to, so that customers can rely on the product. Where compost is only used for cover, (e.g., mulch) content predictability is not as critical, but for higher value uses such as in potting

mixes, for nurseries, etc., this factor is very important. The compost must be laboratory tested periodically to assure quality control.

The reliability of demand for compost is an important consideration, particularly if contracts for feedstock are required and a steady output of compost is projected. In the event of weak or poor demand, producers of competitive products such as peat moss and topsoil have the luxury of not harvesting their products, and marketers of fertilizers need not order a resupply. Large volume composters of yard waste and/or sludge will be required to accept waste as a feedstock every week of the year regardless of the marketplace. They also must have a consistent, quality product on hand to meet demand fluctuations.

E. USERS OF COMPOST

There are a variety of consumers who buy soil amendments having the attributes of compost. These consumers normally purchase soil amendments such as topsoil, manure, sawdust, or peat moss. Compost, as discussed in this report, has qualities of each of the above materials, which enhances its position in the soil amendment marketplace.

The Consultant conducted a phone survey from June 13 to July 19, 1989, to determine the potential marketability of a yard waste compost produced by the City of Sacramento. A wide range of local businesses were contacted, including:

- Compost Producers
- Sod Producers
- Landscapers (including yard maintenance)
- Nurseries
- Retailers/Wholesalers (topsoil, sand and gravel, fertilizer, compost, etc.)
- Golf Courses
- Cemeteries

The businesses contacted were asked the following questions:

- Do you buy and sell organic compost?
- From whom do you buy your products?
- To whom do you sell compost products?
- What types of compost products do you sell?
- What is the cost of each compost product per yard?
- What quantity of compost do you sell weekly?
- Would you be interested in buying a yard waste compost product from the City of Sacramento?
- If so, how much?

The following sections outline the results of the survey in terms of existing suppliers, demand, and market prices for the various types of compost products. The potential impact of City of Sacramento yard waste compost products on the existing market is also discussed, along with market options for the City.

The bulk commercial sector is characterized by high volume, bulk demand and low profit margins, whereas the specialty sector involves low to medium demand, low to potentially high profits, and includes bulk and bagged compost end users. A brief description of some markets within the commercial sector follows.

F. EXISTING COMPOST SUPPLIERS

The majority of larger compost suppliers in the Sacramento area import wood scrap from lumber mills in northern California. The scrap is processed and marketed for many different uses, such as sod production, topsoil enhancement, landscaping, etc. Other imported compost products sold in the area include mushroom compost from Santa Cruz and a variety of organic products from companies in southern California, the Bay Area, and San Joaquin County.

Only a small portion of the compostable wastes generated in the Sacramento area are processed into a compost product. The City provides separate collection service for its yard waste, but only 1,265 tons of the 69,829 tons of yard waste collected in 1988 were composted. Much of the local agricultural waste is either burned on-site or used as fuel in nearby co-generation power facilities. Sludge, though available in large quantities, is not an option included in this evaluation. Hence, the only compost products that use local materials are small amounts of manure, wood-waste, and the City's yard waste compost.

1. Demand

In a survey conducted in the fall of 1977, JCM & Associates concluded that there is an important trend toward "low input" agriculture among smaller commercial farmers who want to reduce operating costs, including fertilizer. These farms could consume 3-7 tons of compost per acre. However, it would have to be boosted with a nitrogenous supplement and strongly promoted, and the relatively low market price and high transport and spreading costs could consume revenues at this time. However, demand and price costs could rise substantially in the 1990's. Organic farmers may be interested in yard waste compost, but only after the product is available and tested. These agricultural demand sectors have the potential of consuming all of Sacramento's yard waste compost, but the market is not an existing one. It is a serious contingency option for the long term, if higher value markets are not successfully developed.

Landscapers represent a substantial part of the potential demand for compost. However, some do not use soil amendments at all, especially those who do exclusively maintenance. Currently, those that use redwood compost almost exclusively, do so primarily for mulch. A single major construction project may require thousands of cubic yards of compost, whereas maintenance rarely requires more than a few hundred yards in a year. Architects often set the specifications, and decide by easy availability, familiarity and price. They want something dry so it is spreadable, and uniform from one shipment to the next. Prompt delivery at an arranged time may also be important. Brokers typically charged \$20 for delivery only if less than 150 cu. yds.

Nurseries that sell soil amendments are the largest potential buyers, but for some, part of their use is for wholesale and retail distribution, rather than their own plantings. About ten nurseries estimated that they buy 500-2,000 cu. yd./yr. for their own use, then some under 300 cubic yards. Cut flower nurseries do not use soil amendments. Cuttings are usually grown in sand and perlite. Those that did use compost for their own operation often preferred a custom mix suited to their particular operation, that was either supplied to them or that they made themselves. They were generally concerned much more than other users about composition, homogeneity, consistent supply and a product that resisted compaction (not too fine).

Cemeteries/golf courses/amusement parks use little compost for maintenance -- (e.g., a few use it as top dressing for lawns). When they build a new ride or tee, they may need 10-200 cu. yd. Most use fertilizer, often several tons costing \$3-10,000. Some make their own compost from their own yard waste. Some expressed interest if compost was free.

The survey indicated significant demand for a variety of compost products in the Sacramento area. This demand is due to a number of factors, including:

- Rapid development of new housing and businesses in the County
- Long transportation distances from existing suppliers
- Growing popularity of organic farming in the area
- Local topsoil in urban areas is poor and often needs soil amendments

Putting together the fragmented estimates of demand from the relatively different sectors, total known demand of bulk soil amendments excluding fertilizer and wood bark is 210,000-270,000 cu. yd./yr. This would be equivalent to 80,000-105,000 tons per year.

There is a market for soil amendments all year long, but demand is lowest in winter, and highest in the Spring and Fall for most uses. Although most businesses did not have sales broken down to specific categories such as soil amendments or were not willing to share specific sales estimates by month, they did provide their "sense" of sales trends over the course of the year. Considering the entire market place, compost from Sacramento yard waste that is shredded and screened can be competitively marketed in bulk by distributors for \$4-7/cu. yd. (\$16-21 per ton) for purchases over 100 cu. yd. and \$5-8/cu. yd. (\$20-32 per ton) for no minimum purchase. Of course, if not sold directly, the City will have to sell the compost to distributors for less, possibly \$3-4/cu. yd. or \$12-16/ton.

The demand for compost can be broken down into three basic categories: low process bulk, finished bulk, and finished bagged compost. The following is a discussion of the three categories.

2. Low Process Bulk Compost

Compost producers could provide a large market for the City's yard waste. Many producers currently bring their compostable materials from other areas of the state. Much of the raw wood scrap is transported 100 to 250 miles from mills in northern California. Wilbur Ellis, a local compost producer, imports its raw materials over 400 miles from southern California. A dependable source of local organic material could save these companies considerable transportation costs. Table IV-4 lists the major compost producers in the area, their location, if they would purchase compost from the City, and the potential quantity of compost they could purchase from the City.

TABLE IV-4		
Compost Producers in the Sacramento Area		
Compost Producer	Location	Quantity
Neilson-Ferrar* Phone # 622-9211	Placerville	Depends on Quality
Sun Up Forest Products Phone # 920-0665	Sacramento	Up to 40,000 TPY
Mallard Creek Ind. Phone # 645-1681	Rocklin	In direct competition with City produced compost
Wilbur Ellis Co. Phone # 662-0287	Woodland	Depends on Quality and Price
North Highlands Rock Phone # 334-4381	North Highlands	100,000 cy/yr
* Also known as R. V. Neilson and Sons.		

North Highlands Rock has stated that it would be willing to buy up to 100,000 cubic yards per year of low process compost from the City if, in turn, the City agreed to purchase North Highland products exclusively for its own compost needs.

A low process compost can also be used as landfill cover. The City's 28th Street Landfill is scheduled to close at the end of 1991. It is estimated that 55 acre-feet of cover will be required to close the landfill, approximately one-third of which, or almost 30,000 cubic yards, could be low process compost.

3. Finished Bulk Compost

Sixteen wholesale and retail compost distributors, topsoil producers, and landscapers were contacted about their interest in a finished bulk compost. Six of these stated that they would be able to use the City's compost immediately; nine others commented that they are interested but would have to know more about the quality, availability, and chemical constituents of the product; and only one had no interest at all. Table

IV-5 lists the interested companies, the quantities they would use on a weekly basis, and the estimated prices they would be willing to pay for the product.

TABLE IV-5		
Compost Users in the Sacramento Area		
Company	Quantity	Est. Price
North Highlands Rock	150 cy/wk	\$4-7 per cy
Redi-Grow Corporation	500-750 cy/wk	\$4 per cy
Arcade Sand and Gravel	25 cy/wk	\$5-6 per cy
Johnson's Organic Topsoil	150 cy/wk	Unknown
Handford Sand and Gravel	25 cy/wk	Unknown
Longer's Landscaping Mat.	25 cy/wk	\$6-7 per cy
Allan's Landscaping Mat.	*	Unknown
Cascade Rock Inc.	*	Unknown
Delta Sand and Gravel	*	Unknown
Hastie's Capitol S&G	*	Unknown
Nimbus Landscaping	*	Unknown
South Sacramento Nursery	*	Unknown
Sunrise Home Improvement	*	Unknown
Sunrise Rock and Readymix	*	Unknown
Sunshine Sand and Gravel	*	Unknown
Smitty's Organic Compost	*	Unknown
* Have asked for more information on the product.		

Redi-Grow Corporation, a Sacramento company, has expressed interest in buying 30,000 to 40,000 cubic yards per year of finished bulk compost which would pass through a one-quarter inch screen. They would like to bag and sell it to retailers and other distributors.

Out of the five other companies who gave quantity estimates, only Johnson's Organic Topsoil cannot be considered a viable market option. North Highlands Rock appears to be a strong market for finished compost if an agreement cannot be reached on the low process product.

Local residents provide another market for a finished compost product. The City has had a leaf composting program for many years and recently sold 2,400 cubic yards during three weekend sales in Spring 1989. The demand for this type of sale depends heavily on public promotion and product quality.

4. Finished Bagged Compost

The survey indicated that the demand for a bagged product is not nearly as great as for a finished product in bulk form. Forty-seven nurseries were contacted and only one expressed interest in a bagged compost sold by the City. Every other nursery commented that it was satisfied with its current product line.

5. Market Prices

The wholesale and retail prices for compost in the Sacramento area depend on the following factors:

- Chemical and Organic Composition
- Transportation costs for raw materials
- Quantity purchased
- Transportation to work site

The companies contacted in Table IV-4 quoted retail prices between \$13.50 and \$21.50 per cubic yard, with "Superblend" and other similar mixes being the most expensive. Many claimed that they offer a reduced price or free delivery for larger purchases. Of those who sell compost wholesale, the price was around \$5.00 per cubic yard and \$7.00 per cubic yard delivered.

6. Impact of City of Sacramento Compost Products on Existing Market

As noted previously, the existing supply does not meet the great demand for compost and compostable materials in the Sacramento area. Currently, transportation of materials affects the cost and availability of compost substantially. The City's product could add stability to the existing market and possibly even reduce the cost of compost to the local residents, though its effect would probably be moderate. If properly marketed, the City could avoid competition with local compost distributors while offering them a new source of materials for processing and sales.

7. Market Options

The City needs to consider several points in evaluating its compost market options:

- Stability of local compost markets
- Ability to sell all (or most) of the compost produced

- Competition with existing compost markets
- Quality of existing products
- Quality of City products to be marketed
- Degree of processing that each product requires
- Capital costs for processing equipment
- Image presented to the public
- Area restraints of existing composting site
- Future expansion of yard waste collection program
- Avoided landfilling and environmental costs

Another consideration is that the majority of compost produced in 1990-91 can be used as cover for the closure of the 28th Street Landfill in 1991. Therefore, markets can be developed slowly and some equipment expenditures can be postponed for at least a year.

The results of the market survey indicate that the City has several market options. The market for both a low process product and a high process, or finish compost product is very strong. It appears that North Highlands Rock is willing to purchase all of the City's low process compost if an acceptable agreement can be reached between both parties. If a deal can not be made with North Highlands, the other five compost producers will be able to buy a large portion of the low process compost produced.

With a low process compost, the shredded product can be stacked into large piles which need little or no processing and maintain moisture better than windrows. Moisture retention is a major consideration in the Sacramento area. In addition, by selling a non-finished product, the City will not be competing with existing high quality compost products. The City may also transfer marketing responsibilities to the compost producers.

The City also has the option of processing the yard waste into a finished compost product. North Highlands Rock has expressed interest here as well. By their recent estimates, they would be able to buy

almost 18,000 cubic yards of compost annually. Redi-Grow claims it would buy 30,000 to 40,000 cubic yards a year, but they are asking for a very fine product (one-quarter inch) that would slow production capacity considerably. The Consultant believes that Redi-Grow would be willing to take a three-eighths inch material, though that would require negotiation. The other 13 companies found in Table IV-5 could eventually buy up to 20,000 cubic yards per year, assuming 30 cubic yards per week per company. The City could also use a finished compost for its own needs in parks, roadways, etc., which could account for 20,000 cubic yards a year. Finally, the City could expand its periodic weekend sales to the public, which could account for annual sales of 20,000 cubic yards. Therefore, the consultant estimates that a market for approximately 108,000 cubic yards of finished compost currently exists.

Production of a finished compost has many advantages and disadvantages. It would allow the City to expand its market base to include a whole range of compost products. The compost could be used for many applications in the city and county, allowing the City to truly recycle its waste and providing substantial public relations for the composting program. If the residents can openly see the benefits of the program in their parks and yards, they may be more likely to continue their support.

The primary disadvantages of producing a finished compost are the added capital, site development, and labor costs needed to construct and operate a processing facility. The City may also need to budget more for compost marketing to compete with existing compost products. However, the increased revenue received from selling finished compost will partially offset increased capital costs. This is fully discussed in Section V.

The City must consider that the ultimate goal of a composting program is to divert waste from going to the landfill. More than likely, the program will not pay for itself initially, if ever, but when compared to the costs for landfill disposal, the program makes both economic and environmental sense.

Eight program options are presented in Section V that the City may adopt to expand its compost program.

SECTION V

SYSTEM ECONOMICS

A. INTRODUCTION

There are costs associated with the proper management of the waste stream. In Sacramento, the residents pay a monthly service fee to have their discards collected and properly disposed of. As a result of voter approval for Measure F In November 1988, the City will continue to separately collect residential yard waste. In order to keep disposal costs relatively stable after the City's landfill is closed, the City may choose to reduce the amount of solid waste disposed of in landfills by implementing an aggressive vegetal waste composting program.

The yard waste composting options presented in this section have three distinct processing approaches: high technology, medium technology, and low technology.

Operation and maintenance cost for processing range from \$7.66 to \$10.86 per ton depending on the degree of processing done and the final quality of the compost materials. Debt service for capital costs ranges from \$5.90 to \$7.69 per ton depending on the type of equipment used and the amount of site improvements made. Total gross annual operating costs range from \$13.56 to \$18.55 per ton.

Projected revenue from the sale of compost ranges from \$1.94 to \$10.37 per ton depending on the quality of the compost produced. On the aggregate, net costs range from \$3.19 to \$16.61 per ton depending on equipment, site improvements and projected revenues. Table V-1 compares gross operating costs for yard waste compost operations around the United States. In order to determine net operating costs, the City will have to make policy decisions regarding the level of production to project revenue, and if unprocessed yard waste will be disposed of at either the County landfill or L&D landfill. Table V-2 compares the differences in gross costs between the eight options presented in this section and Table V-3 shows levels of projected revenue.

Table V-1	
Average Cost Per Ton Comparisons	
Location	Cost/Ton
Davis, CA	\$15
Hennepin County, MN	25
Ramsey County, MN	20
Sacramento, CA *	16
Woodbury, MN	14

* Average costs for the 8 options presented in this section.

Table V-2			
Projected Cost Per Ton For the City of Sacramento			
Option	Debt Service	Processing	Gross Cost
High Tech			
Option 1	\$ 5.90	\$ 7.66	\$13.56
Option 2	\$ 8.00	\$ 7.66	\$15.66
Medium Tech			
Option 3	\$ 6.16	\$ 9.88	\$16.04
Option 4	\$ 6.91	\$ 9.88	\$16.79
Option 5	\$ 6.16	\$ 9.88	\$16.04
Option 6	\$ 6.91	\$ 9.88	\$16.79
Low Tech			
Option 7	\$ 6.93	\$10.86	\$17.79
Option 8	\$ 7.69	\$10.86	\$18.55

Source: Computer model developed by R.W. Beck and Associates and GroCo, Inc. Complete spreadsheets with all input assumptions are included in Appendix F.

TABLE V - 3					
PROJECTED REVENUE FOR PROCESSED COMPOST					
Quantity Produced		Price per Cubic Yard			
Cu. Yards	Tons	\$2.00	\$3.00	\$4.00	\$5.00
15,000	6,000	\$30,000	\$45,000	\$60,000	\$75,000
30,000	12,000	\$60,000	\$90,000	\$120,000	\$150,000
45,000	18,000	\$90,000	\$135,000	\$180,000	\$225,000
60,000	24,000	\$120,000	\$180,000	\$240,000	\$300,000
75,000	30,000	\$150,000	\$225,000	\$300,000	\$375,000
90,000	36,000	\$180,000	\$270,000	\$360,000	\$450,000
105,000	42,000	\$210,000	\$315,000	\$420,000	\$525,000

B. PROGRAM OPTIONS

The options presented below were developed from a computer simulated economic model which estimates area requirements, labor, power and fuel requirements, estimates operation, capital, and present worth costs, and calculates the cost per unit of material processed. In all the options presented here, the model was based on at operating at full capacity of 85,330 unprocessed tons per year. Revenue calculations are based on selling 50 percent, or approximately 88,771 cubic yards, of the compost produced. Avoided landfill costs are based on the additional cost to transport and dispose yard waste at the County landfill. Therefore, actual operating costs and revenue generated may change according to the level of production and the marketing strategy the City pursues. The spreadsheets which show all assumptions used to develop the options are shown in Appendix F.

1. OPTION 1 (High Tech):

Option #1 will have a total capital cost of \$3,093,766. This is broken down into the following areas: Construction costs of \$993,039, Administration and Engineering costs of \$378,906, Equipment Purchase cost of \$1,533,000, and Sales Tax cost of \$188,821. A percentage of the sales tax dollars will come back to the City of Sacramento. The Consultant estimates that Measure A alone could return approximately \$25,724 to the City.

For this option, all unprocessed yard waste would be delivered to the compost site by the City's packer trucks. It would be loaded with a grapple loader onto a conveyor belt feeding a magnetic separator to remove metal contaminants. Next the material would be shredded, then screened. Oversized or rejected materials would be returned to the shredding machine for re-shredding. Front end loaders would form the shredded and screened material into 7 foot high windrows which would be turned weekly by windrow machines. Water would have to be added to the piles to retain the necessary moisture content.

The annual costs of this option are broken down into two areas: Annual Debt Service of \$503,496, and Operation and Maintenance costs of \$653,746. These costs will be offset by an expected operating revenue of \$442,353 from the sale of compost, and an equipment salvage value of \$14,844. This will leave the program with a net operating cost of \$700,023. When compared to the cost of processing, transporting and tipping fees at the County landfill, which is estimated at \$25.40 per ton per year for a total of \$1,778,000, the City could realize a cost savings of approximately \$1,077,977.

CONSTRUCTION

Construction costs fall into three distinct areas. These are: structures, paving, and services. Structures in this option will cost \$130,984, for 9,356 sq.ft. Paving will cost \$472,072, for 236,036 sq. ft.. Services extension will cost \$60,000 for the extension of the sewer collection line by 2,000 feet.

EQUIPMENT

The purchase of equipment for this option is shown in the table below.

Type	Cost/Each	# Required	Cost/Total
Front End Loader	\$ 170,000	4	\$680,000
Grapple Loader	50,000	1	50,000
Shredder	400,000	1	400,000
Windrow Turner	100,000	1	100,000
Magnetic Drum Roller	8,000	1	8,000
Screen	90,000	1	90,000
Odor Control Equipment	35,000	Lump Sum	35,000
Conveyors & Storage Containers	100,000	Lump Sum	100,000
Power Supply Equipment	N/A	N/A	70,000
Total Equipment Costs			\$1,533,000

OPERATION AND MAINTENANCE

Operation and maintenance costs for the initial year of operation for this option is \$653,746. This is broken down into four separate budget items. Labor will cost \$195,405, this takes into consideration 1.1 operators per piece of equipment and a total of 2,086 operating hours per year for the facility with 1,854 hours per operator, and a total of 5 operators. Utilities are broken down into three areas, electric \$6,570, sewer \$1,800, and misc. \$1,000. Fuel will cost a total of \$74,455, which represents an annual consumption of 64,018 gallons. Finally equipment maintenance is estimated at \$228,963 per year.

ADMINISTRATION AND MARKETING

The total cost for administration and marketing is estimated to be \$145,108 per year. This is broken down as follows: Marketing \$66,355, Annual Report \$1,017, administration \$12,716, quality control \$14,156, and a Contingency Fund of \$50,864.

Results:

Option 1 will require a total of 14.39 acres for production, storage and handling facilities. Production cost estimates are as follows:

	Total	\$/CY of Compost Produced	\$/Unprocessed ton Yard Waste
Annual Debt Service	\$503,496	\$2.85	\$10.45
O & M	\$653,745	\$3.69	\$10.31
Revenue	(\$442,364)	(\$5.00)	(\$10.37)
Salvage Value	(\$ 14,844)	(\$0.08)	(\$ 0.17)
Net Operating Cost	\$700,033	\$4.76	\$ 9.87
Total quantities Produced		88,472 CY	85,330 Tons

2. OPTION 2 (High Tech):

Option #2 will have a total capital cost of \$4,194,076. This is broken down into the following areas: Construction cost of \$1,891,935, Administration and Engineering cost of \$513,665, Equipment Purchase cost of \$1,532,500, and Sales Tax cost of \$255,976. A large percentage of the sales tax dollars will come back to the City of Sacramento. Measure A alone could return approximately \$17,369 to the City.

For this option, all unprocessed yard waste would be delivered to the compost site by the City's packer trucks. It would be loaded with a grapple loader onto a conveyor belt feeding a magnetic separator to remove metal contaminants. Next the material would be shredded, then screened. Oversized or rejected materials would be returned to the shredding machine for re-shredding. Front end loaders would form the shredded and screened material into windrows 7 foot high which would be turned weekly by windrow machines. Water would have to be added to the piles to retain the necessary moisture content.

The annual costs of the option are broken down into two areas: Annual Debt Service of \$682,567, and Operation and Maintenance costs of \$653,746. These costs will be offset by an expected operating revenue of \$442,363 from the sale of compost, and an equipment salvage value of \$29,904. This will leave the program with a net operating cost of \$864,045. This should amount to a savings of approximately \$850,955 when compared to the cost of processing, transporting and tipping fees at the county landfill, which is estimated at \$25.40 per ton, or \$1,778,000 per year.

CONSTRUCTION

Construction costs fall into three distinct areas: structures, paving, and services. Structures in this option will cost \$130,094 for 9,356 sq. ft. Paving will cost \$1,253,285 for 626,643 sq. ft.. Services extension will cost \$60,000 for the extension of the sewer collection line by 2,000 feet.

EQUIPMENT

The purchase of equipment for this option is shown in the table below.

Type	Cost/Each	# Required	Cost/Total
Front End Loader	\$ 170,000	4	\$ 680,000
Grapple Loader	50,000	1	50,000
Shredder	400,000	1	400,000
Windrow Turner	100,000	1	100,000
Magnetic Drum Roller	8,000	1	8,000
Screen	90,000	1	90,000
Odor Control Equipment	35,000	Lump Sum	35,000
Conveyors & Storage Containers	100,000	Lump Sum	100,000
Power Supply Equipment	N/A	N/A	70,500
Total Equipment Costs			\$1,532,500

OPERATION AND MAINTENANCE

Operation and maintenance costs for the initial year of operation for this option is \$653,746. This is broken down into four separate budget items. Labor will cost \$195,405, this takes into consideration 1.1 operators per piece of equipment and a total of 2,086 operating hours per year for the facility with 1,854 hours per operator, and a total of 5.1 operators. Utilities are broken down into three areas, electric \$6,570, sewer \$1,800, and misc. \$1,000. Fuel will cost a total of \$74,901, which represents an annual consumption of 64,018 gallons. Finally equipment maintenance is estimated at \$228,963, per year.

ADMINISTRATION AND MARKETING

The total for administrative and marketing costs will be \$ 130,952 per year. This is broken down as follows: Marketing \$66,355, Annual Report \$1,017, Administration \$12,716, Quality Control \$14,156, and a Contingency Fund of \$50,804.

Results:

Option 2 will require a total of 16.07 acres for production, storage and handling facilities. Production cost estimates are as follows:

	Total	\$/CY of Compost Produced	\$/Unprocessed ton Yard Waste
Annual Debt Service	\$682,567	\$3.86	\$ 8.00
O & M	\$653,746	\$3.69	\$ 7.06
Revenue	(\$442,363)	(\$5.00)	(\$10.37)
Salvage Value	(\$ 29,904)	(\$0.17)	(\$ 0.35)
Net Operating Cost	\$864,046	\$3.30	\$ 4.94
Total quantities Produced		88,472 CY	85,330 Tons

3. OPTION 3 (Mid Tech):

Option #3 has a total capital cost of \$3,227,429 which is broken down into the following areas: Construction costs of \$789,953, Administration and Engineering costs of \$395,276, Equipment Purchase costs of \$2,042,200, and \$196,979 for Sales Tax. A percentage of the sales tax dollars will come back to the City of Sacramento. Measure A should return approximately \$14,097 to the City.

For this option, all unprocessed yard waste would be delivered to the compost site by the City's packer trucks. It would be loaded with a grapple loader onto a conveyor belt to be shredded, then screened. Oversized or rejected materials would be returned to the shredding machine for re-shredding. Front end loaders would form the shredded and screened material into windrows 10 foot high which would be turned monthly by front end loaders. Water would have to be added to the piles to retain the necessary moisture content. Leaf material would be processed separately from other yard waste to produce higher quality compost.

The annual costs of this option are broken down into two areas: Annual Debt Service of \$512,249, and Operation and Maintenance costs of \$842,739. These costs will be offset by an expected operating revenue of \$262,655 from the sale of compost, and an equipment salvage value of \$6,826. This will leave the program with a net operating cost of \$1,098,507. This should save the City approximately \$679,493 compared to the cost of processing, transportation and tipping fees at the county landfill, which is estimated at \$25.40 per ton, or \$1,778,000 per year.

CONSTRUCTION

Construction costs fall into three distinct areas: structures, paving, and services. Structures in this option will cost \$130,984 for 9,356 sq. ft. Paving will cost \$58,471, for 29,236 sq. ft. Services extension will cost \$60,000 for the extension of the sewer collection line by 2,000 feet.

EQUIPMENT

The purchase of equipment for this option is shown in the table below.

Type	Cost/Each	# Required	Cost/Total
Front End Loader	\$ 170,000	6	\$1,360,000
Grapple Loader	50,000	1	50,000
Shredder	400,000	1	400,000
Windrow Turner	100,000	0	0
Magnetic Drum Roller	8,000	0	0
Screen	90,000	1	90,000
Odor Control Equipment	35,000	Lump Sum	35,000
Conveyors & Storage Containers	30,000	Lump Sum	40,000
Power Supply Equipment	N/A	N/A	67,000
Total Equipment Costs			\$2,042,200

OPERATION AND MAINTENANCE

Operation and maintenance costs for the initial year of operation for this option is \$892,739. This is broken down into four separate budget items. Labor will cost \$264,433, this takes into consideration 1.1 operators per piece of equipment and a total of 2,086 operating hours per year for the facility with 1,854 hours per operator, and a total of 7 operators. Utilities are broken down into three areas, electric \$4,380, sewer

\$1,800, and misc. \$1,000. Fuel will cost a total of \$108,544, which represents an annual consumption of 92,777 gallons. Finally equipment maintenance is estimated at \$709,425, per year.

ADMINISTRATION AND MARKETING

The total for administration and marketing costs will be \$153,402 per year broken down as follows: Marketing \$51,700, Annual Report \$1,379, Administration \$17,233, Quality Control \$14,156, and a Contingency Fund of \$68,934.

Results:

Option 3 will require a total of 9.65 acres for production, storage and handling facilities. Production cost estimates are as follows:

	Total	\$/CY of Compost Produced	\$/Unprocessed ton Yard Waste
Annual Debt Service	\$525,249	\$2.97	\$ 6.16
O & M	\$842,739	\$4.76	\$ 9.88
Revenue	(\$262,655)	(\$2.97)	(\$ 6.16)
Salvage Value	(\$ 6,826)	(\$0.04)	(\$ 0.08)
Net Operating Cost	\$1,098,507	\$2.69	\$ 9.80
Total quantities Produced		88,472 CY	85,330 Tons

4. OPTION 4 (Mid Tech):

Option #4 will have a total capital cost of \$3,626,515. This is broken down into the following areas: Construction cost of \$919,926, Administration and Engineering costs of \$443,419, Equipment Purchase costs of \$2,042,200, and Sales Taxes cost of \$220,970. A percentage of the sales tax dollars will come back to the City of Sacramento. Measure A should return \$14,092 to the City.

For this option, unprocessed yard waste would be delivered to the compost site by the City's packer trucks. It would be loaded with a grapple loader onto a conveyor belt to be shredded, then screened. Oversized or rejected materials would be returned to the shredding machine for re-shredding. Front end loaders would form the shredded and screened material into 10 foot high windrows which would be turned monthly by front end loaders. Water would have to be added to the piles to retain the necessary moisture content. Leaf material would be processed separately from other yard waste to produce a higher quality compost.

The annual costs of this option are broken down into two areas: Annual Debt Service of \$589,222, and Operation and Maintenance costs of \$842,739. These costs will be offset by an expected operating revenue of \$221,182 from the sale of compost, and an equipment salvage value of \$12,207. This will leave the program with a net operating cost of \$1,198,572. This should save the City approximately \$579,428

compared to the cost of processing, transportation and tipping fees at the county landfill, which is estimated at \$25.40 per ton, or \$1,778,000 per year.

CONSTRUCTION

Construction costs fall into three distinct areas which are: structures, paving, and services. Structures in this option will cost \$130,984 for 9,356 sq. ft. Paving will cost \$337,560, for 168,780 sq. ft. Services extension will cost \$60,000 for the extension of the sewer collection line by 2,000 feet.

EQUIPMENT

The purchase of equipment for this option is shown in the table below.

Type	Cost/Each	# Required	Cost/Total
Front End Loader	\$ 170,000	6	\$1,360,000
Grapple Loader	50,000	1	50,000
Shredder	400,000	1	400,000
Windrow Turner	100,000	0	0
Magnetic Drum Roller	8,000	0	0
Screen	90,000	1	90,000
Odor Control Equipment	35,000	Lump Sum	35,000
Conveyors & Storage Containers	30,000	Lump Sum	40,000
Power Supply Equipment	N/A	N/A	67,000
Total Equipment Costs			\$2,042,200

OPERATION AND MAINTENANCE

Operation and maintenance costs for the initial year of operation for this option is \$842,739. This is broken down into four separate budget items. Labor will costs \$264,443, this takes into consideration 1.1 operators per piece of equipment and a total of 2,086 operating hours per year for the facility with 1,854 hours per operator, and a total of 7 operators. Utilities are broken down into three areas, electric \$4,380, sewer

\$1,800, and misc. \$1,000. Fuel will cost a total of \$108,544, which represents an annual consumption of 92,777 gallons. Finally equipment maintenance is estimated at \$309,175, per year.

ADMINISTRATION AND MARKETING

The total for cost for administration and marketing is \$153,207 per year broken down as follows: Marketing \$51,700, Annual Report \$1,379, Administration \$17,233, Quality Control \$14,156, and a Contingency Fund of \$68,739.

Results:

Option 4 will require a total of 9.65 acres for production, storage and handling facilities. Production cost estimates are as follows:

	Total	\$/CY of Compost Produced	\$/Unprocessed ton Yard Waste
Annual Debt Service	\$589,222	\$3.33	\$ 6.91
O & M	\$842,539	\$4.76	\$ 9.88
Revenue	(\$221,182)	(\$2.97)	(\$ 6.16)
Salvage Value	(\$ 12,207)	(\$0.07)	(\$ 0.14)
Net Operating Cost	\$1,115,626	\$5.05	\$10.48
Total quantities Produced		88,472 CY	85,330 Tons

5. OPTION 5 (Mid Tech):

Option #5 will have a total capital cost of \$3,227,429. This is broken down into the following areas: Construction costs of \$592,980, Administration and Engineering costs of \$395,276, Equipment Purchase costs of \$2,042,200, and Sales Tax cost of \$196,979. A percentage of the sales tax dollars will come back to the City of Sacramento. Measure A alone should return approximately \$16,944 to the City.

For this option, all unprocessed yard waste would be delivered to the compost site by the City's packer trucks. It would be loaded with a grapple loader onto a conveyor to be shredded, then screened. Oversized or rejected materials would be returned to the shredding machine for re-shredding. Front end loaders would form the shredded and screened material into 10 feet high windrows which would be turned monthly by front end loaders. Water would have to be added to the piles to retain the necessary moisture content.

The annual costs of this option are broken down into two areas: Annual Debt Service of \$525,244, and Operation and Maintenance costs of \$842,739. These costs will be offset by an expected operating revenue of \$521,183 from the sale of compost, and a salvage value of \$6,826. This will leave the program

with a net operating cost of \$1,153,627. This should save the City approximately \$624,373 compared with the cost of processing, transportation and tipping fees at the county landfill, which is estimated at \$25.40 per ton, or \$1,778,000 per year.

CONSTRUCTION

Construction costs fall into three distinct areas which are: structures, paving, and services. Structures in this option will cost \$130,984 for 9,356 sq. ft. Paving will cost \$58,471, for 29,236 sq. ft. Services extension will cost \$60,000 for the extension of the sewer collection line by 2,000 feet.

EQUIPMENT

The purchase of equipment for this option is shown in the table below.

Type	Cost/Each	# Required	Cost/Total
Front End Loader	\$ 170,000	6	\$1,360,000
Grapple Loader	50,000	1	50,000
Shredder	400,000	1	400,000
Windrow Turner	100,000	0	0
Magnetic Drum Roller	8,000	0	0
Screen	90,000	1	90,000
Odor Control Equipment	35,000	Lump Sum	35,000
Conveyors & Storage Containers	30,000	Lump Sum	40,000
Power Supply Equipment	N/A	N/A	67,000
Total Equipment Costs			\$2,042,200

OPERATION AND MAINTENANCE

Operation and maintenance costs for the initial year of operation for this option is \$842,739. This is broken down into four separate budget items. Labor will cost \$264,433, this takes into consideration 1.1 operators per piece of equipment and a total of 2,086 operating hours per year for the facility with 1,854 hours

per operator, and a total of 7 operators. Utilities are broken down into three areas, electric \$4,380; sewer \$1,800, and misc. \$1,000. Fuel will cost a total of \$108,549, which represents an annual consumption of 92,777 gallons. Finally equipment maintenance is estimated at \$309,175, per year.

ADMINISTRATION AND MARKETING

The total for administration and marketing costs is \$153,402 broken down as follows: Marketing \$56,403, Annual Report \$1,379, Administration \$17,233, Quality Control \$14,156, and a Contingency Fund of \$68,934.

Results:

Option 5 will require a total of 9.65 acres for production, storage and handling facilities. Production cost estimates are as follows:

	Total	\$/CY of Compost Produced	\$/Unprocessed ton Yard Waste
Annual Debt Service	\$6525,244	\$2.97	\$ 6.16
O & M	\$842,739	\$4.76	\$ 9.88
Revenue	(\$221,182)	(\$2.50)	(\$ 5.18)
Salvage Value	(\$ 6,826)	(\$0.04)	(\$ 0.08)
Net Operating Cost	\$1,139,980	\$5.19	\$10.77
Total quantities Produced		88,472 CY	85,330 Tons

6. OPTION 6 (Mid Tech):

Option #6 will have a total capital cost of \$3,620,515. This is broken down into the following areas: Construction costs of \$913,926, Administration and Engineering costs of \$443,419, Equipment Purchase costs of \$2,042,200, and Sales Tax cost of \$220,970. A percentage of the sales tax dollars will come back to the City of Sacramento. Measure A should return approximately \$16,944 to the City.

For this option, all unprocessed yard waste would be delivered to the compost site by the City's packer trucks. It would be loaded with a grapple loader onto a conveyor belt to be shredded, then screened. Oversized or rejected materials would be returned to the shredding machine for re-shredding. Front end loaders would form the shredded and screened material into 10 foot high windrows which would be turned monthly by front end loaders. Water would have to be added to the piles to retain the necessary moisture content.

The annual costs of this option will be broken down into two areas: Annual Debt Service of \$589,222, and Operation and Maintenance costs of \$842,739. These costs will be offset by an expected operating revenue of \$221,182 from the sale of compost, and a salvage value of \$12,207. This leaves the program with a net operating cost of \$1,198,573. When this is compared with the cost of processing, transportation and tipping fees at the county landfill, which is estimated at \$25.40 per ton, or \$1,778,000 per year, this would result in savings of \$579,427 to the City.

CONSTRUCTION

Construction costs fall into three distinct areas. These are: structures, paving, and services. Structures in this option will cost \$130,984 for 9,794 sq. ft. Paving will cost \$337,560, for 168,780 sq. ft. Services extension will cost \$60,000 for the extension of the sewer collection line by 2,000 feet.

EQUIPMENT

The purchase of equipment for this option is shown in the table below.

Type	Cost/Each	# Required	Cost/Total
Front End Loader	\$ 170,000	6	\$1,360,000
Grapple Loader	50,000	1	50,000
Shredder	400,000	1	400,000
Windrow Turner	100,000	0	0
Magnetic Drum Roller	8,000	0	0
Screen	90,000	1	90,000
Odor Control Equipment	35,000	Lump Sum	35,000
Conveyors & Storage Containers	30,000	Lump Sum	40,000
Power Supply Equipment	N/A	N/A	67,000
Total Equipment Costs			\$2,042,200

INITIAL YEAR OF OPERATION

Operation and maintenance costs for the initial year of operation for this option is \$842,739. This is broken down into four separate budget items. Labor will cost \$264,433, this takes into consideration 1.1 operators per piece of equipment and a total of 2,086 operating hours per year for the facility with 1,854 hours per operator, and a total of 7 operators. Utilities are broken down into three areas, electric \$4,380, sewer \$1,800, and misc. \$1,000. Fuel will cost a total of \$108,544, which represents an annual consumption of 92,777 gallons. Finally equipment maintenance is estimated at \$309,175, per year.

ADMINISTRATION AND MARKETING

The total for administration and marketing costs will be \$153,402 per year. This is broken down as follows: Marketing \$51,700, Annual Report \$1,379, Administration \$17,233, Quality Control \$14,156, and a Contingency Fund of \$68,934.

Results:

Option 6 will require a total of 9.65 acres for production, storage and handling facilities. Production cost estimates are as follows:

	Total	\$/CY of Compost Produced	\$/Unprocessed ton Yard Waste
Annual Debt Service	\$589,222	\$3.33	\$ 6.91
O & M	\$842,739	\$4.76	\$ 9.88
Revenue	(\$221,182)	(\$2.50)	(\$ 5.18)
Salvage Value	(\$ 12,207)	(\$0.07)	(\$ 0.14)
Net Operating Cost	\$1,198,573	\$5.52	\$11.45
Total quantities Produced		88,472 CY	85,330 Tons

7. OPTION 7 (Low Tech):

Option #7 will have a total capital cost of \$3,635,883. This is broken down into the following areas: Construction costs of \$274,667, Administration and Engineering costs of \$445,301, Equipment Purchase costs of \$2,332,000, and Sales Tax cost of \$211,908. A percentage of the sales tax dollars will come back to the City of Sacramento. Measure A should return approximately \$16,242 to the City.

For this option, all unprocessed yard waste would be delivered to the compost site by the City's packer trucks. It would be loaded onto a conveyor belt to be shredded, then screened. Oversized or rejected materials would be returned to the shredding machine for re-shredding. Front end loaders would form the

shredded and screened material into 15 foot high stacks which would be turned monthly by front end loaders. Water would have to be added to the piles to retain the necessary moisture content.

The annual costs of this option are broken down into two areas: Annual Debt Service of \$591,723, and Operation and Maintenance costs of \$926,615. These costs will be offset by an expected operating revenue of \$82,947 from the sale of compost, and an equipment salvage value of \$6,826. This leaves the program with a net operating cost of \$1,428,575. When this is compared with the cost of processing, transportation and tipping fees at the county landfill, which is estimated at \$25.40 per ton, or \$1,778,000 per year, this would result in a savings of \$349,425 for the City.

CONSTRUCTION

Construction costs fall into three distinct areas. These are: structures, paving, and services. Structures in this option will cost \$130,984 for 9,356 sq. ft. Paving will cost \$58,481, for 29,236 sq. ft. Services extension will cost \$60,000 for the extension of the sewer collection line by 2,000 feet.

EQUIPMENT

The purchase of equipment for this option is shown in the table below.

Type	Cost/Each	# Required	Cost/Total
Front End Loader	\$ 170,000	8	\$1,700,000
Grapple Loader	50,000	0	0
Shredder	400,000	1	400,000
Windrow Turner	100,000	0	0
Magnetic Drum Roller	8,000	0	0
Screen	90,000	1	90,000
Odor Control Equipment	35,000	Lump Sum	35,000
Conveyors & Storage Containers	30,000	Lump Sum	40,000
Power Supply Equipment	N/A	N/A	67,000
Total Equipment Costs			\$2,332,000

INITIAL YEAR OF OPERATION

Operation and maintenance costs for the initial year of operation for this option is \$926,615. This is broken down into four separate budget items. Labor will cost \$293,877, this takes into consideration 1.1 operators per piece of equipment and a total of 2,086 operating hours per year for the facility with 1,854 hours per operator, and a total of 7.9 operators. Utilities are broken down into three areas, electric \$4,380, sewer \$1,800, and misc. \$1,000. Fuel will cost a total of \$124,880, which represents an annual consumption of 106,740 gallons. Finally equipment maintenance is estimated at \$333,175, per year.

ADMINISTRATION AND MARKETING

The total for administration and marketing costs will be \$167,201 per year broken down as follows: Marketing \$56,934, Annual Report \$1,518, Administration \$18,978, Quality Control \$14,156, and a Contingency Fund of \$75,615.

Results:

Option 7 will require a total of 8.08 acres for production, storage and handling facilities. Production cost estimates are as follows:

	Total	\$/CY of Compost Produced	\$/Unprocessed ton Yard Waste
Annual Debt Service	\$591,723	\$3.34	\$ 6.93
O & M	\$926,615	\$5.24	\$10.86
Revenue	(\$ 82,947)	(\$0.94)	(\$ 1.94)
Salvage Value	(\$ 6,826)	(\$0.04)	(\$ 0.08)
Net Operating Cost	\$1,428,565	\$7.60	\$15.77
Total quantities Produced		88,472 CY	85,330 Tons

8. OPTION 8 (Low Tech):

Option #8 will have a total capital cost of \$4,031,166. This is broken down into the following areas: Construction costs of \$954,419, Administration and Engineering costs of \$493,713, Equipment Purchase costs of \$2,332,000, and Sales Tax cost of \$246,034. A percentage of the sales tax dollars will come back to the City of Sacramento. Measure A should return approximately \$19,516 to the City.

For this option, all unprocessed yard waste would be delivered to the compost site by the City's packer trucks. It would be loaded with a grapple loader onto a conveyor belt to be shredded, then screened.

Oversized or rejected materials would be returned to the shredding machine for re-shredding. Front end loaders would form the shredded and screened material into 15 foot high stacks which would be turned monthly by front end loaders. Water would have to be added to the piles to retain the necessary moisture content.

The annual costs of this option are broken down into two areas: Annual Debt Service of \$656,054, and Operation and Maintenance costs of \$926,615. These costs will be offset by an expected operating revenue of \$82,947 from the sale of compost, and a salvage value of \$12,237. This will leave the program with a net cost of \$1,487,485. When this is compared with the cost of processing, transportation and tipping fees at the county landfill, which is estimated at \$25.40 per ton, or \$1,788,000 per year, this would result in a savings of \$290,515 for the City.

CONSTRUCTION

Construction costs fall into three distinct areas. These are: structures, paving, and services. Structures in this option will cost \$130,984 for 9,356 sq. ft. Paving will cost \$339,120 for 169,560 sq. ft. Services extension will cost \$60,000 for the extension of the sewer collection line by 2,000 feet.

EQUIPMENT

The purchase of equipment for this option is shown in the table below.

Type	Cost/Each	# Required	Cost/Total
Front End Loader	\$ 170,000	8	\$1,700,000
Grapple Loader	50,000	0	0
Shredder	400,000	1	400,000
Windrow Turner	100,000	0	0
Magnetic Drum Roller	8,000	0	0
Screen	90,000	1	90,000
Odor Control Equipment	35,000	Lump Sum	35,000
Conveyors & Storage Containers	40,000	Lump Sum	40,000
Power Supply Equipment	N/A	N/A	67,000
Total Equipment Costs			\$2,332,000

INITIAL YEAR OF OPERATION

Operation and maintenance costs for the initial year of operation for this option is \$926,615. This is broken down into four separate budget items. Labor will cost \$293,877, this takes into consideration 1.1 operators per piece of equipment and a total of 2086 operating hours per year for the facility with 1,854 hours per operator, and a total of 7.9 operators. Utilities are broken down into three areas, electric \$4,380, sewer \$1,800, and misc. \$1,000. Fuel will cost a total of \$124,880, which represents an annual consumption of 106,740 gallons. Finally equipment maintenance is estimated at \$333,175, per year.

ADMINISTRATION AND MARKETING

The total for administration and marketing costs will be \$167,498 per year broken down as follows: Marketing \$56,934, Annual Report \$1,518, Administration \$18,978, Quality Control \$14,156, and a Contingency Fund of \$75,615.

Results:

Option 8 will require a total of 8.08 acres for production, storage and handling facilities. Production cost estimates are as follows:

	Total	\$/CY of Compost Produced	\$/Unprocessed ton Yard Waste
Annual Debt Service	\$656,054	\$3.71	\$ 7.69
O & M	\$926,615	\$5.24	\$10.86
Revenue	(\$ 82,947)	(\$0.94)	(\$ 1.94)
Salvage Value	(\$ 12,237)	(\$0.07)	(\$ 0.14)
Net Operating Cost	\$1,321,592	\$7.94	\$16.46
Total quantities Produced		88,472 CY	85,330 Tons



SECTION VI

RECOMMENDATIONS & IMPLEMENTATION PLAN

INTRODUCTION

This chapter presents recommendations and an implementation plan for the City's Yard Waste Composting Program. Based on the overall cost effectiveness, both in terms of cost to the City and flexibility of the compost program, the Consultant recommends that the City consider selecting Option 1 (High-Tech). A more detailed discussion of Option 1 is presented in Chapter V.

The proposed plan takes a phased approach to implementing the compost program by incrementally increasing system capacity over a four-year period until processing capacity for all yard waste separately collected by the City is reached. By doing so, factors such as equipment requirements, land use requirements, labor and fuel costs, and projected revenues are adjusted to reflect annual operating capacities. Avoided landfill costs are shown for both transporting and disposal at the County landfill and at L & D landfill.

The Consultant recommends that all processing equipment, with the exception of front-end loaders, be purchased during the first year of operation. This should be done in order for the City to avoid purchasing downsized equipment to match lower processing levels during the initial years of operation, then having to make additional equipment purchases to accommodate increased processing levels. Therefore, even though the program would be phased in over a four year period, the majority of capital expenditures for processing equipment should be budgeted to coincide with the first year of operation. After the first year of operation, the only additional equipment requirements would be for additional front-end loaders.

It is important for the City to recognize that during the first year of operation, the Consultant does not anticipate the program to generate any revenue through the sale of compost. This is based on a six month lead time necessary to order and set up processing equipment, to make the necessary site improvements prior to any processing occurring, and to secure markets for the finished product. We estimate that an additional six months will be necessary for yard waste to be processed into marketable compost material. Therefore, it is unlikely that large quantities of compost will be available for sale for approximately one year.

Table VI-1 is a summary of costs for the first five years of operation. Annual capital costs reflect the cost to purchase all processing equipment and perform all site improvements amortized on a ten-year basis. Accordingly, even though the City only needs to purchase one front end loader during the first year of operation, the capital costs for the first year include amortized costs for four front end loaders. Revenue projections are given in Table VI - 2.

TABLE VI-1					
COMPARISON OF ANNUAL OPERATING COSTS					
	First Year (25% capacity)	Second Year (50% capacity)	Third Year (75% capacity)	Fourth Year (100% capacity)	Fifth Year (100% capacity)
Quantity Processed	17,500 tons	35,000 tons	52,500 tons	70,000 tons	70,000 tons
Quantity Produced	44,236 CY	88,473 CY	132,709 CY	176,945 CY	176,945 CY
Annual Debt Service	\$503,496	\$503,496	\$503,496	\$503,496	\$503,496
Operation and Maintenance	\$303,121	\$432,769	\$562,416	\$663,746	\$663,746
Gross Operating Cost	\$806,667	\$936,265	\$1,065,912	\$1,167,242	\$1,167,242
Gross Cost Per Ton	\$46.10	\$26.75	\$20.30	\$16.67	\$16.67
Gross Cost Per Household Per Month	\$.67	\$.78	\$.89	\$.97	\$.97
Avoided Landfill Cost Per Ton (\$25.40/ton)*	(\$444,500)	(\$880,000)	(\$1,333,500)	(\$1,778,000)	(\$1,778,000)
Avoided Landfill Cost Per Household (\$25.40/ton)*	(\$0.37)	(\$0.74)	(\$1.11)	(\$1.48)	(\$1.48)
Avoided Landfill Cost Per Ton (\$13.08/ton)**	(\$228,900)	(\$457,800)	(\$686,700)	(\$915,600)	(\$915,600)
Avoided Landfill Cost Per Household (\$13.08/ton)**	(\$0.19)	(\$0.38)	(\$0.57)	(\$0.76)	(\$0.76)
* Costs for transport and disposal at the County landfill. **Costs for transport and disposal at L & D landfill. Costs per household are based on 100,000 households served.					

TABLE VI - 2					
PROJECTED REVENUE FOR PROCESSED COMPOST					
Quantity Produced		Price per cubic yard			
Cu. Yards	Tons	\$2.00	\$3.00	\$4.00	\$5.00
15,000	6,000	\$30,000	\$45,000	\$60,000	\$75,000
30,000	12,000	\$60,000	\$90,000	\$120,000	\$150,000
45,000	18,000	\$90,000	\$135,000	\$180,000	\$225,000
60,000	24,000	\$120,000	\$180,000	\$240,000	\$300,000
75,000	30,000	\$150,000	\$225,000	\$300,000	\$375,000
90,000	36,000	\$180,000	\$270,000	\$360,000	\$450,000
105,000	42,000	\$210,000	\$315,000	\$420,000	\$525,000

B. FIRST YEAR OF OPERATION (25 percent capacity)

During the first year of operation, the Consultant recommends that the City process 25 percent, or approximately 17,500 tons, of separately collected yard waste for the compost program. The following is an outline of the elements recommended for the first year of operation.

Processing

- Utilize a "high-tech" approach to process the yard waste into marketable end products. The process should include shredding and screening yard waste, and windrowing compostable materials.

Marketing

- The City should utilize compost in its building grounds, parks, community gardens, etc.
- The City should purchase small quantities of various types of compost from local processors for comparative analysis.
- The City should contract with UC Agricultural Extension to provide experimental plots and analyses of the City's processed yard waste.
- The City should negotiate contracts with the major compost users and brokers identified in Section IV for long-term purchase of compost materials.

Administrative

- The City should monitor and track the program from collection of yard waste to marketing composted materials. This should be done to allow the City to identify potential problems and modify the program to achieve greater efficiency prior to increasing system capacity. A final report should be developed at the end of the first year which discusses end-use findings and potential market expansion strategies.
- The City should prepare applicable environmental review and facility siting documents related to the program. This should include a review of other projects related to the compost program and the preparation of documents related to their environmental and siting clearance.

1. Processing Recommendations

- The yard waste should be processed into end products based on size and quality standards negotiated with end users or brokers. All material should be shredded and screened with a one-quarter inch screen, then formed into windows and composted. As the seasonal types of yard waste are shredded and screened, samples should be analyzed by City staff to ensure marketability of the compost product being produced. This should be a continuous process throughout the first year of the program.
- Monies should be provided for site improvements at the City landfill, for purchasing equipment for processing yard waste into a compost product, and for annual operating costs.

The following budget should be adopted for the first year of the program:

TABLE VI-3

1990/91 BUDGET RECOMMENDATIONS

YARD WASTE COMPOSTING PROGRAM

FIRST YEAR

Equipment

Front end loader (1)	\$170,000
Grapple Loader	\$ 50,000
Shredder	\$400,000
Windrow Turner	\$100,000
Magnetic Drum Roller	\$ 8,000
Screen	\$ 90,000
Odor Control Equipment	\$ 35,000
Conveyors	\$100,000
Electric Power Supply	\$ 70,500

Structures

Metal Buildings	\$130,984
Asphalt paving	\$148,356
Sewer Extension	\$ 60,000

CAPITAL COST SUBTOTAL **\$1,362,840**

Construction Cost	\$204,426
contingencies	
Administration and	\$235,090
Engineering Costs	
Sales Tax	\$117,153

TOTAL CAPITAL COST ESTIMATE **\$1,919,509**

Annual Debt Service **\$ 503,496**

Operation and Maintenance

Labor	\$ 62,046
Fuel	\$ 18,725
Equipment Maintenance	\$160,963
Marketing	\$ 16,589
Annual Report	\$ 500
Administration	\$ 6,278
Quality Control	\$ 3,539
Contingency	\$ 25,121

OPERATING AND MAINTENANCE SUBTOTAL **\$303,121**

TOTAL GROSS OPERATING COSTS **\$806,617**

PROJECTED REVENUE **-0-**

TOTAL NET OPERATING COSTS **\$806,617**

2. Marketing Recommendations

Because of the developing nature of the compost marketplace, it will be desirable for the City to utilize a large portion of the compost produced during the first year to stabilize the soil amendment market. Since the introduction of Sacramento yard waste compost might displace up to 20% of the existing soil amendment market, time is needed for the product to find its niche in the marketplace. However, most of the displacement will be for compost producers located outside of the Sacramento Region. Providing several years of stability for the industry will enable the private sector to develop marketing strategies to reach the public and purchasers willing to pay premium prices. Therefore, demonstrations that promote public and private use will be valuable in the first years of Sacramento's yard waste program.

The public sector and community consumption strategy should encourage public demonstrations by Public Works, Parks and Recreation, and the Fire Department to determine where the compost resource has the most value for internal use by City departments. The City could also encourage further citizen participation in community gardens and in neighborhood gardens for flowers and food.

Prior to its dissemination to City Parks, building grounds, etc. City staff from Parks and Public Works should meet with the UC Extension to determine the best applications of the processed Yard Waste.

The City should purchase small quantities of various types of compost from local processors and study its application properties along with the City's processed material. This process will serve the long-term goal of competitive and varied local processing/compost operations and markets for the City's yard waste.

C. SECOND THROUGH FIFTH YEARS OF OPERATION (50 - 100 percent capacity)

The Consultant recommends that approximately 35,000 tons, or 50 percent of all separately collected yard waste be processed during the second year of operation. This number could be increased to 52,500 tons, or 75 percent during the third year of operation if either viable markets are located, or if alternative forms of disposal are deemed feasible. Likewise, during the fourth year of operation, the program could process all yard waste separately collected by the City, or approximately 70,000 tons. As was discussed in Section 2, the actual amount of yard waste processed may be reduced by 13 percent because of unsuitable material.

Because the system is designed to process up to 85,330 tons of yard waste per year account for seasonal variations, the main constraint to processing all City collected yard waste is the viability of markets.

The following is an outline of the elements recommended for the continuation and expansion of the Yard Waste Composting Program operating at between 50 to 100 percent capacity.

Processing

- Continue to utilize a "high-tech" approach to process the yard waste into marketable end products. The process should include shredding and screening yard waste, and windrowing compostable materials.

Marketing

- The City should expand the use of City-produced compost in its building grounds, parks, community gardens, etc.
- The City periodically should analyze the City's processed yard waste to ensure quality.
- The City should continue to negotiate contracts with the major compost users and brokers identified in Section V for long-term purchase of compost materials.
- The City should examine providing compost to Sacramento County to use as cover at the County landfill. This could be done either as a long-term purchase agreement or to partially offset the cost to the City for using the County's landfill.
- The City should examine securing markets for its compost with end users or brokers located outside of the Sacramento Region.
- The City should expand its weekend sales to four months per year.

Administrative

- The City should modify the program based on recommendations for increasing efficiency obtained from the first year of operation.

1. Processing Recommendations

- The yard waste should continue to be processed into end products based on size and quality standards negotiated with end users or brokers. All material should be shredded and screened with a one-quarter inch screen, then formed into windrows and composted. As the seasonal types of yard waste are shredded and screened, samples should be analyzed by City staff to ensure marketability of the compost product being produced. This should be continued for as long as the program is in operation.
- Monies should be provided for additional site improvements at the City landfill, for purchasing additional equipment for processing yard waste into a compost product,

and for increases in annual operating costs until all yard waste separately collected is processed.

Using the 1990/91 budget as the base year, Table VI - 4 shows budgets that should be considered for the second through fifth years of the program. Annual capital costs reflect the cost to purchase all processing equipment and perform all site improvements amortized on a ten-year basis. Accordingly, even though the City only needs to purchase one front end loader during the first year of operation, the capital costs for each year include amortized costs for four front end loaders. Specific capital cost budget items that are increased (front end loaders, labor, asphalt paving, etc.) are indicated with an asterisk.

TABLE VI-4

1991 - 1995 BUDGET RECOMMENDATIONS

YARD WASTE COMPOSTING PROGRAM

	1990/91	1991/92	1992/93	1993/94	1994/95
Equipment					
*Front end loader	\$170,000	\$170,000	\$170,000	\$170,000	0
Grapple Loader	\$ 50,000	0	0	0	0
Shredder	\$400,000	0	0	0	0
Windrow Turner	\$100,000	0	0	0	0
Magnetic Drum Roller	\$ 8,000	0	0	0	0
Screen	\$ 90,000	0	0	0	0
Odor Control Equipment	\$ 35,000	0	0	0	0
Conveyors	\$100,000	0	0	0	0
Electric Power Supply	\$ 70,500	0	0	0	0
Structures					
Metal Buildings	\$130,984	0	0	0	0
*Asphalt paving	\$148,356	\$107,905	\$107,905	\$107,905	0
Sewer Extension	\$ 60,000	0	0	0	0
CAPITAL COST SUBTOTAL	\$1,362,840	\$1,640,745	\$1,918,650	\$2,196,556	0
*Construction cost contingencies	\$204,426	\$ 41,686	\$41,686	\$41,686	0
*Administration and Engineering Costs	\$235,090	\$ 47,939	\$47,939	\$47,939	0
*Sales Tax	\$117,153	\$ 23,889	\$23,889	\$23,889	0
TOTAL CAPITAL COST	\$1,919,509	\$1,754,259	\$2,032,164	\$2,310,070	0
Annual Debt Service	\$503,496	\$503,496	\$503,496	\$503,496	\$503,496
For Capital Expenditures					
(ten year amortization)					
Operation and Maintenance					
*Labor	\$62,046	\$106,499	\$150,952	\$195,405	\$195,405
*Fuel	\$18,725	\$37,450	\$56,176	\$74,901	\$74,901
Utilities	\$9,370	\$9,370	\$9,370	\$9,370	\$9,370
*Equipment Maintenance	\$160,963	\$194,963	\$228,963	\$228,963	\$228,963
*Marketing	\$16,589	\$ 33,177	\$ 49,766	\$ 66,355	\$66,355
*Annual Report	\$500	\$ 697	\$ 891	\$ 1,017	\$1,017
*Administration	\$6,278	\$ 8,707	\$ 11,137	\$ 12,716	\$12,716
*Quality Control	\$3,539	\$ 7,078	\$ 10,617	\$ 14,156	\$14,156
*Contingency	\$25,121	\$ 34,828	\$ 44,546	\$ 50,864	\$50,864
OPERATING AND MAINTENANCE SUBTOTAL	\$303,121	\$432,769	\$562,416	\$653,746	\$653,746
TOTAL GROSS OPERATING COSTS	\$806,617	\$936,265	\$1,065,912	\$1,660,738	\$1,660,738

2. Marketing Recommendations

The City should continue to utilize a large portion of the compost produced during the first several years of the program to stabilize the soil amendment market while aggressively pursuing local and regional markets. In addition, the City should actively investigate the use of compost as a cover for the City's landfill as well as for the County of Sacramento's landfill.

The major potential users of compost within City Departments are Public Works, Parks & Recreation, and the Fire Department. In the short term, Parks & Recreation has the greatest potential for utilizing the material. Weed abatement demonstrations with the Fire Department should be scheduled to determine the potential effectiveness of compost in reducing the need for spraying of herbicides by contractors of the Fire Department. Depending on the results of the weed abatement demonstrations, the Fire Department may prove to be a large user of compost in the future.

The public sector and community consumption strategy should actively encourage or require use by Public Works, Parks and Recreation, and the Fire Department to determine where the compost resource has the most value for internal use by City departments, as well as establishing a base volume of material used by the City. After the annual amount of compost used by the City is determined, production capacity should be adjusted to reflect this amount as well as growth in the compost market. In addition, the City should continue to encourage citizen participation in community gardens and in neighborhood gardens for flowers and food.

Some short term market displacement may occur if during the third or fourth year of operation the City were to market all compost that was produced. For example, if the City were to operate the program at 50 percent capacity, approximately 75,000 cubic yards of compost would be produced. This represents between 25 percent to 31 percent of the known commercial soil amendment market in the Sacramento Region. Although the Consultant estimates that some market displacement will occur, however, most of the displacement will be for compost producers located outside of the Sacramento Region.

Even though the Consultant estimates that the City should be able to market approximately 108,000 cubic yard of compost, because actual market conditions can not be controlled by the City and the City must budget for known costs, revenue projections for City produced compost have not been factored in the gross operating costs. However, the City may choose to use revenue received from the sale of compost to either offset the annual operating cost of the program or to retire the debt for capital costs on an expedited schedule. Table VI - 5 lists identified markets for compost.

TABLE VI - 5		
MARKETS FOR PROCESSED COMPOST		
USER	Cubic Yards/Year	Tons/Year
North Highlands Rock	18,000	7,200
Redi-Grow	30,000	12,000
Other Companies	20,000	8,000
City Parks and Recreation	20,000	8,000
City weekend sales	20,000	8,000
TOTAL	108,000	43,200