Title: Real Cost of Material Recovery at Transfer Stations

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Abstract: The cost of recovering recyclable materials from the garbage at a transfer station has not been used in evaluation of transfer station proposals in the Metro area. This study developed a method to provide decision makers with economic information about material recovery costs based on proposed capital investment and O&M expenses. The effect over time of different recovery rates were evaluated along with the expected value of recovery and break-even rates.

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AT TRANSFER STATIONS

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EXECUTIVE SUMMARY

The cost of recovering materials for recycling from the garbage at a transfer station has not been used in evaluation of transfer station proposals in the Metro area. This study developed a method to provide decision makers with economic information about material recovery costs based on proposed capital investment and O&M expenses. The effect over time of different recovery rates were evaluated along with the expected value of recovery and break-even rates.

INTRODUCTION

State law in Oregon mandates that recyclable materials be recovered from garbage.[1] Each area in the state must meet specified recovery rate targets by prescribed dates. Any combination of different recovery methods may be used to achieve the targets.

In the Portland Metropolitan Service District (Metro), Oregon's Department of Environmental Quality requires that specific methods be used to achieve the recovery targets.[2] Among these methods is material recovery at all new transfer stations. This decision was made as a matter of public policy . The economic impacts of adding material recovery to a transfer station was not considered in the decision.

Metro uses public money to develop transfer stations and therefore has an obligation to use the funds in the most efficient manner. To do this, the economic ramifications of material recovery at a transfer station should be calculated so that it can be compared with other recovery programs. The decision makers can then weigh the effectiveness of all options against their costs. The political considerations may still outweigh the economic considerations, but at least the information would be included in the decision process.

BACKGROUND

Metro recently solicited proposals for the development of a transfer station in Washington County, Oregon.[3] Two proposals were received which contained a total of five design configurations.[4] [5] There were great variations in the material recovery portions of the proposals, including space allocation, equipment complexity, extent of manual operations, expected rate of recovery and proportion of the capital expense. All of these aspects have an impact on the fixed capital cost and the variable operation and maintenance (O&M) expense of the facility. The material recovery costs were

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[1]State of Oregon, A Bill for an Act Relating to Solid Waste, Enrolled Senate Bill 66, Section 6, 1991.
[2]Environmental Quality Commission, Metro's waste Reduction Program, Oregon, EQC Order SW-WR-89-01, Section 4J, 1989.
[3]Metropolitan Service District.,Request for Franchises for a Transfer and Material Recovery Services for Western Washington County, RFF-SW-91, Portland , Oregon, 1991.
[4]A.C.Trucking, Forest Grove Transfer Station (Innovation in Recycling & Transfer Services), Portland. Oregon, November 18,1991.
[5]Waste Management of Oregon, Provision of Transfer and Materials Recovery Facilities and Services for Western Washington County, Portland, Oregon, November 18, 1991.

aggregated with the remainder of the transfer station so no separate economic analysis of material recovery portion was performed.[6] The winning proposal was selected by a multi-discipline evaluation team. The selection criteria were the design team's technical experience, the proposal's technical strength and the proposer's bid for building and operating the transfer station. Metro would finance the construction of the transfer station through a bond issue. The operator's O&M expenses would be paid out of the disposal fee charged by Metro to dump garbage at the transfer station.

PURPOSE

The purpose of this study is to separately evaluate the economic aspects of the material recovery portions of the winning transfer station proposal.[7] The desired result is to develop economic measures that will be useful to decision makers for evaluating the extent to which material recovery should be incorporated into the transfer station.

METHODOLOGY

The winning proposal was used as the subject of this study. The following procedure was developed to determine the costs of the material recovery portion of a transfer station.

1 Calculate the cost of financing and operating a transfer station with material recovery included for each year of the contract. Determine the uniform annual cost on a per ton basis.

2 Calculate the cost of financing and operating the same transfer station without including material recovery for each year of the contract. Determine the uniform annual cost on a per ton basis.

3 Subtract the cost of the transfer station without material recovery from the cost of the transfer station with material recovery to determine the cost of the material recovery portion of the project. Determine the uniform annual cost on a per ton basis. These costs become the basis for further evaluation of the material recovery operation. This would be the first step in the procedure if the proposers had been asked to separate the costs in their proposals.

4 Allocate the cost of material recovery to the tons of material recovered based on various percentages of material recovered from the garbage.

5 Determine the break-even recovery rate at which material recovery cost is equal to its benefit.

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[6]Metropolitan Service District, Evaluation Report for Franchise Applications for the Provision of Transfer and Materials Recovery Facilities and Services for Western Washington County, Portland, Oregon, January 16, 1992.

[7]Waste Management of Oregon, op. cit.

6 Determine the expected value of material recovery based on the subjective evaluation of the operator's ability to recover specific percentages of material from the garbage.

A key element in the study of material recovery costs at transfer stations is determining the quantity of garbage that will be received at the transfer station. Metro included the projected tonnage figures in the request for proposals for the twenty year life of the contract. The variation in tonnage over time made direct comparisons of cost impractical for this study, therefore a cost per ton basis was used for each year of the contract. Cost per ton analysis has an added benefit, since the tipping fee (the per ton price charged for the dumping garbage at the transfer station) for any year can be calculated and compared to tipping fees at other facilities. This would be especially useful to decision makers who are very familiar with tipping fees.

Another key element is the rate of recovery of materials. This is dependent on a large number of variables both within and beyond the control of the transfer station operator. The recovery rate is also expected to change over time. The evaluation of material recovery in this study was completed for a range of recovery rates, since it is difficult to predict what the recovery rate will be in the proposal stage of a project. This allows the decision makers to evaluate the cost of material recovery at many different levels. The assumption that was made in this study was that the capital cost and the effort that the operator made to recover materials were constant for all of the recovery rates. This implies that external forces determine the recovery rate. The quality and market value of the recovered materials was also excluded from this analysis since it would require a separate study to determine their effects on the material recovery costs.

EVALUATION

Table 1 shows the cost of the proposed transfer station with material recovery for the twenty year term of the contract. The Excel equations used to generate the table are included in the appendix. The costs for each column were developed in the following manner:

Year - The contract term included in the request for proposals was twenty years.

Tons Per Year -The tons per year figures were based on population and employment projections for Washington County and were included in the request for proposals.

Debt Service -The total capital cost of the transfer station must be covered by the bond issue. The term of the bond is equivalent to the life of the contract. The debt service per year is fixed and based on the bond interest rate. As the tonnage at the transfer station increases, the debt allocated to each ton decreases. The costs of bond issuance and the construction financing structure were not included in this study.

O & M Cost Per Ton - Operating and maintaining the transfer station is a variable cost dependent on the amount of garbage received. The proposal included an O&M

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TABLE 1

TRANSFER STATION WITH MATERIAL RECOVERY

YEAR	TONS PER YEAR	DEBT SERVICE PER TON	O & M COST PER TON	HAULING AND DISPOSAL COST PER TON	METRO FEES PER TON	TOTAL COST PER TON	TIPPING FEE PER TON
1	95000	$8.59	$14.50	$36.00	$13.00	$72.09	$77.38
2	97000	$8.42	$15.15	$37.61	$13.65	$74.83	$80.27
3	98000	$8.33	$15.83	$39.30	$14.33	$77.80	$83.40
4	100000	$8.16	$16.55	$41.06	$15.05	$80.82	$86.60
5	102000	$8.00	$17.29	$42.91	$15.80	$84.00	$89.96
6	105000	$7.78	$18.07	$44.83	$16.59	$87.27	$93.41
7	109000	$7.49	$18.88	$46.85	$17.42	$90.64	$96.97
8	112000	$7.29	$19.73	$48.96	$18.29	$94.27	$100.80
9	116000	$7.04	$20.62	$51.16	$19.21	$98.03	$104.77
10	119000	$6.86	$21.55	$53.47	$20.17	$102.05	$109.01
11	120000	$6.80	$22.52	$55.88	$21.18	$106.38	$113.59
12	120000	$6.80	$23.53	$58.41	$22.23	$110.98	$118.44
13	120000	$6.80	$24.59	$61.04	$23.35	$115.78	$123.52
14	120000	$6.80	$25.70	$63.81	$24.51	$120.82	$128.84
15	120000	$6.80	$26.85	$66.69	$25.74	$126.09	$134.40
16	120000	$6.80	$28.06	$69.71	$27.03	$131.61	$140.23
17	120000	$6.80	$29.32	$72.87	$28.38	$137.38	$146.32
18	120000	$6.80	$30.64	$76.18	$29.80	$143.42	$152.71
19	120000	$6.80	$32.02	$79.64	$31.29	$149.75	$159.39
20	120000	$6.80	$33.46	$83.26	$32.85	$156.37	$166.38
UAC		$7.57	$20.36	$50.55	$19.01	$97.49	$104.20

BOND INTEREST	8%
BOND PERIOD	20
BOND PAYMENTS	20
BOND AMOUNT	$8,016,000
O&M	$14.50
HAUL COST	$15.00
DISPOSAL COST	$21.00

METRO FEES	$13.00
CPI	5%
O&M CPI	90%
HAUL CPI	75%
EXCISE TAX	1.056
DEQ FEES	$1.25

cost per ton of garbage dumped at the transfer station. A percentage of the Consumer Price Index (CPI) was bid by the proposers to escalate the O&M costs over time. In the 1980's, Metro attempted to compile an inflation index tied to the specific economic variables within a contract.[8] This proved to be too complex to bid and administer. CPI was subsequently accepted the indicator of inflation for all Metro contracts.

Hauling and Disposal Cost Per Ton - These costs are dictated by separate, twenty year Metro contracts for hauling and disposal. The hauling cost is escalated by a bid percentage of CPI. The disposal cost is escalated by the entire CPI.

Metro Fees Per Ton - Metro receives an administrative and program fee for each ton of garbage received at the transfer station. It is expected to grow at the CPI rate.

Total Cost Per Ton - The total cost per ton is the sum of all of the previous costs.

Tipping Fee Per Ton - External charges are levied for garbage dumped at the transfer station. These include DEQ fees and excise tax.

UAC - The uniform annual cost(UAC) is the present worth of each cash flow spread evenly over the contract period. The current long term discount rate of approximately 8% was used in this study. This utilizes the philosophy that the social discount rate should be the equivalent to the private sector cost of lost opportunity.[9] This rate is higher than the 7% rate used in the Metro evaluation.

The results of Table 1 show that the tipping fee for the proposed transfer station would be $77.38 per ton for the first year. This exceeds the current Metro tipping fee at all other transfer stations by $9.38 per ton. The hauling and disposal costs, Metro fees and external fees are the same for all of the transfer stations, so the debt service and O&M costs account for this difference.

Table 2 shows the costs of the transfer station with material recovery removed. The proposal did not split out these material recovery costs, however there was sufficient detail in the estimate to make an engineering estimate of the costs that would be removed. These calculations are shown in the appendix. A more exact estimate could have been obtained if Metro had asked for the break-out price of material recovery. Removing material recovery reduced the debt from a Uniform Annual Cost (UAC) of $7.57 per ton to $5.78 per ton and reduced the O&M cost from $20.36 per ton to $10.18 per ton. The resulting first year tipping fee was $67.58 or $0.42 lower than that at the other transfer stations.

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[8]Interview with Chuck Geyer, Senior Solid Waste Planner, Metro, Portland ,Oregon, March 9,1992.
[9]Fleischer, G.A., Engineering Economy Capital Allocation Theory, Boston, Massachusetts: PWS Engineering, 1984, pp. 402 -404.

TABLE 2

TRANSFER STATION WITHOUT MATERIAL RECOVERY

YEAR	TONS PER YEAR	DEBT SERVICE PER TON	O & M COST PER TON	HAULING AND DISPOSAL COST PER TON	METRO FEES PER TON	TOTAL COST PER TON	TIPPING FEE PER TON
1	95000	$6.57	$7.25	$36.00	$13.00	$62.82	$67.58
2	97000	$6.43	$7.58	$37.61	$13.65	$65.27	$70.17
3	98000	$6.36	$7.92	$39.30	$14.33	$67.91	$72.97
4	100000	$6.24	$8.27	$41.06	$15.05	$70.62	$75.83
5	102000	$6.12	$8.65	$42.91	$15.80	$73.47	$78.83
6	105000	$5.94	$9.03	$44.83	$16.59	$76.40	$81.93
7	109000	$5.72	$9.44	$46.85	$17.42	$79.43	$85.13
8	112000	$5.57	$9.87	$48.96	$18.29	$82.69	$88.57
9	116000	$5.38	$10.31	$51.16	$19.21	$86.06	$92.13
10	119000	$5.24	$10.77	$53.47	$20.17	$89.65	$95.92
11	120000	$5.20	$11.26	$55.88	$21.18	$93.51	$100.00
12	120000	$5.20	$11.77	$58.41	$22.23	$97.60	$104.32
13	120000	$5.20	$12.30	$61.04	$23.35	$101.88	$108.84
14	120000	$5.20	$12.85	$63.81	$24.51	$106.37	$113.57
15	120000	$5.20	$13.43	$66.69	$25.74	$111.06	$118.53
16	120000	$5.20	$14.03	$69.71	$27.03	$115.97	$123.71
17	120000	$5.20	$14.66	$72.87	$28.38	$121.11	$129.14
18	120000	$5.20	$15.32	$76.18	$29.80	$126.50	$134.83
19	120000	$5.20	$16.01	$79.64	$31.29	$132.13	$140.78
20	120000	$5.20	$16.73	$83.26	$32.85	$138.04	$147.02
UAC		$5.78	$10.18	$50.55	$19.01	$85.53	$91.57

BOND INTEREST	8%	METRO FEES	$13.00
BOND PERIOD	20	CPI	5%
BOND PAYMENT:	20	O&M CPI	90%
BOND AMOUNT	$6,124,000	HAUL CPI	75%
O&M	$7.25	EXCISE TAX	1.056
HAUL COST	$15.00	DEQ FEES	$1.25
DISPOSAL COST	$21.00		

The cost of the material recovery system is shown on Table 3. The debt service and O&M cost from tables 1&2 were subtracted to obtain the costs associated with the material recovery system. The remaining columns were calculated in the following manner:

Cost of Recovery Per Ton - The sum of the debt service and O&M costs for a year were multiplied by the ratio of the tons of material recovered to the tons of garbage dumped. The recovery rate is one of the primary variables in a transfer station. The proposal estimated that a 16% recovery rate could be achieved. Metro's evaluation of the proposal projected a maximum rate of 10% recovery. To account for the possible fluctuation in the recovery rate, a series of recovery rates were used to define the cost of recovery curve. Table 3 used a recovery rate of 2%. This rate was incrementally increased by 4% for each of the subsequent tables until it reached 30% in Table 10 (Tables 4 through 10 are included in the appendix).

Avoidance Cost Payment to Operator Per Ton Recovered - For every ton of material recovered from the garbage, the transfer station operator is given the cost that was avoided by not having to haul and dispose of that ton of garbage. This cost is equivalent to the hauling and disposal cost per ton from Tables 1 and 2.

Real Cost of Recovery Per Ton - This is the cost of recovery minus the avoidance cost payment to the operator. The difference shows the premium subsidized by Metro for every ton of material that is recovered and diverted from disposal. The subsidy is in the form of the debt service paying for the equipment to remove the material and the O&M payments for processing the material. The real cost of recovery gives the decision makers a tangible measure of the cost of recycling at the transfer station. This is significant since it may be possible to build a transfer station without material recovery and divert the annual cost difference to another program that has lower real cost of recovery. It would be necessary to evaluate the other recycling programs in the same manner to make the comparison. The only other report located for the Metro area that presented similar information was completed for curbside recycling programs.[10] The net cost per ton collected varied from $210 to $598 depending on variables like the type of collection vehicles used and the service area size.

Chart 1 shows the cost recovery curve based on the UAC of the real cost of recycling column from Tables 3 through 10. The break-even point is where the curve crosses the $0.00 value of "Real Cost of Recovery Per Ton " axis. This point represents approximately 23.5% recovery. This means that if the actual recovery rate is less that 23.5%, Metro will be subsidizing the recovery operation . If there is a greater recovery rate, the operation will be self-sustaining and profitable in its own right. The proposal stated that the expected recovery rate was 16%. This would indicate that Metro would be required to subsidize the operation by about $25 per ton recovered. Metro's estimated 10% recovery rate would require a $69 subsidy.

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[10]Association of Oregon Recyclers, Curbside Recycling Report: Evaluation of Four Oregon Programs and Resulting Recommendations, Portland , Oregon, October 8, 1990.

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TABLE 3

REAL COST OF RECOVERY

RATE OF RECOVERY = 2%

YEAR	TONS PER YEAR	DEBT SERVICE PER TON	O & M COST PER TON	COST OF RECOVERY PER TON	AVOIDANCE COST PAYMENT TO OPERATOR PER TON RECOVERED	REAL COST OF RECOVERY PER TON
1	95000	$2.03	$7.25	$463.92	$36.00	$427.92
2	97000	$1.99	$7.58	$478.14	$37.61	$440.53
3	98000	$1.97	$7.92	$494.18	$39.30	$454.88
4	100000	$1.93	$8.27	$510.02	$41.06	$468.96
5	102000	$1.89	$8.65	$526.75	$42.91	$483.85
6	105000	$1.84	$9.03	$543.50	$44.83	$498.67
7	109000	$1.77	$9.44	$560.47	$46.85	$513.62
8	112000	$1.72	$9.87	$579.34	$48.96	$530.38
9	116000	$1.66	$10.31	$598.57	$51.16	$547.41
10	119000	$1.62	$10.77	$619.68	$53.47	$566.21
11	120000	$1.61	$11.26	$643.24	$55.88	$587.36
12	120000	$1.61	$11.77	$668.58	$58.41	$610.17
13	120000	$1.61	$12.30	$695.05	$61.04	$634.01
14	120000	$1.61	$12.85	$722.71	$63.81	$658.91
15	120000	$1.61	$13.43	$751.62	$66.69	$684.93
16	120000	$1.61	$14.03	$781.83	$69.71	$712.12
17	120000	$1.61	$14.66	$813.40	$72.87	$740.53
18	120000	$1.61	$15.32	$846.39	$76.18	$770.21
19	120000	$1.61	$16.01	$880.87	$79.64	$801.23
20	120000	$1.61	$16.73	$916.89	$83.26	$833.64
UAC		$1.79	$10.18	$598.36	$50.55	$547.81

BREAK - EVEN RATE FOR RECOVERY AT A TRANSFER STATION

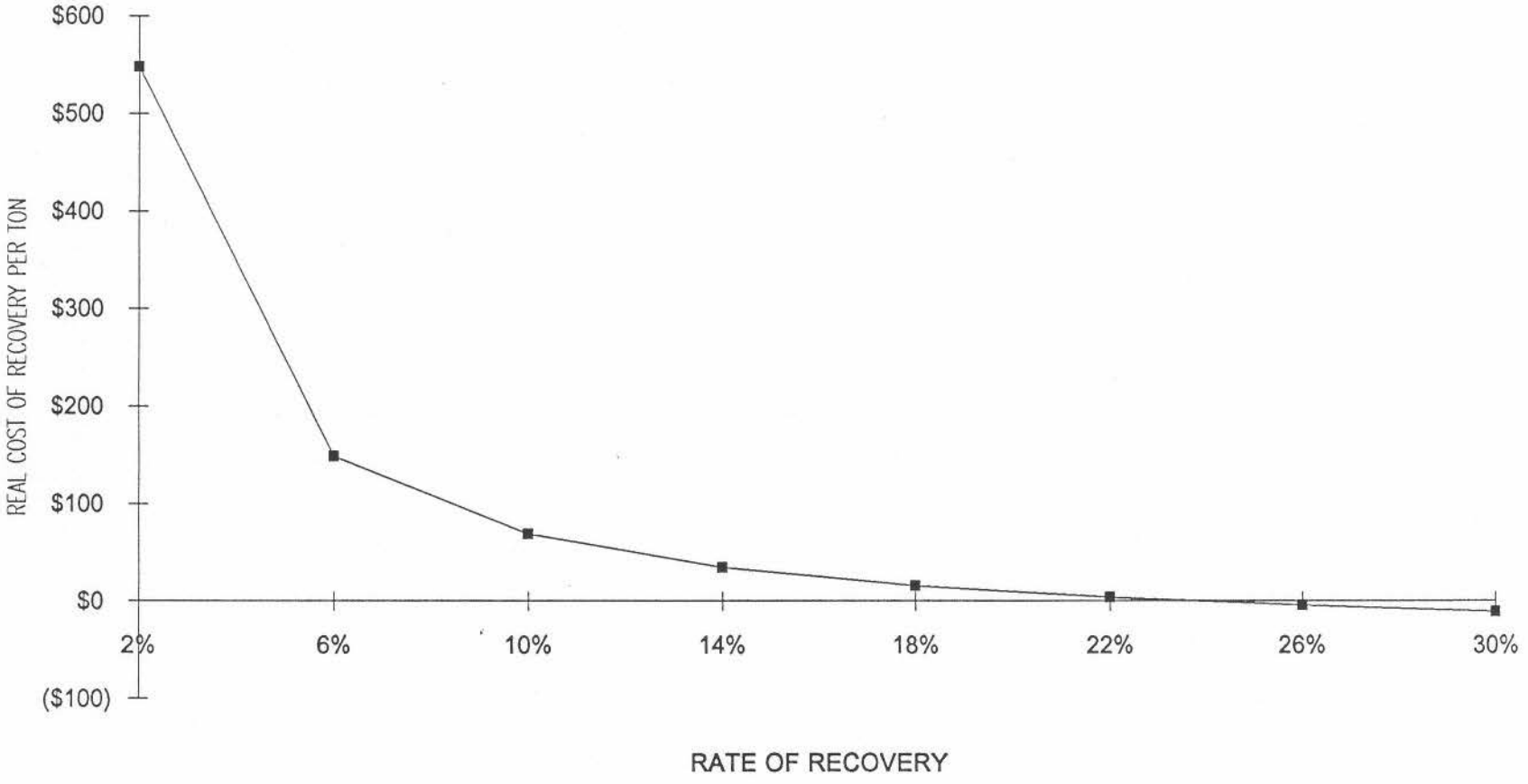

CHART 1

It is possible to place probabilities on the recovery rates used in the study to determine the expected value of the real cost of recovery. The probabilities are subjective, but are based on Metro staff's review of the proposal, the recovery philosophy, the equipment and techniques proposed, and the recoverability of material in the garbage. The calculation is made as follows:

Exp. Real Cost of Recovery = (prob. or recovery rate)(real cost at the recovery rate)

= 0.20($547) + 0.35($148) + 0.25($69) + 0.15($35)+ 0.05($16)+ 0.00($4)
+ 0.00(-$5) + 0.00(-$11)

Exp. Real Cost of Recovery = $ 185.

This value differs substantially from the values derived from the proposer's and Metro's estimated rate of recovery. All of these values should be presented to the decision makers since they will need to weigh the values with the other factors in the decisions.

CONCLUSIONS

The results of the procedure used to evaluate the real cost of material recovery at a transfer station provide decision makers with economic information that was previously missing from proposal evaluations. It separates the costs that are associated with just the material recovery aspects of the facility and puts them into terms that the decision makers can understand like tipping fee and the real cost of recycling. It also presents analysis for a range of recovery rates which are expected to vary during actual operation.

The same evaluation of the real cost of recovery could be conducted for all other material recovery and recycling programs in the Metro region. This would give the decision makers information with which they could evaluate the effectiveness of the various programs on an equivalent basis. Decisions could be made that would distribute money to the programs that utilize the public's funds most efficiently.

Even though this procedure is a valuable tool, the realities of making decisions in a political environment must be recognized. There are multiple external forces that must also be evaluated by the decision maker. This does not diminish the importance of providing the best information so that the impact of their decisions can be fully evaluated.

RECOMMENDATIONS

If the analysis used in this study becomes a standard part of project evaluation, the following items should be addressed:

The request for proposals should reflect this approach. The capital and O&M costs for the recovery portion of the project should be broken out in the proposals. Metro should develop some guidelines for evaluating this information and include them in the request for proposal.

If there is an option to add equipment to the project with Metro financing at a later date , evaluation criteria should be developed to ahead of time. It is quite possible that an acceptable expected value for the real cost of recovery could be predetermined.

The real costs of other recovery methods should be evaluated on a regular basis so that comparisons can be made between various programs.

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APPENDICES

Excel Equations

Tables 4 through 10

Calculation of Transfer Station Capital and O&M Costs Without Material Recovery

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EQUATIONS FOR CALCUALTIONS IN TABLES 1 AND 2

COLUMN NAME	EQUATION
DEBT SERVICE PER TON	PMT(BONDINTEREST,BONDPERIOD,BONDAMOUNT)/TOTAL TONS
O & M COST PER TON	OPANDMAINT*(1+OPANDMAINTCPI*CPI)^(YEAR-1)
HAUL AND DISP COST /TON	HAULCOST*(1+HAULCPI*CPI)^(YEAR-1)+DISPOSALCOST*(1+CPI)^(YEAR-1)
METRO FEES PER TON	METROFEES*(1+CPI)^(YEAR-1)
TOTAL COST PER TON	DEBTSERV + O&M + HAUL&DISPOSE + FEES
TIPPING FEE PER TON	COST PER TON*EXCISETAX+DEQFEES

EQUATIONS FOR CALCUALTIONS IN TABLES 3 THROUGH 10

COLUMN NAME	EQUATION
DEBT SERVICE PER TON	TABLE 1 PMT(BONDINTEREST,BONDPERIOD,BONDAMOUNT)/TOTAL TONS- TABLE 2 PMT(BONDINTEREST,BONDPERIOD,BONDAMOUNT)/TOTAL TON
O & M COST PER TON	TABLE 1 OPANDMAINT*(1+OPANDMAINTCPI*CPI)^(YEAR-1)- TABLE 2 OPANDMAINT*(1+OPANDMAINTCPI*CPI)^(YEAR-1)
COST OF RECOVERY PER TON	(DEBT SERVICE + O&M)/((RECOVERYRATE*TOTAL TONS)/TOTAL TONS)
AVOIDANCE COST PAYMENT	HAULCOST*(1+HAULCPI*CPI)^(YEAR-1)+DISPOSALCOST*(1+CPI)^(YEAR-1)
REAL COST OF RECOVERY	COST OF RECOVERY - AVOIDANCE COST

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ECONPAP4.XLS

TABLE 4

REAL COST OF RECOVERY

RATE OF RECOVERY = 6%

YEAR	TONS PER YEAR	DEBT SERVICE PER TON	O & M COST PER TON	COST OF RECOVERY PER TON	AVOIDANCE COST PAYMENT TO OPERATOR PER TON RECOVERED	REAL COST OF RECOVERY PER TON
1	95000	$2.03	$7.25	$154.64	$36.00	$118.64
2	97000	$1.99	$7.58	$159.38	$37.61	$121.77
3	98000	$1.97	$7.92	$164.73	$39.30	$125.43
4	100000	$1.93	$8.27	$170.01	$41.06	$128.95
5	102000	$1.89	$8.65	$175.58	$42.91	$132.68
6	105000	$1.84	$9.03	$181.17	$44.83	$136.33
7	109000	$1.77	$9.44	$186.82	$46.85	$139.97
8	112000	$1.72	$9.87	$193.11	$48.96	$144.16
9	116000	$1.66	$10.31	$199.52	$51.16	$148.36
10	119000	$1.62	$10.77	$206.56	$53.47	$153.09
11	120000	$1.61	$11.26	$214.41	$55.88	$158.53
12	120000	$1.61	$11.77	$222.86	$58.41	$164.45
13	120000	$1.61	$12.30	$231.68	$61.04	$170.64
14	120000	$1.61	$12.85	$240.90	$63.81	$177.10
15	120000	$1.61	$13.43	$250.54	$66.69	$183.85
16	120000	$1.61	$14.03	$260.61	$69.71	$190.90
17	120000	$1.61	$14.66	$271.13	$72.87	$198.26
18	120000	$1.61	$15.32	$282.13	$76.18	$205.95
19	120000	$1.61	$16.01	$293.62	$79.64	$213.98
20	120000	$1.61	$16.73	$305.63	$83.26	$222.37
UAC		$1.79	$10.18	$199.45	$50.55	$148.90

ECONPAP5.XLS

TABLE 5

REAL COST OF RECOVERY

RATE OF RECOVERY = 10%

YEAR	TONS PER YEAR	DEBT SERVICE PER TON	O & M COST PER TON	COST OF RECOVERY PER TON	AVOIDANCE COST PAYMENT TO OPERATOR PER TON RECOVERED	REAL COST OF RECOVERY PER TON
1	95000	$2.03	$7.25	$92.78	$36.00	$56.78
2	97000	$1.99	$7.58	$95.63	$37.61	$58.02
3	98000	$1.97	$7.92	$98.84	$39.30	$59.54
4	100000	$1.93	$8.27	$102.00	$41.06	$60.94
5	102000	$1.89	$8.65	$105.35	$42.91	$62.44
6	105000	$1.84	$9.03	$108.70	$44.83	$63.87
7	109000	$1.77	$9.44	$112.09	$46.85	$65.24
8	112000	$1.72	$9.87	$115.87	$48.96	$66.91
9	116000	$1.66	$10.31	$119.71	$51.16	$68.55
10	119000	$1.62	$10.77	$123.94	$53.47	$70.47
11	120000	$1.61	$11.26	$128.65	$55.88	$72.77
12	120000	$1.61	$11.77	$133.72	$58.41	$75.31
13	120000	$1.61	$12.30	$139.01	$61.04	$77.97
14	120000	$1.61	$12.85	$144.54	$63.81	$80.74
15	120000	$1.61	$13.43	$150.32	$66.69	$83.63
16	120000	$1.61	$14.03	$156.37	$69.71	$86.65
17	120000	$1.61	$14.66	$162.68	$72.87	$89.81
18	120000	$1.61	$15.32	$169.28	$76.18	$93.10
19	120000	$1.61	$16.01	$176.17	$79.64	$96.54
20	120000	$1.61	$16.73	$183.38	$83.26	$100.12
UAC		$1.79	$10.18	$119.67	$50.55	$69.12

ECONPAP6.XLS

TABLE 6

REAL RATE OF RECOVERY

RATE OF RECOVERY = 14%

YEAR	TONS PER YEAR	DEBT SERVICE PER TON	O & M COST PER TON	COST OF RECOVERY PER TON	AVOIDANCE COST PAYMENT TO OPERATOR PER TON RECOVERED	REAL COST OF RECOVERY PER TON
1	95000	$2.03	$7.25	$66.27	$36.00	$30.27
2	97000	$1.99	$7.58	$68.31	$37.61	$30.69
3	98000	$1.97	$7.92	$70.60	$39.30	$31.30
4	100000	$1.93	$8.27	$72.86	$41.06	$31.80
5	102000	$1.89	$8.65	$75.25	$42.91	$32.34
6	105000	$1.84	$9.03	$77.64	$44.83	$32.81
7	109000	$1.77	$9.44	$80.07	$46.85	$33.22
8	112000	$1.72	$9.87	$82.76	$48.96	$33.80
9	116000	$1.66	$10.31	$85.51	$51.16	$34.35
10	119000	$1.62	$10.77	$88.53	$53.47	$35.06
11	120000	$1.61	$11.26	$91.89	$55.88	$36.01
12	120000	$1.61	$11.77	$95.51	$58.41	$37.11
13	120000	$1.61	$12.30	$99.29	$61.04	$38.25
14	120000	$1.61	$12.85	$103.24	$63.81	$39.44
15	120000	$1.61	$13.43	$107.37	$66.69	$40.68
16	120000	$1.61	$14.03	$111.69	$69.71	$41.98
17	120000	$1.61	$14.66	$116.20	$72.87	$43.33
18	120000	$1.61	$15.32	$120.91	$76.18	$44.73
19	120000	$1.61	$16.01	$125.84	$79.64	$46.20
20	120000	$1.61	$16.73	$130.98	$83.26	$47.73
UAC		$1.79	$10.18	$85.48	$50.55	$34.93

ECONPAP7.XLS

TABLE 7

REAL COST OF RECOVERY

RATE OF RECOVERY = 18%

YEAR	TONS PER YEAR	DEBT SERVICE PER TON	O & M COST PER TON	COST OF RECOVERY PER TON	AVOIDANCE COST PAYMENT TO OPERATOR PER TON RECOVERED	REAL COST OF RECOVERY PER TON
1	95000	$2.03	$7.25	$51.55	$36.00	$15.55
2	97000	$1.99	$7.58	$53.13	$37.61	$15.51
3	98000	$1.97	$7.92	$54.91	$39.30	$15.61
4	100000	$1.93	$8.27	$56.67	$41.06	$15.61
5	102000	$1.89	$8.65	$58.53	$42.91	$15.62
6	105000	$1.84	$9.03	$60.39	$44.83	$15.56
7	109000	$1.77	$9.44	$62.27	$46.85	$15.42
8	112000	$1.72	$9.87	$64.37	$48.96	$15.41
9	116000	$1.66	$10.31	$66.51	$51.16	$15.34
10	119000	$1.62	$10.77	$68.85	$53.47	$15.38
11	120000	$1.61	$11.26	$71.47	$55.88	$15.59
12	120000	$1.61	$11.77	$74.29	$58.41	$15.88
13	120000	$1.61	$12.30	$77.23	$61.04	$16.18
14	120000	$1.61	$12.85	$80.30	$63.81	$16.50
15	120000	$1.61	$13.43	$83.51	$66.69	$16.82
16	120000	$1.61	$14.03	$86.87	$69.71	$17.16
17	120000	$1.61	$14.66	$90.38	$72.87	$17.50
18	120000	$1.61	$15.32	$94.04	$76.18	$17.86
19	120000	$1.61	$16.01	$97.87	$79.64	$18.24
20	120000	$1.61	$16.73	$101.88	$83.26	$18.62
UAC		$1.79	$10.18	$66.48	$50.55	$15.93

ECONPAP8.XLS

TABLE 8

REAL COST OF RECOVERY

RATE OF RECOVERY = 22%

YEAR	TONS PER YEAR	DEBT SERVICE PER TON	O & M COST PER TON	COST OF RECOVERY PER TON	AVOIDANCE COST PAYMENT TO OPERATOR PER TON RECOVERED	REAL COST OF RECOVERY PER TON
1	95000	$2.03	$7.25	$42.17	$36.00	$6.17
2	97000	$1.99	$7.58	$43.47	$37.61	$5.86
3	98000	$1.97	$7.92	$44.93	$39.30	$5.63
4	100000	$1.93	$8.27	$46.37	$41.06	$5.30
5	102000	$1.89	$8.65	$47.89	$42.91	$4.98
6	105000	$1.84	$9.03	$49.41	$44.83	$4.58
7	109000	$1.77	$9.44	$50.95	$46.85	$4.10
8	112000	$1.72	$9.87	$52.67	$48.96	$3.71
9	116000	$1.66	$10.31	$54.42	$51.16	$3.25
10	119000	$1.62	$10.77	$56.33	$53.47	$2.86
11	120000	$1.61	$11.26	$58.48	$55.88	$2.59
12	120000	$1.61	$11.77	$60.78	$58.41	$2.37
13	120000	$1.61	$12.30	$63.19	$61.04	$2.14
14	120000	$1.61	$12.85	$65.70	$63.81	$1.90
15	120000	$1.61	$13.43	$68.33	$66.69	$1.64
16	120000	$1.61	$14.03	$71.08	$69.71	$1.36
17	120000	$1.61	$14.66	$73.95	$72.87	$1.07
18	120000	$1.61	$15.32	$76.94	$76.18	$0.77
19	120000	$1.61	$16.01	$80.08	$79.64	$0.44
20	120000	$1.61	$16.73	$83.35	$83.26	$0.10
UAC		$1.79	$10.18	$54.40	$50.55	$3.84

ECONPA10.XLS

TABLE 9

REAL COST OF RECOVERY

RATE OF RECOVERY = 26%

YEAR	TONS PER YEAR	DEBT SERVICE PER TON	O & M COST PER TON	COST OF RECOVERY PER TON	AVOIDANCE COST PAYMENT TO OPERATOR PER TON RECOVERED	REAL COST OF RECOVERY PER TON
1	95000	$2.03	$7.25	$35.69	$36.00	($0.31)
2	97000	$1.99	$7.58	$36.78	$37.61	($0.83)
3	98000	$1.97	$7.92	$38.01	$39.30	($1.28)
4	100000	$1.93	$8.27	$39.23	$41.06	($1.83)
5	102000	$1.89	$8.65	$40.52	$42.91	($2.39)
6	105000	$1.84	$9.03	$41.81	$44.83	($3.03)
7	109000	$1.77	$9.44	$43.11	$46.85	($3.74)
8	112000	$1.72	$9.87	$44.56	$48.96	($4.39)
9	116000	$1.66	$10.31	$46.04	$51.16	($5.12)
10	119000	$1.62	$10.77	$47.67	$53.47	($5.80)
11	120000	$1.61	$11.26	$49.48	$55.88	($6.40)
12	120000	$1.61	$11.77	$51.43	$58.41	($6.98)
13	120000	$1.61	$12.30	$53.47	$61.04	($7.58)
14	120000	$1.61	$12.85	$55.59	$63.81	($8.21)
15	120000	$1.61	$13.43	$57.82	$66.69	($8.88)
16	120000	$1.61	$14.03	$60.14	$69.71	($9.57)
17	120000	$1.61	$14.66	$62.57	$72.87	($10.30)
18	120000	$1.61	$15.32	$65.11	$76.18	($11.07)
19	120000	$1.61	$16.01	$67.76	$79.64	($11.88)
20	120000	$1.61	$16.73	$70.53	$83.26	($12.73)
UAC		$1.79	$10.18	$46.03	$50.55	($4.53)

ECONPAP9.XLS

TABLE 10

REAL COST OF RECOVERY

RATE OF RECOVERY = 30%

YEAR	TONS PER YEAR	DEBT SERVICE PER TON	O & M COST PER TON	COST OF RECOVERY PER TON	AVOIDANCE COST PAYMENT TO OPERATOR PER TON RECOVERED	REAL COST OF RECOVERY PER TON
1	95000	$2.03	$7.25	$30.93	$36.00	($5.07)
2	97000	$1.99	$7.58	$31.88	$37.61	($5.74)
3	98000	$1.97	$7.92	$32.95	$39.30	($6.35)
4	100000	$1.93	$8.27	$34.00	$41.06	($7.06)
5	102000	$1.89	$8.65	$35.12	$42.91	($7.79)
6	105000	$1.84	$9.03	$36.23	$44.83	($8.60)
7	109000	$1.77	$9.44	$37.36	$46.85	($9.49)
8	112000	$1.72	$9.87	$38.62	$48.96	($10.34)
9	116000	$1.66	$10.31	$39.90	$51.16	($11.26)
10	119000	$1.62	$10.77	$41.31	$53.47	($12.16)
11	120000	$1.61	$11.26	$42.88	$55.88	($13.00)
12	120000	$1.61	$11.77	$44.57	$58.41	($13.83)
13	120000	$1.61	$12.30	$46.34	$61.04	($14.71)
14	120000	$1.61	$12.85	$48.18	$63.81	($15.62)
15	120000	$1.61	$13.43	$50.11	$66.69	($16.58)
16	120000	$1.61	$14.03	$52.12	$69.71	($17.59)
17	120000	$1.61	$14.66	$54.23	$72.87	($18.65)
18	120000	$1.61	$15.32	$56.43	$76.18	($19.75)
19	120000	$1.61	$16.01	$58.72	$79.64	($20.91)
20	120000	$1.61	$16.73	$61.13	$83.26	($22.13)
UAC		$1.79	$10.18	$39.89	$50.55	($10.66)

PRELIMINARY CAPITAL COST ESTIMATE			
DIRECT COST	$/UNIT	QUANTITY	TOTAL AMOUNT
PART I.			
A. SITE WORK			
Land	$65,000 /acre	10 acre	$650,000
Demolition	/unit	unit	$0
Earth work	6.07 /cu.yd.	20,100 cu.yd	$122,000
Grading – Incl. in Earth Work	/unit	unit	$0
Drainage	46.27 /unit	2,550 unit	$118,000
Paving	1.86 /sq.ft.	168,093 sq.ft	$312,000
Landscaping	0.41 /sq.ft.	182,000 sq.ft	$75,000
Other (fences, lighting, etc.)	154,000 /unit	1 unit	$154,000
B. BUILDINGS			
Recovery/Transfer	/sq.ft.	sq.ft	$0
Foundations	234.23 /cu.yd.	111 cu.yd	23000 ~~$26,000~~
Push walls, etc.	13.77 /sq.ft.	24,693 sq.ft	170000 ~~$339,956~~
Slab	12.84 /sq.ft.	25,000 sq.ft	161000 ~~$321,000~~
Structure	13.56 /sq.ft.	25,000 sq.ft	158000 ~~$339,000~~
Fire protection	152.99 /unit	268 unit	21000 ~~$41,000~~
Electrical	80,000 /unit	1 unit	40000 ~~$80,000~~
HVAC	4,250 /unit	8 unit	17000 ~~$34,000~~
Plumbing	22.22 /unit	450 unit	5000 ~~$10,000~~
Sewer Gas	31.67 /unit	600 unit	10000 ~~$19,000~~
Communication	/unit	unit	$0
Scalehouse	200 /sq.ft.	500 sq.ft	$100,000
Source–separated depot	15 /sq.ft.	3,200 sq.ft	$48,000
Truck wash	25 /sq.ft.	2,400 sq.ft	$60,000
Maintenance area storage – Incl wth Build.	/sq.ft.	sq.ft	$0
Yard debris – Incl with Site	/sq.ft.	sq.ft	$0
General office area	75 /sq.ft.	3,712 sq.ft	$278,400
Metro Office area	100 /sq.ft.	600 sq.ft	$60,000
C. PROCESS EQUIPMENT			
Scale	77,667 /unit	3 unit	$233,001
Compactor	524,000 /unit	1 unit	$524,000
Materials recovery equipment	/unit	unit	$0
Sort Line & Conveyors	225,000 /unit	1 unit	0 ~~$225,000~~
Baler	199,000 /unit	1 unit	0 ~~$199,000~~
Bins & Containers	2,806 /unit	28 unit	0 ~~$78,560~~

(continued

PRELIMINARY CAPITAL COST ESTIMATE			
D. ROLLING STOCK			
Front End Loader	80,316 /each	2	$160,632
Forklift	22,531 /each	1	@ ~~$22,531~~
Bobcat	41,375 /each	1	@ ~~$41,375~~
Yard Goat Truck	60,000 /each	1	$60,000
Rolloff Truck	30,000 /each	2	$60,000
Pickup Truck	15,000 /each	1	$15,000
E. UTILITIES			
Electricity	145,000 /unit	1	100 acc ~~$145,000~~
Water, Domestic	10,000 /unit	1	$10,000
Sewer, Sanitary	30,000 /unit	1	$30,000
Water, Fire	130,000 /unit	1	$130,000
Gas	/unit		$0
Communication	1,250 /unit	4	$5,000
F. OFF–SITE IMPROVEMENTS			
G. FURNITURE & FIXTURES	30000 /unit	1	$30,000
			$0
PART I. SUBTOTAL			3939acc ~~$5,156,454~~
PART II. INDIRECT COSTS (Overhead)			
Permitting	0.6%		$30,000
Project Management	1.7%		$90,000
Consultant fees	0.3%		$15,000
Engireering fees	3.9%		$200,000
General construction	13.1%		$674,467
PART II. SUBTOTAL	19.6%		7720 ~~$1,009,467~~
TOTAL (PARTS I. AND II.)			12140 acc ~~$6,165,921~~
CONTINGENCY	30 %		14430 acc ~~$1,849,776~~
GRAND TOTAL			61290 acc ~~$8,015,697~~

ITEMIZED ANNUAL OPERATING COSTS

(1991 Dollars)

A. FACILITY OPERATING PERSONNEL

Job Title	No. of Personnel	Price ($000)	% of Total
Operators/Maintenance	10 ~~22~~	243 ~~$561.0~~	34.8%
Supervision/Administration	2~~3~~	76 ~~115.0~~	7.1%
Subtotal	25	282 ~~$676.0~~	41.9%

Note: Above operating personnel pricing includes a fringe benefit multiplier of 35.0%

B. UTILITIES (as applicable)

1.	Electricity			0.0%
2.	Water			0.0%
3.	Natural Gas			0.0%
4.	Fuel Oil			0.0%
5.	Sewer – (Incl. in Water)			0.0%
6.	Other	General	45 ~~64.0~~	4.0%
		Subtotal	$64.0	4.0%

C. FACILITY MAINTENANCE

1.	Supplies			0.0%
2.	Spare Parts			0.0%
3.	Other	Maintenance/Taxes	130 ~~218.0~~	13.5%
		Subtotal	$218.0	13.5%

		Price ($000)	% of Total
D. ACCEPTABLE WASTE RECEIVING AND PROCESSING EQUIPMENT MAINTENANCE			
1.	Facility Supplies		0.0%
2.	Material Recovery System Supplies		0.0%
3.	Facility Spare Parts		0.0%
4.	Material Recovery System Spare Parts		0.0%
5.	Other Miscellaneous	95 ~~159.0~~	9.9%
	Subtotal	$159.0	9.9%
E. BUILDING MAINTENANCE			0.0%
	Subtotal	$0.0	0.0%
F. CONTRACT SERVICES (specify)			
1.	Legal		0.0%
2.	Accounting		0.0%
3.	Janitorial		0.0%
4.	Other		0.0%
	Subtotal	$0.0	0.0%
G. EQUIPMENT RENTALS OR LEASES (Specify)			
1.	Rolling Stock		0.0%
2.	Other		0.0%
3.	Other		0.0%
	Subtotal	$0.0	0.0%
H. EQUIPMENT REPLACEMENT FUND		204 ~~$408.0~~	25.3%
I. INSURANCE (Annual Premium Cost)		50 ~~$87.0~~	5.4%
J. DIRECT OPERATING SERVICES COSTS (A–I)		866 ~~$1,612.0~~	100.0%

Note: Not included in the above schedule are certain indirect costs such as interest expense and administrative overhead, etc..