Analysis of Urban Rail-Service Alternatives

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ABSTRACT

A segment of rail line running through Memphis, Tennessee, along the Mississippi River is owned by the city and leased to Illinois Central Gulf (ICG) Railroad Company. The operation is perceived by proponents of downtown redevelopment to be a retardant to new commercial and residential development that is now being experienced in the downtown area. This study was performed to assist public officials in making a decision concerning renewal of the rail line lease, which expires in 1986. A wide range of rail-service alternatives were considered, many of which were eliminated in a preliminary screening analysis. Those remaining were examined in detail. The study analyzed the impacts of all of the alternatives on ICG, Memphis users of ICG, Memphis development, and the public. A benefit-cost analysis was also performed. Although results of the analysis are given in this paper, the study did not identify a best alternative, because such a selection is the responsibility of public officials and not a responsibility of this analysis.

On May 1, 1986, a 100-year lease agreement between the city of Memphis, Tennessee, and the Illinois Central Gulf (ICG) Railroad Company for property through the downtown area along the Mississippi Riverfront will expire. The ICG maintains trackage and operates trains in this 2.3-mile corridor extending from Saffarans Avenue in the north to Calhoun Street in the south (Figure 1).

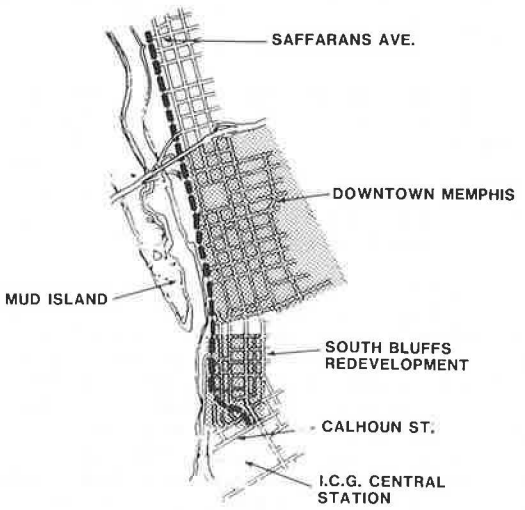

FIGURE 1 The riverfront corridor.

In recent years redevelopment activities in downtown Memphis and along the Mississippi River bluff south of downtown have accelerated. This development is occurring adjacent to the rail corridor, and attention has been focused on the impact that continued rail operations within the corridor will have on future commercial and residential development along the riverfront. Proposals have been made by developers and proponents of downtown redevelopment that (a) the lease not be renewed in 1986, (b) the tracks be abandoned, and (c) the train traffic currently using the Riverfront Rail Corridor be diverted to other portions of the Memphis rail network. An opposing view, that the elimination of this rail link will severely affect users and will result in a degradation of rail service in and through Memphis, especially to customers within the corridor and to industries north of the downtown area, has been presented by companies served by ICG and the railroad.

The objectives of this investigation were to develop an evaluation methodology and to evaluate the various alternatives to renewing the ICG lease and continuing to allow the line to operate as it has in the past. Included in the set of alternatives was the no-action alternative, that is, continuing the lease in its present form. The evaluation included an analysis of the capital, operating and maintenance, and road user costs for each alternative. Additional evaluation measures included environmental impacts and effects on rail customer service. Economic analyses of the costs and benefits associated with each alternative were also conducted.

THE MEMPHIS RAIL NETWORK

There are five Class I railroads that serve Memphis: ICG Railroad, Burlington Northern railroad (formerly Frisco), Seaboard Coast Line Railroad Company (formerly Louisville and Nashville), Union Pacific Railroad (formerly Missouri Pacific), and Norfolk Southern Railway Company (formerly Southern). The locations of these railroads are shown in Figure 2. ICG serves Memphis from the north and south. At the northern end of the urban area at Woodstock ICG branches into two lines, one single track line proceeding along the Mississippi River through the Driving Park Industrial Area, into the downtown (double track) area, and south through the ICG South Yard where another branch is made. One branch extends to the west of Johnston Yard, which is the railroad's major maintenance and classification facility in Memphis. This line connects with the South Main line and extends into Mississippi. The second branch at the South Yard is to the east of the Johnston yard and becomes the Grenada Main, extending south into Mississippi. The second branch at Woodstock is dual track and proceeds directly to

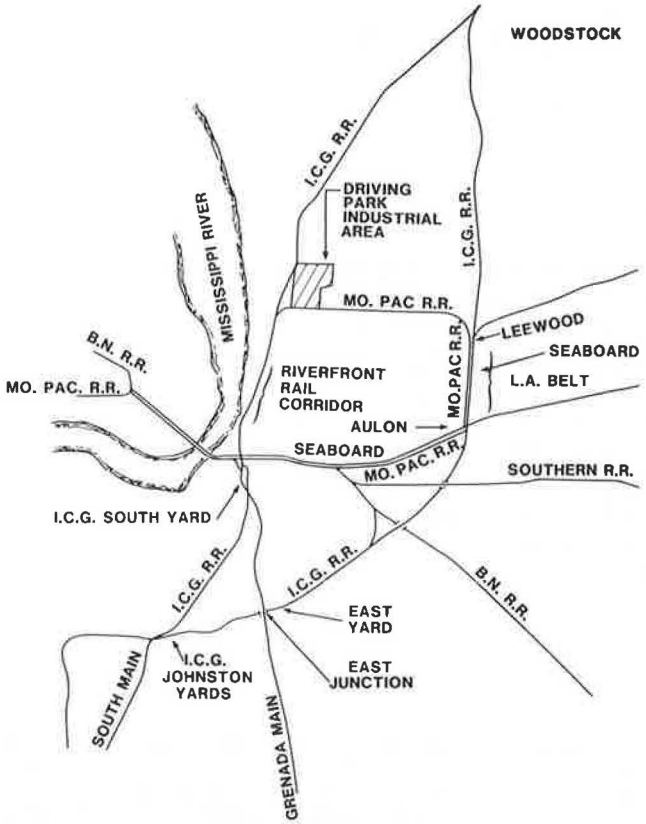

FIGURE 2 The Memphis rail network.

Leewood Junction, where the ICG operates on track owned by Seaboard for a length of approximately 2 miles to Aulon Junction. At this point the ICG has dual track leading southwest to Johnston Yard. No direct connection currently exists between this line and the Grenada Main.

Seaboard enters Memphis from the east. At Leewood this line is double track that proceeds in a southerly direction to Aulon. Seaboard facilities continue to the west. Norfolk Southern also serves Memphis from the east. Its operations terminate in Memphis.

Burlington Northern enters Memphis from Arkansas, south of downtown, and heads in a southeasterly direction toward Alabama. Union Pacific (MOPAC) also enters from Arkansas south of downtown and proceeds to its Sargent Yard facility, which is located in the central part of the city. MOPAC operates a single track circumferential route that first proceeds eastward, then travels northward (paralleling the Seaboard tracks in the Leewood-Aulon corridor), and then turns west and travels toward the Driving Park Industrial Area.

PRESENT OPERATIONS--ICG SYSTEM

Within the dual-track Riverfront Rail Corridor, the area in which it has been proposed to abandon operations, there is currently an average of 9 train movements per day. These include two scheduled Amtrak trains that use the passenger station located at the southern end of the downtown area, 5 through trailer-on-flat-car (TOFC) trains, and 2 transfers between the Driving Park Industrial Area and the ICG South Yard. TOFC trains use this corridor because it has direct connection to the Grenada Main. All through the corridor, mixed freight operations use the alternative eastern route. This route is known as the LA Belt.

IDENTIFICATION OF RAIL-SERVICE ALTERNATIVES

The initial task in this study consisted of identifying all options proposed for providing rail service subsequent to the end of the present ICG lease for use of the Riverfront Rail Corridor. The emphasis at this level of analysis was to generate a wide range of options without regard to the feasibility of each option.

The rail-service options developed were grouped into 7 categories. Category 1 contained a single element--the no-action alternative in which the lease would be renewed without any changes in physical layout or operating practices in the Riverfront Rail Corridor. The options in Category 2 contained physical changes that could be made in the Riverfront Rail Corridor. Category 3 contained a list of modifications to operating practices that could be implemented in the Riverfront Rail Corridor. Revisions to operating practices along the LA Belt and on the portions of the Memphis rail network were continued in the Category 4 options. Category 5 consisted of options based on physical changes in the railroad right-of-way owned by ICG. Improvements within the right-of-way owned by other railroads in Memphis were listed in Category 6. Category 7 was composed of additional alternatives that involved significant railroad construction in new corridors or major changes in the transportation system.

ALTERNATIVES CONSIDERED FOR DETAILED ANALYSIS

Four alternatives were selected to be evaluated in detail after completion of a preliminary screening analysis, which was conducted to eliminate alternatives that were not feasible or that were dominated by other alternatives. This screening was based on consideration of the following two factors:

1. Economic comparison of one alternative with other alternatives that could provide similar levels of service; and
2. Analysis of whether this alternative was dominated by other alternatives that could provide equal or better levels of service with less disruption, less construction, or lower operating costs.

The selected alternatives were developed by synthesizing the options being considered into concepts that combined the physical and operational changes required to maximize rail system capacity and level of service to users given existing constraints, such as the necessity of routing trains over longer distances and of using the tracks of other railroads.

It became apparent as the study progressed that the objective of providing system users, especially those in the Driving Park Industrial Area, with a level of service equal to what they were currently receiving could not be achieved by using viable alternatives (including abandonment of the Riverfront Rail Corridor) without major new construction and system disruption. Several alternatives that would provide service comparable to the current level were considered, but the associated costs and other negative impacts were judged unacceptable. For example, one concept that had been developed included expansion of the ICG East Yard near East Junction, addition of a third main track along the LA Belt from Leewood to East Yard, and installation of centralized traffic control (CTC) along the entire length of the LA Belt. This would provide a

major improvement in the efficiency of transfer and through movements, but the capital expenditures that would be required were estimated to exceed $25 million.

Even if funds were available to provide these extensive physical improvements, there are other constraints that limit the provision of a level of service equal to the current level. The primary factor is that for any alternative that does not include use of the Riverfront line, ICG trains would be forced to use trackage of other railroads for all through and transfer movements. Although there are existing agreements permitting trains from one line to use tracks of another railroad, it is important to note that the railroad that owns the right-of-way and physical plant sets the priority of use. For example, if ICG operates over the tracks of other railroads, its access will be limited to avoid its interfering with the operation of the railroad whose line ICG is using.

This situation exists today along the LA Belt: ICG trains use the segment from Leewood to Aulon, which is owned by Seaboard. Informal conversations with Seaboard personnel revealed that ICG may pay up to 60 percent of the cost to operate and maintain the corridor through transfer fees collected by Seaboard. In spite of this, Seaboard trains--even switching operations--have priority over ICG through trains in this section. It has been reported that ICG trains may wait an hour or more to receive permission to proceed while Seaboard switching activities are taking place.

Given this constraint, the approach taken in developing alternatives for detailed analysis was to weigh the capital costs required for the improvements and to define alternatives that would provide maximum service within the limitations imposed by the existing railroad system, which consists of the properties of several railroads. This resulted in the generation of alternatives that would provide adequate service, although the level of service might not be equal to the level that is currently being provided with the Riverfront Rail Corridor in its existing form.

On the basis of an analysis of all available information and a review of the alternatives' feasibility and constraints, four alternatives were selected for detailed analysis. These are:

1. No change in physical layout or operating practices in the Riverfront Rail Corridor;
2. Enhanced Riverfront Rail Corridor;
3. Use of the existing MOPAC trackage for transfer movements and the LA Belt for through ICG trains; and
4. Transfer of all ICG operations to the LA Belt.

The extent of improvements that are necessary for each alternative is described in detail in the following sections.

No-Action Alternative

The "no-action" alternative assumes that the lease between the city of Memphis and ICG Railroad will be renewed in 1986. Two tracks will remain in the corridor, and no major changes will be made in train schedules, physical conditions in the corridor, or other operating practices.

Enhanced-Riverfront-Rail-Corridor Alternative

This alternative includes renewal of a modified lease in the Riverfront Rail Corridor by ICG Railroad. Corridor modifications to be considered include:

1. Removing one track in the corridor,
2. Replacing the existing rail on the remaining track with continuous welded rail,
3. Improving the highway grade crossings at major streets with rubberized surfaces, and
4. Landscaping the corridor.

Additional operational improvements that may be implemented include prohibiting blowing of whistles and ringing of bells and rescheduling train movements to minimize conflicts with peak street traffic volumes and evening operations.

The examination of this alternative will include an evaluation of the incremental costs and benefits associated with the proposed modifications.

Use of Existing MOPAC Trackage for Transfer Movements and the LA Belt for ICG Through Trains

Existing MOPAC trackage from the Driving Park Industrial Area to the LA Belt and parallel to the LA Belt and to Aulon will be used for transfer movements to the ICG South Yard. These transfer movements will use Seaboard or MOPAC tracks along Broadway to Kentucky Street and existing wye-shaped trackage to South Yard. Through trains will use the LA Belt from Woodstock and a new wye at East Junction to connect to the Grenada main line. The Riverfront Rail Corridor tracks will be abandoned and a new Amtrak station will be built. Specific modifications will include:

1. Rehabilitating the existing Missouri-Pacific track from the Driving Park Industrial Area east to the MOPAC North Yard near Leewood and south to Aulon, including replacement of turnouts and grade-crossing improvements;
2. Constructing a new Amtrak station along the LA Belt;
3. Constructing a new wye at East Junction; and
4. Constructing new track at East Yard to connect with the new wye.

Transfer All ICG Operations to the LA Belt

All train movements that use the Riverfront Rail Corridor will be transferred to the LA Belt. Specific improvements to be included are:

1. Constructing a new wye at East Junction,
2. Constructing new track at East Yard to connect with the new wye,
3. Purchasing existing right-of-way and track for the wye in the northeast quadrant at East Junction,
4. Constructing a 1-mile passing track and required crossovers along the LA Belt,
5. Constructing a 1,000-ft passing track and required crossovers in the Leewood to Aulon segment,
6. Constructing a 0.25-mile lead track at Woodstock,
7. Constructing a new Amtrak Station along the LA Belt,
8. Installing a new signal system from Aulon to East Yard, and
9. Improving signals from Leewood to Aulon.

ANALYSIS OF CAPITAL, OPERATING, AND MAINTENANCE COSTS

A principal component of the evaluation process was the development of estimates for the capital, oper-

ating, and maintenance costs associated with each of the alternatives that were being considered. The following cost elements were included in this analysis:

1. Capital costs for new construction or rehabilitation;
2. Additional maintenance costs or maintenance cost savings attributed to each alternative;
3. Additional operating and delay costs to ICG trains that formerly used the Riverfront Rail Corridor; and
4. Additional operating and delay costs to other train movements (both ICG and other railroads) on the Memphis Rail Network, which are a result of the increased train volumes on the existing system.

Documents prepared for estimating engineering cost estimates were used to determine railroad capital expenditures. An additional source of information was a 1974 publication of the Federal Railroad Administration, Guidebook for Planning to Alleviate Urban Railroad Problems (1). This document contains procedures for determining operations costs and maintenance costs based on consideration of time, distance, and delay factors. Figures from this publication were updated to a 1983 base by using cost-index data provided by the Association of American Railroads.

In preparing the cost estimates it was assumed that no additional right-of-way purchases would be needed at Woodstock, along MOPAC trackage, or along the LA Belt, and that modification to the existing system could be made within present rights-of-way. It was further assumed that land would be provided at no cost to the ICG Railroad to construct the wye in the southwest quadrant at East Junction, and that the privately owned wye that is in place in the northwest quadrant at East Junction would be purchased for $100,000. Tables 1-3 give lists of the recommended improvements and associated costs for the three alternatives. Table 4 gives a summary of the capital, maintenance, and operating and delay costs for all alternatives.

TABLE 1 Recommended Improvements to and Associated Costs of the Enhanced-Riverfront-Rail-Corridor Alternative

Recommended Capital Improvement	Cost ($)
Welded rail	560,000
Grade-crossing improvement	200,000
Landscaping	100,000
Total	860,000
Annual Maintenance	
Track maintenance	18,000 (savings)
Landscaping	40,000
Total	22,000/year

Analysis of Impacts on the Road User

Several measures of effectiveness (MOEs) were used to describe impacts on the road user both inside and outside of the study area. These were:

- Average delay per vehicle at railroad grade crossings,
- Number of vehicles per day that experienced delay,
- Total vehicle-hours of delay (per year),
- Excess fuel consumption due to railroad grade crossings (gal/yr),

TABLE 2 Recommended Improvements to and Associated Costs of Missouri-Pacific-Transfer Alternative

Recommended Capital Improvement	Cost ($)
Track rehabilitation	1,350,000
Turnouts	225,000
Grade-crossing rehabilitation	105,000
Amtrak station	250,000
Wye at East Junction	368,000
Track at East Yard	110,000
Total	2,408,000
Annual Maintenance	
Abandon riverfront	60,000 (savings)
Additional	31,200 (LA Belt)
	18,000 (MOPAC)
Total	10,800 (savings)
Annual Operation and Delay	
ICG trains diverted	1,107,209
Other train traffic	1,136,610
Total	2,243,819

TABLE 3 Recommended Improvements to and Associated Costs of LA-Belt-Woodstock-to-East-Junction Alternative

Recommended Capital Improvement	Cost ($)
East Junction Wye	
SE quadrant	368,000
NE quadrant—land	100,000
Passing track	
Airways to Cincinnati	1,344,000
Leewood to Aulon	260,000
Lead track, Woodstock	219,000
Track at East Yard	110,000
Amtrak station	250,000
Signals, Aulon to East Yard	419,000
Signal improvement (Leewood to Aulon)	50,000
Total	3,120,000
Annual Maintenance	
Abandon riverfront	60,000 (savings)
Additional maintenance	50,000 (new track)
	31,200 (LA Belt)
Total	21,200
Annual Operation and Delay	
ICG trains diverted	1,967,058
Other train traffic	1,441,841
Total	3,408,899

- Costs to the road user due to delay and fuel consumption ($/yr), and
- Expected potential accident conflicts (which is referred to as the safety index).

The values of these MOEs were obtained from several computer programs that were developed for this project. These programs considered train length, time of train arrival, street traffic volume at that time of day, and anticipated traffic growth between the years 1986 and 2000. These impacts are summarized in Table 5 for those alternatives that were selected for detailed analysis.

Impacts on the road user are the same for the do-nothing and enhanced-Riverfront-Rail-Corridor alternatives. Considering anticipated growth of street traffic in the study area, an average of 519 vehicles per day would be delayed an average of 71.3 sec each for these two alternatives. This would be an average of 3,753 vehicle-hr of delay each year. The total equivalent uniform annual costs to the road user

TABLE 4 Summary of Railroad Capital, Maintenance, and Operation and Delay Costs for All Rail-Service Alternatives

Alternative	Capital ($)	Maintenance ($/yr)	Operation and Delay ($/yr)
No action	0	0	0
Enhanced riverfront rail corridor	860,000	22,000	0
Missouri-Pacific transfer	2,408,000	10,800 (savings)	2,243,819
LA Belt-Woodstock to East Junction transfer	3,120,000	21,200	3,408,899

(considering the costs of delay and fuel consumption) for these two alternatives would be $23,590 per year.

These impacts on the road user would be eliminated if the riverfront line were removed. However, increased impact on the road user would occur outside of the study area because rail traffic currently using the riverfront line would be crossing different streets (and these streets would therefore carry increased amounts of traffic).

Both alternatives associated with removal of the riverfront line include routing through trains from East Junction to Woodstock via the LA Belt. The difference between these two alternatives is the manner in which transfers would take place. For ICG transfers made by using the MOPAC tracks, an average of 1,918 additional vehicles would be delayed an average of 76.9 sec each, which would amount to 14,957 vehicle-hr of delay per year. The total equivalent uniform cost to the road user would be $93,645 per year. If ICG transfers were to take place via East Junction and Woodstock, the additional number of motorists delayed would be 1,331 per day, which would result in an average of 10,373 vehicle-hr of delay per year. The equivalent uniform annual cost to the road user for this alternative would be $62,974 per year.

Comparing the two alternatives associated with removal of the riverfront rail line with those alternatives in which at least one track remains in place, the savings to the road user from removal of the rail line are more than offset by increased costs to the road user elsewhere in the city. By using the MOPAC tracks to accomplish ICG transfers, the number of additional vehicles delayed would be 3.7 times the number for which delay would be eliminated in the study area. This ratio would be approximately 2.6 if the transfers were made via East Junction and Woodstock. Similarly, total delay increases outside of the study area would exceed savings in the study area by a factor of 4 for the MOPAC alternative and by a factor of 2.8 for the East Junction-Woodstock alternative. The respective ratios for equivalent uniform annual costs to the road user would be 4.0 and 2.7.

ANALYSIS OF IMPACTS ON SAFETY

The impacts on safety for each alternative were assessed using a safety index, which represents the potential for a highway vehicle-train conflict. The conflicts occur when a vehicle attempts to cross tracks when grade-crossing controls prohibit crossings because of the approach or presence of a train. These conflicts may or may not result in an accident, depending on whether the motorist is successful in crossing the tracks. Nevertheless, a crossing accident will have a conflict associated with it. The potential for these conflicts (or safety index) is the number of times per year that at least one vehicle is present in each line while grade-crossing controls prohibit crossing. The values for the safety index of each alternative are given in the last column of Figure 5. It is emphasized that these values cannot be used to forecast accidents. They merely indicate that for the city as a whole, the do-nothing and enhanced-Riverfront-Rail-Corridor alternatives are likely to be the safest alternatives for providing the desired level of service.

ANALYSIS OF IMPACTS ON INDUSTRY

A survey of selected Memphis industries was conducted to determine the perceived impacts on economics and employment that would result from shipping delays that were expected to occur if the Riverfront Corridor was abandoned. The industries that were surveyed were those listed in the 1980 report entitled Memphis Riverfront Rail Impact Analysis (2). Each firm was asked to estimate the economic impact and the projected number of jobs lost for two conditions, a 24- to 36-hr shipping delay and a 2-hr shipping delay; a decrease in shipping reliability was assumed for both situations. An attempt was made to contact the 21 firms listed in the earlier survey. However, because some of the companies were no longer in operation in Memphis, it was only possible to contact 18 companies.

The results of the survey indicated that the estimates contained in the previous report of job losses resulting from a 24- to 36-hr shipping delay were still considered valid by most firms. For delays of this magnitude, a total of 300 jobs were projected to be lost. The majority of these lost jobs would not be existing jobs, but rather would be jobs that are never created, because the poor transportation service would cause firms to look for other locations in which to expand operation.

The estimates of the dollar value of the economic impacts to affected firms were highly variable because most of the industries that were surveyed included the value of future jobs lost, as well as extra shipping charges. However, based on the data supplied in the survey, an estimate of the minimum extra costs that would be incurred by industries as a result of 24- to 36-hr shipping delays would be about $750,000 per year.

Most of the firms surveyed believed that 2-hr shipping delays would not affect employment. However, a few firms indicated that any delays would mean decreased shipping reliability, which could influence decisions about future expansion. The total number of jobs projected to be lost by 11 industries was 100.

The majority of companies indicated that the

TABLE 5 Summary of Impacts of All Rail-Service Alternatives on Road Users

Alternative	Avg Delay/Vehicle (sec)	No. of Delayed Vehicles/Day	Annual Vehicle-Hr of Delay	Excess Fuel/Year (gal)	Annual Road User Costs ($)	Safety Index
No action	71.3	519	3,753	4,079	23,590	53,518
Enhanced riverfront rail corridor	71.3	519	3,753	4,079	23,590	53,518
Missouri-Pacific transfer	76.9	1,918	14,957	15,466	93,645	91,088
LA Belt-Woodstock to East Junction transfer	76.9	1,331	10,373	10,729	62,974	67,511

economic impacts of a 2-hr shipping delay would be minimal. However, if this delay resulted in missed connections, costs would accumulate. A conservative estimate of the extra shipping costs that would be attributed to 2-hr shipping delays would be approximately $100,000 per year.

The dollar value of the loss of jobs that would result from abandoning the Riverfront Rail Corridor was calculated by using the estimates provided for number of jobs lost, salary data, and information collected on train schedule reliability. The expected loss per year was computed to be $2,317,700. This was based on the following assumptions:

1. An average salary of $21,070 per year, and
2. A probability distribution of delays with a 95 percent probability of 2-hr delay and a 5 percent probability of 24-hr delay.

Based on these assumptions, the expected value of loss per year was computed in the following manner:

.05 x 300 jobs @ $21,070 + .95 x 100 jobs @ $21,070 = $2,317,700.

BENEFIT-COST ANALYSIS

An incremental benefit-cost analysis was used in the economic analysis of the alternatives. Capital costs, annual operating and maintenance costs, and annual costs to the road user were discussed in preceding sections of this paper. A separate study, Downtown Development Potential Analysis (3), was conducted by Memphis State University's Regional Economic Development Center to determine the land development potential and resultant benefits associated with improvement or removal of ICG tracks in the Riverfront Rail Corridor. This study developed estimates of employment gain and tax benefits that would occur if the railroad operations were eliminated or reduced in the downtown area.

A summary of the costs and benefits associated with each alternative is given in Table 6. The column labeled Annual Employment Gains gives the value of jobs that are gained from removal or reduction in rail service in the corridor. The Annual Employment Losses column gives estimates of the value of jobs lost by industry as a result of reduction in the level of service provided by the railroad. To provide consistency of units, capital costs are multiplied by a capital recovery factor to provide units of $/yr.

For the first comparison, the alternative with the lowest capital cost is the base alternative and that with the next lowest capital cost is the proposed alternative. For the proposed alternative to be economically superior to the base alternative, a benefit/cost (B/C) greater than 1 (a positive value) is required. For this comparison, the calculated B/C value was -0.09. This negative value of B/C indicates that the base alternative is superior to the proposed alternative. Thus, the enhanced corridor alternative was eliminated from further economic consideration.

For the next comparison, the proposed alternative involves transfers via MOPAC tracks. The do-nothing alternative is again the base. The B/C that was calculated was -14.5. Again, the do-nothing alternative is economically superior. It also serves as the base for the final comparison--that for which the proposed alternative assumes that transfers are accomplished via East Junction and Woodstock. The B/C for this comparison was -14.6. The do-nothing alternative is once again economically superior; therefore, from an economic perspective, it is the best of the entire set of alternatives. Note that this same conclusion would be reached even if there were no jobs lost by removal of the riverfront line. The benefit-cost ratios, however, would have different magnitudes.

CONCLUSIONS

This study was an in-depth investigation of the costs, benefits, and other impacts of alternative methods of providing rail service in Memphis if the present lease between the city of Memphis and ICG Railroad for the Riverfront Rail Corridor is not renewed in its existing form in 1986. A detailed study of feasible options for maintaining service at the current level has been conducted, and the costs (and their impacts) associated with each option have been calculated. The results of this study are intended to guide the mayor's committee in formulating a recommendation about renewal of the ICG lease.

No specific recommendations concerning the best alternative were developed; however, several conclusions are made as a result of this study. The first conclusion is that the recurring annual costs for maintenance and operations for all of the alternatives that were selected for detailed analysis were more significant than the capital costs for the improvements. This was especially true for the alternatives that included costs to the railroads for additional travel distances and time delays.

A second conclusion is that the trade-off among benefits must be considered for each alternative. For example, abandonment of the Riverfront Rail Corridor will benefit employment opportunities in the South Bluff Area, but will have a negative impact on the number of potential jobs in the Driving Park Industrial area. Likewise, reductions in delays to motorists in the downtown area that would result from removal of train traffic would be outweighed by the increased delays to vehicles that would be caused by additional trains traveling on other portions of the rail network.

A final conclusion is that any resolution of the current problem will require cooperation among all affected railroads. These railroads should not be expected to agree to rail system modifications unless it is demonstrated that the railroads will

TABLE 6 Summary of Costs and Benefits of All Rail-Service Alternatives ($/yr)

Alternative	I x CR	K	U	Annual Employment Gains	Annual Employment Losses	E	T
No action	0	0	23,590	0	0	0	0
Enhanced riverfront rail corridor	108,841	22,000	23,590	(-)9,738	0	(-)9,738	2,469
Missouri-Pacific transfer	298,684	2,233,019	93,645	(-)221,077	2,317,700	2,095,923	(-)76,115
LA Belt-Woodstock to East Junction	376,081	3,430,099	62,976	(-)221,077	2,317,700	2,095,923	(-)76,115

Notes: Benefits are indicated by a negative sign. I = capital improvement cost; K = equivalent uniform annual operating and maintenance costs (relative to the no-action alternative); U = equivalent uniform annual road user costs; E = equivalent uniform annual net employment costs; T = equivalent uniform annual taxes; and CR = capital recovery factor.

benefit and that their operations will not suffer as a result of recommended changes.

ACKNOWLEDGMENTS

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