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GUIDEBOOK FOR PLANNING TO ALLEVIATE URBAN RAILROAD PROBLEMS

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FINAL REPORT

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16. Abstract
This report is the third of four volumes reporting the results of a project to analyze the nationwide magnitude of the urban railroad relocation and to prepare methodology for future relocation studies. Volume 1 is an executive summary; Volume 2 is a community guide for preliminary assessment of the potential for planning to alleviate urban railroad conflicts; and Volume 4 presents a nationwide estimate of the nature and magnitude of urban railroad relocation. The purposes of Volume 3 are to suggest an appropriate approach to planning for community policy makers, to outline analytical processes to be used by technical specialists, and to provide supporting data. The approach to planning explains identification of problems, preliminary assessment of the potential for planning, organization for planning, and conduct of the planning process. The approach to planning stresses the complex interactions between groups in the community such as railroad users, railroads, highway users, and residents. Community leadership must organize to bring these groups together to produce improvements in the railroad system that will benefit all those diverse groups. The analytical process describes how to estimate railroad capital and operating costs, railroad user costs, highway user costs, and the effects of proposed changes on the neighborhood, community, state, and nation. Worksheets are provided to guide and assist the analysis.

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Many cities are currently considering urban railroad relocation as a means to solve their community -- railroad problems.

Distributed with this memorandum is the subject DOT report which provides guidelines for planning urban railroad relocation projects. Guidelines are suggested for community policy makers in Part I and analytical processes to be used by technical specialists are provided in Part II. The analytical processes are illustrated with data obtained from actual case study cities.

This guidebook represents a pioneering effort to systematize the analysis of a complex urban railroad problem. The complexity of the urban railroad situation compels that the general process for planning and analysis as illustrated in this guidebook be adapted to the characteristics of individual cities.

These guidelines have been developed as part of a joint contract effort sponsored by the Federal Railroad Administration and the Federal Highway Administration. The study was conducted by Stanford Research Institute.

This report is the third in a four volume series. The titles and brief description of all four volumes are given on DOT Form 1700.7 on page i.

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I INTRODUCTION

While many communities in the United States owe their origins to the railroad and actively sought, or bought, railroad service, it was not long before conflict between the community and the railroad began. Interference with street traffic was the first problem. Records show that as early as 1880 there was concern about the disruption of horse drawn traffic by the railroads. As motor vehicle traffic grew, the problems grew, and a number of communities prepared plans for alleviation of the railroad and highway traffic conflicts in the 1920s and 1930s. Projects for grade separation and street improvement were widespread in the depression years.

Noise, vibration, smoke and cinders, community division between the "wrong" and "right" side of the tracks, blight and ugliness were also problems in the early days. However, they were usually considered necessary evils which were more than offset by convenient railroad service that benefited the community with a vital economic and social link to the outside world. Conversion to diesel locomotives after the mid-1930s substantially removed the problems of smoke and cinders, but the other problems continued unabated.

Prior to the 1950s, the major mode of long distance passenger transportation was still the railroad. The convenience of the passenger depot in the center of town was important both to the passengers and to the downtown businesses. The need for tight schedules to give passengers the fastest service possible dictated that a main railroad line serve the passenger station. Coach yard facilities in junction cities were often located near the passenger station to expedite service and to coordinate train makeup with passenger scheduling. Industries tended to cluster near the central part of town and relied extensively on railroad service. Bus and streetcar lines in larger communities carried workers to their jobs and shoppers to the stores in the center of the city, and railroad passengers to either the downtown district or wherever they needed to go.

By 1960 the convenience of railroad facilities in downtown districts had waned considerably and the inconveniences had become much more apparent. Air and highway travel had attracted almost all of the regular long distance travelers. The migration of people from the farm to the city, combined with the need for space for the large families of that time, led to the swift development of sprawling suburbs beyond the limits of the public transportation system. New industries and established firms needing to expand could locate far from the center of town on much less expensive land, be close to the suburban labor market, and rely on new, larger trucks for much of their freight service. The individual automobile became so necessary to reach widespread destinations that families commonly owned two or more, and rental cars were used by long distance air travelers for local transportation. Customers and employees came to the downtown district by automobile rather than by train, bus, or streetcar. Bus and streetcar schedules were curtailed in many cities. Traffic problems multiplied, and every train coming through town and crossing streets magnified street congestion. Many customers deserted downtown stores to patronize the stores closer to their suburban homes.

Today there are still places were railroad service is needed in downtown areas, but railroad lines through the middle of town not only occupy land that frequently could be used in a higher-valued way, they also cause occasional very serious accidents and create considerable distress among motorists delayed at grade crossings. On the other hand, passenger traffic is so small that it has been discontinued altogether to many cities. Station and switching facilities near the downtown become unnecessary. Other problems related to railroads have come to the attention of cities that want to reduce noise levels, improve their appearance, expand an activity center next to the railroad corridor, or implement a flood control plan requiring railroad relocation.

In the 1950s and 1960s, almost 50 communities have prepared detailed plans for relocation of part or all of their downtown railroad lines. Several places--Colorado Springs, Niagara Falls, McKeesport (Pennsylvania), and Beaumont (Texas), succeeded in relocating tracks.

The Highway Safety Act of 1970 authorized a demonstration project for the elimination or protection of grade crossings in Greenwood, South Carolina. Greenwood, like many other cities in the country, was bisected by multiple railroad lines resulting in downtown traffic congestion and loss of mobility for emergency vehicles. The demonstration project, now partially completed, includes the construction of new track and connections that will consolidate operations over existing tracks that bypass the downtown area. The tracks in the downtown area are being removed. When completed, the project will result in improvement in the appearance and cohesiveness of the downtown area, increased highway safety and mobility, and improved railroad operations.

The demonstration in Greenwood prompted other communities to seek federal assistance with their railroad problems. In order to determine the need for a program of railroad relocation, the Federal Railroad Administration and the Federal Highway Administration initiated a study designed (1) to estimate the nature and magnitude of the railroad relocation problem in urban areas and (2) to develop a methodology for planning and implementing local studies aimed at solving the problem. This guidebook presents the results of the second part of the study.

During the course of the study, the team led by SRI reviewed reports of over 50 railroad relocation proposals; studied dozens of other related reports; and traveled to 17 cities in the United States. Detailed field investigations were conducted in seven of these cities, where planners, railroad personnel, elected officials, and businessmen were interviewed to obtain their opinion of the impact of relocation projects on their communities. Railroad operations were observed in the other ten cities as part of a study of problems in larger cities. In addition, 150 planners in cities with populations greater than 100,000 were surveyed by mail questionnaire and detailed comments and maps were received from many of these; over 500 maps of cities were analyzed.

State highway departments in six states provided information about every urban grade crossing in their states. This information was analyzed to determine the potential benefits of eliminating urban grade crossings.

Summary of the Nature and Magnitude Study

Companion volumes to this guidebook (1) report in detail on the nature and magnitude, nationwide, of the railroad relocation problem in urban areas; (2) provide the guidance for preliminary assessment in a separate document; and (3) provide a summary of the project work. The report on nature and magnitude is summarized below.

Relocation of the railroads in urban areas--which in some cities include consolidation of railroad trackage--offers the potential for combining several kinds of benefits from one project: improved highway safety and mobility, improved environment, improved use of land in the community, and improved railroad efficiency. The tangible and intangible benefits from all these improvements could justify relocating the railroad, whereas any one of the benefits would not necessarily, by itself, make the relatively high cost worthwhile. Therefore, railroad relocation and consolidation should be added to the arsenal of weapons at the disposal of transportation and land use planners as they cope with the problems of the city.

The report estimates the total number of places in the United States that are experiencing conflicts between the railroad and community activities, and also the cost to remedy these problems through programs that would require justification in terms of benefits to highway users; or to highway and railroad users combined, and all benefits, no matter to whom they accrue.

The need for planning and financial support is identified.

Purposes of the Guidebook

The purposes of this guidebook are to suggest the appropriate approach to planning for community policymakers (Part I), to outline analytical processes to be used by technical specialists (Part II), and to provide supporting data (in Part II and the appendices). The analytical processes are illustrated with data from the case study cities.

This guidebook is a pioneering effort to codify the analysis of complex railroad, urban, and transportation problems. As the guidebook is used by practitioners, refinements in procedures, analysis, and cost factors will doubtless be made. Because of the complexity of the problems, the procedures described here can only illustrate the general process of planning and analysis: the guidebook is not intended as a complete text in any of the many disciplines that need to be applied to the problem. Professional judgment, as always, is an essential ingredient in good planning.

II SUMMARY

Urban railroad relocation must be considered within the context of a complex array of problems in a community. As such, it must be handled within an integrated framework which includes many elements--economic conditions, community commitment, land use, traffic and transportation, physical conditions, and environmental factors.

Railroad Relocation in Comprehensive Urban Planning

Urban areas of over 50,000 population are required to develop long-range highway plans which are properly coordinated with plans for improvements in other forms of transportation. Smaller communities may have such plans in varying degrees. It is important that consideration of a railroad relocation and consolidation be a part of such long-range plans.

Ideally, both the economic and physical impacts of railroads would have been included in all comprehensive planning programs for years. However, for a variety of reasons--most notable of which seem to be the high costs of railroad removal and construction, and the remoteness of railroad company headquarters--communities have been more reluctant to confront railroad problems than their other problems. Urban planning has typically "worked around" railroads or tried to capitalize on their presence (e.g., by developing industrial buffer zones). This approach may lead to the correct solution, but using such built-in constraints may result in lost opportunities by ignoring the potential solution of relocating or consolidating railroad facilities.

Special Considerations in Planning Railroad Projects

Planning of a particular kind is needed to resolve the conflict between the railroad and the community. There are many interests: railroad operating companies, railroad users, highway users (owners, operators, and occupants of automobiles, buses and trucks), tenants in the immediate area of the railroad, landowners, the community at large, and the rest of the State and Nation.

Whatever the solution finally chosen by a particular community, railroad conflicts represent an urban problem of a very special kind: the costs of solving the problem are high, and a myriad of parties are involved in the decision making. An entrepreneurial element of substantial magnitude--shippers and railroad operating companies--must be included and their institutional objectives and constraints must be understood.

It will do no good to make a distinction between the private and public sectors and then bias the planning work by claiming that the public interest is the first priority; railroads are quasi-public in nature by virtue of federal regulation. Rather, what is needed is a completely openminded approach which is sympathetic to the interest of all parties. In turn, this requires an extraordinary--and expensive--coordinative effort on the part of whatever professional planning team is utilized. The professional/political process is always one of compromise and recompromise. In a sense, decision making is the rational adjustment of self-interests. It requires patience and a recognition that railroad projects must be evaluated not only in terms of their costs and benefits, but also in terms of their priority relative to other community priorities and capabilities.

Regardless of whoever else is interested in community railroad problems, there must be some benefit to the railroad company if the planning is to have any hope of success. Further, a community should always keep in mind that the physical expanse of the railroad system means that distant communities, shippers, highway users, other railroad operations, etc., may be affected by the local plan. Therefore, great care should be used in defining a study area and designating the appropriate body to be responsible for the planning.

One final point: it is important that legal regulations and current federal policies be built into the planning program. Interstate Commerce Commission powers, questions of railroad land tenancies, shippers' rights, safety standards, environmental regulations, and national transportation planning policies--all must be considered in the local planning.

Assumptions Used in the Development of Planning Methodology

Funding

Urban railroad relocation demonstration planning study and implementation projects have been authorized in specific cities by various Federal legislation since 1970. Related railroad projects have also been undertaken in connection with programs of the Department of Housing and Urban Development (HUD).

At the time we go to press with this planning guidebook, there is no comprehensive provision for funding of either detailed planning or implementation of projects specifically to alleviate urban railroad problems. Therefore, this guidebook has been prepared under these assumptions:

- Federal funds for planning and implementation will be available.
- The availability of funds for detailed planning will be somehow related to the results of the preliminary assessment carried out by a community.
- The amount of funds available for implementation of the selected alternative will be related to the costs and impacts estimated during the detailed planning analyses.

The approach followed in this guidebook also assumes that, regardless of the availability of outside funds for implementation, the community will be required to make a substantial investment of its own resources. Therefore, guidance is provided to assist the community in its decision to commit its resources.

Future Railroad Transportation

This guidebook has also assumed that the national railroad system will continue to be a vital part of the national economy for many years to come. However, the emphasis will continue on the freight transportation function, as railroads will probably not regain their place as long-haul passenger carriers. In certain short-haul corridors of high density, the railroads will likely increase their passenger services because of competing demands for energy, crowded airspace, and restrictions on environmental degradations. In the places where these kinds of services are foreseen, planners will have to adapt the principles presented herein to meet those special situations.

Summary of the Guidebook

This guidebook is divided into two parts: an approach to planning that describes background, organizational, and procedural aspects of planning; and guidelines to analytical support for plan development.

The Approach to Planning: Organization and Procedures

The planning begins with the perception that there is a railroad conflict problem of significance to the community and that something should be done about it. With this perception, a guiding organization, commonly called a steering committee, is formed of representatives from interested public and private organizations, including each railroad. This steering committee, with the assistance of any required additional technical personnel either from within the community or from outside it, arrives at a preliminary assessment of the available alternative solutions to the problem. As a result of this preliminary assessment, the decision makers will be able to determine the approximate cost and probable impacts of a range of alternatives to alleviate the problem that is perceived. If the costs appear to be within the capability of the community to finance, considering the probable contributions from outside the community, financial assistance may be sought for further study using the information developed for the preliminary assessment. All study data and information should be fully integrated with other transportation planning for the area.

The development of a plan is undertaken by specialists using an iterative procedure of alternative description, impact assessment, and definition of new alternatives. In its final version, the plan describes alternative solutions to the railroad conflict problem, estimates their costs, and assesses their impacts.

The steering committee guides the general conduct of the plan development and acts as a focal point for communicating to the community the results of the plan development as it progresses. As the assessment of the alternatives is completed, the steering committee receives the response of the community and provides leadership for adoption of the most favorable alternative.

After a plan is adopted, a new organization with much broader powers is required for implementation of the provisions of the chosen plan.

Special consideration should be given to the commitment of the community to the solution of the problem, in terms of its ability to provide both leadership for the detailed planning process and money for the implementation. Also due special consideration is the management of the technical aspects of the plan development to assure that the many different specialists needed to develop the plan are properly coordinated.

Analytical Support for Planning

The analysis portion of plan development consists of a circular or iterative process of identifying alternatives, describing alternatives in physical terms and estimating their cost, assessing the impacts of the alternatives, and evaluating and comparing alternatives. The first decision point in this iterative process is at the end of the preliminary assessment, wherein the initial look at the costs and impacts of a range of alternatives is completed in a short period of time. The analytical process continues as alternatives are defined in greater detail, and their costs and impacts measured more carefully.

Important in the plan development as well as in the administration of planning is an understanding of railroad operations. As already noted, the railroad in a community is part of a system that covers the entire nation, and changes made in one place can affect the system for thousands of miles. There are also technological restrictions on railroad operations that are not generally understood. This guidebook provides all the planning participants with better understanding of these operations.

To assist the specialist team that must develop the plan, guidance is provided on the estimation of railroad capital costs, railroad company impacts, railroad user impacts, highway user impacts, neighborhood and community impacts, and state and national impacts. Guidance on comparing alternatives is also provided, including technical data for estimating the magnitude of impacts, and worksheets to explain the procedure the analyst follows in his estimating. The worksheets appear at the end of each relevant section in Part II of this guidebook.

Part I

THE APPROACH TO PLANNING

III THE AFFECTED PARTIES--THE STAKEHOLDERS

Problems associated with the railroad in the community are far-reaching and their resolution will make profound changes in the lives and pocketbooks of many people and groups in the community. Moreover, the effects will fall unevenly on the various groups. Those likely to feel the effects are called the stakeholders, and an understanding of who they are and their interests is an important consideration from the very beginning of the planning effort.

In general, the stakeholders may be divided into the following groups:

- Railroad operating companies.
- Railroad employees.
- Highway users.
- Residents and tenants of property adjacent to existing or new railroad facilities.
- Railroad users.
- Owners of property adjacent to existing or proposed railroad facilities.
- Residents, tenants, and property owners in other areas affected by the proposed changes in railroad facilities.
- The community at large.
- The remainder of the state and nation.

These stakeholder groupings may prove too broad for analysis of particular projects. For example, in comparing alternative resolutions to the problems associated with the railroad, residents and tenants of adjacent property may have to be subdivided into railroad users with potential loss of rail service under one of the alternatives, and tenants who may be forced to move either because the property on which their homes or businesses stand is to be used for right-of-way or because of general redevelopment of the area after the project is complete.

It should also be recognized that the classifications overlap--railroad employees may be tenants of abutting property; tenants and owners frequently are the same people; and the majority of the motor vehicle users are residents of the community and also members of other stakeholder groups. Nevertheless, the listing provides a convenient format for discussing "the stakes" in solving railroad relocation problems, and is followed below.

Railroad Operating Companies

A railroad is a private business that operates to produce a return on the investments of the stockholders. However, because it is a for-hire carrier of freight, it provides a service to the community in shipping merchandise and raw materials to and from the railroad users, who in turn provide jobs for the community. The railroads are regulated by the Interstate Commerce Commission which must approve service arrangements, rates, additions and abandonments of track, and agreements among railroads.

Even the profitable railroads have had difficulty in recent years in making a sufficient return on investment to compete for capital with other industries, and a number of railroads are operating in bankruptcy. These conditions have made it almost impossible for many railroads to tap capital markets for equity or loans. As a result, the railroads must be extremely careful in their investment decisions. They have opportunities for investments that have very high returns--investments they cannot make from their available cash--so that they are reluctant to consider any kind of new investment that is not highly profitable.

Railroad cooperation and assistance have been provided to many communities in their planning. However, it must be remembered that the railroads also serve other communities and this situation, together with their financial difficulties, may make them reluctant to set precedents which might be widely applied in the other communities.

Railroad technology generally requires an interconnected system, connecting the shipper with the consignee. Unloading and reloading operations are costly and impractical ways of bridging gaps in the system. While intermodal operations such as truck trailers or containers carried on railroad cars have a definite and increasingly sizable role in rail transport, such operations are applicable only to certain types of freight.

Finally, the design, configuration, and condition of the track network has a major influence on the cost of railroad operations. Railroads typically have design limits for the maximum allowable steepness of grades and sharpness of curves, as these characteristics have a definite effect upon operating efficiency and safety. Operating costs will usually be reduced by decreasing the distance that trains must travel over a given line segment, increasing operating speed, or decreasing the number and complexity of rail and highway crossings.

Railroad Employees

Railroad employee unions have bargained over the years to maintain their jobs in the face of declining utilization of railroads and the modernization of railroad equipment and operations. There are no known situations where the employees have objected to the relocation of railroads, but rearrangement of tracks that would move work from one territory to another, or that would affect working conditions or the amount of work available would be of concern to the employees.

Highway Users

Highway users are owners, operators, and occupants of automobiles, buses, and trucks that use the streets in the city. They are the largest group of travelers in the city and the city's economy, form, and patterns of activity depend greatly on its network of highways and streets. Highway users and the railroad come into conflict at railroad grade crossings, where the driver must slow his vehicle to determine if it is safe to cross or to avoid effects of roughness at the crossing, and must stop if the crossing is occupied by a train or if a train is approaching.

Slowing and stopping increases travel time for motor vehicle occupants, as well as vehicle operating costs: more fuel for slowing and acceleration, and more maintenance for brakes, transmissions, and tires, in addition to tire and suspension effects from the crossing roughness. Time delays are more or less important to the occupants depending on what they are doing, and the delays may be a source of severe irritation. If the vehicle is a commercial one, the driver is being paid and the truck being maintained to produce revenue for a business, and delays cause both the truck and the driver to be less productive. At the other end of the spectrum, persons driving for recreational purposes--going to a picnic or sightseeing--are less concerned with the delay. Monetary equivalents have been assigned to delays of various types and these are used in the evaluation of alternatives, as described later.

Accidents are also a cost. In a train-vehicle accident, the cost to the road user includes the value of property damaged and, in the event of injury or death, the medical costs and the economic loss of productive capability. The accident cost is listed as a road user cost because it is primarily the vehicle that is damaged, and it is the occupant of the vehicle most often injured or killed. However, the railroad or the motorist's insurance company is frequently called upon to compensate for damages to the user or his heirs.

One benefit of a railroad relocation to road users--the value of time saved--has a tendency to be passed on. The fact that a trip from home to downtown, for example, requires less time may result in (1) more frequent trips downtown to patronize merchants there, i.e., higher sales downtown, (2) new trips from more distant homes to downtown, again resulting in higher sales downtown, or (3) willingness to pay somewhat more for a residence because of its increased convenience, i.e., higher values for residential property.

In summary: highway users and others benefit from the elimination of the slowdowns, stops, delays, and accidents at grade crossings. Elimination can be accomplished by grade separation of the highway and the railroad at the crossing, by relocation of the railroad, by rerouting the traffic, or by encouraging the community to develop traffic patterns that do not have to cross the railroad.

Residents and Tenants of Adjacent Property

Those who live in or occupy the buildings on the property that abuts the railroad track are among the people most vitally affected by the relocation approach to the solution of railroad problems. Noise, vibration, and visual intrusion are the tangible effects of the railroads on these people, but the social stigma of living by the railroad tracks may be equally important as a negative factor. The noise is disturbing to some, although others claim that they get accustomed to the sound and the vibration. The visual intrusion is also something they live with.

Tenants of buildings near the railroad may enjoy lower rents because the property they occupy is seen as being less valuable. Taking the railroad away may be a disadvantage to some stakeholders because the cost of living at that location might go up or pressures to develop the land to a higher use after the railroad is removed may make the economic pressure great enough to force the tenants out. Mitigation of these impacts should be part of the planning program.

Properties abutting the railroad track--whether urban lots near the old location or farms that may be cut across if the railroad is relocated beyond suburbia--often have access problems.

Railroad Users

Railroad users are those establishments that depend on receipt or shipment of materials by rail to operate their businesses. Railroad shipment is often the least costly way of moving their goods. Changing to another mode of freight service (such as motor trucks) would mean higher costs and many of the users could not operate under the burden of these higher costs. Realignments of track that interrupt or remove railroad service to the user will mean that at best he will be inconvenienced during the interruption, and at worst he must move to a new site. Conversely, if realignment makes for more efficient and faster local railroad operations, the user will benefit from faster or more reliable service.

Owners of Property Adjacent to Railroad Facilities

Another group likely to be affected by relocation or by grade separation projects is the owners of the property abutting the old or new right-of-way. Owners of property abutting a railroad that is removed may gain, both from the removal of the damaging effects of the railroad and from subsequent development that is triggered by removing the railroad. Real estate appraisers usually feel that a railroad abutting a property lowers its value, the amount being dependent on the use of the land. Residential land is adversely affected by the railroad more than commercial property, and industrial land may be benefited. Higher valued land may lose a greater proportion of its value than lower valued property.

Tenants and Owners in Other Affected Areas

Even though the effects of a railroad may be most pronounced for those who occupy or own property immediately adjacent to it, those who live or own land further away from the railroad--up to several tenths of a mile--may also experience the effects of changes. A railroad is a barrier to travel and communication in subtle as well as obvious ways. Removing it may mean that patterns of travel in the city, neighbors who are visited, and neighborhood frameworks will change. Conversely, moving the railroad to a new location must be done with care in order to avoid disrupting other established neighborhoods--especially those where there is a strong sense of community brought about by common characteristics (for example, older persons) or common interests (for example, many wage earners employed in one company or industry).

Businesses may benefit or lose from changes caused by grade separation or railroad relocation. Making an area more accessible will mean that a retail establishment in the area gains an advantage over its competitors. Conversely, businesses in neighborhoods where tracks are relocated or where streets are closed may experience less accessibility and thus lose a competitive advantage.

The Community at Large

The community includes all the residents of the area who must share a portion of the cost of the improvement project and who expect to receive a share of the benefits in return. The share of costs borne by the community is usually met by local taxes, although funds from such sources as revenue sharing may be used. If these funds are used, they will obviously not be available for other programs. The benefits expected by the community include improved safety, reduction of irritating delays, improvements in emergency services resulting from better accessibility, a more attractive environment, increased community pride, and improved economic activity that will ultimately lead to a larger tax base (or possibly lower taxes) to cover local government expenditures.

The State and Nation

The states and the nation have interests in resolving the problems associated with railroads in urban settings: (1) preservation of a railroad system and enhancement of the efficiency of that system as a national resource, (2) stewardship of highway taxes dedicated to the improvement of highway travel, (3) preservation of national resources, including federal funds and energy, (4) preservation and improvement of central cities, and (5) commitment to improvement of the quality of life.

IV ORGANIZATION AND ADMINISTRATION OF THE PLANNING PROCESS

The need for a careful and purposeful organization to plan for resolving urban railroad problems is paramount. The extent to which and sensitivity with which a community prepares for decision making and efficiently coordinates the gathering and analysis of information will prove to be critical.

At the outset, two points should be emphasized:

- An organization is established to do something: it should perform work directed toward some end.
- The structure of an organization cannot be derived from universally agreed formulas. Rather, its structure is derived from the nature of the work it is expected to perform.

Perception of the Problem and the Objectives

The extent to which a railroad is or is not perceived as a problem by the community will provide considerable insight into the near term prospects for building an effective organization to solve the problem. Perception is an indicator, although an informal one, of the existence of a problem, and its magnitude may be measured by the sense of urgency that is evident.

For example, community concern over such problems as accidents and delays at railroad crossings, or visual blight associated with a railroad, is commonly expressed in letters and calls to city engineers and elected officials, to the mass media, and in its editorials. As perception in creases, the prospect of the creation of a climate conducive to action also increases. This leads to the next point--once a problem has been perceived, one must ask what are the fundamental objectives of a proposed action strategy. At the outset, it is not imperative for a community or decision maker to try to cast objectives in concrete. Yet it is important for the people concerned to say what objectives are important to them. Simply by articulating their objectives those involved are forced to think carefully about the problem. This process in itself helps to create greater sensitivity about the values, needs, and problems of each stakeholder group.

Organization for Planning

A policymaking and administrative group is needed to organize, coordinate, and direct the planning effort. The duties of the agency are to identify goals and objectives, select and direct the consultants and specialists who conduct the detailed analyses in support of the planning, and serve as an administrative agency for the receipt and disbursement of planning funds. The group should be constituted to include representation of a wide range of stakeholders--as a minimum, relevant governmental agencies, the affected railroad operating companies, areawide transportation planning agency, highway agency, and special interest groups from the community.

The local government representative(s) will not only provide policy inputs from the view of the community government, but will provide access to technical staff support--engineers and planners--for the planning. Government representatives may also provide the channels through which funds to pay for the planning are received and disbursed.

Similarly, a railroad representative from each of the affected operating companies will not only provide protection for the railroad interest but also access to technical support from the railroad company.

The community interest group representatives should be few in number and chosen for their ability to be concerned with policy, rather than with detail of the work.

The planning group, in most cases, should be part of the areawide transportation agency. The group will benefit from legislative sanction by a city, county, or state government if an areawide transportation planning agency does not exist.

The important thing to remember is that the planning agency be a coordinating group that is acceptable to all the stakeholder groups and that it possess not only substantive skills but abilities in the arts of negotiation and compromise.

Commitment to Planning

Managerial skills, administrative framework, and the ability to generate timely and thoughtful analyses that aid decision making are all important to developing a unified planning program. However, before any managerial or administrative talent can be successfully utilized, there must be evidence in the community of a commitment to effectively deal with the problem(s) of railroad facilities in urban areas. It is not particularly important for designated persons or entities to be the ones who are committed--what is important is that commitment exists and can be easily identified. Thus, the initial commitment may be found in the City Council, among city staff, in local service organizations/citizens groups, or elsewhere in the community. The point is that a railroad in an urban setting is more than a technical problem--it is a community-wide issue of significant magnitude.

Citizen Committees and Community Participation

Community participation has emerged over the last decade as an essential aspect of the planning process. This is a process by which the community as a whole can have some control over its destiny and such participation is a legitimate exercise of power by citizens as well as a way of bringing together many resources to confront problems.

A few guidelines applicable to citizen participation may help to ensure the establishing of a viable citizen group within planning:

(1) The role of the group should be clear to all concerned. If the group is to be advisory only, this must be clearly articulated at the outset.

(2) The citizen group should be established very early in the planning process. To wait until relocation planning is well under way is to invite unnecessary problems and controversy.

(3) While citizen committees and participation are an important part of the overall process of planning and decision making, in the final analysis it is the elected public officials, usually the City Council, who will be held accountable for the project.

(4) A citizen group should interact with the coordinating agency, the local city staff, and consultants retained to bring special technical abilities to bear on the problems. Joint meetings should be carefully planned and purposeful.

(5) A citizen group must include both high level and grassroots representation. It must reflect the concerns of all major stakeholder groups in the community.

The Iteration Process

Planning is almost always described as a linear process with discrete steps or tasks to be completed along the way. Steps frequently listed are:

(1) Establish goals and objectives

(2) Collect relevant data

(3) Analyze conditions

(4) Recommend alternative solutions to the problem

(5) Select the most desirable alternative

(6) Implement the selected alternative

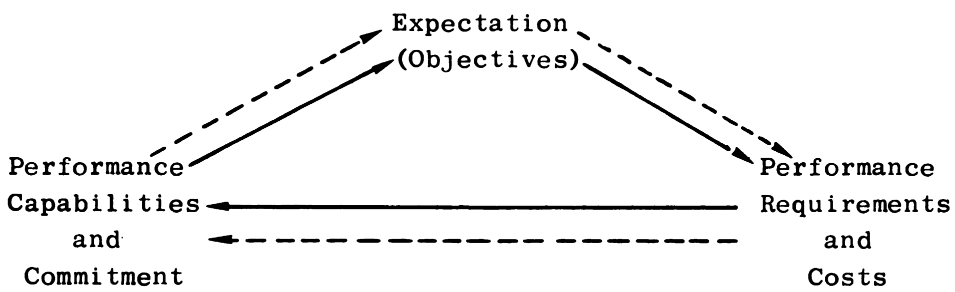
(7) Evaluate the action taken.

It should be remembered, however, that discussion of planning and implementation as a linear progression from one step to another may simplify the description of the process, but is not the way planning is actually carried out. Experienced planners will recognize that the process of developing a plan is iterative; that is, tasks are done in shallow detail, then repeated in more detail as a result of what was learned from the previous pass. If this iterative process is not followed, difficulties are encountered, particularly in the collection of relevant data. This activity is usually very time-consuming and frequently disappointing as to the quality of material obtained. Furthermore, it often prevents sufficient attention to decision making.

The iteration process is initiated with a minimum of data and yet it allows the utilization of data collected later on in the process. It is based on the view that planning is a cyclical phenomenon that basically involves successive reviews of:

- Expectations (objectives)
- Performance requirements and costs
- Performance capabilities and commitment.

Each review or iteration examines these elements in light of what is known at the moment, what the operative assumptions are, and identified constraints. The iteration can be visualized as follows:



Preliminary Assessment

In urban railroad improvement planning, an early round in the iteration process can result in an adequate preliminary assessment; that is, the expectations, performance requirements and costs, and performance capabilities and commitment can be roughly determined, documented, and assessed in a minimum amount of time--two to six weeks. The keys to a successful preliminary assessment are to resist the temptation to seek and analyze large amounts of data at first, and to be willing to be somewhat bold in making judgments and assumptions. (Guidance for making preliminary assessments is presented early in Part II of this guidebook.)

The preliminary assessment step is used to help determine whether a community wishes to invest in a full-blown planning study. It should also help to frame the problem in a way that provides insight into the various dimensions of railroad relocation. If the initial iteration reveals high costs, suggests minimal benefits, and holds unacceptable implications for stakeholders, then a community may choose to live with the current problems associated with the railroad. In such instances, techniques short of relocation or consolidation--such as grade separation and buffering--may be pursued.

Initiation of Plan Development

The preliminary assessment will provide the necessary information and support for the community to apply for whatever planning assistance is available. A work plan for a full-scale planning study should be drawn up that incorporates the steps in the planning process just described, which in practice would be carried out in an iterative way according to the guidance presented in Part II.

The Role of Consultants

One aspect of railroad relocation that sets it out as a special urban planning problem is the large number of specializations required to develop a workable plan. The list includes:

- Business, finance, and economics
- Engineering
- Legal
- Urban planning
- Railroad operations
- Transportation
- Traffic
- Urban design.

Few firms or agencies have expertise in all these fields. A team of specialists, with professional respect and compatibility, is needed to assure that a high quality plan is produced in the time constraints. Local jurisdictions may wish to provide some of the necessary expertise by assigning certain staff to the planning team. The team should be led by a manager with a successful record in the management of complex planning projects, and expertise in one of the technical specialties.

Management of the Detailed Study

As discussed in Part II, there are a number of technical tasks that should be completed in order to develop meaningful alternative solutions to the problems associated with railroads in urban settings. Many of the analyses require substantial data gathering. As already noted, it is important not to become so bogged in detail that the overall objectives are lost. At the same time, since project costs are likely to be so high (regardless of whether there is a complete relocation or consolidation, or a simpler solution such as more grade separations) careful studies and evaluations must be made to determine whether the project is worthwhile overall--in nonquantifiable terms as well as financial terms.

To find a reasonable balance between the details necessary to develop a fine-tuned cost-benefit analysis and the constraints imposed by manpower costs requires competent management and judgmental skill. In addition, since there will be a number of diverse disciplines involved in the detailed planning, it is important to have managers (one from the community coordinating group and one from the technical consulting group) who can work well together and who understand the constraints of their groups. A successful study--one which examines all the alternatives in a thorough and workmanlike manner--is one during which all parties respond to each other in a productive manner. This can be a particular problem with the railroad users and the railroad companies who may feel threatened and, therefore, the highest negotiating skill must be applied to ensure their timely response.

Consideration of Concept Alternatives

Once the groundwork for planning has been laid, a specific plan for each alternative should be prepared. These plans of the possible solutions to the railroad problem should be described in graphic form if appropriate. At this stage of the planning effort, the alternatives should include assessments of their impacts on the stakeholders and the community as a whole. These impacts may be both favorable and unfavorable; the solution that balances cost and favorable impacts while minimizing the unfavorable impacts should normally be selected.

Selection of Plan and Techniques for Implementation

One of the criteria for choosing among the alternatives will be the ease or difficulty of implementing that particular solution.

The analyses carried out in support of planning will have described solutions that are physically possible and will have forecast the economic and social impacts of the alternatives. The economic and political feasibility of the project will be evaluated from these impact assessments. It is important that it be made clear to everyone what the plan will accomplish as well as what problems are not solved by the plan. It is at this point that the real community commitment is made: to go ahead with detailed phases of the project, to look for other alternatives, or to go on living with the present problem. If the decision is made to go ahead, the planning organization may have to be restructured, detailed designs of the chosen alternatives will have to be made, and final cost estimates suitable for funding applications will have to be made. Final, detailed planning will in all likelihood be implemented through a legally constituted government agency empowered to apply for federal assistance. This group could be an existing agency such as the City Council or Council of Governments, or it could be a new district created solely for that purpose. In either case, a full-time executive director will probably be needed during the final stages of planning.

The powers and responsibilities of the agency must be tailored to the conduct of the project. Among the powers that may be considered for the agency are the condemnation of property and levy of taxes.

V DOCUMENTATION OF PLANNING RESULTS

Railroad relocation planning programs require special attention to communication. This includes the preparation of appropriate graphic and written materials for a variety of purposes and audiences. Consideration of this aspect of the project must begin at the outset, with an adequate budget allocated.

Few of the documents prepared to date for relocation studies have adequately portrayed a meaningful picture (either graphically or narratively) of the alternate approaches to problem solution. The methodology for analysis is presented in subsequent sections of this guidebook; the presentation of the results, as described below, is necessary to complete the process.

Audiences

Railroad planning, like other urban proposals, must be presented and "sold" to a variety of advisors and decision makers. These include citizens, technical personnel, local officials, elective representatives, and state and federal agency officials. In addition, in many cases, certain of these individuals act as administrators of legislation which in turn requires the submittal of documentation. Thus, it is quite likely that at minimum, the following materials would have to be prepared:

(1) Fund applications (for development and implementation)

- (a) State agencies
- (b) Federal agencies

(2) Environmental impact statements

- (a) National Environmental Protection Agency
- (b) U.S. Department of Transportation
- (c) State requirements

(3) Interstate Commerce Commission (e.g., abandonment petitions)

(4) Public information reports

(5) Forms for U.S. Department of Housing and Urban Development

(6) Local forms (e.g., zone change applications).

Text, graphics, and presentation aids (e.g., slides, models, and panel boards) should be prepared with the thought of using them for diverse audiences and purposes. Technical material should always be handled in a manner that is understandable to all interested parties--not just kindred professionals.

Graphics

It is difficult to portray a subject that is linear in character and narrow in dimension, the typical shape of areas affected by railroad relocation projects. This is particularly true when several railroads are involved and several alternates are under consideration. The range of possibilities is numerous, and it is easy to "get off the track" or find oneself in a complex array of tracks, literally as well as figuratively speaking. One problem is that planners do not recognize railroad company names--not to mention the traditional use of nicknames and initials to identify them.

Since great importance is placed on highway and land use conflicts in relocation planning, great care should be used in showing these interrelationships. While engineering drawings are vitally necessary for the analysis, they are of little use in presenting the impact of the study. Both positive and negative impacts should be illustrated. When working at a relatively small scale, right-of-way dimensions (both railroad and highway), street names, land uses, parcel lines, easements, topography, and new prior commitments (e.g., a proposed new city hall) should all be noted or made easy to scale off where budget permits; color coding should be liberally used.

The graphics on the following pages were used in studies recently completed. Figure 1 illustrates the entire scope of a proposed relocation in Lafayette, Indiana, with numbered sites that were described in detail. In another study--for Wheeling, West Virginia--reuse potential for land (see Figure 2) was a critical issue. Figure 3 illustrates one possible redevelopment alternative.

It is important to keep in mind that the objective of drawings and other graphics is to convey information and ideas, not to be beautiful for the sake of art.

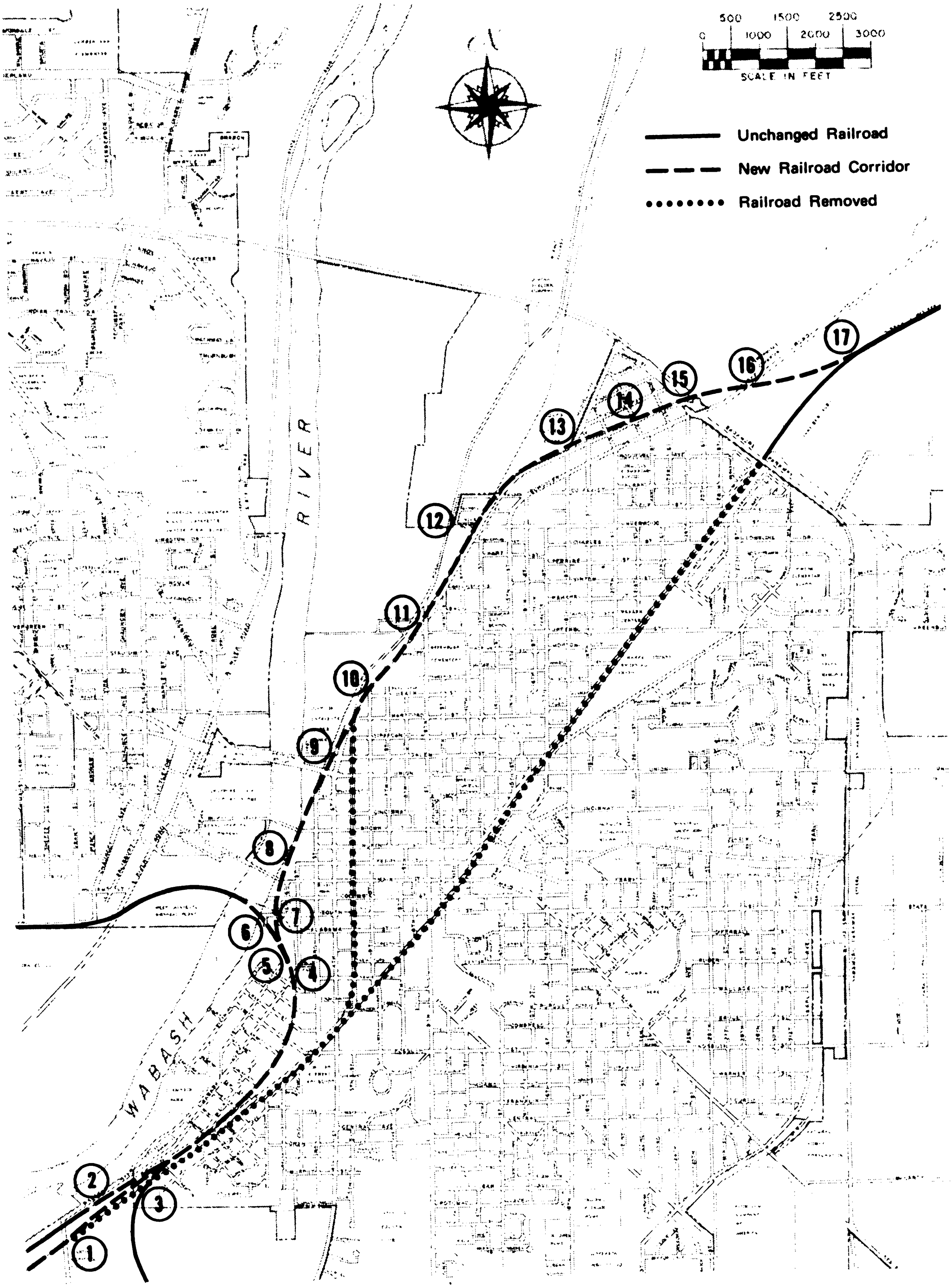


FIGURE 1 PROPOSED RIVERFRONT RAILROAD CORRIDOR

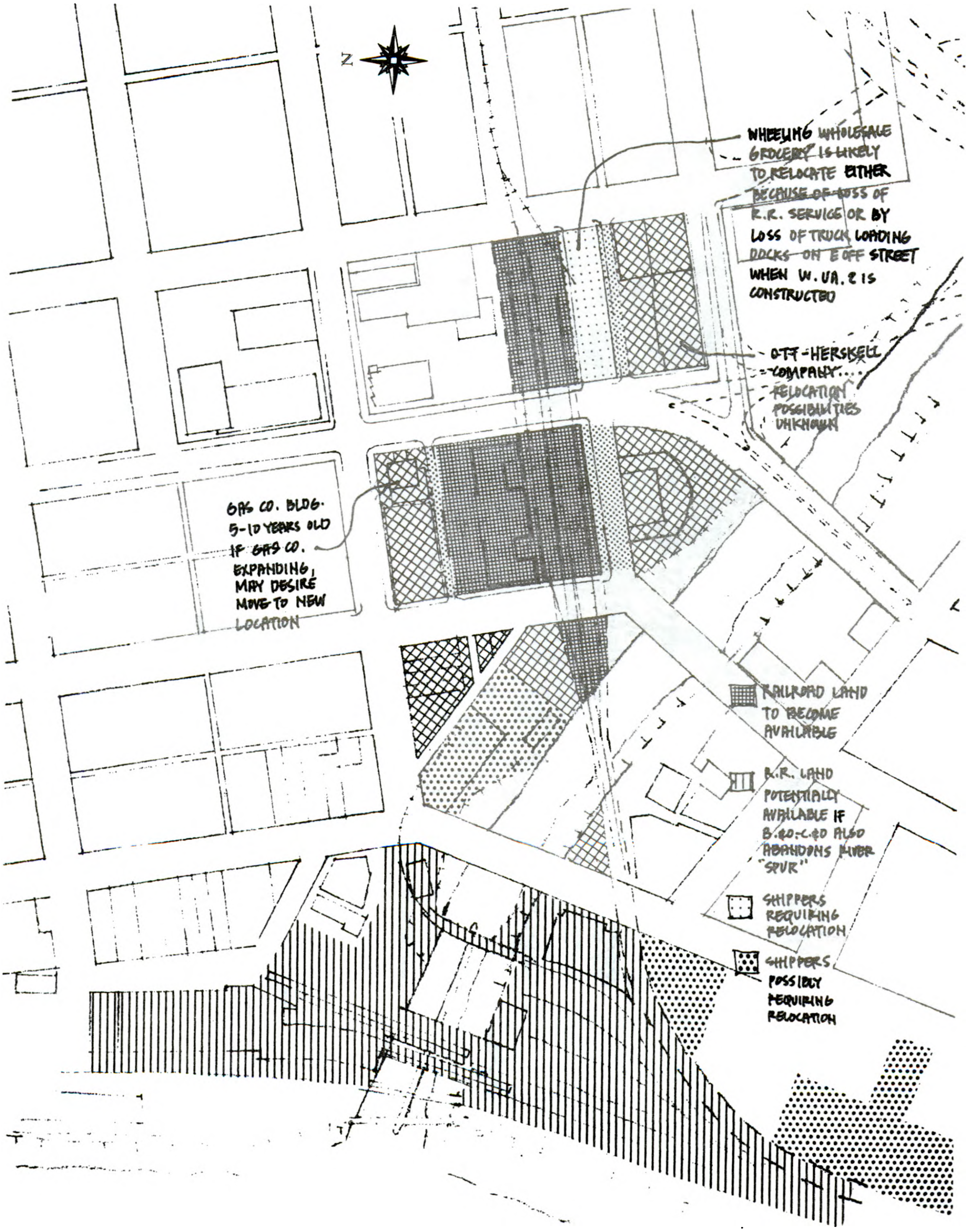


FIGURE 2 LAND AVAILABLE FOR POTENTIAL REDEVELOPMENT

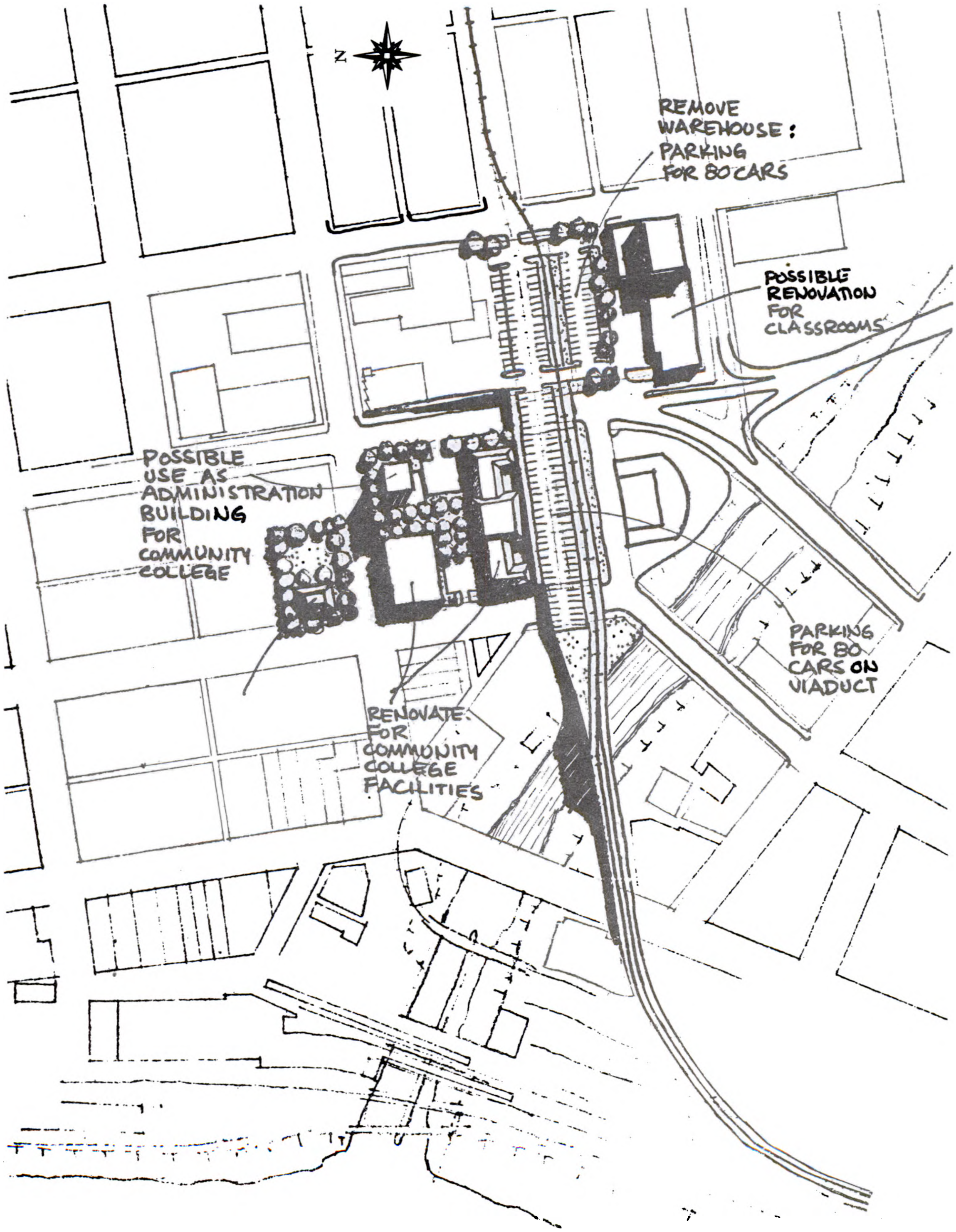


FIGURE 3 POSSIBLE USE OF VIADUCT BY RAILROAD AND FOR PARKING

Part II

ANALYTICAL SUPPORT FOR PLANNING

VI OVERVIEW

Part II of this guidebook is designed to aid members of community planning and engineering departments and other specialists who may be brought into the planning for resolution of railroad location problems. For the first group--community planners and engineers--there is a two-fold purpose in familiarizing them with the analytical processes that support planning:

(1) So that they can prepare a preliminary estimate of costs and other impacts for the decision on whether to proceed with a full and detailed planning study.

(2) So that they can effectively select specialists as consultants to assist in a full planning study, and monitor the progress of the specialists.

This part of the guidebook will also help the consulting specialists and analysts other than the community planners and engineers to measure the impacts of alternative solutions to the railroad problems of the community in a consistent way, and to prepare the results for presentation to the community.

Preliminary Assessment

A full planning study requires a substantial commitment on the part of the community and there should be indications that the planning will result in a project which will alleviate some or all of the problems associated with railroad location. The decision makers will need to know the approximate cost of several alternative approaches to alleviating the problems, and the approximate size and distribution of the benefits. The knowledge of costs and benefits is important to the federal government in deciding whether to fund a full planning study, and to the community in estimating the amount of such outside help it might get in financing the study. The preparation of the preliminary estimate requires a familiarization with the local railroad system, identification of potential solutions to alleviate the problem, and the estimation of costs and impacts of the alternatives.

Familiarization with Railroad Operations

To provide familiarity with railroad operations at the local level, Section VII of this part of the handbook shows the type of information the community planner/engineer needs to acquire in preparation for subsequent analyses in the preliminary planning stage.

Identification of Alternative Solutions

Having identified the functions and the operations of the local railroad system, the planner must identify the potential solutions to the problem. It is important to state clearly and rank the objectives to be accomplished in any proposed course of action as a first step in identifying alternative courses of action and screening them. For example, is the primary objective to improve traffic flow, to reduce accidents, or to catalyze community development? If the emphasis is on traffic flow improvement, perhaps railroad relocation might be compared with grade separations, or perhaps a general improvement of the arterial street circulation might produce comparable results. Safety might be enhanced by improving marking and warning at grade crossings as well as by relocating railroads or grade separations. Community development might be accomplished by redevelopment projects as well as by relocation or grade separation of railroad grade crossings to improve accessibility.

The planner will be interested in the range of opportunities, so should look for a modest, moderate, and comprehensive approaches to the problem:

- Modest approaches may include improvement of warning devices at grade crossings where accidents are especially bad, together with a grade separation at an especially heavily-traveled street.
- Moderate approaches include more grade separation projects, together with rerouting short sections of the railroad, if the opportunity presents itself.
- Comprehensive approaches could include extensive relocation and/or consolidation of tracks and facilities, together with grade separations at critical points of the revised railroad system.

Discussions with the railroad and with parties in the community will be necessary to identify these alternatives.

Estimating the Cost of the Alternatives

Once the general nature of the potentially best alternatives is defined, the planner can use Section VIII as a basis for roughly estimating railroad construction costs if any of the alternatives would require such construction. He will also need to consult with state and local highway departments for guidance in estimating costs of highway improvements associated with the alternatives.

Estimating Impacts

Guidance for preliminary impact assessment is presented in a companion document.

The impacts of the alternatives that have been tentatively selected should be identified in terms of the goals and objectives that have been established at this stage. The major impacts on the various stakeholders should be estimated in a preliminary way--the costs, savings, and other impacts on railroad operating companies, the impacts on railroad users, the impacts on highway users, and the impacts on neighborhoods. Certain cost factors relating to railroad operations and highway users are provided for use when specific community data are not available.

Planners should keep in mind the ultimate requirement for preparing an environmental impact statement, although it is not anticipated that it will be a requirement in applications for funding of detailed planning.

Preliminary Evaluation

The preliminary evaluation should be based on the procedure described in Section XV although, for this first evaluation, certain data may not be available and certain steps may have to be ignored. In this evaluation, dollar values of project costs are compared with estimated monetary benefits, and other advantages and disadvantages are identified and quantified to the extent possible.

At some point in the plan development, which is described on the following pages, refinements that will increase the benefit or reduce the cost of the project will lead to more precise definitions of the alternatives identified in the preliminary evaluation.

Conduct of Plan Development

Professional specialists will enter the planning process after the preliminary assessment has been accomplished. This preliminary assessment, and the evaluation of the results in the decision to proceed with planning, will provide the specialists (and the community technical staff who will continue to be involved in the plan development) with some guidelines on the size of the project the community expects to undertake and the expectations of the community. The specialist team will be responsible for identifying further opportunities to meet the objectives of the community, for describing and estimating the cost of selected alternative solutions, providing information to help identifv the impact of the alternatives on stakeholders, and for presenting this information in a meaningful way to the officials and members of the community who must make decisions about the railroad project.

Identification of Potential Solutions

Good professional practice includes a continuous evaluation of alternative solutions to the problem at hand. The preliminary investigation should have identified all the opportunities within the range of the resources of the community for meeting the community objectives. The planner may wish to begin by classifying the alternatives selected for detailed analysis into conceptual solutions and analyzing these groups of approaches to find the most attractive. For example, in Springfield, Illinois, studies were conducted on three concepts: consolidation of existing rail lines within the city, construction of a new rail corridor close to the existing city boundaries, and relocation of the rail facilities to a rail corridor at a greater distance from the city. The concepts were analyzed from the standpoint of railroad operations, topography, and fulfillment of the city's objectives. This kind of concept analysis appears to be useful in the identification and development of specific routes for further analysis. In Lafayette, Indiana, two alternative routes were selected for detailed study as a result of such a concept analysis. One of the corridors was initially rejected but it was later reinstated with a new design as a depressed, rather than elevated route. This illustrates the importance of examining alternatives within the concepts in order to fully explore the potential of the concept.

As the description of alternative solutions progresses through a process of iteration, the level of detail of the analysis will become greater. Lafayette provides an example of a feasibility analysis of a riverfront corridor. Three factors were considered: railroad design criteria, space for a highway grade separation at a major river crossing, and the environmental impact of the railroad on the riverbank. The railroad would have to descend into a cut to pass under a major bridge and to be unobtrusive at the water's edge; hence the railroad design criteria of maximum grade and curvature and the desired freedom from interruption of operations because of high water were governing factors from the railroad standpoint. The railroad would cross the approaches to a major new highway bridge in the new corridor, and the location and type of grade separation at this crossing were important to the feasibility. Finally, the effect of the appearance of the rail facility at the river's edge on the value of properties with riverfront views and frontage were also considered in the detailed analysis and evaluation.

Conflicting principles govern the number of alternatives that can and should be selected for analysis beyond the concept stage. On the one hand, the cost and time needed to describe and evaluate the alternatives from this point forward is significant. On the other hand, the wider the range of alternatives that is analyzed, the less likely it is that the best one for the community as a whole is overlooked.

To minimize the possibility of pursuing an alternative that contains some flaw, discussions should be held with responsible community officials and neighborhood representatives before making the final selection of alternatives for detailed study.

Physical Description of Remaining Alternatives

Once the preliminary and conceptual screenings have been accomplished, the alternatives retained for further study need to be described well enough that their capital costs can be estimated and their likely consequences projected with some confidence. In general, the description of each alternative will include a plan and profile of the proposed railroad changes, and capital cost estimate for each of these changes, and a description and capital cost estimate for the changes required to other facilities, such as the street and highway system and utilities.

To accomplish this descriptive step requires application of good engineering design and cost estimating practices. It should be noted at this point, however, that a complete engineering design is not yet needed to compare the alternatives unless it is determined that the feasibility of an alternative hinges on detailed engineering study, or that the cost of the alternative could change radically with a design change. But in most cases, typical sections of the route and required structures are identified, and costs are estimated according to the consulting team's experience with similar structures. Only when a choice has been made from among the alternatives will detailed design of the project be prepared and final cost estimates made from the detailed design.

Guidelines for estimation of capital costs are presented in Section III. These guidelines contain general estimating factors as well as detailed cost factors for various components needed to design a new or revised railroad cross section. Highway-related construction costs can be estimated by qualified professionals from available state and federal sources.

The value of land used for rights-of-way must be included in estimating railroad and highway construction costs. Section XI contains short and general discussion of land values but again, professional appraisers on the consulting team will normally provide the detailed estimates needed.

Measuring the Impact of the Alternatives

The final two steps in the analysis process--measuring the impacts of the alternatives and evaluating the alternatives--are closely related, since the measurement must be directed toward generating data that are useful for the evaluation. Because the evaluation is concerned only with differences in impact, the techniques used must be dependable for measuring differences rather than absolute magnitudes in the values of the impacts. For example, Section XI of this guide for planners includes a procedure for computing the cost of operation of vehicles and delays to occupants at all of the grade crossings in a community but, in the final analysis, only the costs at those crossings that are somehow modified by one of the alternatives will be important, and thus costs at the crossings not affected need not be considered

Because there is this emphasis on comparison, one of the alternatives that must be analyzed and described in terms of its impacts is "no change," i.e., no action toward improvement of the railroad situation is undertaken. This base case, or "alternative 0," is included in some of the computations to facilitate the comparison of the remaining alternatives.

Measurement implies a numerical result, and the object is to achieve such a result wherever possible. Dollars should be used as the measurement unit to make the judgment on trade-offs easier. However, some things can be measured that are not easily valued in dollars--numbers of households disrupted in a neighborhood, pounds of pollutant emissions reduced, and similar counts. Finally, some of the impacts can be described only in general terms--visual improvement, effects of removing a psychological barrier, and so on. For convenience, the impacts that can be expressed in dollars are called "costable"; those that can be counted but not valued in dollars are called "quantitative"; and those impacts that cannot be assigned any numerical value are designated as "qualitative."

Often it is better to describe an impact as favorable or unfavorable than as a cost, cost saving, benefit, disbenefit, and so on. The latter terms are not widely used and may be confusing.

The measurements of impact of community railroad improvements on the stakeholder groups are discussed in subsequent sections. Because many of the measurement techniques are closely related, these sections cannot be precisely separated by stakeholder group but the match is fairly exact, as the list below shows:

Stakeholder	Guidebook Section	
Railroad operating company	IX	Railroad Operating Company Impact
Railroad users	X	Railroad User Impact
Highway users	XI	Highway User Impact
Tenants and residents of property near the railroad	XII	Neighborhood Impact
Owners of property near the railroad	XII	Neighborhood Impact
Tenants and owners of other property affected by the railroad	XII	Neighborhood Impact
Community as a whole	XIII	Community Impact
State and nation	XIV	State and National Impact

Final Evaluation of Alternatives

The final evaluation, the last step in the detailed planning, prepares the impact measurements developed in the analysis for the community as a whole to analyze and express its preference for one alternative. The evaluation process is an organized way of listing the costs and other impacts of the alternatives in such a way that representatives and other citizens of the community can relate the effect of the various alternatives to their own experience and participate in the process of adopting a plan of action.

Two formats for the evaluation are recommended: (1) a benefit-cost analysis that examines to the extent possible all the costable and other impacts so as to determine the overall feasibility of the alternatives, and (2) a descriptive analysis that presents the principal differences which the various stakeholders may experience so as to prepare for allocation of costs in the alternatives. The benefit-cost analysis accounts for the timing of the project so that the return for each dollar invested in the various alternatives can be compared. Details of these evaluation procedures are presented in Section XV of this guidebook.

Most of the example worksheets in all the sections of this guidebook relate to the railroad problem in Lafayette, Indiana. In some instances, numbers have been changed slightly to clarify the procedures. The Lafayette problem with its railroads is described, with the alternative proposed solutions, in Appendix A.

VII UNDERSTANDING RAILROAD OPERATIONS

Whatever the stage of the railroad planning study for a community--preliminary analysis, screening of alternative solutions, or detailed descriptions of alternatives--an understanding of railroad operational requirements and the effects that altering the system will have on operating costs is essential. In some studies the analysis that leads to this understanding is called an inventory of local railroad facilities, but the term "inventory" is misleading. The essential point is that railroad operations must be understood--not that every last foot of unused spur or each rusty spike is counted.

The railroad operations within a given urban area are a reflection not only of local factors but also of railroad operations hundreds or thousands of miles outside the local sphere. The portion of a railroad line within the area cannot be considered separately from the balance of the system of which it is a part. However familiar the planner may be with local matters, he also requires much additional information about the role of local railroad line segments as parts of larger systems. This "system" view of railroad operations is absolutely essential for the development of rational relocation and consolidation alternatives. Furthermore, many members of the planning team will not ordinarily be in possession of all the technical details of local railroad operations.

For these reasons, it is essential that the planners open up effective lines of communication with the involved railroads. The importance of communication channels that really work cannot be too highly stressed.

In many cases, the appropriate officer of an affected railroad to contact is the division superintendent. He has direct responsibility for operations, and will in addition generally have some authority over such diverse functions as public relations and traffic solicitation. When a relocation study reaches a moderately advanced stage of preparation, many other railroad departments will enter the picture: law, traffic, real estate, etc. Usually, the planners should deal initially with the division superintendent and his immediate assistants in operations and engineering. However, it is important that higher level officers of the railroad organization be brought into the planning process as soon as important decisions are to be made.

Information Required

Assuming that reasonably detailed maps are already available to the urban planner, the minimum additional information required from the concerned railroads is as described below.

All Train and Engine Movements, Including Switching

Both average and peak values should be determined for the frequency, speed, direction, tonnage and/or length, and type of all train and engine movements over all routes and route segments within the study area. It is also beneficial to know the anticipated rate of increase or decrease, if any, in traffic on the line. The percentage of "private" versus railroad owned cars in route movements should also be determined.

Included in "type" of movement is through freight, local freight, Amtrak, commuter, and switching.

Separate compilations are required for each segment of line between points where the size, number, or character of movements changes significantly, such as junctions, yards, terminal stations, and so forth.

Worksheet RO-1 can be used to tabulate train and engine movements on a particular segment.*

Destination or Purpose of the Movement

In addition to the above data, it is helpful to have narrative backup information on train and engine movements; e.g., the morning switch move is to deliver cars to XYZ Manufacturing Co., the noon move is to pick up cars from an interchange with another railroad, the long heavy coal "drag" coming through about midnight is a low priority movement, and so on. Additional information on delays (e.g., frequency, duration, location) or other special operating considerations should also be sought.

System Function of Each Major Railroad Facility

It is essential to know, for example, which yards are used to receive and dispatch trains to and from particular routes, and which yards serve primarily to support local industries. The same understanding of purpose

*The RO worksheets appear at the end of this section, starting on p. VII-9.

should be sought by the planner with respect to depots, freight houses, major bridges, and all other major elements of fixed railroad plant.

Physical Nature of Each Line

Suggested minimum data on each line within the study area are:

- Number of main and side tracks.
- Spacing and length of passing tracks and crossovers between main tracks.
- Weight of rail (in pounds per yard).
- Maximum allowable speeds for freight and passenger trains.
- Relative amount and maximum degree of curvature and its effect on permitted speed.
- Controlling gradients in each direction.
- Amount of Rise and fall.
- Type of signaling.
- Features inhibiting greater or better use of the line such as clearance impairments, bridge weight restrictions, and frequent grade crossings.
- General state of maintenance of the line.

A possible tabulation form for this information is shown in Worksheet RO-2.

To facilitate future analyses and comparison of alternative plans, the railroad corridors, line segments, using railroads, major facilities, etc., may be coded in some standard format acceptable to the planner. This physical inventory should be converted to maps/diagrams of the existing rail network in sufficient detail for working purposes.

On- and Off-Duty Points for Classes of Employees

This information is needed particularly for yard and switch crews and, if they are changed locally, for through train crews. The limits within which yard crews instead of local train crews perform industry switching should also be determined for the purposes of costing switching moves.

Local circumstances will usually suggest additional types of information which should be elicited from railroad operating officers. Such additional information might include: specific information as to condition of major structures, description of specialized operations (helper engines, run-through agreements, nature and extent of unit train and jumbo car movements etc.), and the general impact of local climatic conditions upon study area operations.

All the above background information should be accumulated in a series of interviews timed to allow the planner to assimilate the material gradually and modify his techniques so as to maximize the exchange of useful information. When complete, the background information will be sufficient for the planner to formulate a notion of what railroad operating changes may result from each aspect of the proposed alternative. If the planner is uncertain of the probable effect of a proposed change upon railroad operations, he is not ready to evaluate the costs and benefits of that change.

Combining the Information

At this stage map data and general knowledge of the study area can be combined with the information described above to give the planner clues for further developing his understanding of the existing and potential future railroad plant. The planner should begin to consider the need for each piece of apparently redundant railroad trackage and question its proprietor. This calls for considerable insight and exercise of independent judgment. The planner must take responsibility for drawing tentative conclusions in a field where he is relatively inexpert, and they "try them on" for correctness. Railroad companies may retain much duplicating trackage largely because they cannot agree with other lines or other interests on how to share costs and benefits and/or provide satisfactory alternate facilities. One of the planner's primary roles is to facilitate such agreement. On the other hand, there may be an obscure but valid reason for retaining some apparently-unneeded trackage. The planner should seek out the obscure reasons for doing things.

A railroad officer may offer a mixture of valid and invalid reasons (invalid to the planner) in the course of an interview. The planner should encourage a high credibility standard--he should question alleged "facts" until they are established as such--and retain complete flexibility. The planner must ask questions until he uncovers what is probably true, and be prepared to accept it.

A First Use of the Information: Checking Adequacy of Proposed Railroad Plant

An important step in understanding the railroad operating environment is to feed back what has been learned about it into the proposed alternative. The planner's newly-acquired information affords an opportunity to improve the workability and salability of the entire relocation or consolidation project.

If a consolidation is proposed, the feedback process should include an appraisal of the ability of tracks and yards within the study area to absorb additional activity. However, there are no absolute rules for establishing the capacity of a railroad facility. Determining that facility "A" could probably absorb the activity of facility "B" may be judgmental, or may be made by one of several simulation techniques.

If capacity estimates are made solely upon judgment, the planner is obliged to rely heavily on the railroads' opinions. Often a railroad estimates its capacity slightly low, while planners with other viewpoints may judge the capacity of a line to be higher than it actually is. Perhaps the wisest course is to obtain an opinion from several railroads, e.g., the prospective host line, prospective tenant line, and one unaffected line. Knowledge of the traffic load handled by other similar lines may assist the planner in appraising the ability of one facility to absorb others.

Simulation of railroad operations by computer is often fruitful and, in the hands of experimenters familiar with simulation, not particularly difficult. Simulation is suggested as a technique for assessing the workability of railroad relocation proposals, particularly from the standpoint of plant capacity and elimination of possible bottlenecks from the proposed network. Simulation is of greatest benefit where a plan is relatively complex.

A simple form of simulation has been used by railroads for decades in working out scheduling and capacity problems. This technique is called "redispatching." It consists of taking all the data about train operations for a given past period (perhaps a busy week), assuming the proposed change had been in effect, and then graphing the progress the trains would have made through the network under study. A graph of time versus distance is made, and each train's progress is represented by a line--diagonal while it is moving, and horizontal when stopped for whatever reason. Figure 4 is a sample redispatch graph. Such a graph clearly shows up such problems as a faster train blocked by a slower preceding train, insufficient sidings for meeting opposing trains, and other capacity-related

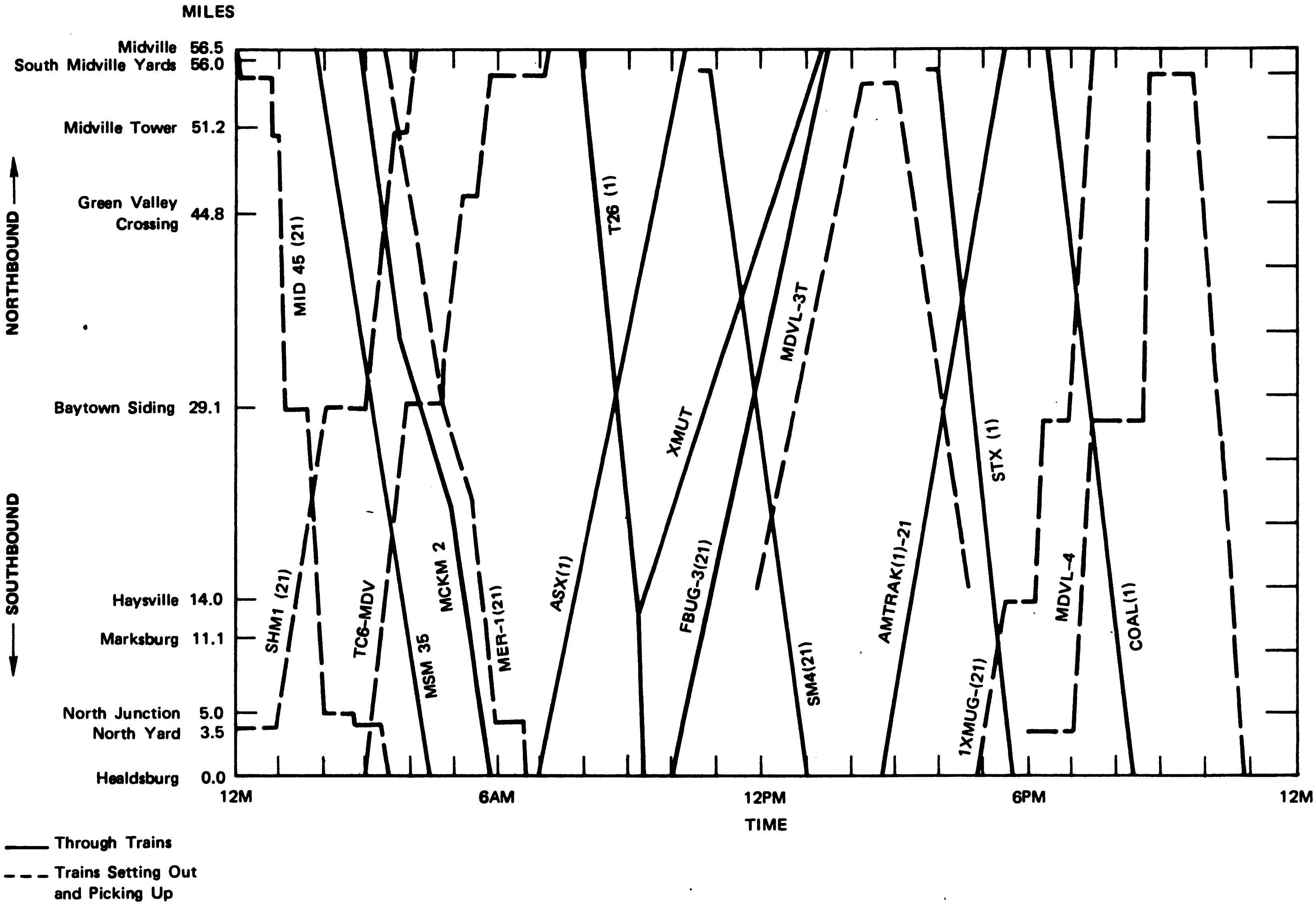


FIGURE 4 TRAIN REDISPATCH GRAPH

problems. Changes in operating time resulting from alternative network plans are also determined from this procedure.

The planner should be in possession of sufficient information to make a redispatch of operations on each line in his proposed network. It is suggested that he do so for all line segments likely to be critical from a capacity standpoint. This will serve to test both the adequacy of the planned network and the completeness of the planner's understanding of the railroad operations involved.

The ease with which a facility can absorb operations displaced from a retired facility will depend on the type as well as the degree of use. A switching line without proper signals would strangle with the addition of even a few high-speed through trains. Likewise, industry switching from a line handling frequent high-speed commuter trains is undesirable.

In general, a double-track line will handle somewhat more than twice the traffic volume of a single-track line since it eliminates the slowing and stopping at sidings for meets with opposing trains. However, trains operated at different speeds in the same direction may interfere with one another on double track.

The type of signaling as well as the number of main tracks helps determine line capacity. Block signaled track may have about 50 percent more capacity than unsignaled track, and centralized (remote) traffic control may increase capacity by an additional 50 percent under suitable conditions.

An adequate number of suitably long passing tracks at convenient intervals is essential to obtain best use from single track. Double- and other multiple-tracks should have crossovers at intervals consistent with the type of signaling used to maximize capacity potential.

Signal spacing and number of signal aspects may have some effect on capacity and maximum permissible speed. Short intervals between successive signals, as used to permit close headway for light and easily-stopped commuter trains, are inadequate for long, heavy freights, and the latter would have to traverse such stretches at much lower speed, possibly causing congestion. Some railroads have used four-aspect signals (flashing yellow, for example, in addition to steady yellow) to give additional steps in the speed-restriction scale indicated by the signal system. Such a system tends to permit heavy trains to operate at higher speeds.

The capacity of a yard is frequently determined by the design of its key approach and connecting trackage, rather than total car storage room.

A yard functions properly when it sorts cars and builds trains, not when it stores cars. Efficient functioning of a yard requires:

(1) Adequate (in length and number) approach and connecting tracks at and near entrance and exit points to permit simultaneous, noninterfering arrival, departure, sorting, and transfer of trains and groups of cars. Several engines may have to work at each end and should not obstruct one another.

(2) Sufficiently long tracks to permit receipt or makeup of trains of economical length without doubling two or more tracks, or handling outside the yard and thus blocking connecting tracks.

(3) A sufficient total number of tracks (some of which may be short) to permit assignment of one track to each outbound destination area for which efficient train makeup requires an individual sorting. Tracks are also required for sorting cars for other reasons, such as repairs, weighing, and storage.

Worksheet RO-1

TRAIN AND ENGINE MOVEMENTS ON A RAILROAD LINE SEGMENT

1. Railroad L&N 2. Line Segment from 10th St. to LAFAYETTE JCT. 3. MP 118.8 to MP 121.3

4. Interview with MR. CLAY WHIDBY 5. Title ASST. SUPT. 6. On (date) 1/25/74

7. General Description of Line:

ST. – ABS

8. Typical Daily Train Data:

Switch or Freight	Time (A or P)	Direction	Loads/ Empties/ Tonnage	Origin/ Destination	Length (feet)	Number of Locomotive Units	Speed or Schedule	Remarks
FREIGHT	12:40A	NB	90/NC/5000 AVE.	LOUISVL/SO. HAMMOND	NC	4 RD. UNITS	FAST FREIGHT	
FREIGHT	3:30A	SB	85/NC/5000 AVE.	SO. HAMMOND/LOUISVL	NC	4 RD. UNITS	FAST FREIGHT	
FREIGHT	6:00P	NB	12/NC/600 AVE.	LAF./BAINBRIDGE/LAF.	NC	1 SW	LOCAL	
SWITCH	8:00A	SB	20/NC/800 AVE.	MONON YD./LAF. JCT./IND/MONON YD.	NC	1 SW	TRANSFER	IND/INTERCHANGE

(ETC.—CONTINUED)

9. Other Information Supplied by Interviewee:

4-6 THRU TRAINS AVE.
2 LOCAL " "
4-6 SWITCH ASSIGN AVE.

TRAIN SPEED 10 MPH – 5th ST.
L&N/N&W INTERCHANGE AT LAF. JCT.
INTERLOCKING RULES IN EFFECT, LAF. JCT.

LAF. A TRAIN ORDER OFFICE.
L&N OPERATIONS STABLE YEAR-ROUND (SOME INCREASE IN COAL EXPECTED).
NO CUSTOMERS IN STUDY AREA.
ALL TRAINS YARDED AT MONON YARD.

DATE: 1/28/74 INITIALS: JCD

Worksheet RO-2

PHYSICAL CHARACTERISTICS OF A RAILROAD LINE SEGMENT

1. Railroad L&N
2. Segment from 10th St. to LAFAYETTE JCT.
3. MP 118.8 to MP 121.3
4. Interview with C. WHIDBY
5. Title ASST. SUPT.
6. On (date) 1/25/74
7. General Description of Line:
   ST – ABS
   ELEVATION 535.5' @ MP 118.8 (NORTH END),
   562.0' @ MP 121.3 (SOUTH END).
8. Specific Description of Line:
   a. Main tracks: number 1 rail weight 115 LB
      allowable speed 10 MPH – 5th St. curvature 3° MAX
   b. Secondary running tracks: number 1 rail weight 115 LB
      allowable speed 10 MPH normal operating speed 10 MPH
   c. Name, location, and length of passing tracks and crossovers:
      N/A
   d. Types of signaling and limits of each type by milepost:
      AUTOMATIC BLOCK SIGNALS EXC MP 117.8 – 120.3
   e. Controlling gradients in each direction: NB 1%, SB 0.96%
   f. Total amount of rise and fall: 118.8 – 119 = +.5', 119 – 120 = +19', 120 – 120.58 = +24', 120.58 – 121 = +5', 121 – 121.3 = +10'
   g. Curvature (degrees of central angle) between mileposts: 118.8 – 119 = 7°5', 119 – 120 = 31°, 120 – 120.58 = 47°20', 120.58 – 121 = 4°7', 121 – 121.3 = 4°5
   h. Condition of rails, ties, ballast, structures TRACK IN 5th ST. MUST BE RAISED – 40% TIE REPLACEMENT WHEN COMPLETED; BALLAST FOULED, PUMPING JOINTS SO. OF 3RD ST.; RAIL CONDITION ADEQUATE.
      Clearance and weight restrictions 23' OH, 14' SIDE / 263,000# MAX 4 AXLE C
      Location and volume of industry spurs N/A

Worksheet RO-2
Page 2

i. Location and description of other facilities:* 1. MONON YARD AND SHOP FACILITIES NO. OF UNDERWOOD ST; SYSTEM CAR SHOPS, LOCOMOTIVE REPAIR FACILITIES, ALL SERV., WEIGHING, INSPEC. ACTIV.; TRAINMEN & CARMEN QUARTERS. 2. INTERLOCKING (PC-N&W) @ LAF. JCT.

j. Type and location of street grade crossings and protection:

2 CROSSBUCKS, 13 FLASHING LIGHTS, 2 FLASHING LIGHTS W/GATES; (SEE MAP FOR LOCATIONS)

k. Other physical features:† LAND AREA OF YARD ~ 200 ACRES; LINE SUBJECT TO WABASH FLOODING (EL 533.5') THOUGH MORE CRITICAL OUTSIDE STUDY AREA.

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*Scales, team tracks, passenger stations, freight houses, intermodal facilities, junctions and interlockings, interchanges, shops, crew change points, train order offices, etc.

†Right-of-way width, land area of yard facilities, flooding potential of adjacent waterways, etc.

DATE: 1/25/74 INITIALS: JCD

VIII RAILROAD CONSTRUCTION COSTS

The following guidance will aid planning organizations and their staff members in initially investigating the feasibility of a railroad relocation. However, specific application will require some, and possibly a great deal, of refinement by experienced civil engineering project estimators.

To simplify the discussion, this section outlines the requirements and costs of railroad construction; railroad operating costs are outlined in the next section. In the face of this convenience in presentation, it must be emphasized that definite, substantial, and complex relationships exist between the physical configuration of the railroad fixed plant and the costs of operating over it. These relationships will often require detailed trade-off analyses even within the context of a single relocation proposal. The value of personnel experienced in railroad civil engineering design cannot be stressed too highly in the relocation planning process.

Projecting Alignments

A first approach at projecting a proposed alignment can be made on recent, accurate aerial photographs, preferably on a scale not smaller than 1 inch = 500 feet, and on the topographic maps of the U.S. Geological Survey, which are usually available on a scale of 1 inch = 2,000 feet. Caution should be used with the latter, as many USGS maps are 20 or more years old. Field reconnaissance should be carried out concurrently with the aerial photo and map studies. It is common practice first to project a number of alternate lines, then to narrow them down to those most feasible.

Individual railroads usually will have specific design criteria for the locational and constructional aspects of a proposed line. These should be solicited early in the planning process to facilitate meaningful feasibility studies which take into account any unique constraints imposed by such criteria and/or allow initial discussion and possible compromise of conflicting views. A basic list of these criteria can be developed with Worksheet CC-1.*

Real estate and street location considerations are factors of primary importance in projecting a proposed line. The elements of real estate costs are land, improvements, severance damages, assemblage, demolition, and utility relocation or protection. "Assemblage" (in the context of railroad right of way cost) is the excess cost of assembling long, narrow strips of land over and above the going price per square foot of comparable property. Railroad rights-of-way are commonly one hundred feet in width, with exceptions where cuts or fills require a greater width. Railroad companies usually require fee title to property rather than easements. In the area to which the railroad is to be shifted, acceptance by the public will be greatly influenced by the amount of improvements that will have to be removed to make way for the railroad and the number of streets that will have to be crossed. These two factors also have a heavy influence on cost.

Railroad Design and Construction Requirements

At least 18 specific elements--and government permits and authorities--have to be considered in estimating design and construction requirements. All these are summarized below.

Horizontal Alignment

The degree of a railroad curve is defined as the central angle subtended by a chord of 100 feet. A one degree curve has a radius of 5,729.65 feet, and the radius is approximately inversely proportional to the degree of curve.

The central portion of railroad curves is connected to the enclosing tangents by spiral transition curves. The calculation of these spiral curves is outside the scope of this guidebook, but it is noted that spiral curves are not usually used on slow speed spur tracks and sidings.

The maximum speeds that can usually be run are shown below, by degree of curve, assuming proper spiral curves and superelevation (the amount that the "outside" rail on a curve is elevated to counteract centrifugal force):

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*The CC worksheets appear at the end of this section, starting on p. VIII-20.

1°	80 mph	8°	35 mph
2°	75 mph	9°	30 mph
3°	60 mph	10°	30 mph
4°	55 mph	11°	25 mph
5°	45 mph	12°	25 mph
6°	40 mph	13°	25 mph
7°	35 mph	14°	20 mph

Maximum allowable speed may be less on steep grades, so that the superelevation will not cause the wheels of slow moving trains to bear heavily against the inside rail of the curve.

Each railroad company has its own standards for superelevation, length of spirals (transition curves), and permissible speeds for each degree of curve. Generally, the less the central angle and degree of curve specified for a relocated railroad, the better.

Track Spacing

Tracks today are commonly spaced between center lines as follows (see Figure 5):

Between main tracks	15 feet
Between main track and adjacent track (except yard track)	15
Between main track and adjacent yard track	16
Between yard tracks	14
Between ladder tracks (lead tracks on either end of a yard) and adjacent track	20
Between industrial lead tracks and spur tracks	13

Distances between track centers are often increased on curves.

Modern practice is to use highway trucks and other off-track equipment for track maintenance; thus frequent access along the right of way is required, with parallel roadways frequently provided adjacent to main tracks.

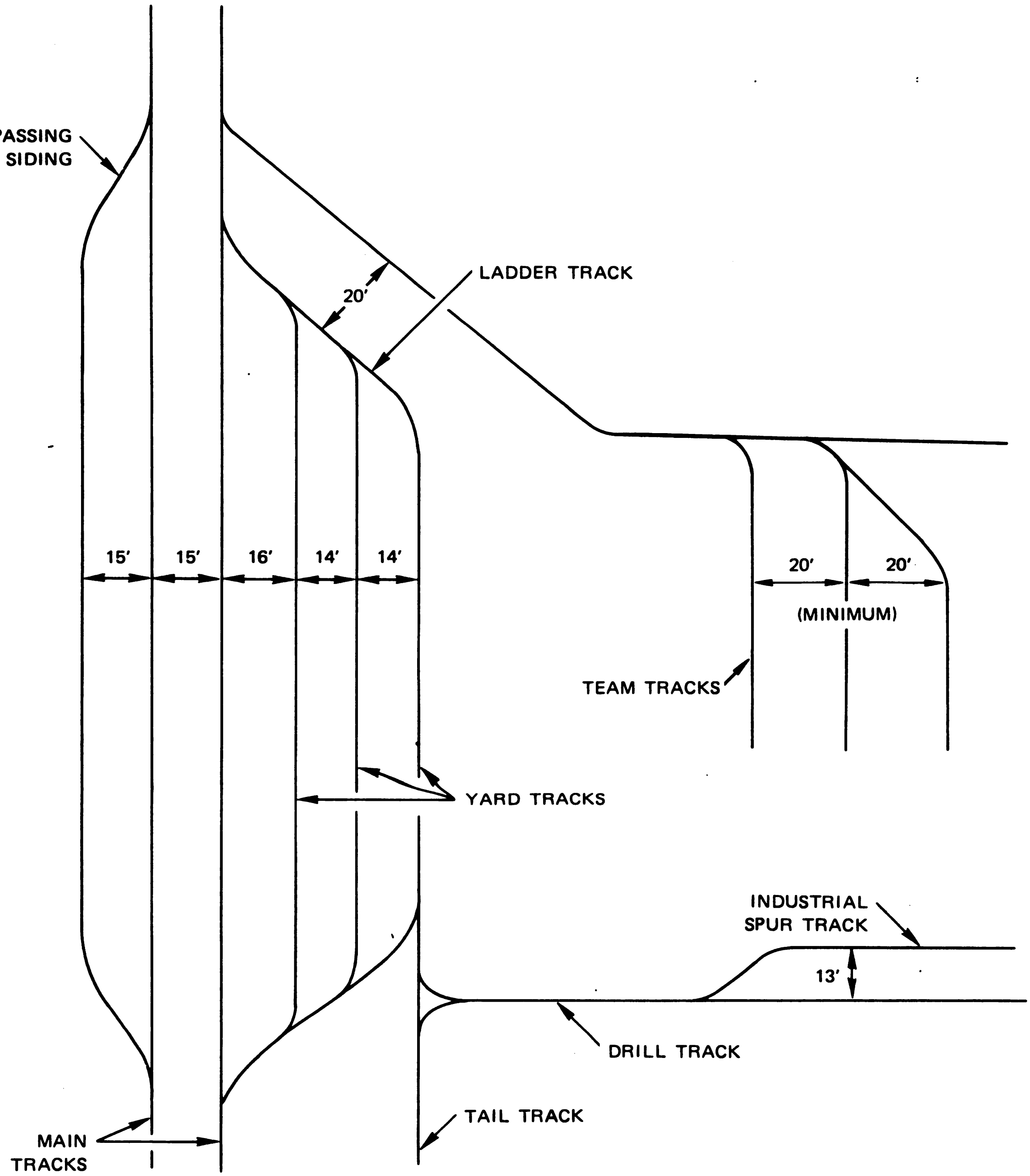

FIGURE 5 TYPICAL TRACK SPACING REQUIREMENTS

Grades

A ruling grade is defined as the steepest compensated grade for a specific train length for a given engine district. Railroad grades are compensated for curvature, usually .04 feet per degree of central angle. An engine district is the district over which a particular engine or combination of engines is operated. For example, a railroad may operate 2,000 to 3,000 hp diesel locomotives on a 5,000 ton train over a 400-mile engine district. It can be readily seen that, if any portion of this line were relocated on a grade greater than the existing ruling grade, either an additional diesel unit would have to be added for the 400-mile engine district or a "helper" district would have to be established. Either situation would increase the operating expense substantially. For this reason it is important to hold the ruling grade on a relocation within the existing ruling grade for the district.

Vertical Curves

Railroads use parabolic vertical curves at changes in gradients. The length of a vertical curve (in feet) on main lines is usually 1,000 times the algebraic difference in percent of grades at sags and 500 times the algebraic difference at summits.

Roadbed Widths and Slopes

Here again railroads each have their individual standards. Roadbed widths for single-track main line are commonly 26 to 32 feet, plus a maintenance road. Common slopes in cuts with stable soil conditions are 1:1 and 1.5:1 on fills, with flatter slopes in poorer soils to provide more adequate roadbed stability.

Ballast

Ballast section normally consists of 6 to 8 inches of sub-ballast (depending on soil conditions), plus 8 to 12 inches of ballast below the bottom of the ties. The ballast is usually dumped from railroad cars and the track raised, lined, and surfaced in several lifts.

Ties

Most railroads use 7 inch by 9 inch by 9 foot creosoted timber ties on 19-1/2 inch centers on main lines.

Tie Plates

Tie plates, which are placed under the rail to spread the load on the ties, are usually 8-3/4 inches by 14 inches, double-shoulder, for main line track.

Rail

The common size for heavy traffic main lines is 132# to 136# per yard, shop-welded into quarter-mile lengths. The cost per weld is about the same as the cost of joints, including angle bars, bolts, nuts and nutlocks; however, the cost of laying continuous-welded rail is less than the cost of laying jointed rail. The electric flash-butt welding equipment, together with the rail trains and other special equipment, is normally not available from contractors. Instead, the railroad involved usually welds the rail on a price-per-weld basis, and furnishes the rail trains and rail-handling equipment to the contractor on a rental basis.

Suitable secondhand 90# to 136# rail is often used in light-traffic sidings and other back tracks, although good secondhand rail is not always available.

Turnouts (Switches and Frogs)

Turnouts are used to divert trains to other tracks. Frogs provide flangeways to carry wheel flanges across opposing rails. Turnouts are described by the number of the frog, which is the length in feet along the main track for each foot of offset. For instance, a No. 10 frog has a tangent of 0.1, and a frog angle of $5^{\circ}43'29''$. Each railroad usually has its own turnout standards. Commonly, Nos. 7 through 9 may be used for low-speed yard tracks, and Nos. 10 through 14 for spurs and other tracks diverging from main tracks. Nos. 12 through 20 are used at the ends of passing sidings, and Nos. 20 and 24 at the ends of double tracks. The latter are often laid as equilateral turnouts.

Crossovers between parallel tracks consist of two turnouts and a short piece of track connecting them.

Switch points are usually 16-1/2 feet long for yard switches, 24 feet long at ends of passing sidings, and 30 to 39 feet at ends of double track.

Switch Machines

Switches are activated (thrown) by various devices or machines. Manually thrown switches are activated by a ground throw lever. Remote control switches may be pneumatically, electrically, or hydraulically operated depending on location, use, and type of power available. Switch heaters are used in heavy snow territory.

Signals

The signaling used on railroads varies considerably, according to traffic, but can usually be classified into the following:

(1) Block Signals are designed so that when one train is occupying a section of trackage, called a block, no other train is permitted to enter that block. This type of signaling supplements train order dispatching (in which train movement is specified by written orders from the dispatcher to the train crew) and, if properly utilized, prevents two trains from simultaneously occupying the same track.

Automatic block signals may have four aspects: (a) green to indicate that the block is unoccupied, (b) red to show that it is occupied, (c) yellow to show that the next block beyond the one being approached is occupied, and (d) flashing yellow to indicate the second block beyond is occupied.

(2) Centralized Traffic Control is a signaling system employing the services of a dispatcher who throws switches by remote control to control the movement of trains. Automatic signals indicate to the engine crew the position of the switch as it is approached and also provide safety by indicating track occupancy. CTC may be installed on either single or multiple track, although it is more commonly used on single track with appropriately spaced passing tracks.

(3) Automatic Train Control is a signaling system which controls the speed of trains, or at least prevents a train from entering a restricted block.

Bridges

Modern railroad bridges are usually of steel or prestressed concrete, designed for Cooper's E-72 or greater loading,* with ballast deck. Culverts can be either corrugated metal or extra-heavy concrete pipe.

Tunnels

Tunnels are usually constructed of reinforced concrete, with inside dimensions on tangent track of 16 feet width and 22-1/2 feet height above top of rail at centerline, although individual railroads' requirements may vary. Long tunnels may require ventilation, at considerably greater expense.

Clearances

Minimum clearances are usually as prescribed by the Public Utilities Commission of the state involved. Most common are side clearances on tangent track of 8-1/2 feet from centerline (with certain exceptions such as in tunnels, under bridges, and adjacent to dwarf signals), and overhead clearances of 22-1/2 feet above top of rail (in practice, 23 feet is usually provided to permit future resurfacing of track).

Yards and Terminals

Yards and terminals are so varied they must be treated individually, with careful attention given to the functions and capacity of each. The principal function of a yard is to classify cars and build trains. Various support facilities are usually provided, such as locomotive servicing and repair, car repair, car cleaning tracks, yard offices, and locker rooms. Intermodel facilities and equipment may also be a part of the yard. Yard facilities in urban areas may frequently require special noise attenuation equipment and procedures. Floodlights in such yards may require special shielding. Sometimes it is possible to replace several small yards with one larger yard. The attendant operating savings can be substantial if the single replacement yard has sufficient traffic volume to justify the expense of constructing an automated classification yard.

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*Theodore Cooper, Standard Loadings, Trautwine Engineering Standards, 21st edition (1937).

Generally, yard tracks should be constructed on grades not exceeding 0.20 percent (less if possible). Receiving and departure tracks should be long enough to hold the longest train handled.

Joint Trackage and Facilities

Some of the greatest potential for improvement, both to the railroads and to the community,exist where two or more railroads operate parallel lines through a city and the capacity on one line permits consolidation of other lines in that one location. Such situations may require installation of a centralized traffic control system to accommodate the joint and potentially conflicting operations, and will usually require the establishment of owner-tenant relationships among the participating lines. Although the negotiation of agreements to satisfy all interested parties may present a challenge, the general public benefits arising from such a solution may well dictate this as the only feasible answer which will justify public participation in the cost of a project. In the end, the reduction of railroad fixed plant will result in a reduction in track maintenance costs; a saving in the cost of installation and maintenance of railroad highway grade crossings and required warning devices wherever major streets or highways would have crossed the railroad; and savings to highway users. Every effort should be made to realize the benefits that can be obtained from the elimination of excess railroad fixed plant.

Salvage of Existing Line

Where the existing line that has been replaced by a new line is not needed to serve existing industries, certain items can be salvaged, including rail, ties, tie plates, joints, signal material, and sometimes even bridges. In most cases, ballast and culverts cost more to remove than their salvage value.

Government Permits and Authorities

Common carrier railroads must obtain ICC authority for new lines, retirement of existing lines, line changes (except where they are very minor), and for any joint track arrangements with other railroads. Long periods of time--in some cases, several years--are required to obtain these authorities.

If protests have been voiced by shippers, it is currently quite common for regulatory commissions to deny authority to retire an existing line, even where the line serves only a few shippers.

In most states, Public Utilities Commission authority is required to cross public streets, either at grade or by grade separations.

Environmental impact statements will probably be required for a railroad relocation project.

Preliminary Construction Cost Estimates

Table 1 presents low, typical, and high estimates of railroad unit construction costs, by ICC primary account.* The data refer to January 1973, and should be increased for inflation to levels current at the time of the study. A number of indices relating costs to years are available, including those of the Engineering News-Record, and the ICC.

The tabulated cost figures should be sufficient for preliminary estimates of the magnitude of cost. More precise estimates will have to be made by professional engineers after survey lines are run, cross sections taken, etc. The planner is cautioned that preliminary estimates are very often too low: later and detailed estimates often turn up unforeseen items, such as unknown underground utilities or required flattening of grading slopes.

Worksheet CC-2 is provided for the estimation of railroad construction costs.

The following notes are offered for use with the low, typical, and high values shown in Table 1 for making preliminary construction estimates. The discussion is organized by ICC account numbers.

ICC Account 1--Engineering

The low figure in Table 1 should be used if, for instance, a city engineering department did much of the survey work and perhaps very little or none of the overhead costs are to be charged to the project.

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*More details on the accounting practices of common carrier railroads, as prescribed by the Interstate Commerce Commission, are given in the next section of this guidebook.

Table 1

RAILROAD CONSTRUCTION COST FACTORS

Item	Unit	Low	Typical	High
Property	Acre	$ 5,000	$ 100,000	$ 1,000,000
Damages to improvements	Acre	0	50,000	1,000,000
Severance damages	Acre	0	25,000	300,000
Assemblage costs	Acre	5,000	25,000	200,000
Demolition costs	Acre	0	5,000	50,000
Utility relocation and protection	Acre	0	3,500	100,000
Grading	Cubic yard	1.50	3	20
Riprap	Cubic yard	5	7	10
Tunnels and subways (single track)	Lineal foot	1,500	2,500	5,000
Bridges and trestles (single track)	Lineal foot	400	1,500	2,800
Culverts	Lineal foot	7	25	200
Elevated structures (single track)	Lineal foot	400	1,500	2,800
Track, comp. incl. ballast (single track)	Track mile	110,000	125,000	160,000
Turnouts	Each	5,000	6,000	8,000
Fences	Lineal mile	5,000	18,500	25,000
Signs	Each	40	50	75
Stations and office buildings	Each	10,000	100,000	5,000,000
Roadway buildings	Each	5,000	20,000	100,000
Water stations	Each	5,000	25,000	100,000
Fuel stations	Each	10,000	35,000	150,000
Shops and enginehouses	Each	200,000	1,500,000	10,000,000
Communication systems	Lineal mile	10,000	25,000	100,000
Automatic block signals (single track)	Lineal mile	15,000	18,000	25,000
Centralized traffic cont. (single track)	Lineal mile	25,000	30,000	40,000
Interlocking plants	Each	35,000	150,000	750,000
Flashing light signals (highway crossing)	Set	15,000	22,000	40,000
Automatic gates (highway crossings)	Set	20,000	30,000	60,000
Grade crossings	Each	2,000	5,000	50,000
Grade separations	Each	200,000	1,000,000	7,500,000
Railroad removal costs	Track foot	0.85	1.25	1.75
Other				
Engineering (percent of total)		8%	10%	10%
Contingencies (percent of total)		10%	10%	10%
Track salvage	Track mile	($15,000)	($25,000)	($35,000)

The high figure should be used where practically all of the engineering work is done by a consulting firm, or a particularly high proportion of structural work such as grade separations is involved.

Normally, railroad companies would expect to be reimbursed for all engineering work, including preliminary design work, which they expend on a project.

ICC Account 2--Property

Property costs are best determined by a qualified appraiser. Land values are determined on a square foot or acre basis by comparing recent sales of comparable adjacent land, where a willing seller has sold to a willing buyer. Severance damages are incurred where only a portion of the seller's land is taken and the remaining portion loses some of its value. Improvement values are the appraised value of buildings, utilities, etc. on the property taken. Demolition costs are the costs of removing the improvements in order to prepare the property for railroad use.

In most states, property may be acquired by eminent domain for railroad purposes.

ICC Account 2-1/2--Other Right-of-Way Expenditures

This account includes protection or removal of irrigation systems, pipelines, power lines, etc. on the property purchased.

ICC Account 3--Grading

In urban areas, a greater portion of railroad lines are on embankments rather than in excavations. This means that fill usually must be imported to the job. The cost per cubic yard of grading can vary widely, depending upon the availability of fill material and the distance it must be hauled. Rock excavation is four to five times as expensive as dirt excavation.

Riprap is large rock used against the sides of fills to prevent scouring and washing away of the fill.

ICC Account 5--Tunnels and Subways

Here again the cost can vary over a wide range, depending on the type of ground (earth, hard rock, soft rock, etc.) and interferences such as underground water, underground utilities, and building foundations requiring shoring. Long tunnels cost more per lineal foot than short ones.

ICC Account 6--Bridges, Trestles, and Culverts

The low figure given in Table 1 for bridges and trestles should be used for timber trestles, where acceptable, and the high figure for steel bridges. Long steel spans cost more per lineal foot than short ones, and through trusses cost more per foot than, for example, deck plate girders. High piers and abutments cost more than low ones. Culverts of either corrugated metal or extra heavy reinforced concrete pipe are acceptable to most railroads.

ICC Accounts 8 through 12--Track

An average price for main line single track is $125,000 per mile, including labor and material. Costs vary up or down depending on weight of rail used, size and spacing of ties, depth and unit cost of ballast, distance from rolling mills, etc.

Turnouts vary with the weight of rail and specified frog number of the turnout.

A number of contractors in the United States are qualified to lay main line track, with proper inspection by the railroad company. Most railroads insist for safety reasons upon constructing with their own forces any connection to a track in operation to a point where the tracks have 13 feet between centers (the "clearance point") from an operated track.

ICC Account 13--Fences and Signs

The figures shown in Table 1 are per lineal mile--two lineal miles are required per mile of railroad line. The low figure is the cost of four-strand barbed wire fence, the medium figure is for a six-foot high chain link fence.

ICC Account 16--Stations and Office Buildings

The costs of stations and office buildings vary greatly depending on the type and size of building. An ordinary yard office building of prefabricated steel will average about $35 per square foot.

ICC Account 17--Roadway Buildings

This account includes section gang quarters, toolhouses, small shops, etc. Average cost is $25 to $30 per square foot, depending on the function of the building.

ICC Account 18--Water Stations

The low figure for water station costs would be for a simple plant with a tank for treating city water for use as radiator water; the high figure would reflect the necessity to sink a deep well, with large pumps and tankage.

ICC Account 19--Fuel Stations

Variance in the cost of fuel stations is due mainly to the volume of fuel to be delivered, the amount of tankage, and the number of fueling masts; $35,000 would cover a medium size facility.

ICC Account 20--Shops and Enginehouses

The low figure for shops and enginehouses would be for only a diesel servicing facility. The high figure is for a major backshop.

Car repair facilities can vary from $50,000 for the simplest rip (car repair) track facility to $1.5 million for a large, modern, shop where cars requiring repair are moved mechanically to sequenced work stations.

ICC Account 26--Communications

The cost per mile for communications varies considerably depending upon whether the communications system consists of telephone and telegraph lines on poles, VHF radio, microwave, or a combination of these.

ICC Account 27--Signals

The simplest installation of single-track automatic block signals costs approximately $15,000 per mile. More complex installations may cost $25,000 per mile or more. (CTC signaling costs can run to $40,000 per mile, depending on line complexity, number and spacing of sidings, type of circuitry, etc.)

For railroad tracks that cross at grade, at junctions, or at other locations where there are a number of main line power switches, interlocking plants are used. These may be interspersed in block signal territory. The cost of interlocking plants varies widely, depending upon the number of switches and signals handled, and the sophistication of the plant. For simple railroad crossings at grade, it is possible to install unmanned automatic interlocking plants, or plants under the control of a CTC dispatcher.

Grade crossing warning signals usually consist of flashing light signals, supplemented with automatic crossing gates at the busier crossings. The low cost shown in Table 1 is for a simple single track where there are no switches and where trains do not normally stop or carry on switching operations in the crossing circuits. The high figure is for more complex installations with a number of switches and switching operations. The latter sometimes include Grade Crossing Predictors, which are small computers that continuously monitor the speed of an approaching train and adjust the gate controls automatically so that the gates are lowered approximately 25 seconds ahead of the train.

ICC Account 39--Public Improvements - Construction

This account includes such items as grade crossings, alterations to roads and streets, and grade separations.

The cost of grade separations can vary greatly depending upon whether the separation is an overpass or underpass, the number of tracks to be traversed, width of the street, and approach grades of the street. Property damage costs are often an important item in a commercially developed area, where a business is severed from street access when the street grade is changed. Where built on an existing railroad, an overpass is usually less expensive than an underpass. With the latter, railroad traffic must be maintained either by the construction of a railroad "shoofly" (temporarily circumferential track) or by the placement of false work to carry the traffic while the underpass is under construction. Both of these processes are time-consuming and costly.

Sequence and Timing of Railroad Construction

The sequence and timing of the various components of a railroad relocation project are usually determined by the critical path method. After plans and agreements are finalized, financing is in hand, and all required permits and government authorizations are obtained, the first step is property acquisition. This can take from a few months to several years, depending upon the number of owners that have to be negotiated with and whether or not condemnation will be required.

The first negotiations are usually for critical parcels of property, such as those underlying proposed bridge and grade separation structures. As the normal time required to construct a major bridge or railroad-highway grade separation is 12 to 15 months, these activities are usually started as early as possible. In a few cases it may be necessary to build portions of the railroad roadbed to provide access to the structure sites. The acquisition of the balance of the right-of-way, and site clearing, usually can be carried on simultaneously with the bridge and grade separation construction.

The placing of culverts and smaller structures, such as prestressed concrete trestles, is accomplished next, with the grading either following or being completed simultaneously under the same contract.

Track laying can start as soon as portions of the finished grading have been completed. Laying of a mile of track per day is not uncommon, particularly with continuous welded rail, if sufficient ballast, ballast cars, and surfacing equipment are provided so that the ballasting can be kept up with the laying. Where there are a large number of turnouts or road crossings involved, track laying is slower. Sufficient ballast must be unloaded behind the laying to prevent thermal expansion and contraction of the rail from skewing the ties. After the track is laid, ballast is applied and the track raised (usually in several lifts), lined, and surfaced.

Signal work usually comes next, although there can be some overlap with the track work. Fencing can be carried on simultaneously with the track work.

Railroad company forces usually make the final cut-ins to connect the new track with the existing track. On some railroad relocation projects, stage construction may be necessary to keep the railroad in operation. It may also be necessary to construct shooflys (tracks on temporary grades or alignment).

Figure 6 is a bar chart showing the engineering and construction phases of a hypothetical 30-month railroad relocation project. Figure 7 is a plot showing estimated percent of expenditures versus percent of time.

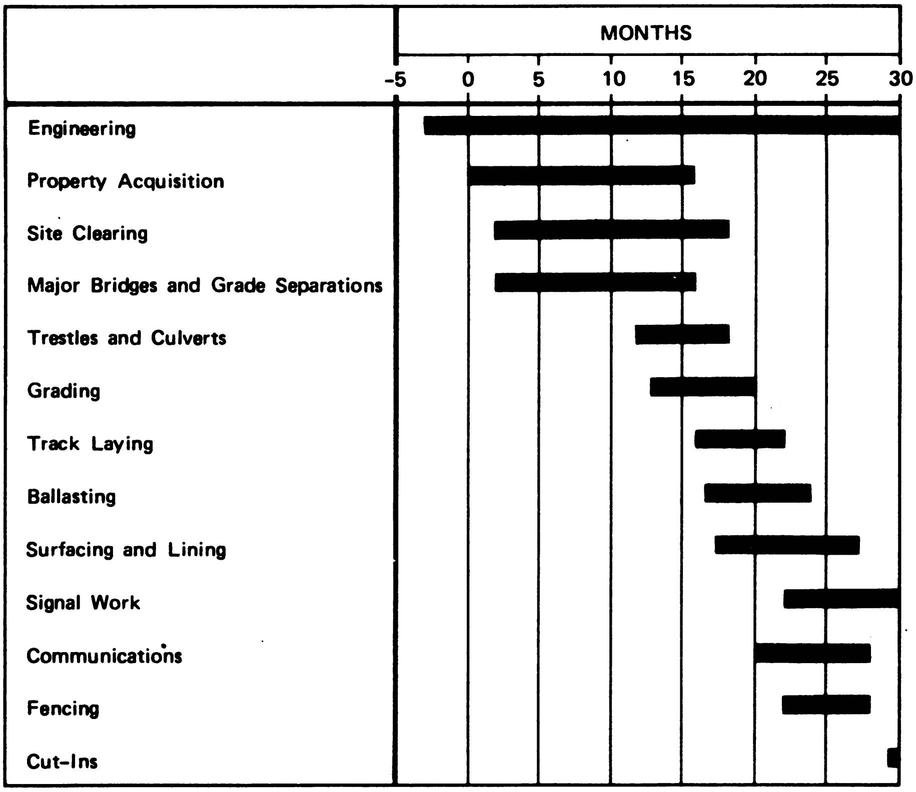

FIGURE 6 ENGINEERING AND CONSTRUCTION SCHEDULE FOR HYPOTHETICAL 30-MONTH RELOCATION PROJECT

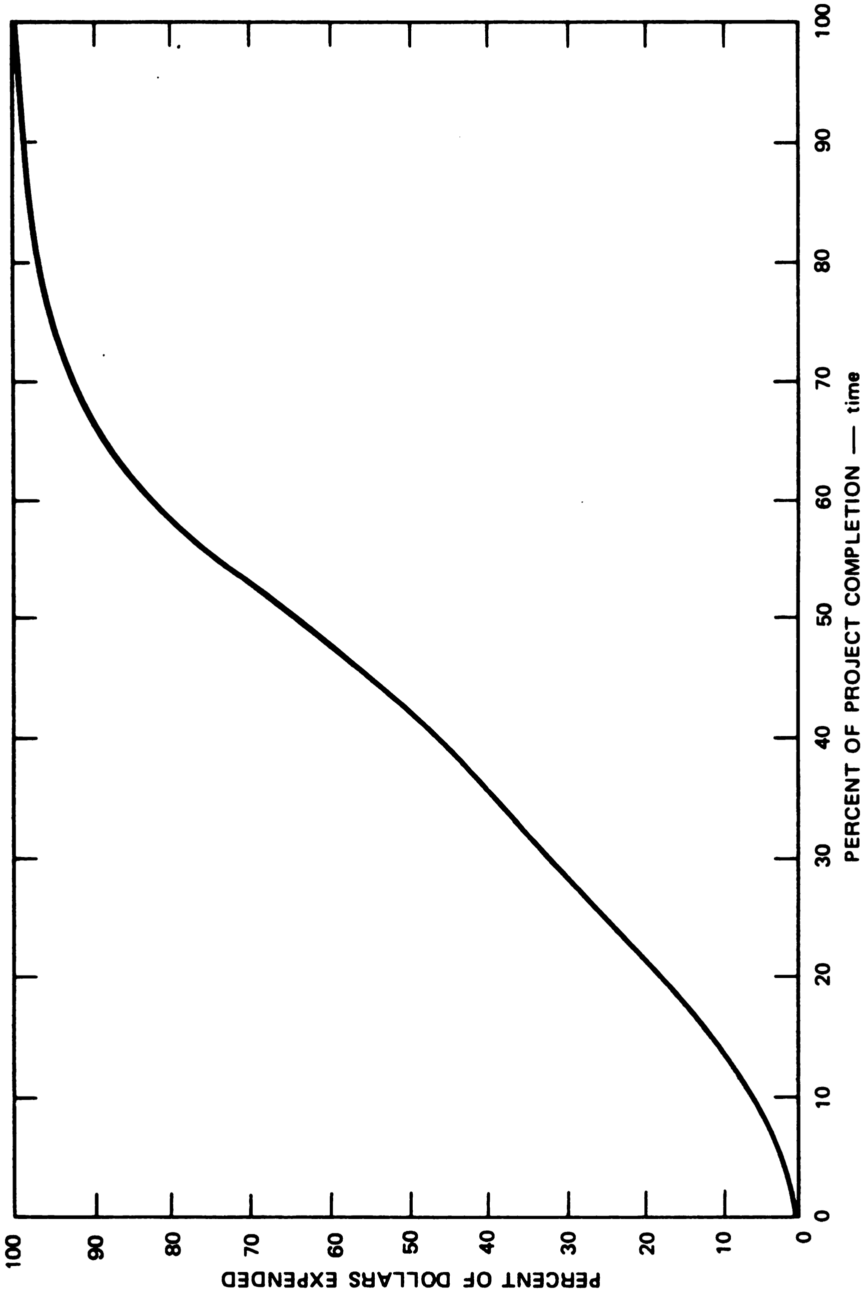

FIGURE 7 PERCENT OF PROJECT EXPENDITURE VERSUS PERCENT OF PROJECT COMPLETION

Worksheet CC-1

RAILROAD DESIGN CRITERIA

1. Number of Tracks Required (including sidings, crossover requirements, if any) 3 TRACKS; 1 CROSSING: PC/N&W NICKEL PLATE (SINGLE) OVER N&W WABASH (DOUBLE).

2. Clearance Requirements: a. Overhead 23'0" b. Side 14'0"

3. Horizontal Alignment (based on design speed 50 MPH)

   a. Curve criteria 1° (3° MAX), SPIRAL TRANSITIONS

   b. Track spacing criteria 15 FT. MAIN

   c. Roadbed width 58 FT. (50 FT. IN CUT)

   d. Right-of-way width 100 FT. MIN.

4. Vertical Alignment (based on train length 125 CARS)

   a. Ruling grades 0.65% MAIN (0.5% PREF.) 1.0% CONNECTIONS

   b. Vertical curve criteria 0.1 FT./100 FT.

5. Drainage Requirements (including permissible location, depth, and frequency of flooding) NO FLOODING, 539 FT. MIN. ELEVATION (2 FT. ABOVE 500 YR. FLOOD).

6. Ballast Type and Section CRUSHED ROCK/SLAG, 18" BELOW TIE.

7. Cross Tie Size, Spacing, and Type 7"x9"x8'6", 20" SPACE, CREOSOTED WOOD.

8. Rail and Turnouts

   a. Weight and section of rail 132 LB/YD MAIN, 115 LB/YD SIDING, YARD

   b. Frog angle of turnouts #15 MAIN, #10 SIDING

9. Type of Signaling Required (CTC, ABS, etc.) CTC

10. Crossing Protection (type, standards) GATES & FLASHERS

11. RR Bridges

   a. Type (steel, pre-stressed concrete, timber, etc.) STEEL (TPG)

   b. Cooper's E rating required E80

DATE: 1/30/74 INITIALS: JCD

Worksheet CC-2

APPROXIMATE RAILROAD CONSTRUCTION COSTS

(Alternative 1 : RIVERFRONT)

Item	Quantity*	Unit	Unit Price	Amount (000)
1. Property Acquisition and Related Costs				
a. Right-of-way acquisition				
b. Assemblage costs				
c. Severance damages				
d. Damages to improvements				
e. Total (EXCLUSIVE OF RR PROPERTIES)				850
2. Site Preparation Costs				
a. Demolition costs	ALLOW	RESIDENCES @ 55; OTHER @ 105		160
b. Utility relocation and protection (SEWER, WATER, PHONE)	LS			515
c. Grading	160,000 250,000	CY	3.00 2.50	1,105
d. Riprap	24,000	CY	8	192
e. Total				1,972
3. Track Work and Track Structure Costs				
a. Temporary relocation	LS			200
b. Track, complete including ballast (single track)	67,100	LF	45.	3,020
c. Turnouts	LS			200
d. Tunnels and subways (RETAINING WALL)	13,000	CY	175.	2,275
e. Bridges and trestles (REMODEL)	LS			100
f. Elevated structures (CUTOFF WALL)	ALLOW			1,200
g. Culverts (PUMPS & DRAINAGE)	LS			64
h. Other: NOISE CONTROL	ALLOW			120
i. Total				7,179

* CY = CUBIC YARDS LS = LUMP SUM
LF = LINEAR FEET SF = SQUARE FEET

Item	Quantity	Unit	Unit Price	Amount (000)
4. Right-of-Way Protection				
a. Fences				130
b. ~~Signs~~ EROSION CONTROL @ 7 / STREET BARRICADES @ 7				14
c. Total				144
5. Railroad Buildings and Facilities				
a. Stations and office buildings				
b. Roadway buildings				
c. Water stations				
d. Fuel stations				
e. Shops and enginehouses				
f. Total				0
6. Signals and Communications Systems				
a. Automatic block signals (single track)				
b. Centralized traffic control (single track)	ALLOW			500
c. Interlocking plants				
d. Communications systems	ALLOW			360
e. Total				860
7. Highway Crossing and Crossing Warning Devices				
a. Flashing light signals				70
b. Automatic gates				
c. Grade crossings — NEW	500,000	SF	3	1500
REHAB	43			55
d. Grade separation — 11 RAMPS, OVER/UNDERPASSES				8,500
FERRY STREET BRIDGE				6,880
e. Total				17,005

	Item	Quantity	Unit	Unit Price	Amount (000)
8.	Total Construction Cost Estimate (1e + 2e + 3i + 4c + 5f + 6e + 7e)				28,010
9.	Engineering (SEE BELOW)				4,563
10.	Contingencies (SEE BELOW)				5,432
11.	Railroad Removal Cost	____	____	____	0
12.	Track Salvage	____	____	____	(305)
13.	GRAND TOTAL				37,700

ENGINEERING:

PRELIMINARY @ 1% OF CONSTRUCTION COSTS LESS PROPERTY COSTS PLUS CONTINGENCIES = 326.

DETAIL DESIGN, PROCUREMENT, AND CONSTRUCTION SUPERVISION @ 13% OF CONSTRUCTION COST LESS PROPERTY COSTS PLUS CONTINGENCIES = 4237.

CONTINGENCIES:

AT 20% OF CONSTRUCTION COSTS LESS PROPERTY COSTS.

DATE: 1/31/74 INITIALS: JCD

IX RAILROAD OPERATING COMPANY IMPACT

Modifications to improve the railroad in an urban area will affect the companies that operate the railroad(s) in three ways:

- Changing railroad operating costs.
- Changing value and use of railroad land and modifying industrial development activities.
- Changing financial requirements and tax liabilities.

These three types of effect are discussed in this section.

Operating Cost Impact

Restructuring the rail network in an urban area may either increase or decrease specific railroad costs. Methodologies for the identification and analysis of both the recurring operating costs and one-time, non-capital costs associated with altering the railroad fixed plant are presented below.

The nature and complexity of railroad operations and their related costs will pose many of the same problems for relocation planners and analysts which have confronted railroad companies and the industry's regulatory agencies for many years. The existence of both joint and common costs, costs that exhibit wide variability under differing service conditions, and an industry accounting system structured to render only very broad, aggregated data for regulatory purposes have all combined to hinder refined railroad cost analysis. For these and other reasons, understanding and correctly analyzing relocation plan alternatives in the context of their real economic and financial consequences to affected railroads are among the foremost tasks facing planners. The extent to which proposed changes in route length, gradient, and curvature affect rail linehaul and switching costs and impact scheduling, network congestion, and other time-related factors will be paramount considerations. Gains or losses of freight traffic, increases or decreases in exposure to rail-highway crossing accidents, increases or decreases in fixed plant maintenance costs: these and many other factors must be evaluated in terms of the railroad's ability not only to sustain but to improve its present competitive position and financial condition.

The analytical methodology and unit costs presented in this section are based on the experience of one major Class I railroad. They are furnished with the knowledge that case-specific refinements will be required for any given railroad relocation project.

General Categories of Operating Costs

There are three general categories of operating costs: linehaul costs, terminal costs, and freight car expense. A general understanding of the causes and nature of these railroad costs will assist in their analysis.

- Linehaul costs are the costs of operating trains over the road. The elements of linehaul costs may be stated in approximate order of importance (that is, decreasing dollar cost) as follows:

  (1) Train and engine crew wages

  (2) Maintenance and depreciation of locomotives

  (3) Maintenance of way and structures

  (4) Locomotive fuel

  (5) Dispatching, caboose, and miscellaneous train expenses.

  Unusually heavy trains and/or operation in mountainous districts may cause locomotive costs to displace crew wages as the most significant linehaul cost, and other ranking changes are also possible under circumstances differing from average.

- Terminal costs include:

  (1) Wages of switch engine crews.

  (2) Fuel, maintenance, and depreciation of switch engines.

  (3) Station clerical expense for billing, dispatching, crew calling, yard supervision, etc.

  (4) Maintenance of yard tracks and structures.

It will be noted that the costs included in one general category have analogues in the other. However, the usual causes of variation are different. For example, the pay of linehaul crews usually varies with distance, while that of switch crews varies with time.

- Freight car expense: A railroad incurs ownership costs, usually in the form of principal and interest payments, on its own equipment. Cars owned by other railroads are compensated for on a combined time-plus-mileage schedule of fees which also reflects the age and original cost of the equipment. Most freight cars are railroad-owned. Private (shipper or leasing company) freight cars--usually tank, flat, or refrigerator types--are paid for by the handling railroad on a straight mileage basis. Most freight car repairs are the responsibility of the owner, but certain items are the responsibility of the handling railroad.

Certain other expenses connected with day-to-day operations are not included in the above categories. Worthy of mention in connection with this study are joint facility rental,* freight loss and damage claims, public liability costs, property taxes, and certain depreciation and interest expense.

In addition to the tangible costs noted above, a change in facilities may bring about certain benefits and detriments that are difficult to translate directly into dollar consequences. For example, a faster route permits either faster schedules or more reliable deliveries or both. The carrier will obviously benefit directly in terms of traffic solicitation and retention. Also, in times of equipment shortage, the ability to deliver empty cars to shippers sooner or more frequently will permit the railroad to handle more business. It is very difficult to quantify such service benefits and opportunity costs, and it may be necessary to overlook them unless they are obviously very significant factors in the desirability of the project to a carrier.

Causes of Variation in Operating Cost

With this general background information on the categories of recurring operating expense, the planner next needs to know how the method of operation or plant design brings about increases or decreases in costs, which costs are affected, and to what extent.

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*Joint facility rental is the payment by a tenant line to the owner (or lessee) of a shared facility. Where there is only one tenant, often the rental is one-half the interest on the ledger value of facility investment, plus one-half of any ad valorem taxes, plus a portion of maintenance expense based on relative proportion of use calculated on a carload or wheelage basis.

The method of accounting for operating expenses used by the railroads for ICC reporting purposes does not lend itself readily to determining the variability of total cost with plant or operating changes. As an example of ICC expense account classification, Figure 8 reproduces the operating expense schedule from the annual report format required of Class II (small) railroads. The format followed by Class I (large) railroads is structurally similar, with more detail shown.

Table 2 lists the categories and subcategories of cost discussed above and shows the degree of responsiveness of each to various plant or operating changes which might result from a railroad relocation project. (The table is intended as general information only, since substantial variation can be expected between localities due to localized conditions.) Table 3 reverses the format of Table 2, to show the categories of cost that may be affected by given plant or operating changes.

Table 2

CAUSES OF VARIATION IN SELECTED CATEGORIES OF RAILROAD OPERATING COST

Category of Variable Cost	Type of Change Likely To Affect This Cost
Through train crew wages/benefits	Route length
Local train crew wages/benefits	Route length, but more often running time
Switch engine crew wages/ benefits	Time
Certain additional benefits and payroll taxes	Number of employees
Fuel expense: varies with work done by locomotive	Gradient, rise and fall, route length, speed reduction zones, and curvature
Locomotive repair/depreciation expense	Fuel consumption measures most, also route length
Maintenance of way and structures	Route length
Freight car rental or ownership cost, including cabooses	Route length and running time
"Fixed" costs such as manning of signals, "fixed" maintenance, interest and depreciation, etc.	Addition or removal of fixed facility
Profit from traffic (a "negative cost")	Carloads originated and/or terminated.

2002. RAILWAY OPERATING EXPENSES

1. State the railway operating expenses of the respondent for the year, classifying them in accordance with the Uniform System of Accounts for Railroad Companies.

2. Any unusual accruals involving substantial amounts included in columns (b) and (d) should be fully explained in a footnote.

Line No.	Name of railway operating expense account (a)	Amount of operating expenses for the year (b)	Name of railway operating expense account (c)	Amount of operating expenses for the year (d)
		$		$
	MAINTENANCE OF WAY AND STRUCTURES	x x x x x x	TRANSPORTATION—RAIL LINE	x x x x x x
1	(2201) Superintendence		(2241) Superintendence and dispatching	
2	(2202) Roadway maintenance		(2242) Station service	
3	(2203) Maintaining structures		(2243) Yard employees	
4	(2203½) Retirements—Road		(2244) Yard switching fuel	
5	(2204) Dismantling retired road property		(2245) Miscellaneous yard expenses	
6	(2208) Road property—Depreciation		(2246) Operating joint yards and terminals—Dr.	
7	(2209) Other maintenance of way expenses		(2247) Operating joint yards and terminals—Cr.	
8	(2210) Maintaining joint tracks, yards, and other facilities—Dr.		(2248) Train employees	
9	(2211) Maintaining joint tracks, yards, and other facilities—Cr.		(2249) Train fuel	
10	Total maintenance of way and structures		(2251) Other train expenses	
11	MAINTENANCE OF EQUIPMENT	x x x x x x	(2252) Injuries to persons	
12	(2221) Superintendence		(2253) Loss and damage	
13	(2222) Repairs to shop and power-plant machinery		(2254) Other casualty expenses	
14	(2223) Shop and power-plant machinery—Depreciation		(2255) Other rail transportation expenses	
15	(2224) Dismantling retired shop and power-plant machinery		(2256) Operating joint tracks and facilities—Dr.	
16	(2225) Locomotive repairs		(2257) Operating joint tracks and facilities—Cr.	
17	(2226) Car repairs		Total transportation—Rail line	
18	(2227) Other equipment repairs		MISCELLANEOUS OPERATIONS	x x x x x x
19	(2228) Dismantling retired equipment		(2258) Miscellaneous operations	
20	(2229) Retirements—Equipment		(2259) Operating joint miscellaneous facilities—Dr	
21	(2234) Equipment—Depreciation		(2260) Operating joint miscellaneous facilities—Cr.	
22	(2235) Other equipment expenses		GENERAL	x x x x x x
23	(2236) Joint maintenance of equipment expenses—Dr.		(2261) Administration	
24	(2237) Joint maintenance of equipment expenses—Cr.		(2262) Insurance	
25	Total maintenance of equipment		(2264) Other general expenses	
26	TRAFFIC	x x x x x x	(2265) General joint facilities—Dr.	
27	(2240) Traffic expenses		(2266) General joint facilities—Cr.	
28			Total general expenses	
29			GRAND TOTAL RAILWAY OPERATING EXPENSES	
30	Operating ratio (ratio of operating expenses to operating revenues), ... percent. (Two decimal places required.)			

FIGURE 8 REPRODUCTION OF AN ICC REQUIREMENT FOR CLASS II RAILROAD ANNUAL REPORTS

Table 3

CATEGORIES OF OPERATING COSTS
AND SELECTED CAUSES OF VARIATION

Cause of Variation	Cost Categories Likely To be Affected
Change in route length	Through train crew wages Mileage portion of car rental and ownership costs, including cabooses Maintenance of way Smaller part of fuel expense Part of locomotive expense
Change in running time	Local and switch crew wages Time portion of car rental Most other cost categories are slightly affected, but can be ignored unless change is large
Change in gradient, rise and fall, curvature, speed restriction zones, etc., affecting work done by locomotives	Greater part of fuel expense Greater part of locomotive expense
Change in "fixed" plant	"Fixed" plant maintenance and operating costs
Change in traffic volume	Profit from traffic

These two tables are intended primarily as background for the planner. They are not used directly in the cost-benefit calculation. The understanding they provide of the cause and nature of railroad costs is considered important.

The physical plant changes and costs they affect are summarized in the following paragraphs.

Changes in Route Length. Linehaul train crew wages generally vary with distance. The only exceptions would be unusually slow trains performing considerable way switching between terminals.* Associated fringe benefits would not vary quite so strictly with mileage, but it is reasonably safe to allocate all linehaul train crew wage/benefits and expense to distance: the approximate level as of January 1974 was $2.60 per train-mile.

Other linehaul expenses vary directly with distance, provided other conditions are unchanged. These expenses include maintenance of way cost; part of freight car rental; and a portion of train fuel, and locomotive and freight car and caboose depreciation and repair cost.

Distance also affects time, hence time-related costs vary with distance. However, whenever time is the direct cause of the expense, the expense should be treated as time-variable rather than distance-variable, to avoid possible double counting.

<u>Changes in Running Time</u>--Changes in the time to traverse a route or perform some other function such as switching will affect the level of certain costs, chief among which are the wages and benefits of railroad yard and industry switching crews. A portion of freight car rental will vary with the time required to handle cars.

Some time-oriented costs such as basic wages will vary continuously; other costs or benefits will accrue only at discrete intervals. For example, there is no benefit from delivering cars to the next yard two hours earlier in an afternoon if the next yard engine able to deliver them to

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*Other instances in which through-train crew wages will not vary with distance arise where the crew district is unusually short, e.g., less than the commonly prevailing 100-mile guaranteed minimum. Over a period of time, work-rule changes, consolidation of districts, reassignment of work, and other economic factors tend to make even these cases behave as distance-related. It seems best to presume crew costs are distance-related and require convincing evidence to rebut that presumption. Also, distances between crew terminals are rounded to the nearest full mile, so that a fractional change will be either a full mile or zero in effect on crew wages.

In some cases, the full potential savings from a line change may not be realizable at once because of labor agreements respecting severance pay, job or pay protection, etc. Examples are the so-called "Washington Agreement" and "Burlington Conditions" (257 ICC 700).

an industry does not go on duty until the next morning. On the whole, however, the planner should treat costs and benefits from time as flowing continuously unless it is known specifically that a particular cost or benefit will or will not always accrue with time change.

Route transit times on affected segments of the existing rail network must be ascertained for use in the analysis of time-related costs. This may be done by sampling current operations (usually one week's data, with seasonal variations taken into account, are sufficient), by various simulation techniques, or by judgmental analysis.

<u>Change in Gradient and Curvature</u>--Gradient and curvature may affect costs indirectly, by influencing running time or route length. However, gradient and curvature also have direct consequences. Train fuel and much of locomotive repair expense are attributed directly to work performed by the locomotive in overcoming grade resistance and, to a much lesser extent, curve resistance. Grades also determine the minimum amount of locomotive horsepower required to handle a given train over the road within schedule constraints. It is obviously undesirable to relocate a railroad main line over a new route which has a higher maximum gradient, or which has substantially greater total rise and fall. Introducing a gradient more severe than that prevailing elsewhere in the territory is even more undesirable, as additional through-locomotive horsepower must be employed. Conversely, reduction in the maximum and/or the cumulative grade can produce large savings.

For estimating purposes, a common formula is .075 gallons of fuel per 1,000 foot-tons of locomotive work. The tonnage figure required is the total weight of all locomotives, cars, and contents. The footage factor is the total equivalent rise: actual uphill feet plus an allowance for the resistance-equivalent of straight and level track, plus curve resistance, less an allowance for coasting downhill where there is no energy loss from braking.

Methodology for the calculation of equivalent rise and fuel consumption is given in Appendix B.

Initial Estimation of Railroad Operating Cost Changes

The need to estimate roughly the changes in railroad operating costs arises early in the planning of potential railroad relocation alternatives. At this stage the analyst needs the ability to quickly estimate order of magnitude cost effects. Worksheet RR-1* and Table 4 are provided as aids in this initial estimating.

Later in the process, more detailed estimates on which to base cost allocation negotiations and funding requests will be needed. These procedures are described below.

Detailed Operating Cost Analysis

Since the costs and benefits to each participating railroad company have to be known separately for negotiations, it is easier and more useful to compute each separately. Table 5 contains unit cost factors suitable for these calculations. Where more accurate unit costs are available for a specific railroad, these may be substituted for the values in the table. Any large discrepancies, however, should be fully substantiated.

Worksheet RR-2 is provided to facilitate the detailed cost analysis. Essentially, the procedure is to go through the entire list of possible cost or benefit items, applying the relevant unit cost pertaining to each of the proposed alternatives. For instance, if the proposal will save the North & South Railway 47 yard-engine hours a week (perhaps from eliminating a wait at a junction), multiply the yard engine costs that vary with hours by 47 to obtain the weekly saving. Continue through the entire list, carefully observing which items are costs and which are benefits, and also being sure to use the same time span--do not subtract a cost per week directly from a saving per year.

To choose from a range of unit costs (low-typical-high), the planner will usually have to rely on his experience and judgment, supplemented by the knowledge gained during the interviews with railroad people. However, certain guidelines can be followed, as outlined below.

- All the unit costs shown are adjusted to place the "typical" at the level anticipated in urban areas. For example, maintenance of way costs (per 1,000 gross ton-miles) are low on rather heavily-used double track in flat, warm, dry country where deterioration owing to weather is minimal, interference with maintenance work by trains is rare, there is ample room at trackside for off-track machinery, and working conditions

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*The RR worksheets appear at the end of this section, starting on p. IX-19.

Table 4

SIMPLIFIED RAILROAD OPERATING COST OR SAVINGS FACTORS
(January 1974 Levels)

Item	Unit	Cost or Saving		
		Low	Typical	High
Train delay or running time				
Through train	Hour	$ 10.00	$ 16,00	$ 20.00
Local train	Hour	60.00	75.00	100.00
Yard engine doing switching or industry work	Hour	55.00	70.00	80.00
Route length or distance				
Maintenance of yard and branch tracks	Mile (annual cost)	1,000.00	2,400.00	5,000.00
Maintenance of mainline track	Mile (annual cost)	4,000.00	8,000.00	20,000.00
Train operating cost				
Yard engine or local	Train-mile	1.50	2.75	3.50
Through train	Train-mile	12.00	14.00	17.00
Manned signal or interlocking	Per position manned 24-hr/day (annual cost)	30,000.00	40,000.00	60,000.00
Speed reduction zones				
5 mph below prevailing speed	Per train	0.50	1.00	2.00
10 mph below prevailing speed	Per train	1.25	2.50	4.00
25 mph below prevailing speed	Per train	7.00	10.00	15.00
Gradient				
Each foot of additional rise (over 0.3% but less than maximum grade on division)	Per train	0.05	0.16	0.30
Each foot of additional rise in grades exceeding existing maximum grade elsewhere on division	Per train	0.07	0.20	0.60
Traffic gained or lost	Profit per carload	50.00	150.00	500.00

Table 5

DETAILED RAILROAD OPERATING COST OR SAVINGS FACTOR
(January 1974 Levels)

Item	Service Units or Cause of Variation of Cost	Cost per Service Unit: Low	Typical	High
Linehaul expenses*				
Train and engine crew wages	Train-mile	$ 2.35	$ 2.60	$ 2.90
Dispatching expense	Train-mile	0.90	1.15	1.40
Locomotive cost assigned to miles	Locomotive unit-mile	0.05	0.07	0.10
Locomotive cost assigned to fuel	Gallons of fuel consumed (computed from rise data)	0.27	0.32	0.35
Cost of fuel consumed	Gallons of fuel consumed (computed from rise data)	0.18	0.20	0.24
Maintenance of way (variable part)	Gross ton-miles (thousands)	0.40	0.55	0.75
Terminal expenses*				
Switch engine service or time	Switch-engine hour	55.00	70.00	80.00
Freight car expenses				
Time rental (per diem)	Car-hour of railroad-owned car	0.13	0.18	0.25
Mileage rental (railroad cars)	Car-mile of railroad-owned car	0.025	0.030	0.035
Mileage rental (private cars)	Car-mile of shipper or car-line leased car	0.055	0.065	0.085
Joint facility expenses	Actual charges as in Contract		Refer to Contract	
"Fixed" plant expenses				
Maintenance of way, branch line and yard† (excluding grade crossing maintenance)	Miles of track built or removed (annual cost)	$ 1,000.00	$ 2,000.00	$ 4,500.00
Maintenance of way, main line† (excluding grade crossing maintenance)	Miles of track built or removed (annual cost)	3,500.00	7,000.00	17,500.00
Manned signals, bridges, etc.‡	Per 24-hour position (annual cost)	30,000.00	40,000.00	60,000.00
Maintenance of grade crossings§				
Crossbuck signs	Crossings removed or installed		410.00	
Wigwags	Crossings removed or installed		1,150.00	
Flashing lights	Crossings removed or installed		1,525.00	
Gates	Crossings removed or installed		2,390.00	
Profit from traffic lost/gained	Per carload lost or gained from relocations	50.00	150.00	500.00
Interest expense/saving	Include as a percentage of capital cost/saving	10%	15%	25%
Cost to administer agreements	Per man-hour to collect and process data	$ 10.00	$ 12.50	$ 15.00
Tax expense/saving on increases/decreases in recurring costs	Include as a percentage of total increase/decrease	Refer to locale and financial condition of railroad(s) involved		

*Local trains may be treated as through trains or as switchers depending on which they more nearly resemble, especially as to variance of pay (miles or time). Association of American Railroads' quarterly indices may be used to up-date.

†Cost to maintain and operate large facilities such as stations, major bridges, etc. to be calculated separately.

‡Cost shown is manning cost only—maintenance to be calculated separately.

§Includes crossing surface maintenance.

generally favor efficient, fast and safe work.* However, the typical value shown in the tables and worksheets is the estimated level of cost for urban conditions and assumes some crowding, a larger-than-average number of switches per mile, substantial interference with train and switch engine operations, frequent grade crossings and pavement over the track, and other factors peculiar to urban areas that impair the efficiency of track maintenance operations. In the more difficult-to-maintain urban areas, the unit cost will tend to approach the high figures; in more rural areas, actual unit cost may be close to the low figure.

- The planner will usually have a feel for the relative complexity of the rail plant under study, even if he has no specific railroad experience. He will also have some feel for the relative level of cost in his community. For example, other things being equal, unit costs for outdoor work will tend to be higher in bad weather areas (the northern plains in winter), and labor and incidental costs tend to be higher in certain regions than in others. Intuitive and subjective methods for selecting unit cost levels are necessary when no more formal scales are available.

- Some of the unit costs can be adjusted after discussion with the railroads. For example, the cost per gallon of fuel may be obtained from the companies' annual reports to the Interstate Commerce Commission. Note, however, that the unit cost for fuel shown in the tables and worksheets includes costs of handling, storage, and issue as well as the purchase price of the fuel.

- The value of switch engine time will vary from the low to the high end of the unit cost scale according to the crew size, whether overtime is involved, and the size of the locomotive unit employed.

- Freight car rental costs will be best represented by the low, typical, or high unit cost depending on the relative age and complexity of the cars in question. The typical (medium) level will be accurate in most cases, but sometimes the cars may be especially low value (old coal hoppers) or especially high value (new refrigerator cars, specially-equipped auto parts cars, etc).

- The cost or benefit accruing to the railroads from traffic lost or gained will vary greatly in importance between projects. In

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*A completely satisfactory formula for separating maintenance of way expenses between fixed and variable components and determining the rate of variation with traffic continues to elude railroad cost analysts.

most relocation projects, removal of railroad access to shipper facilities may be a major factor requiring considerable special study.

- Remember not to overlook the recurring capital costs to amortize the outlay for physical plant changes. In addition, increases or decreases in recurring costs will have varying tax implications, depending on the railroad(s) involved.

The planner must exercise special care in dealing with the sensitive matter of abandoning railroad service to customer sidings. Information about tonnage and dollar volume of freight is confidential; railroads are prohibited by law from releasing data about shipper activity except as specified in the Interstate Commerce Act.

If other sources fail, the planner may judge approximate railroad volume by simple observation. The size of the railroad siding, condition (weeds, rust), and frequency with which different rail cars appear on it are clues to volume. A notion of the relative profitability of traffic in different commodities can be obtained from the relative value of the commodities and their susceptibility to handling by competitive modes; this information can be deduced from published tariffs, or from public documents such as the Department of Transportation's "Burden Study."*

If freight traffic profitability becomes a major financial issue, it may be desirable to use a cost-finding method, such as ICC Form A,† to determine probable cost for comparison with revenue developed from published tariff rates.

Of course, it is always preferable to obtain the confidence and cooperation of the industries involved, but this will often be extremely difficult. If the matter is not handled diplomatically, the entire project could be jeopardized.

Nearly all railroad service abandonments require prior ICC approval, and abandonments arising out of condemnation actions are no excpetion. As a

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*The full title is "An Estimation of the Distribution of the Rail Revenue Contribution by Commodity Groups and Type of Rail Car--1969--An Application of Rail Form A Costs to the One Percent Rail Waybill Sample," Office of Policy Review (January 1973).

†The basic document is "Rail Carload Cost scales by Territories for the Year 1970," or updates thereof, published by the ICC's Bureau of Accounts. Further references are cited within it.

general rule, the ICC may be extremely reluctant to grant abandonment where there is an operating profit to the railroad carrier and substantial shipper opposition to abandonment. Minor relocations of trackage not involving changes in the service available to the shipping public do not require ICC approval, but it is always safer to let the Commission make the determination. Construction of new lines, joint track agreements, rearrangement of interchanges, and certain signal or interlocking changes also require ICC or Federal Railroad Administration approval.

In summary, the procedure for estimating recurring railroad costs and benefits arising from urban railroad relocation projects is as follows:

(1) Obtain the necessary background information on the railroad plant and its use and function in railroad operations. Concentrate on understanding, rather than statistical detail.

(2) Select the unit costs that apply and multiply them by the units affected by the proposed change. The sum of these is the cost or benefit.

(3) At each stage of analysis, step back from the detail and look at the project in its entirety to see whether, in the light of new findings, it can be beneficially reconceived.

Railroad Land and Industrial Development Impact

The potential for higher and better use of urban land currently occupied by railroad facilities may be one of the strongest economic and/or social forces behind a plan for urban railroad relocation. Railroad operating companies and/or the land and development subsidiaries of railroad holding companies are increasingly turning to the economic potential of railroad-held land as a means to bolster earnings.

From the railroad's standpoint, one of the most important issues surrounding the potential alternative use of railroad land will be the ownership and control of railroad properties, both during and after railroad facility relocation. Railroads view their land holdings not just as marketable assets, but as long-term investments with significant earning potential. Obstacles may arise in the relocation planning process to the extent that the planned control and disposition of railroad land subsequent to relocation would impair the railroad's ability to share in the future earning potential of the developed property. Thus the railroad operating company may expect and desire particularly careful consideration if a relocation project will result in a decrease in the value of its land holdings.

If land made available by removal of railroad facilities is to be put to public use, the establishment of its fair market value will of course also be a most important issue. It should be recognized that conflict over land use objectives (opinions as to "highest and best use") between railroads and public bodies may give rise to the need for extensive negotiations between these interests.

Additional issues surrounding the land use aspects of a railroad relocation project include: (1) clarity of title to railroad lands, (2) incentives for railroad development of land made available by relocation, (3) property tax implications, and (4) air rights development. All these are discussed briefly below.

Title to Railroad Land

Removal of railroad facilities from railroad land may have an effect upon the clarity of title to such land. Some railroads hold title to land on a reversionary basis, i.e., use of the land for other than railroad transport purposes implies a possible reversion of title to individual or government jurisdictions. To the extent that title complications may require considerable time to resolve, these cases should be identified early in the planning process, particularly if the railroad is to retain control of lands to be developed for other uses.

Incentives for Development

Most railroads are fully aware of the economic potential of development of railroad land. The extent that they themselves have not initiated specific trackage removals or facility relocations to realize such potential is an indication that they either lack real estate expertise or that available resources could be more optimally invested in other alternatives. Financial incentives in the form of low interest (government guaranteed) loans would foster such private development activities as part of the relocation project, if such incentives were made available as part of federal or local programs.

Railroads may have many of the same economic incentives with regard to railroad facility relocation as do public and other private interests. If the presence of railroad facilities has essentially blocked the expansion and economic growth of a particular sector of an urban area, such growth may proceed in other directions, to the possible eventual detriment of commercial and industrial land values surrounding the railroad land.

Property Tax Implications

The impact of changes in assessment values and property taxes upon both the public and private interests involved in a relocation project must be thoroughly investigated. Evaluation of relocation projects should include consideration of changes in taxes resulting from transfers in ownership or use.

Air Rights Development

Property development utilizing the air space over railroad facilities has drawn increasing attention in urban areas where available land is at a premium. If it is determined that compatible use may be made of such air space ("compatible" both from the standpoint of railroad operations and commercial/industrial requirements), determination of the valuation of air rights may prove to be an extremely difficult and complex issue.

Financial Requirements

In analyzing the financial impact upon railroads resulting from the construction of trackage and facilities, it is important to note that project costs are seldom allocated between capital and operating expense according to "accepted accounting principles." This is due primarily to the railroad industry's use of "betterment" accounting procedures, rather than those associated with standard depreciation accounting. Suffice it to say that reasonably detailed financial analysis of any given relocation project may require considerable expertise in railroad industry accounting practice.

As noted earlier, accounting practices of common carrier railroads are prescribed by the Interstate Commerce Commission. The two main classes of ICC accounts are Investment Accounts (Accounts 1 through 80), and Operating Accounts (Accounts 101 through 462). These two groups of accounts have different taxation effects. Under ICC accounting, certain accounts--such as engineering, land, track, and grading--are not depreciable until the track or line is retired. Tax retirements associated with a relocation project result primarily from the retirement of non-depreciable property, with subsequent charges to operating accounts which decrease tax liability. These charges include the ledger value of non-depreciable property retired, less salvage, plus the cost to remove such property. The tax reduction would reflect the appropriate tax rate liability applied to this amount.

It should be noted that treatment of a relocation project under existing taxation and ICC accounting policies may depend upon the extent of the physical relocation of a line from its present position, e.g., for determination of allocation as to capital or operating costs. It is also important to note that the allocation between capital and operating expense may have very different financial implications for different railroads and may well affect their attitudes toward specific projects.

Each railroad line, and each section of line, carries a "ledger value" under ICC accounting rules. These values were determined by appraising the value of the line in 1916, under federal valuation procedures, and adding additions and betterments at the cost actually expended. Thus, the "ledger value" of a line is far below the current replacement cost.

Income Tax Expense or Saving

Federal and various state and local income taxes often play important roles in determining the economic impact of a relocation project on its tax-paying corporate participants. Each project will directly affect operating expenses and revenues, which will result in changes in liability for income taxes in each affected year. In addition, relocation projects will often involve retirements of property that is not fully depreciated, capitalized investments in depreciable property, capital losses or gains on certain retired assets, investment tax credits, and so forth. It would be difficult for an outsider, particularly one not an income tax authority, to estimate the tax impact. The analyst should be aware, however, that the effect of income taxes is generally to cushion, sometimes to halve, the benefit of a gain and the detriment of a loss--since gains are taxed and losses are deductible. Railroads that operate at a loss and pay no current taxes may still consider accrued tax loss carry-forwards of some value, so current tax-paying status is not the only determinant.

In the example that follows, the tax effects are related to capital cost savings which may result from retirement of railroad facilities during a railroad relocation project. When railroad lines and facilities are relocated and/or consolidated, and existing trackage is removed, the nondepreciable portions of these lines (primarily trackwork) are retired and charged to operating expense. This has an impact upon both taxable earnings and capital cost savings. The one-time savings in corporate taxes would generally be computed as illustrated below:

Estimated ledger value of nondepreciable property		$200,000
Estimated tax base of depreciable property, retirement of which qualifies for special obsolescence		50,000
Subtotal:		$250,000
Less:		
Estimated salvage value	$50,000	
Estimated past depreciation	20,000	70,000
Subtotal:		$180,000
Add:		
Cost to remove		20,000
Total estimated tax deduction		$200,000
One-time tax reduction at 48 percent (tax rate liability X estimated tax deduction)		$ 96,000
Annual capital cost (interest) savings at 7 percent (interest rate X tax reduction)		$ 6,720

Worksheet RR-1

APPROXIMATE ANNUAL RAILROAD OPERATING COSTS

1. Railroad N & W   2. Line/Segment Corridor WABASH

		Alt. 0	Alt. 1	Alt. 2	etc.
3.	Route Miles				
	a. Through train	3.99 ~~2.77~~	4.64 →	2.77	
	b. Local train	3.99 ~~2.77~~	4.64 →	2.77	
	c. Switching assignment	N/C	N/C	N/C	
4.	Track Miles				
	a. Main line	LUMP SUM ESTIMATE USED FOR TRACK COSTS			
	b. Branch line	N/A	N/A	N/A	
	c. Yard	N/C	N/C	N/C	
5.	Maximum Grade: percent				
	a. On division	0.65	1.00	0.65	
	b. On project SW bound	0.239	1.00	0.40	
	c. On project NE bound	0.375	0.60	0.40	
6.	Vertical Rise: total ascents (in feet)				
	a. NE bound on grades > .3% but < max. on div.	9.3	39.4	4.5	
	b. NE bound on grades > max. on div.	0	0	0	
	c. SW bound on grades > .3% but < max. on div.	0	12.0	18.0	
	d. SW bound on grades > max on div.	0	21.36	0	
7.	Train Movements: per day				
	a. Through trains SW bound	12	12	12	
	b. Through trains NE bound	12	12	12	
	c. Total through trains (7a + 7b) 17 NONSTOP 7 SO/RU.	24	24	24	
	d. Local trains SW bound	1	1	1	
	e. Local trains NE bound	1	1	1	
	f. Total local trains (7d + 7e)	2	2	2	
	g. Switching assignments SW bound	5	5	5	
	h. Switching assignments NE bound	5	5	5	
	i. Total switching assignments (7g + 7h)	10	10	10	
8.	Maximum Prevailing Speed: mph ON DIVISION	50	50	50	

		Alt. 0	Alt. 1	Alt. 2	etc.
9.	Speed Reductions Below Prevailing Speed: number	1	0	0	
10.	Speed Reduction: average mph below prevailing speed	25	0	0	
11.	Number of Trains Affected by Speed Reduction: per day	17	0	0	
12.	Train Running Time: hours/train to traverse segment				
	a. Through train ≠ NOT SETTING OUT/PICKING UP	.155 / .158	.106 / —	— / .090	
	b. Local train ≠ NOT SETTING OUT/PICKING UP	.182	.158	.125	
	c. Yard engine time (switching or industry work)	N/C	N/C	N/C	
13.	Manned Signal or Interlocking Positions: number	1	0	0	
14.	Estimated Carload Traffic Lost (or Gained): carloads per year		124	124	

Annual Costs (or Savings)

		Alt. 0	Alt. 1	Alt. 2	etc.
15.	Train Delay or Running Time: dollars (USED 126 FOR 7 SA/RU) —	7440	6459	5110	
	a. Through train: average (7c x 12a x \$16 x 365) 17 NONSTOPS	15388 / 15686	10524 / —	— / 8935	
	b. Local train: average (7f x 12b x \$75 x 365)	9965	8650	6844	
	c. Switching: average (7i x 12c x \$70 x 365)	N/C	N/C	N/C	
	d. Total cost (or saving)	32793 / 33091	25,633 / —	— / 20,889	
16.	Route Length or Distance Costs				
	a. Through train: average (3a x 7c x \$14 x 365) FIGURED AS CHANGES FROM ALT. 0	N/C	79,716	N/C	
	b. Local train: average (3b x 7f x \$2.75 x 365) FIGURED AS CHANGES FROM ALT. 0	N/C	1,305	N/C	
	c. Switching: average (3c x 7i x \$2.75 x 365)	N/C	N/C	N/C	
	d. Main line track maint.: average (4a x \$8,000) LUMP SUM ESTIMATED FOR TRENCH OPERATION	N/C	7,500	7,500	
	e. Branch line track maint.: average (4b x \$2,400)	N/A	N/A	N/A	

	Alt. 0	Alt. 1	Alt. 2	etc.
f. Yard track maint.: average (4c × $2,400)	N/C	N/C	N/C	
g. Total cost (or savings) (sum of lines 16a through 16f)	N/C	88,521	7,500	
17. Grade crossing maintenance cost (use Table 5 and HU-1 from Section XI)				
a. Crossbuck sign	820	0	0	
b. Wigwag signal	0	0	0	
c. Flashing light	18,300	0	0	
d. Gates	16,730	0	0	
e. Total cost (or saving) (sum of lines 17a through 17d)	35,850	0	0	
18. Manned Signal of Interlocking Cost (or Saving): average (line 13 × $40,000)	40,000	0	0	
19. Speed Reduction Costs (lines 9 × 11 × Table 4 factor × 365)	62,050	0	0	
20. Gradient Cost (or Saving) vs. Alt. 0 (approximate cost or saving resulting from changes in vertical alignment).				
a. NE bound grades > .3% but < div. max. ([7a + 7d + 7g] × $.16 × Δ6a × 365)		$31,641	$(5,046)	
b. NE bound grades > div. max. ([7a + 7d + 7g] × $.20 × Δ6b × 365)		0	0	
c. SW bound grades > .3% but < div. max. ([7b + 7e + 7h] × $.16 × Δ6c × 365)		12,614	18,922	
d. ____ bound grades > div. max. ([7b + 7e + 7h] × $20 × Δ6d × 365)		28,067	0	
e. Total (20a + 20b + 20c + 20d)		$72,322	$13876	
21. Traffic Lost (or Gained): (average $ of profit) ($150 × Δline 14)				

Recapitulation and Comparison of Annual Costs (or Savings)

	Alt. 1 vs. 0	Alt. 2 vs. 0	Alt. 2 vs. 1	etc.
22. Train Delay or Running Time Cost* (or Saving) (Δline 15d)	(7,160)	(12,202)	(5,042)	
23. Route Length or Distance Cost* (or Saving) (Δline 16g)	88,521	7,500	(81,021)	
24. Grade Crossing Maintenance Cost (Δline 17c)	(35,850)	(35,850)	0	
25. Manned Signal or Interlocking Cost (or Saving) (Δline 18)	(40,000)	(40,000)	0	
26. Gradient Cost (or Saving) (line 20e)	72,322	13,876	(58,446)	
27. Speed Reduction Cost (or Saving) (Δline 19)	(62,050)	(62,050)	0	
28. Total Operating Costs (or Saving) (sum of lines 22 through 27)	15,783	(128,726)	(144,509)	
29. Traffic Lost (or Gained) (line 21)	18,600	18,600	0	
30. Total Cost before Taxes (or Saving)** (lines 28 plus 29)	34,383	(110,126)	(144,509)	
31. Income Tax Expenses (or Saving)	(16504)	52,860	69,364	
32. Total Annual Costs (or Saving) (lines 30 plus 31)	17879	(57266)	(75,145)	

*ASSUMES NO CHANGE IN SWITCHING COSTS.

**EXCLUDES ONE-TIME TAX SAVINGS FROM TRACK RETIREMENTS.

DATE: 1/31/74 INITIALS: JCD

Worksheet RR-2

DETAILED ANNUAL RAILROAD OPERATING COSTS

1. Railroad L&N 2. Line Segment/Corridor LAFAYETTE
   a. Proportion railroad-owned cars .90
   b. Proportion shipper-owned cars .10

	Alt. 0	Alt. 1	Alt. 2	etc.
3. Train Miles: per year				
a. Through train miles (Worksheet RR-1, lines 3a X 7c X 365)	4378 / 6497	4526 / —	— / 7942	
b. Local train miles (Worksheet RR-1, lines 3b X 7f X 365)	1752 / 1942	1810 / —	— / 3036	
c. Total	6130 / 8439	6332 / —	— / 10,978	
4. Locomotive Unit Miles: per year				
a. Ave. no. loc. per through train (Worksheet RO-1)	4	4	4	
b. Ave. no. loc. per local train (Worksheet RO-1)	1	1	1	
c. Through train loc. miles (3a X 4a)	17,512 / 25,988	18,104 / —	— / 31,768	
d. Local train loc. miles (3b X 4b)	1,752 / 1,942	1,810 / —	3036	
e. Total (4c + 4d)	19,264 / 27,930	19,898 / —	— / 34,804	
5. Equivalent Rise: feet				
a. Equivalent rise-- N bound (Worksheet B-2)*	83.74	88.54	82.92	
b. Equivalent rise-- S bound (Worksheet B-2)*	136.61	124.8	128.56	

*In Appendix B.

	Alt. 0	Alt. 1	Alt. 2	etc.
6. Average Tonnage Per Train Per Day (incl. locomotives)				
a. Avg. N bound through train tonnage (Worksheet RO-1 or other survey data)	4,482	→	→	
b. Avg. S bound through train tonnage (Worksheet RO-1 or other survey data)	3,852	→	→	
c. Avg. N bound local train tonnage (Worksheet RO-1 or other survey data)	498	→	→	
d. Avg. S bound local train tonnage (Worksheet RO-1 or other survey data)	429	→	→	
e. Avg. N bound switch train tonnage (Worksheet RO-1 or other survey data)	373	→	→	
f. Avg. S bound switch train tonnage (Worksheet RO-1 or other survey data)	321	→	→	
7. Average Carloads per Train				
a. Avg. carloads per through train (Worksheet RO-1 or other survey data)	80	→	→	
b. Avg. carloads per local train (Worksheet RO-1 or other survey data)	12	→	→	
c. Avg. carloads per switch train (Worksheet RO-1 or other survey data)	20	→	→	
8. Gallons of Fuel Consumed (see Appendix B)				
a. Fuel consumed due to changes in equivalent rise				
(1) Gallons per N bound through train per day $\left(\frac{.075 \times 5a \times 6a}{1000}\right)$	28.15	29.77	27.87	

	Alt. 0	Alt. 1	Alt. 2	etc.
8. Gallons of Fuel Consumed (continued)				
(2) Gallons per S bound through train per day $\left(\frac{.075 \times 5b \times 6b}{1000}\right)$	39.47	36.05	37.14	
(3) Gallons per N bound local train per day $\left(\frac{.075 \times 5a \times 6c}{1000}\right)$	3.13	3.31	3.10	
(4) Gallons per S bound local train per day $\left(\frac{.075 \times 5b \times 6d}{1000}\right)$	4.40	4.02	4.14	
(5) Total gallons: per year [(8a1 × RR-1, line 7a) + (8a2 × RR-1, line 7b) + (8a3 × RR-1, line 7d) + (8a4 × RR-1, line 7e)] × (365)	64,452	62,736	61,964	
b. Fuel consumed due to slowing down and speeding up of trains (changes in train speed)				
(1) Gallons per ____bound through train $\left[\frac{.075 \times 6a \times .0334 \, (V_1^2 - V_2^2)}{1000}\right]$	NOT APPLICABLE -- ALL L&N TRAINS ARE YARDED IN LAFAYETTE			
(2) Gallons per ____bound through train $\left[\frac{.075 \times 6b \times .0334 \, (V_1^2 - V_2^2)}{1000}\right]$				
(3) Gallons per ____bound local train $\left[\frac{.075 \times 6c \times .0334 \, (V_1^2 - V_2^2)}{1000}\right]$				
(4) Gallons per ____bound local train $\left[\frac{.075 \times 6d \times .0334 \, (V_1^2 - V_2^2)}{1000}\right]$				

	Alt. 0	Alt. 1	Alt. 2	etc.
8. Gallons of Fuel Consumed (continued)				
(5) Total gallons: per year [(8b1 × RR-1, line 7a) + (8b2 × RR-1, line 7b) + (8b3 × RR-1, line 7d) + (8b4 × RR-1, line 7e)] × (365)	N/A	N/A	N/A	
c. Total gallons of fuel consumed [8a(5) + 8b(5)]	64,452	62,736	61,964	
9. Gross Ton-Miles per Year:				
a. Gross ton-miles per day--through trains [(6a X RR-1, line 7a) + (6b X RR-1, line 7b)] X [RR-1, line 3a]	50,004 74,173	51,671 —	— 90,632	
b. Gross ton-miles per day--local trains [(6c X RR-1, line 7d) + (6d X RR-1, line 7e)] X [RR-1, line 3b]	2,225 2,466	2,299 —	— 3,856	
c. Gross ton-miles per day--switch trains [(6e X RR-1, line 7g) + (6f X RR-1, line 7h)] X [RR-1, line 3c]	3,341 3,703	3,452 —	— 5,791	
d. Total ton-miles per year [(9a + 9b + 9c) X 365]	20,283,050 29,324,830	20,959,030 —	36,601,835	
10. Switch Engine Hours per Year (EST. CHANGES FROM ALT. 0) (from sample, survey, and/or judgmental data) DOES NOT INCLUDE POSSIBLE SAVING FROM INTERCHANGE RELOCATION.	N/C	(130)	(110)	
11. Car Hours of Railroad-Owned Cars per Year				
a. Through trains (7a X RR-1, line 7c X 365 X RR-1, line 12a X 1a)	26,937 35,268	11,300 —	— 17,161	
b. Local trains (7b X RR-1, line 7f X 365 X RR-1, line 12b X 1a)	1,616 1,837	678 —	— 1,049	
c. Switch trains (7c X RR-1, line 7i X 365 X RR-1, line 12c X 1a)	4,041 4,592	1,853 —	— 2,621	
d. Total (11a + 11b + 11c)	32,594 41,697	13,831 —	— 20,831	

	Alt. 0	Alt. 1	Alt. 2	etc.
12. Car Miles of Railroad-Owned Cars per year				
a. Through trains (7a X RR-1, line 7c X 365 X RR-1, line 3a X 1a)	315,360 467,784	325,872 —	— 571,590	
b. Local trains (7b X RR-1, line 7f X 365 X RR-1, line 3b X 1a)	18,922 20,971	19,552 —	— 32,797	
c. Switch trains (7c X RR-1, line 7i X 365 X RR-1, line 3c X 1a)	63,269 70,168	65,437 —	— 109,588	
d. Total (12a + 12b + 12c)	397,551 558,923	410,861 —	— 713,975	
13. Car Miles of Shipper-Owned Cars per Year				
a. Through trains (7a X RR-1, line 7c X 365 X RR-1, line 3a X 1b)	35,040 51,976	36,208 —	— 63,510	
b. Local trains (7b X RR-1, line 7f X 365 X RR-1, line 3b X 1b)	2,102 2,330	2,172 —	— 3,644	
c. Switch trains (7c X RR-1, line 7i X 365 X RR-1, line 3c X 1b)	7,030 7,796	7,271 —	— 12,176	
d. Total (13a + 13b + 13c)	44,172 62,102	45,651 —	— 79,330	

Annual Costs - "Average Cost Level"

	Alt. 0	Alt. 1	Alt. 2	etc.
14. Linehaul Costs				
a. Train and engine crew wages (3c × $2.60)	15,938 21,941	16,463 —	— 28,543	
b. Train mile expense (dispatching) (3c × $1.15)	7,050 9,705	7,282 —	— 12,625	
c. Locomotive cost assigned to miles (4e × $.07)	1,348 1,955	1,393 —	— 2,436	
d. Locomotive cost assigned to fuel (8c × $.32)	20,625	20,076	19,828	
e. Cost of fuel consumed (8c × $~~.20~~) $.22 L&N FUEL COST	14,179	13,802	13,632	
f. Maintenance of way (variable portion) $\frac{(9d \times \$.55)}{1000}$	11,156 16,129	11,527 —	— 20,131	

	Alt. 0	Alt. 1	Alt. 2	etc.
14. Linehaul Costs (continued)				
g. Total (14a + 14b + 14c + 14d + 14e + 14f)	70,296 84,534	70,543 —	— 97,195	
15. Terminal Costs--switch engine service (line 10 X $70)	N/C	(9100)	(7700)	
16. Freight Car Costs				
a. Time rental--railroad cars (11d X $.18)	5,867 7,505	2,490 —	— 3,750	
b. Mileage rental--railroad cars (12d X $.030)	11,927 16,768	12,326 —	21,419	
c. Mileage rental--private cars (13d X $.065)	2,871 4,037	2,967 —	— 5,156	
d. Total (16a + 16b + 16c)	20,665 28,310	17,783 —	— 30,325	
17. Joint Facility Expenses	N/C	N/C	N/C	
18. "Fixed" Plant Expenses				
a. Maintenance of way--branch line and yard [(RR-1, line 4b + RR-1, line 4c) X $2,000]	N/A	N/A	N/A	
b. Maintenance of way--main line (RR-1, line 4a X $7,000) LUMPSUM, ESTIMATED FOR OPERATING IN TRENCH + CHANGES IN TRACK MILEAGE.	N/C	2,700	{1,554 2,700	
c. Manned signals, bridges, etc. (RR-1, line 18)	0	0	0	
d. Total (18a + 18b + 18c)	0	2,700	4,254	

NOTE: BOTH ALT. 1 & 2 WILL SAVE L & N ~ $175,000. IF NOT REQUIRED TO RAISE 5th ST. TRACKS TO NEW LEVEL.

	Alt. 0	Alt. 1	Alt. 2	etc.
19. Grade Crossing Maintenance				
a. Crossbuck sign (RR-1, line 17a)	820	0	0	
b. Wigwag signal (RR-1, line 17b)	0	0	0	
c. Flashing light (RR-1, line 17c)	19,825	0	0	
d. Gates (RR-1, line 17d)	4,780	0	0	

		Alt. 0	Alt. 1	Alt. 2	etc.
19.	Grade Crossing Maintenance (continued)				
	e. Total (19a + 19b + 19c + 19d)	25,425	0	0	
20.	Profit Change from Traffic Lost or Gained (RR-1, line 21)		0	0	
21.	Interest expense (or saving) (% of capital cost or savings from Table 5) AND INTEREST SAVINGS ON TAX REDUCTION FROM RETIREMENTS @ 7%.		(3570)	(3570)	
22.	Administrative Expense (Table 5)		N/C	N/C	
23.	Income Tax Expense (or saving) (Table 5)				
	a. Tax on operating cost or saving: percent		48%	48%	
	b. One-time tax saving from retirement		51,000	51,000	

Recapitulation and Comparison of Annual Costs

		Alt. 1 vs. 0	Alt. 2 vs. 0	Alt. 2 vs. 1	etc.
24.	Linehaul Cost (or Saving) (Δline 14g)	247	12,661	12,414	
25.	Terminal Cost (or Saving) (Δline 15)	(9100)	(7700)	1400	
26.	Freight Car Cost (or Saving) (Δline 16d)	(2882)	2015	4897	
27.	Joint Facility Cost (or Saving) (Δline 17)	0	0	0	
28.	"Fixed" Plant Expense (or Saving)* (Δline 18d)	2700	4,254	1,554	
29.	Grade Crossing Maint. Cost (or Saving) (Δline 19e)	(25,425)	(25,425)	0	
30.	Administrative Cost (Δline 22)	0	0	0	
31.	Operating Cost (or Saving) (sum of lines 24 through 30)	(34,460)	(14,195)	20,265	
32.	Traffic Revenue Loss (or Profit) (line 20)	0	0	0	
33.	Interest Expense (or Saving) (line 21)	(3570)	(3570)	0	
34.	Net Cost (or Saving) Before Taxes	(38,030)	(17765)	20,265	
35.	Income Tax Expense (Saving) (line 23a)	18,255	8527	(9728)	
36.	Total Cost after Taxes (Saving)	(19,775)	(9,238)	10,537	
37.	One-time Tax Cost (or Saving) (line 23b)	50,000	50,000	0	

* BOTH ALT. 1 & 2 WILL SAVE L&N ABOUT $175,000 IF L&N DOESN'T HAVE TO RAISE 5th ST. TRACKS TO CURRENT PAVEMENT LEVEL.

DATE: 2/4/74 INITIALS: JCD

X RAILROAD USER IMPACT

Characteristics of Affected Railroad Users

The receipt, storage, and shipment of raw materials and finished goods is a complex and expensive part of many industries. Minimization of freight transportation costs is consequently a prime determinant of many business locations. Industries that choose sites adjoining railroads tend to have a need for shipping or receiving bulky, heavy products, often with a low value per ton, e.g., building materials, minerals, fuel, and bulk agricultural produce. Railroads are increasingly more aggressive in soliciting high-value traffic, but much of their tonnage remains in shipping low-value goods. For goods with higher values per ton, transportation costs usually constitute a smaller fraction of the product costs. There is also more need for reducing shipping and transfer time of these higher-value goods to keep inventory costs low.

A prime characteristic of industries vitally dependent on railroad freight service is that transportation costs tend to constitute a high proportion of total costs. Table 6 gives the percentage split of costs between railroad, intercity truck, and other freight modes for selected industries listed in order of decreasing freight cost as a percent of final cost. Generally, a high percentage of freight costs is associated with a high proportion of railroad freight costs, and vice versa. The proportion of ton-miles shipped by railroad is even higher than the proportion of railroad cost reported in the statistics on which Table 6 is based, because intercity railroad shipping costs per ton may be only 20 to 75 percent of truck costs.

Railroad User Transportation Cost

While the general degree of user dependency on direct railroad freight service can be determined from the National Transportation Report, only a specific and detailed comparison of railroad rates with the costs and service features of alternative transportation modes for the products and routes in question will reveal the costs of replacing rail service. Trucking is the most commonly available alternative mode. In addition, the means and cost of goods storage and distribution within an industry affect the ease with which it can shift from railroad to highway freight. Loading docks and materials handling equipment and personnel may differ

Table 6

PERCENT DISTRIBUTION OF FREIGHT EXPENSES
FOR SELECTED INDUSTRIES, BY MODE

Sector	Total Freight Cost as Percent of Product Cost	Percent Distribution of Freight Expense		
		Railroad	Intercity Truck	Other*
High freight cost industries				
Coal mining	30.2%	68.9%	18.5%	12.6%
Iron ore mining	27.4	55.8	6.9	37.3
Scrap sales	16.7	86.8	7.2	6.0
Lumber and products	13.5	55.6	21.5	22.9
Low freight cost industries				
Furniture	6.7	34.3	41.8	23.9
Textiles and apparel	5.4	16.7	59.4	23.9
Scientific, optical instruments	5.4	11.1	77.8	11.1
Electrical machinery	3.9	28.2	43.6	28.2

*Local trucking, domestic waterway, air carrier, and pipeline.

Source: Adapted from Table III-52, 1972 National Transportation Report, Department of Transportation, July 1972, page 72.

for the two modes, and hence entail conversion costs. Balancing the higher costs of trucking is the possibly faster, more frequent, or more reliable truck service that may permit smaller inventories and consequent savings. All affected costs and savings must be considered in the decision to shift from one mode to the other.

Alternative Provisions for Railroad Users

The planners and the management of enterprises that are rail users have alternatives for handling the needs of the user in a railroad relocation project. Five of these are described below.

User Changes to Alternate Transportation Mode

Not all shippers will experience the same effects from the loss of railroad service. Some can remain in their present locations if their use of the land is compatible with the projected use after the railroad relocation. Those remaining will usually experience an increase in transportation costs but may find that some savings related to the use of alternate modes partially offset the higher shipping costs, or that the increased costs are still smaller than the costs (and disruption) of moving.

If a shipper is forced to give up railroad service and chooses not to move, his recurring costs will increase because of higher shipping or handling costs, and he will incur some one-time investment costs in adapting his production and internal distribution systems from railroad to some other mode. Balancing these costs will probably be some savings in inventory cost (the latter can be checked against industry averages).

The loss of railroad shipping revenues to truckers must be described as a disbenefit to the railroad, but should be included in the distributional comparison of benefits and costs (see Section XV) rather than in the cost-benefit analysis because an offsetting "benefit" is experienced by the truckers.

Railroad Improves Piggyback Service

One means that may facilitate the transition to truck freight service after railroad relocation is the creation of railroad/truck freight transfer stations away from the commercial and residential area. Use of "piggyback" freight service (TOFC, trailer-on-flat car, or COFC, container-on-flat car), by which highway trailers or van-size containers are transported by rail over part of their journey, may seem attractive in some communities. Over one thousand piggyback service locations now exist in the United States. Location of facilities for more than two modes at the same depot, especially truck, railroad, and marine, may provide further economies of scale and flexibility. Also, the transfer of commodities (including bulk commodities) from one mode to another is being speeded and reduced in cost by highly mechanized transfer facilities. Hence, intermodal depots may reduce costs of certain joint railroad/truck shipments to the point that shippers affected by railroad relocation can shift to truck deliveries or pickups. While such depots are a sizable and separate issue by themselves, their inclusion as possibilities in the relocation study can contribute to planning for replacement of railroad service to affected shippers, as well as helping to identify more potential patronage for the depot.

User Relocates

The increase in shipping costs resulting from loss of railroad service may be so severe that an enterprise cannot continue as a viable organization in its present location. Its management may have several options; moving to another location or going out of business altogether are the two most obvious ones to consider.

The decision to move to another site involves consideration of the following costs by the management:

- Construction of new facilities.
- Moving costs.
- Revenue losses (or gains) owing to location of new site.
- Operating savings owing to more efficient plant and equipment.
- Transportation costs for new site.
- Proceeds from sale of old site and facilities, if the current facilities are owned by the user (less any necessary costs of demolition and site clearance).

The ease and cost of a shipper's move to another location will be determined in part by the cost and complexity of his plant. Generally, it appears that process-type industries have the more expensive and complex plants and would be more difficult to move, whereas storage-type industries could move more readily, especially ones housed in small or general-purpose structures. Examples of these two types are:

Process Industries	Storage Industries
Breweries	Freight forwarders
Canneries	Grain elevators
Foundaries	Lumber yards
Manufacturing	Warehouses

The provision of a new plant entails a conceptual problem in evaluation of the impact of the relocation on shippers who move. Clearly, the increased productivity or the increased depreciation charges that attend a new facility cannot reasonably be assigned to the railroad relocation project. To avoid the conceptual problem, and to make benefit computation independent of the decisions of the plant management, a different framework must be found. One such framework, developed from discussions with affected users in case studies of relocation projects, considers that the existing operations are moved to an identical facility, and determines the cost of moving and lost production or service and increased transportation cost from the new site, as well as changes in value of the existing facility. The assessment of changed property value must be judged in the light of the potential land use of the property after the railroad service is eliminated, which may be higher or lower than under the present circumstances.

Alternate Railroad Connections Are Provided

Some railroad relocation and consolidation plans include retaining service to existing customers over downgraded tracks that were formerly parts of the through railroad route in the area. In those instances, no change in railroad user costs will result, although increased railroad operating costs may be incurred because of increased time or distance required to deliver and pick up cars. Nevertheless, this option is necessary if there is a large user who would have high relocation costs. The existence of these kinds of trade-offs leads to the creation of sub-alternatives or variations of the basic alternatives for analysis.

Temporary Railroad Service Is Maintained

Another possibility is to maintain railroad connections to existing customers for a specified period of time--say, five to ten years. At the end of the specified time, railroad connections would be severed. During the "grace period" the user would have time to amortize his plant and equipment and go out of business, convert to other transportation modes, or find a new site. The length of this grace period can be approximated from Internal Revenue Service publications that estimate the lives of facilities in different industries. If the grace period is granted, the user is assumed to be able to manage his affairs so that he will not incur any damage during the period.

Estimating Railroad User Impact

In contrast to the definitive methodology that translates physical measurements of length, number of cars, or vertical elevation differences into railroad operating impacts, estimation of railroad user cost is a very subjective and judgmental process. The planner must realize that there will be a negotiated settlement of the exact amount and he will wish to influence the negotiations as little as possible so that the parties themselves reach what they believe is an equitable settlement. Worksheet RU-1 provides a structure for data collection from a potentially affected railroad user and Worksheet RU-2 provides the necessarily minimal framework for analysis of the data.* The analyst may devise further analytic processes or estimating techniques as applicable. The estimates of moving cost in Worksheet RU-2 are best obtained from a firm with experience in moving the type of industry involved. However, preliminary estimates can usually be obtained from the proprietor or from someone in the community with a similar kind of business that has recently relocated.

Worksheet RU-3 may assist an affected user to determine his alternative transportation costs if he decides to remain. Worksheet RU-4 provides a format for summarizing the impacts on the affected users.

While some planning practitioners survey all users in the community, there is no need to gather the data for Worksheet RU-4 from those users not directly affected by the alternatives being considered; otherwise the sheer volume of information will make it difficult to analyze.

Payments to Railroad Users

Not only should there be concern for the railroad user as a citizen and an employer in the community, but also because of legal considerations affecting the provision of railroad services. The Interstate Commerce Commission has jurisdiction over all additions, abandonments, and changes of railroad service. When the permission of the ICC is sought for the implementation of a project, the Commission will normally announce the intention and ask interested parties if there is an objection. If a railroad user objects, a hearing is scheduled before an ICC examiner, who takes testimony and cross examines in an adversary proceeding. These proceedings can be time-consuming (major cases have taken over ten years).

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*The RU worksheets and instructions for them (where necessary) appear at the end of this section, starting on p. X-8.

The compensation of a railroad user deprived of service is thus a legal matter although, as a general practice, users do not receive compensation for service abandoned by order of the ICC.

In a railroad relocation, the user deprived of railroad service may incur additional costs whether he moves or remains, and the owner of the property may also incur a change in the value of his property. Therefore, in the interest of accelerating the implementation of the project, it may be advisable to try to come to an agreement with the user which will permit him to continue his operations in another location, with compensation for the moving and disruption that the move may cause. The computations made in the worksheets will provide information that will assist in the negotiation of any settlement.

Worksheet RU-1

RAILROAD USER DATA

1. Railroad User P&E LUMBER* 2. Interview with JOE EAGLE

3. Title PROPRIETOR 4. On (date) 6/23/73

5. Business Description

a. Business LUMBER YARD

b. Industry WHOLESALE & RETAIL

c. Main product(s) DIMENSION LUMBER, HARDWARE

d. Approximate annual sales $2,000,000

e. Number of employees 60

f. Annual payroll $500,000

g. Inventory: Commodity LUMBER & HARDWARE

Number of units 600,000 BOARD FEET

Pounds N/A

h. Annual transportation cost:

(1) Railroad $100,000 (INBOUND ONLY)

(2) Other modes 10,000 (" ")

6. Facility Description

a. Land area 2 ACRES

b. Building area 55,000 SF

c. Building construction and age BRICK RETAIL AREA, CORRUGATED SIDING WAREHOUSE.

d. Equipment type STORAGE RACKS, SAW & PLANE.

e. Special features: Railroad siding 2 CARS

Truck dock DELIVERY ONLY -- INCOMING LUMBER UNLOADED WITH STACKER.

*FICTITIOUS FIRM. RAIL USERS ARE NOT AN ISSUE IN THE DEMONSTRATION CITY, SO THIS EXAMPLE IS A COMPOSITE OF ACTUAL INTERVIEWS IN OTHER CITIES.

g. Estimated total value of facilities — $750,000

h. Ownership (tenant or other) — TENANT

7. Railroad Usage

a. Name of railroad serving — SOUTHERN ISLAND RAILROAD

b. Commodities for which railroad service used — LUMBER

c. Annual number of carloads

(1) This year — 120

(2) Last year — 120

(3) Five years ago — 110

d. Average tons per carload — 40

8. User Preference

a. Move — FIRST CHOICE

b. Change transport mode(s) — NOT POSSIBLE

c. Grace period — MAY COMBINE WITH MOVE

d. Other — UNABLE TO IDENTIFY

9. Comments

PROPRIETOR HAS FOUND LIMITED NUMBER OF SITES AVAILABLE. HE IS LOOKING FOR A LARGER SITE IN A PART OF TOWN WHERE THERE IS LIMITED RAIL SERVICE.

DATE: 6/30/73 INITIALS: AEM

Worksheet RU-1 Instructions

Worksheet RU-1 is provided as a convenient format for collection of data on affected rail users. Separate sheets may be prepared for each user, or several similar users may be grouped.

Line 1: Enter the name of the user.

Line 5: Enter the business and industry of the user from the standard industrial classifications, e.g., manufacturing--transportation equipment. Under product, enter the principal product of the facility that will be affected, e.g., brake shoes. Obtain from the proprietor the approximate annual sales, number of employees, approximate payroll, information on the type and amount of inventory carried, and his annual transportation cost by railroad and by all other modes such as truck, air, or water.

This information may appear in the annual report, if one is available for the business. Other sources are regional or state business directories. Missing data may be constructed from industry averages.

Line 6: Enter details of the facility that is affected by the alternative: the land area being used by the enterprise, the size of the building (in square feet), a description of the building (e.g., four-story brick, concrete floors, 10 years old). Describe equipment installed in the building and its size as an aid to estimating the difficulty of moving (3-ton W&S turret drill press, 5 metal cutting lathes, approximately 500 pounds each, etc.). Describe special features of the building such as rail sidings and truck sidings, their size or number of cars or trucks they can handle; also enter other features such as special doors or free space between columns. Finally, determine the proprietor's estimate of the buildings' value and whether the business owns or rents the property.

Line 7: Identify the railroad company that serves the facility, the commodities for which railroad service is used (sheet steel, asbestos, etc.), and the average annual volume (in carloads) of railroad use for the periods indicated. Finally, determine the average tonnage per carload.

Line 8: Discuss with the proprietor his options for continuing to operate his business in the event that railroad service is moved away from his present location, and indicate his preference.

Worksheet RU-2

RAILROAD USER MOVING AND DISRUPTION COSTS
(Alternative 1 OR 2)

1. Railroad User 4 USERS ON N&W

2. Moving Cost

   a. Units of move — 4 ESTABLISHMENTS

   b. Cost per unit (CONSULTANT ESTIMATE) — $2,500

   c. Total — $10,000

3. Disruption Cost

   a. Equivalent days production (or service) lost — N/A

   b. Expense per day lost — ↓

   c. Value of lost production — ↓

   d. Other disruption expenses — ↓

   e. Total — ↓

4. Tax Impact on User

   a. Total disruption expense (line 3e) — 0

   b. Total moving expense (line 2c) — $10,000

   c. Unamortized leasehold improvements — 0

   d. Total before-tax expense (4a + 4b + 4c) — $10,000

   e. Marginal tax rate — REIMBURSED

   f. Tax credit for expense (4d X 4e) — 0

   g. Net expense after tax (4d - 4f) — 0

5. Community Impact

   a. Potential relocation site — CANAL RD.

   b. Is relocation site outside community? (if no, go to line 6a) — NO

   c. How far? — N/A

   d. Will present employees retain jobs after move? — YES

e. Estimated loss of jobs: number N/A

f. Estimated payroll loss: $ N/A

6. Land Owner Impact

a. Is present land use compatible with planned use? YES

b. Appraised value of property as is:

(1) Land ______

(2) Improvements ______

(3) Total ______

c. Estimated value of property after relocation:

(1) Land ______

(2) Improvements ______

(3) Total ______

d. Net land owner impact [6b(3) - 6c(3)] NO CHANGE

7. Community Land Value Loss

(0 if 5b is no, 6d if 5b is yes) 0

8. Comments

DATE: 2/5/74 INITIALS: AEM

Worksheet RU-2 Instructions

Worksheet RU-2 is provided to estimate the impact of moving a railroad user from his present site to another comparable one with railroad service.

Line 1: Identify the railroad user(s) that would be moved under one of the alternatives.

Line 2: Estimate the total amount of inventory and equipment to be moved. Get assistance developing a preliminary estimate from a moving contractor or from the proprietor of the firm.

Line 3: Estimate the number of days of lost production or service that will result from the move. This will include dismantling, removal, reinstallation, and checkout time. If the production is expected to begin at a partial capacity and then build up, enter the equivalent effect as if the production were zero, then built up to 100 percent after the equivalent time. With the assistance of the proprietor estimate the expense per day of lost production. This can later be verified from average sales volume and profitability ratios for the industry. If there are other disruption expenses, such as cleanup, enter these, and add all the disruption expense. (In the example, disruption is minimized by the relatively high turnover of stock and the nature of the business.)

Line 4: Add the moving cost and the disruption expense to the unamortized leasehold improvements (if the facility is leased) to determine the before-tax expense. Compute the tax credit on the expense and determine the after-tax expense.

Line 5: The community will or will not be affected according to whether the employment of the enterprise continues to be drawn from the community or whether the present employees will be displaced because of excessive distance for travel to work. Enter the information designated.

Line 6: The landowner's planned use for the property after the railroad is moved may have a favorable or unfavorable impact on the property. With the assistance of a qualified land appraiser, estimate the values of the land and improvements before and after railroad service is moved, and compute the owner impact. The owner impact will also be a community impact if the enterprise must move outside the community.

Worksheet RU-3

RAILROAD USER TRANSPORTATION COSTS
(Alternative____)

1. Railroad User______________________

2. Annual Railroad Use
   - a. Number of carloads (Worksheet RU-1, line 7c) ________
   - b. Average tons per carload (Worksheet RU-1, line 7d) ________
   - c. Annual tonnage (2a X 2b) ________
   - d. Annual railroad transportation cost (Worksheet RU-1, line 5h1) ________
   - e. Cost per ton (2d + 2c) ________

3. Alternate Mode(s)
   - a. Rate per ton ________
   - b. Alternate mode cost (3a X 2c) ________

4. Additional Transportation Cost (or Saving) (3b - 2d) ________

5. Savings
   - a. Inventory reduction: $ per year ________
   - b. Inventory carrying cost ________
   - c. Annual inventory saving (5a X 5b) ________
   - d. Other savings (or costs) ________
   - e. Total savings ________

6. Tax Impact ________
   - a. Net cost difference (4 - 5e) ________
   - b. Marginal tax rate ________
   - c. Annual tax decrease (or increase) (6a X 6b) ________ ________
   - d. Net increase after tax (6a - 6c) ________

7. Annual Relative Cost Increase (6d ÷ total net profit) ________%

DATE:______________ INITIALS:______________

Worksheet RU-3 Instructions

Worksheet RU-3 is provided to assist in the estimation of the net increase intransportation and handling cost if a user decides to change modes instead of moving to a new location.

Line 1: Enter the name of the railroad user under study.

Line 2: Enter the information from RU-1 for annual railroad usage and make the computations noted.

Line 3: With the assistance of someone from a trucking or other company that provides the alternative transportation services, estimate the cost per ton, from the commodity shipped and average destinations.

Line 4: Compute the additional transportation cost as shown.

Line 5: Estimate savings or costs associated with the alternate mode by estimating the inventory reduction possible by using the new mode. This estimate can be obtained from the proprietor or from the representative of the new mode transportation company. The inventory carrying cost is a percent of the inventory value associated with the capital cost, storage, handling, insurance, and obsolescence of inventory. Industry sources or the proprietor should be able to estimate the carrying charges. Use a figure of 20 to 30 percent if better estimates are not available.

Line 6: Compute the tax impact as shown on the worksheet. The net impact in line e is a measure of the estimate of the importance of the transportation cost increase to the enterprise. The proprietor may indicate his total net profit, or industry averages of the ratio of profits to sales can be applied to the annual sales in Worksheet RU-1.

Worksheet RU-4

SUMMARY OF RAILROAD USER COSTS
(Alternative 1)

	User 1	User 2	User 3	USER 4 etc.	Total
1. Moving/Disruption Expense (Worksheet RU-2, line 4d)	$2500	$2500	$2500	$2500	$10,000
2. Additional Transport Cost (Worksheet RU-3, line 6a)					
3. Total Railroad User Costs					10,000
4. Net Land Owner Cost (Gain) (Worksheet RU-2, line 6d)	INCLUDED	IN	NEIGHBORHOOD		IMPACT
5. Community Land Value Loss (Worksheet RU-2, line 7					0
6. Community Payroll Lost (Worksheet RU-2, line 5f)					0
7. Community Jobs Lost (Worksheet RU-2, line 5e)					0

DATE: ____________ INITIAL: ____________

XI HIGHWAY USER IMPACT

Railroad grade crossings often result in significant increased costs to the highway user, i.e., motorist. Although the impact on individual users may be slight, because of the number of highway users, the aggregate impact is significant. The effects include increases in motor vehicle operating costs associated with speed reductions when crossing the tracks and when stopping for a train, and the associated acceleration back to normal speed. Traveling over or under the railroad on a grade separation structure may also increase operating costs. The speed reductions and stops also result in increased travel time, which can be readily converted to a dollar cost value. A third major component of highway user costs is that of accidents at grade crossings.

Worksheets are presented in this section for use in calculating the incremental operating, time, and accident costs associated with railroad grade crossings. These costs are additional to those that would normally be encountered if the crossing were eliminated. Five worksheets are provided for making the necessary calculations. Each is discussed below, together with relevant assumptions and equations, as appropriate. Several sets of curves are presented for use with the worksheets. Estimates of increased operating cost due to grade separation structures are not included because of the variety of possible configuration and dimension.

Worksheets are provided for preparing an inventory of the affected grade crossings (Worksheet HU-1), for calculating the annual added operating and time costs to the user (Worksheets HU-2 and HU-3), for estimating the annual added accident costs (Worksheet HU-4), and for preparing an estimate of total annual highway user cost including an allowance for traffic growth (Worksheet HU-5).* Curves are provided for estimating the individual time and operating cost components based on the independent variables provided in the grade crossing inventory.

Worksheet HU-6 is provided to compute vehicle emission at grade crossings. Although pollution is a neighborhood or community impact, the worksheet is included here because the computations are related to those for estimating highway user impact.

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*The HU worksheets and instructions for them appear at the end of this section.

Because some of the results of the highway user cost and related computations will be used in the neighborhood impact analysis, the analyst may wish to sort the grade crossings by neighborhood and prepare the analysis in Worksheets HU-1 through HU-6 for each neighborhood. A discussion of the criteria of selecting and identifying neighborhoods for analysis is presented in Section XII. If a neighborhood-by-neighborhood analysis is made, the results of all the neighborhood analyses are summarized in Worksheet HU-7 in this section.

Grade Crossing Inventory

Worksheet HU-1 is provided for preparing an inventory of grade crossings that will be eliminated or affected by changes in railroad or highway traffic. This inventory includes the independent variables necessary for calculating the highway user benefits. The inventory worksheet is to be filled in for each grade crossing of interest based on data from the DOT-AAR Grade Crossing Inventory projected to the year immediately following completion of the railroad relocation project, i.e., the initial year of project implementation. Normally the base case will require a listing of all grade crossings affected by any alternative.

Each component of the grade crossing inventory discussed in the instructions accompanying Worksheet HU-1, should be entered for each grade crossing in the indicated column of that worksheet. Where appropriate, guideline values (average figures available on a national basis) are indicated for use when specific grade crossing variables are not known.

In the sample entries in Worksheet HU-1, the second crossing is a combination of two separate similar crossings, each with 100 vehicles per day average daily traffic (ADT). Default values are assumed where data are not available.

Once the grade crossing inventory has been completed, the subsequent worksheets may be used to estimate the associated changes in operating and time costs for highway users.

Added Vehicle Operating Costs

Worksheet HU-2 provides a method for estimating the added operating costs incurred by the highway user owing to the railroad grade crossings inventoried in Worksheet HU-1. The various values specified in the crossing inventory HU-1, Columns B through H, are used to select the appropriate added vehicle operating cost factors from the sets of curves presented in Figures 9 through 12 on the following pages.*†

Added Traveler Time Cost

Worksheet HU-3 provides a method for establishing the added time costs to the highway user incurred by the railroad grade crossings inventoried. The various values specified in the crossing inventory (Worksheet HU-1), Columns B through H, are used to select the appropriate added time cost factors from the sets of curves presented in Figures 13 and 14.

Added Highway User Accident Costs

The added highway user accident costs are entered in Worksheet HU-4 for each of the grade crossings inventoried in Worksheet HU-1. Figures 15.a‡ and 15.b§ present data relevant to the determination of accident costs, based on the trains per day, average daily traffic, and crossing protection (as identified in Worksheet HU-1).

---

*Implicit in the curves presented in these figures and also in Figures 13 and 14 are assumptions as to vehicle mix (92.7% passenger cars, 4.7% single unit trucks, 2.7% combination trucks) and the values-of-time ($1.80/hr for autos, $5.00/hr for trucks).

†Figures 9-14 and 17 and 18 are derived from material in Curry, David A., and Dudley G. Andersen, "Procedures for Estimating Highway User Costs, Air Pollution, and Noise Effects." National Cooperative Highway Research Program (NCHRP) Report 133, Highway Research Board, Washington, D.C. 1972.

‡Factors in Figure 15.a are from Schoppert, David W., and Dan W. Hoyt, "Factors Influencing Safety at Highway-Rail Grade Crossings," National Cooperative Highway Research Program (NCHRP) Report 50, Highway Research Board, Washington, D.C. 1968; and "A Program Definition Study for Rail-Highway Grade Crossing Improvement," Final Report, Alan M. Voorhees and Associates, Inc., McClean, Virginia, 171 pp. (October 1969).

§Figure 15.b derived from backup material collected for: "Report to Congress on Railroad-Highway Safety, Part II: Recommendations for Resolving the Problem," U.S. Department of Transportation, Washington, D.C., p. 36 (August 1973).

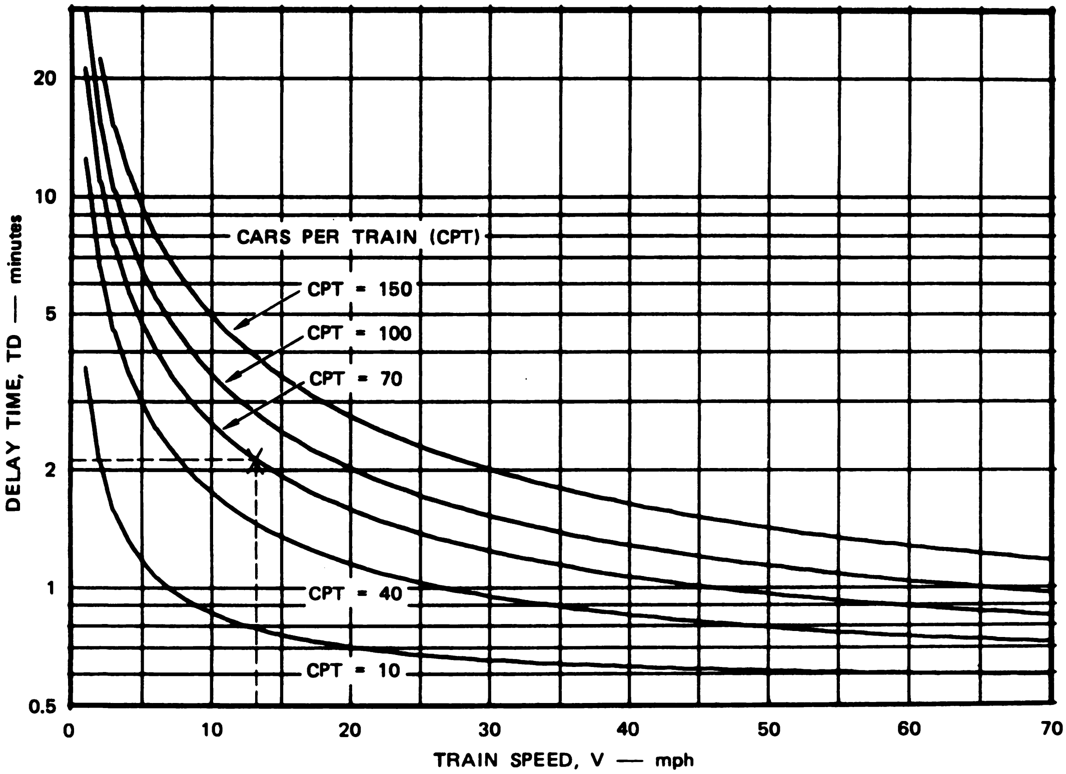


FIGURE 9 DELAY FACTOR CURVES

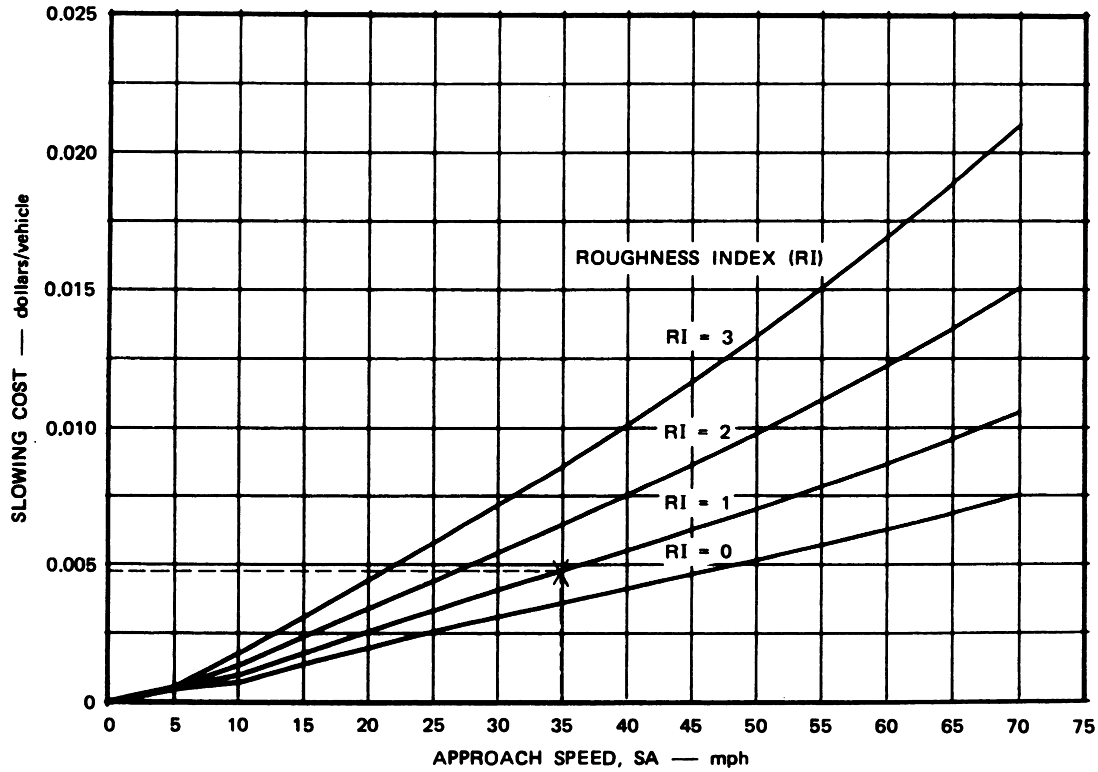


FIGURE 10 SPEED REDUCTION COST CURVES

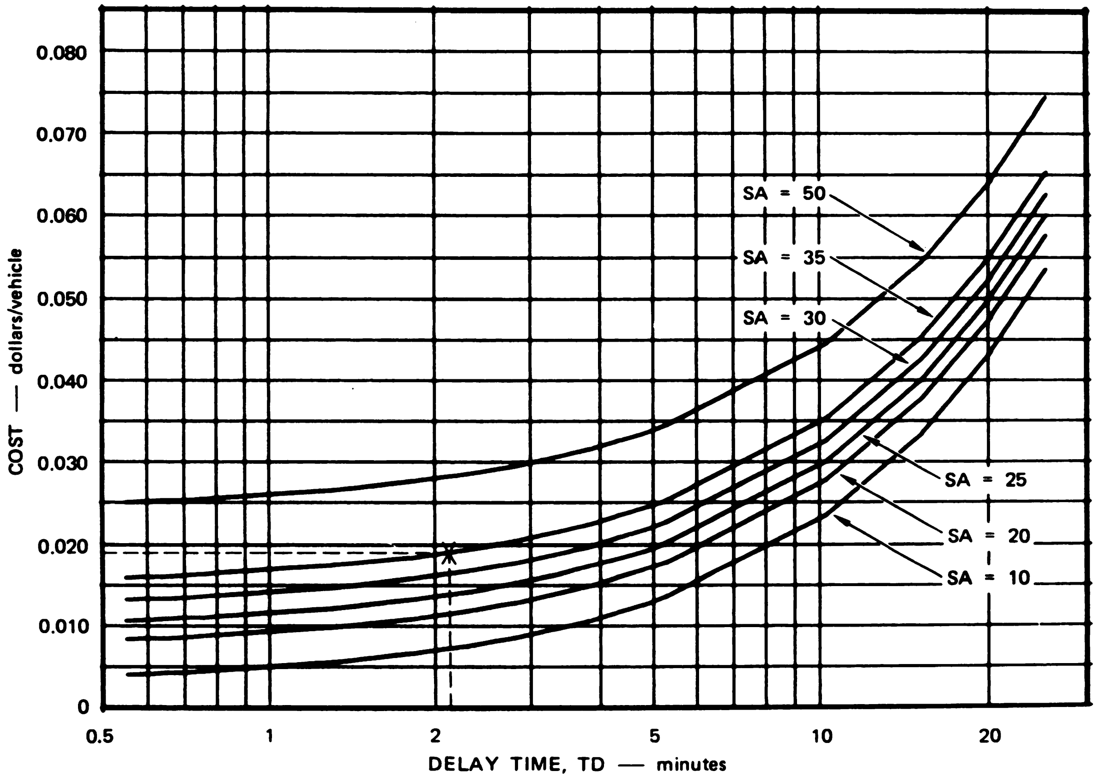


FIGURE 11 STOP/IDLE COST CURVES

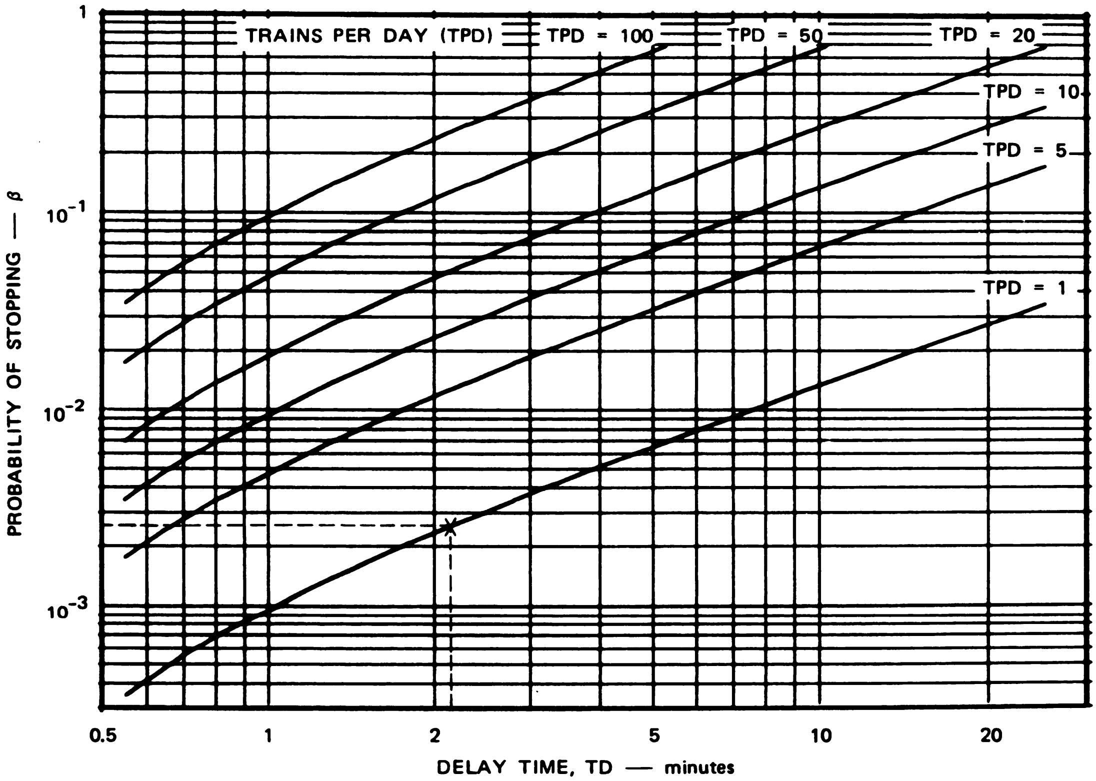


FIGURE 12 STOPPING DISTRIBUTIONS

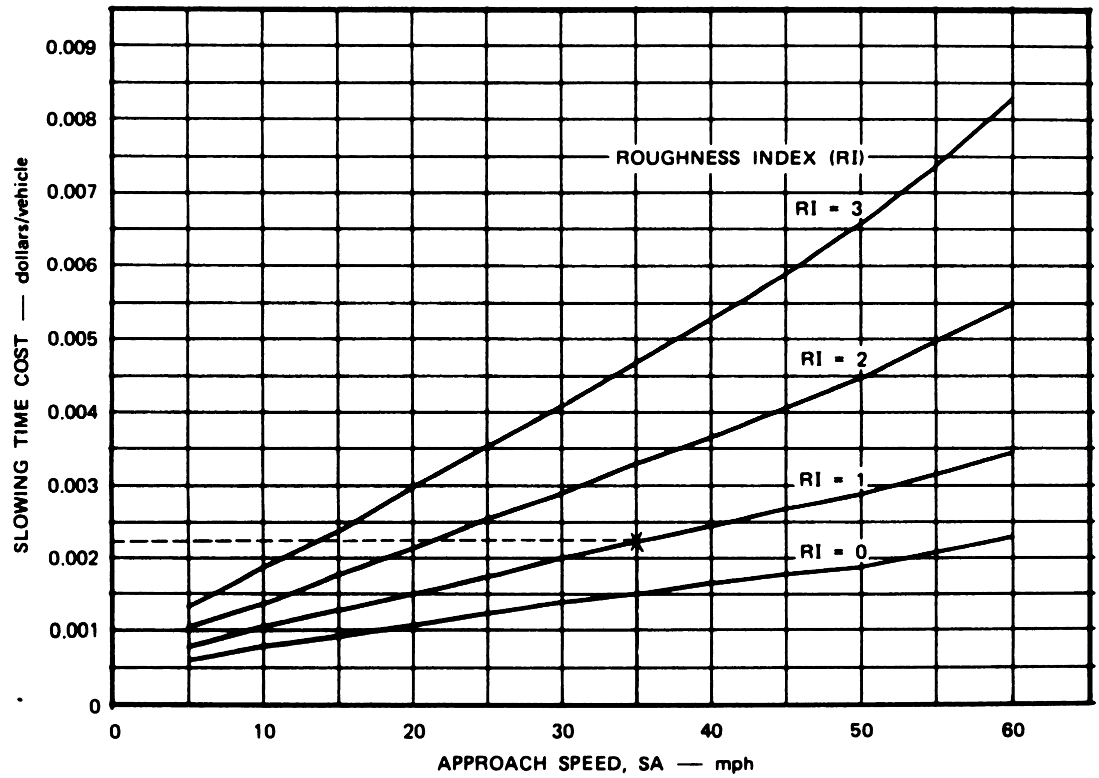


FIGURE 13 SPEED REDUCTION TIME COST CURVES

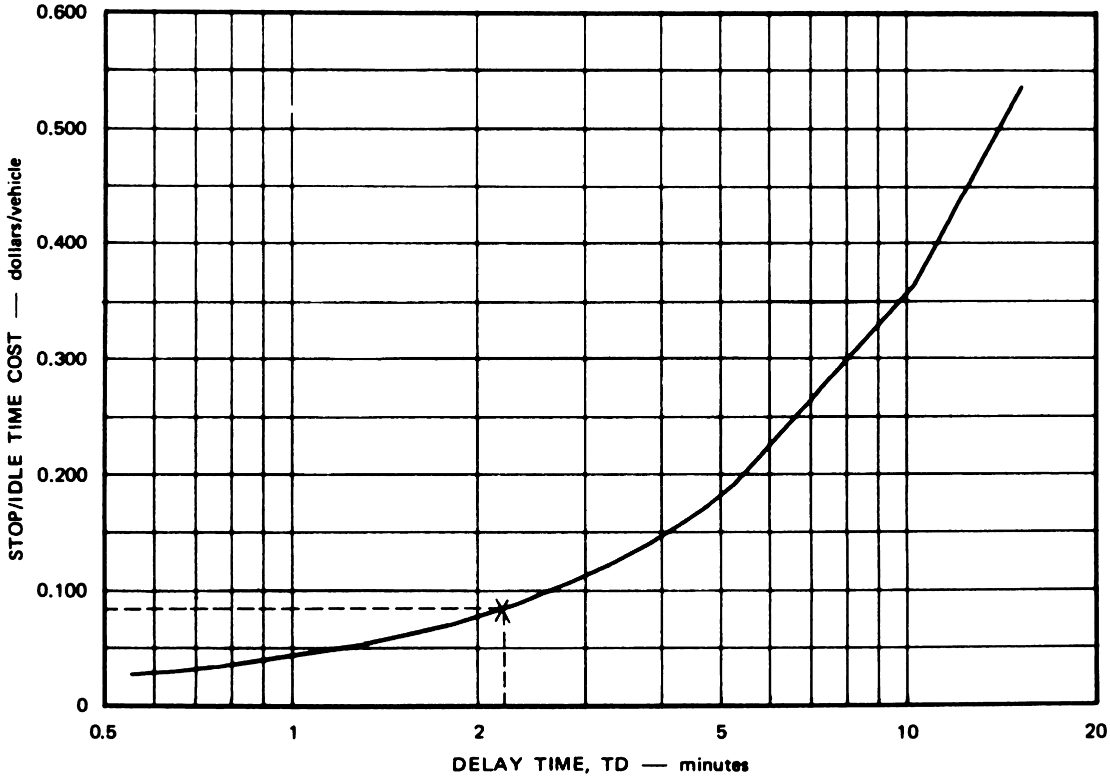
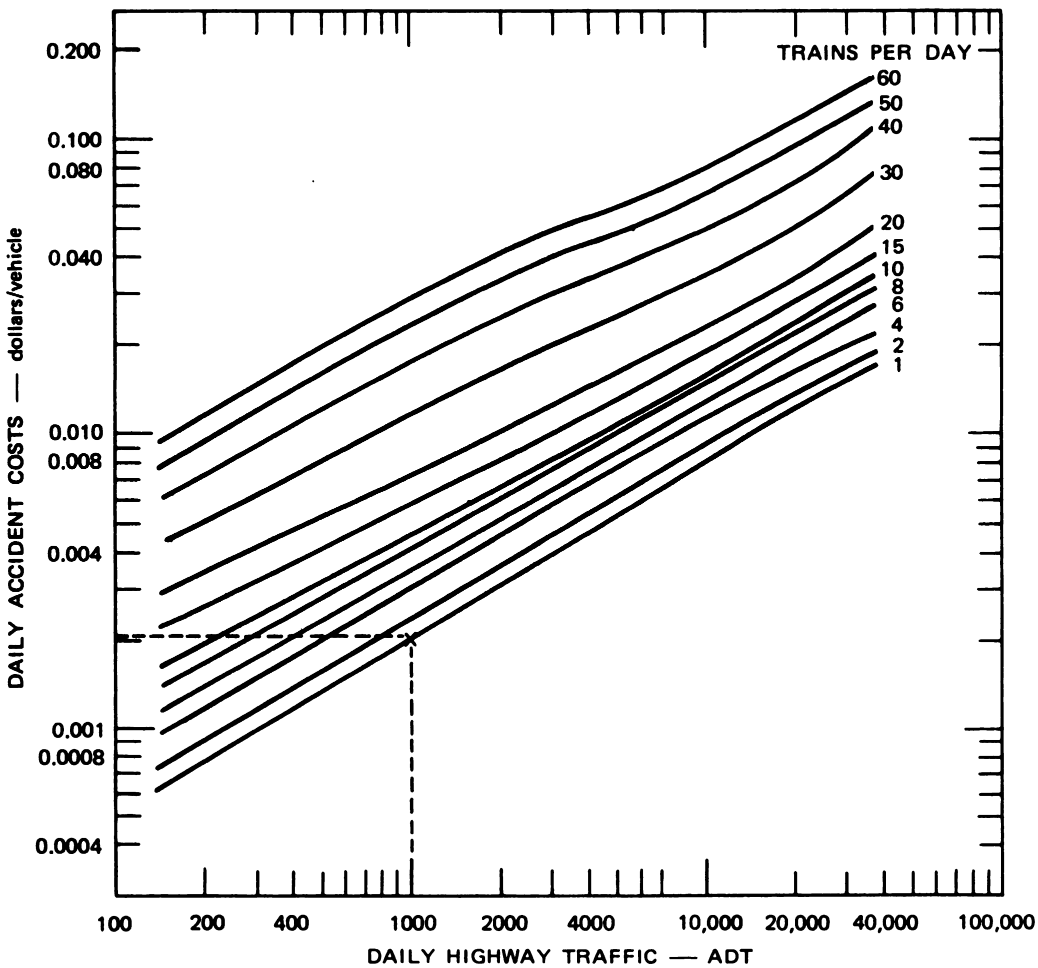


FIGURE 14 STOP/IDLE TIME COST CURVE

PROTECTION DEVICE		FACTOR (F_p)
A	CROSSBUCKS	3.06
B1	STOP SIGNS: ADT < 500	4.51
B2	STOP SIGNS: ADT ≥500	1.15
C	WIGWAGS	0.61
D	FLASHING LIGHTS	0.23
E	AUTOMATIC GATES	0.08

Sources: NCHRP Report 50, p. 61 and
Program Definition Study.

(a) CROSSING PROTECTION FACTOR



(b) AVERAGE ACCIDENT COSTS

FIGURE 15 ACCIDENT COST AND COST GENERATION FACTORS

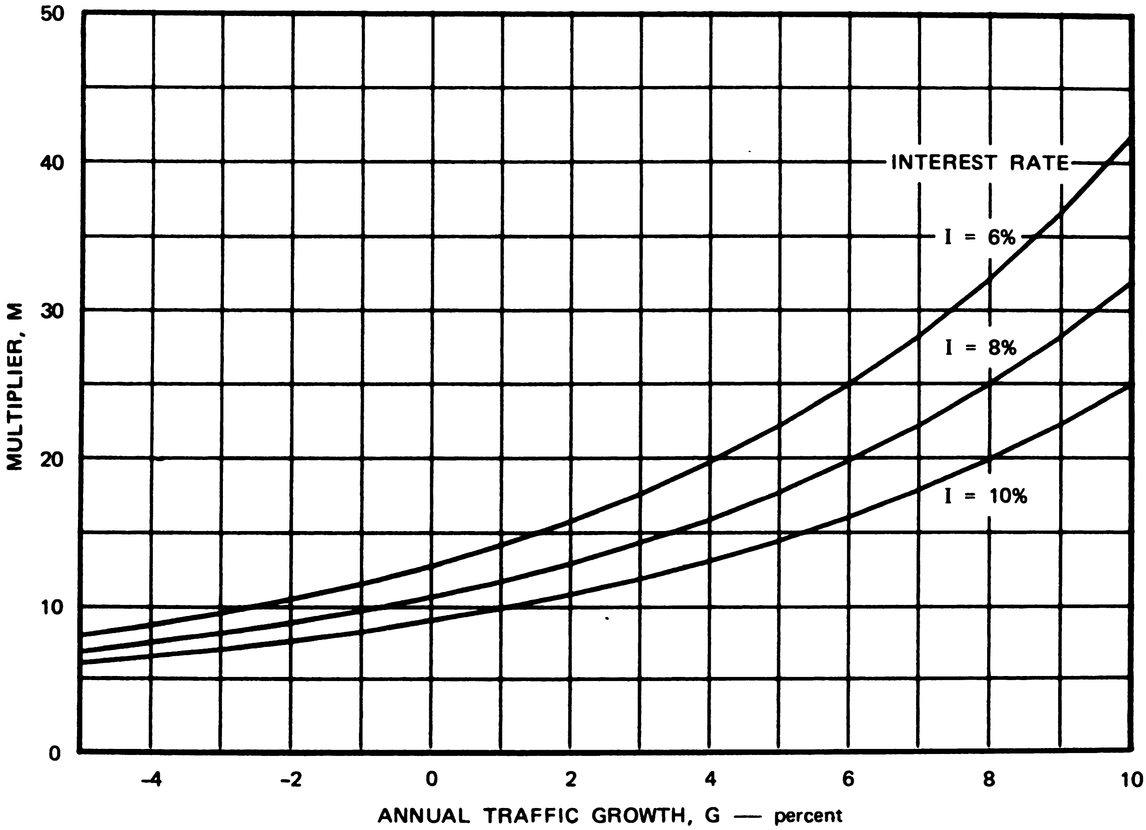


FIGURE 16 PRESENT VALUE MULTIPLIER

Annual Highway User Cost Summary

Worksheet HU-5 provides a summary of all annual highway user costs for the initial year of the proposed railroad relocation project, based on the calculations performed in Worksheets HU-2 through HU-4. These annual costs are then converted to present value, which is determined from the initial year's annual costs, an assumed annual growth rate of traffic, and a specified discount rate (cost of capital).

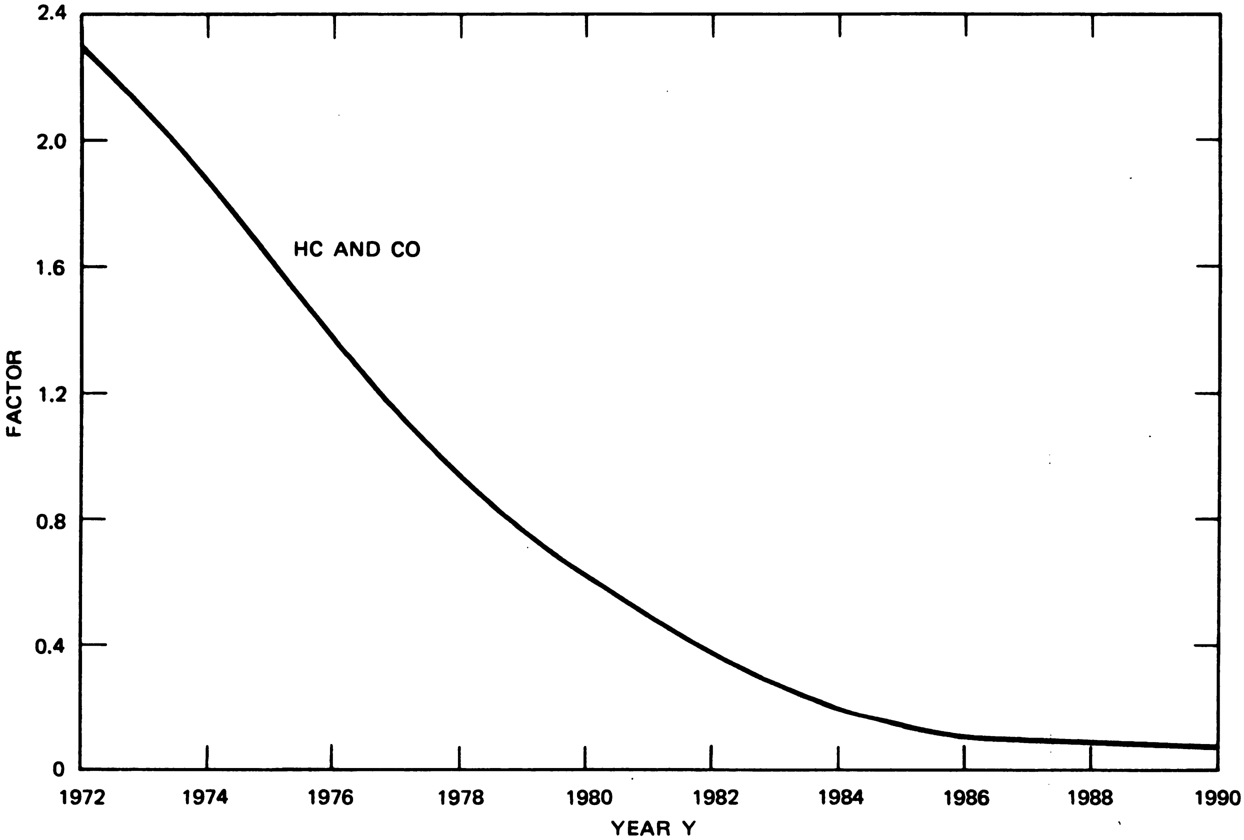
Figure 16 is provided to assist in the conversion of costs in the initial year to present value. Traffic has been assumed to grow at 1 percent annually and future benefits to be discounted at 10 percent, to yield the present value figure shown in final line of Worksheet HU-5.

Vehicle Emissions

Although the air pollution resulting from vehicle emissions is a neighborhood or community impact, the relevant worksheet (HU-6) is included in this section where the data from other HU worksheets are readily available. Figures 17 through 19 are used in computing vehicle emissions.

Highway User Impact on Neighborhoods

Worksheet HU-7 is provided for ease in summarizing the highway user costs and vehicle emissions as they affect neighborhoods.



SOURCE: NCHRP 133.

FIGURE 17 FACTOR TO CONVERT REFERENCE YEAR EMISSIONS TO EMISSIONS IN YEAR Y

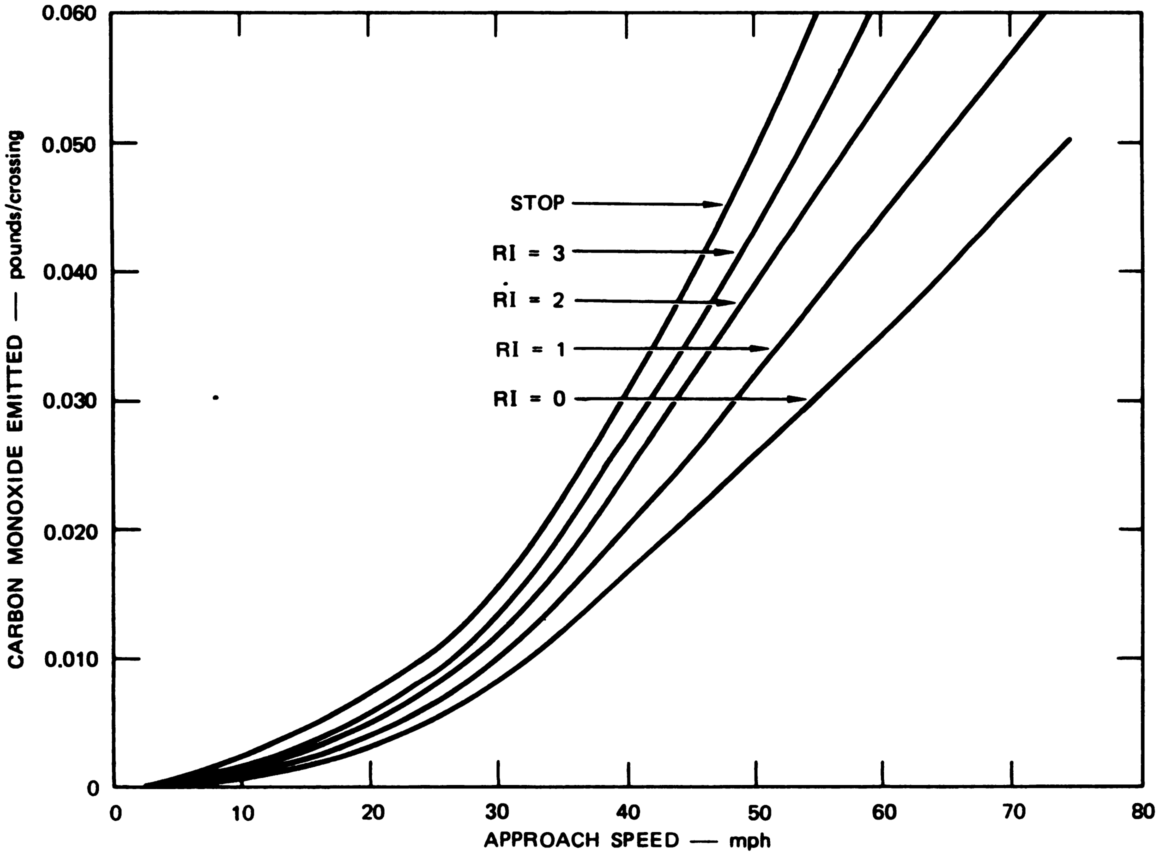


FIGURE 18 CARBON MONOXIDE EMISSIONS ADDED PER CROSSING

By approach speed and crossing roughness.

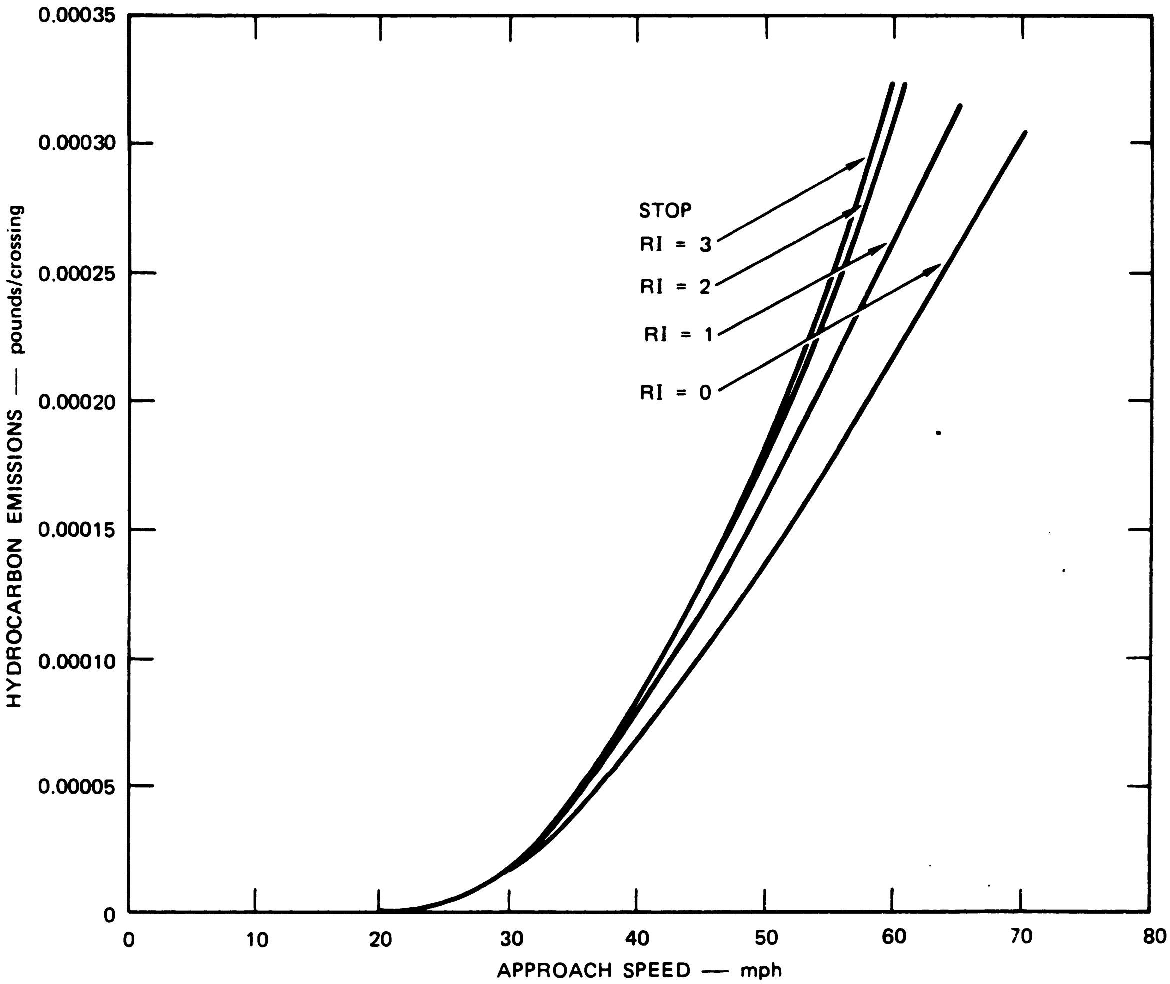


FIGURE 19 HYDROCARBON EMISSIONS ADDED PER CROSSING
By approach speed and crossing roughness.

Worksheet HU-1

GRADE CROSSING INVENTORY
(Alternative 1, Neighborhood SOUTH OF CBD)

Data Year: 1973
Initial Year: 1980

	(A) Grade Crossing Identification	(B) Roughness Index	(C) Number of Crossings	(D) ADT	(E) Approach Speed	(F) Trains per Day	(G) Cars per Train	(H) Train Speed	(I) Crossing Protection
1.	3RD ST.	2	1	1,000	25	43	100	20	D
2.	WEAVER, MADISON	1	2	100	10	30	100	20	A
3.	4TH ST.	1	1	11,500	25	43	100	20	D
4.	5TH ST.	3	1	50	15	30	100	20	A
5.									
6.									
7.									
8.									
9.									
10.									
11.									
12.									
13.									
14.									
15.									
16.									

DATE: 2/5/74 INITIALS: JAH

Worksheet HU-1 Instructions

The purpose of this worksheet is to list and classify all the railroad crossings affected by each alternative in each neighborhood. Note at the top of the page the "Data Year" for which the vehicle traffic levels apply, and the "Initial Year" of project implementation for which other crossing information applies.

Column (A), Grade Crossing Identification: Briefly identify (by location or other description) the crossing(s).

Column (B), Roughness Index (RI): Fill in the index from the values below to indicate the average percentage vehicular speed reductions associated with grade crossings of different roughness:

RI	Estimated Average Speed Reduction
0	30% reduction = "smooth" crossing
1	40% reduction = "typical" crossing
2	50% reduction
3	65% reduction

The selection of the roughness index depends solely on the estimated average reduction in vehicular speed observed at the grade crossing. The speed reduction may be estimated for Alternative 0 by driving, in traffic, across the crossing, and observing the vehicle speed reduction. Guideline value: RI = 1.

Column (C), Number of Crossings (NX): Several crossings may be represented by a single inventory entry [Column (A)] if all characteristics of the individual crossings are the same. More typically, each crossing will differ from the other in at least one variable. A crossing with multiple tracks is considered a single crossing, with NX = 1. Guideline value: NX = 1.

Column (D), Average Daily Traffic (ADT): Enter average daily traffic (vehicles) using the crossing(s). If two or more crossings are combined, ADT should reflect the average traffic per crossing. Guideline value: ADT = 1,000 vehicles.

Column (E), Approach Speed (SA): Note the average speed (mph) with which traffic approaches grade crossing before reducing speed to cross. Guideline value: SA = 35 mph.

Column (F), Trains per Day (TPD): Show the average number of trains per day using the grade crossing(s). Guideline value: TPD = 1.

Column (G), Cars per Train (CPT): Note the average number of cars per train exclusive of locomotive(s) and caboose. On some side tracks, where most movements are to industrial locations, values as low as 10 may be appropriate. Large freight trains may exceed 150 cars. Guideline value: CPT = 70.

Column (H), Train Speed (V): Enter the average speed (mph) of trains using crossing. In some urban and industrial areas, speeds may average as low as 3 to 5 mph, or as high as 30 mph. Guideline value: V = 13.3 mph.*

Column (I), Crossing Protection: Enter the type of grade crossing protection, according to the following designations:

A	Crossbucks
B1	Stop Sign: ADT < 500
B2	Stop Sign: ADT ≥ 500
C	Wigwags
D	Flashing Lights
E	Automatic Gates.

The type of protection affects only accident costs (Worksheet HU-4). Enter "N.A." if information is not available (average accident cost factors can then be used in Worksheet HU-4, as noted in its instructions).

*Assumes 20 mph average speed with allowance of 1/3 reduction in speed to account for switching.

Worksheet HU-2

ADDED HIGHWAY USER OPERATING COSTS
(Alternative 0, Neighborhood SOUTH)

Data Year: 1973
Initial Year: 1980

	(A) Delay Time (Figure 9)	(B) Probability of Stop (Figure 12)	(C) Total Vehicles NX × ADT (HU1C × HU1D)	(D) Stopped Vehicles β × NX × ADT (B × C)	(E) Slowed Vehicles (1 − β) × NX × ADT (C − D)	(F) Slowing Cost (Figure 10)	(G) Stop/Idle Cost (Figure 11)	(H) Expected Added Cost [(D × G) + (E × F)]
1.	2.0	0.09	1000	90	910	0.0045	0.013	5.265
2.	2.0	0.06	200	12	188	0.00075	0.007	0.225
3.	2.0	0.09	11,500	1035	10,465	0.0035	0.013	50.083
4.	2.0	0.06	50	3	47	0.0035	0.009	0.192
5.								
6.								
7.								
8.								
9.								
10.								
11.								
12.								
13.								
14.								
15.								
16.								
GRAND TOTAL								$ 55.77

DATE: 2/6/74 INITIALS: SW

Worksheet HU-2 Instructions

As indicated under the column headings of this worksheet, the curves shown earlier in Figures 9 through 12 provide selected values for the highway user operating costs* that are associated with each inventoried grade crossing.

Column (A), Delay Time (TD): Select from Figure 9 the delay time based on the number of cars per train, CPT, and the average train speed, V, identified in Columns (G) and (H), respectively, of Worksheet HU-1. It is an indicator of the average time that a vehicle is delayed at the grade crossing by a passing train of specified length and speed.

Guideline value: TD = 2.2 minutes

Column (B), Probability of Stop (β): Take this probability, β, from the curves shown in Figure 12, based on the delay time, TD, indicated in Column (A) of this worksheet and the number of trains per day, TPD, as identified in Column (F) of Worksheet HU-1. This is the probability that any vehicle will be stopped when utilizing the grade crossing.

Guideline value: $\beta = 0.0026$

Column (C), Total Average Daily Traffic (ADT_{TOT}): Multiply the number of crossings by the average daily traffic [Worksheet HU-1, Columns (C) and (D)]. This is the total average daily traffic for this set of crossings.

Guideline value: $ADT_{TOT} = 1,000$

Column (D), Average Daily Traffic Stopped (ADT_{STOP}): Multiply the probability of stopping [Column (B)] by the total average daily traffic for this set of crossings [(Column (C)]. This is the average number of vehicles that are stopped at these grade crossings.

Guideline value: $ADT_{STOP} = 2.6$

Column (E), Average Daily Traffic Slowed (ADT_{SLOW}): From the total number of vehicles for this set of crossings [Column (C)], subtract the average daily traffic stopped [Column (D)]. This is the average number of vehicles that are slowed, but not stopped, by this set of grade crossings.

Guideline value: (ADT_{SLOW}) = 997.4

*Other values can be obtained by interpolating between the curves. Also shown in the figures are the average guideline values recommended for use when actual values are not available for some of the variables shown in the inventory.

Column (F), Slowing Cost ($C_{\Delta v}$): Select the slowing cost from Figure 10 based on the grade crossing roughness index, RI, and vehicle approach speed, SA, as identified in Columns (B) and (E), respectively, of Worksheet HU-1. This is the cost per vehicle associated with the reduction in vehicle speed due directly to the railroad grade crossing.

Guideline value: $C_{\Delta v}$ = \$0.00479/vehicle

Column (G), Stop/Idle Cost (C_{si}): Select this factor from Figure 11 based on the delay time, TD, indicated in Column (A) of this worksheet and the average vehicle approach speed, SA, as identified in Column (E) of Worksheet HU-1. This is the total stopping and idling cost per vehicle stop resulting from a train blocking the grade crossing.

Guideline value: C_{si} = \$0.01949/stop

Column (H), Total Expected Added Operating Cost (CT_o): The total expected added operating cost is the sum of the expected speed reduction cost and the expected stop/idle cost. To deduce the former, multiply the slowing cost, $C_{\Delta v}$ [Column (F)], by the expected number of vehicles that reduce speed but do not stop at the crossing [Column (E)]. To deduce the expected stop/idle cost, multiply the stop/idle cost, C_{si} Column (G) , by the expected number of vehicles stopped [Column (D)]. The total is the expected added operating costs associated with grade crossing speed reduction and stops due to blocking of the grade crossing by passing trains.

Guideline value: CT_o = \$4.83/set of crossings

Worksheet HU-3

Data Year: 1973
Initial Year: 1980

ADDED HIGHWAY USER TIME COSTS
(Alternative 0, Neighborhood SOUTH OF CBD)

	(A) Slowing Time Cost (Figure 13)	(B) Stop/Idle Time Cost (Figure 14)	(C) Total Expected Added Time Cost [(A x HU2E) + (B x HU2D)]
1.	0.0025	0.08	9.475
2.	0.001	0.08	1.148
3.	0.00175	0.08	101.114
4.	0.0024	0.08	0.353
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
GRAND TOTAL			$ 112.09

DATE: 2/6/74 INITIALS: SGW

Worksheet HU-3 Instructions

This worksheet is designed for estimating the value of the time lost by highway users when they slow and/or stop for crossings, as distinct from the increase in vehicle operating costs estimated in the previous worksheet.

Column (A), Slowing Time Cost ($T_{\Delta v}$): Select the slowing time cost from Figure 13 based on the grade crossing roughness index, RI, and vehicle approach speed, SA, as identified in Columns (B) and (E), respectively, of Worksheet HU-1. This is the time cost per 1,000 vehicles associated with a reduction in vehicle speed as a direct result of the railroad grade crossing.

Guideline value: $T_{\Delta v}$ = $0.00223/vehicle

Column (B), Stop/Idle Time Cost (T_{si}): Select the stop/idle time cost from Figure 14 based on the delay time, TD, indicated in Column (A) of Worksheet HU-2. This is the total stopping and idling time cost per vehicle stop as a result of a train blocking the grade crossing.

Guideline value: T_{si} = $0.08450/stop

Column (C), Total Expected Added Time Cost (CT_t): The expected time cost of speed reductions is the product of the time cost of slowing per vehicle, shown in Column (A) of the worksheet, and the number of vehicles slowed but not stopped [Column (E) of Worksheet HU-2]. The expected time cost of stop/idle is the product of the stop/idle time cost per vehicle [Column (B) of this worksheet] and the number of vehicles stopped [Column (D) of Worksheet HU-2]. Therefore, under the total expected added time cost, enter the sum of these two products.

Guideline value: CT_t = $2.44/set of crossings

Worksheet HU-4

Data Year: 1973
Initial Year: 1980

ADDED HIGHWAY USER ACCIDENT COSTS*
(Alternative 0, Neighborhood SOUTH OF CBD)

	(A) Protection Factor (Figure 15.a)	(B) Accident Costs (0.000088 x A x HU1F x HU2C)
1.	0.23	0.869
2.	3.06	1.615
3.	0.08	3.462
4.	3.06	0.404
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
GRAND TOTAL		$ 6.35

DATE: 2/6/74 INITIALS: SGW

*If type of grade crossing protection is not specified in Column I of Worksheet HU-1, enter the accident cost factors from Figure 15.b times the ADT, Column D of HU-1, in Column (B) above without completing Column (A).

Worksheet HU-4 Instructions

Column (A), Protection Factor (F): Select the appropriate value from Figure 15.a and enter in Column (A). Do not complete Column (A) if crossing protection is not specified in Worksheet HU-1, Column (I).

Column (B), Accident Costs (CT_A): Enter the product of the protection factor in Column (A) and the trains per day value--Column (F) of Worksheet HU-1--and the constant 0.000088 representing accident cost per vehicle:

$$CT'_A = F_p \times TPD \times 0.000088 \quad .$$

The total accident cost is then given by

$$CT_A = CT'_A \times ADT_{TOT} \quad ,$$

where ADT_{TOT} is determined from Column (C), Worksheet HU-2. If crossing protection is not specified in Worksheet HU-1, enter the accident costs directly in Column (B) from Figure 15.b.

Guideline value: CT_A = \$2.05 per crossing.

Note: Where traffic volumes or train volumes are relatively low (e.g., ADT less than 10,000 or TPD less than 10), use of the protection factor method for calculating accident costs may produce results which are low. Consultation of the curves in Figure 15b and of actual accident data for the city will yield better estimates of accident cost. However, Figure 15b was derived from a composite of crossing protection devices, and is thus not adequate for making cost comparisons between two protection devices.

Worksheet HU-5

Data Year: 1973
Present Year: 1974
Initial Year: 1980

TOTAL ANNUAL HIGHWAY USER COST SUMMARY
(Alternative O, Neighborhood SOUTH OF CBD)

1. Data Year Added Operating Costs

   a. Added operating cost (Grand total from Worksheet HU-2) — $ 55.77

   b. Data year fuel C.P.I. — 139.7 × .003346 = 0.46744

   c. Data year tires C.P.I. — 109.9 × .003106 = 0.34135

   d. Data year maintenance C.P.I. — 144.9 × .002073 = 0.30038

   e. Operating cost factor (b+c+d) — 1.109

   f. Data year added operating cost (a × e) — $ 61.85

2. Data Year Added Time Cost

   a. Added time cost (Grand total from Worksheet HU-3) — $ 112.09

   b. Data year C.P.I. factor — 139.7 ÷ 125.3 — 1.11

   c. Data year added time cost (a × b) — $ 124.42

3. Data Year Added Accident Cost

   a. Added accident cost (Grand total from Worksheet HU-4) — $ 6.35

   b. Data year added accident cost (a × 2b) — 7.05

4. Data Year Total Daily Added Costs (1f + 2c + 3b) — $ 193.32

5. Initial Year Total Daily Added Costs

   a. Years (N) from data year until initial year — 7

   b. Annual traffic growth rate (G) — 1 %

   c. Future worth factor $[(1.00 + G/100)^N]$ — 1.072

   d. Initial year total daily added costs (4 × 5c) — $ 207.24

6. Present Value of Total Added Cost

   a. Years (Y) from present until initial year — 6

   b. Capital cost rate (CC) — 10 %

   c. Present worth factor $[1.00/(1.00 + CC/100)^Y]$ — 0.5645

   d. Initial year present value multiplier for 1 % annual traffic growth rate and 10 % capital cost over a 25-year period (Fig. 16) — 10

   e. Present value of total added cost (365 × 5d × 6c × 6d) — $ 427,000.

Worksheet HU-5 Instructions

This worksheet summarizes all the highway user costs associated with railroad crossings (except the vehicle emissions shown in Worksheet HU-6).

Line 1.a, Added operating cost: Enter the sum of expected added costs (Worksheet HU-2, Column H).

Lines 1.b, c, d: Operating cost elements (e.g., gasoline) for the data year (year in which the inventory of Worksheet HU-1 was made) are likely to have changed in price from the 1972 study upon which this guidebook bases its data. An estimate of the price change may be made by reference to the Consumer Price Index, published by the Bureau of Labor Statistics of the Department of Labor. For the purpose of estimation, it is assumed that 36 percent of operating cost changes consist of fuel price changes, 36 percent of changes in tire prices, and 28 percent consist of vehicle maintenance price changes. (Other components of operating cost, such as depreciation, are less subject to price fluctuations and are excluded here.)

The operating cost factor for the data year is then calculated as follows:

$$\begin{aligned} OCF = 1.00 &+ .36 \times (Fuel_{DY} - Fuel_{72})/Fuel_{72} \\ &+ .36 \times (Tires_{DY} - Tires_{72})/Tires_{72} \\ &+ .28 \times (Maint_{DY} - Maint_{72})/Maint_{72} \\ = 1.00 &+ .36 \times (Fuel_{DY} - 107.6)/107.6 \\ &+ .36 \times (Tires_{DY} - 115.9)/115.9 \\ &+ .28 \times (Maint_{DY} - 135.1/135.1 \end{aligned}$$

This reduces to:

$$OCF = .003346 \times Fuel_{DY} + .003106 \times Tires_{DY} + .002073 \times Maint_{DY}$$

In Line 1.b, Data year fuel C.P.I., enter the seasonally adjusted Consumer Price Index of "Gasoline and motor oil" for the data year, and multiply by .003346.

In Line 1.c, Data year tires C.P.I., enter the seasonally adjusted Consumer Price Index of "Tires" for the data year, and multiply by .003106.

In Line 1.d, Data year maintenance C.P.I., enter the seasonally adjusted Consumer Price Index of "Maintenance," and multiply by .002073.

Line 1.e, Operating cost factor: Sum Lines 1.b, 1.c, and 1.d. Guideline value: 1.000.

Line 1.f, Data year added operating cost: Multiply the added operating cost (Line 1.a) by the operating cost factor (Line 1.e).

Line 2.a, Added time cost: Enter the grand total of expected added time cost from Worksheet HU-3.

In Line 2.b, Data year C.P.I. factor, enter the Consumer Price Index of "All Items," and divide by 125.3, the 1972 C.P.I.

In Line 2.c, Data year added time cost, multiply the added time cost (Line 2.a) by the data year C.P.I. factor (Line 2.b).

Line 3a, Added accident cost: Enter the grand total of accident costs from Worksheet HU-4.

In Line 3.b, Data year added accident cost: Multiply the added accident cost (Line 3.a) by the data year C.P.I. factor (Line 2.b).

Line 4, Data Year Total Daily Added Costs: Sum the data year added operating cost (Line 1.f), the added time cost (Line 2.c), and the added accident cost (Line 3.b).

Line 5.a, Years from data year until initial year: Subtract the year in which the grade crossing inventory data was gathered from the initial year, assumed to be the year following completion of relocation.

Line 5.b, Annual traffic growth rate: Enter the projected (compound) annual traffic growth rate from the data year to the initial year. Guideline value: 2%.

Line 5.c, Future worth factor: Divide the annual traffic growth rate (Line 5.b) by 100, add 1.00, and raise the sum to the power of N, the number of years from the data year to the initial year (Line 5.a). For example, a 2 percent annual traffic growth rate over a four-year period would result in a future worth factor of $(1.04)^4 = 1.0824$.

Alternatively, the future worth factor may be found in an engineering economy reference table for the given traffic growth rate and time span.

Line 5.d., Initial year total daily added costs: Multiply the data year total daily added costs (Line 4) by the future worth factor (Line 5.c).

Line 6.a, Years from present until initial year: Subtract the current year from the initial year, in which relocation project benefits or costs are expected to begin.

Line 6.b, Capital cost rate (CC): Enter the desired discount rate. Guideline value: 10%

Line 6.c., Present worth factor: Divide the capital cost rate (Line 6.b) by 100, add to 1.00, raise the sum to the power of Y, the number of years from the present until the initial year (Line 6.a), and calculate the reciprocal of that product. For example, a 10% capital cost rate over a 3-year period would result in a present worth factor of $1/(1.10)^3 = 0.7513$.

Alternatively, the present worth factor may be found in an engineering economy reference table for the appropriate capital cost rate and time span.

Line 6.d, Initial year present value multiplier: From Figure 16, determine the initial year present value multiplier for the expected annual traffic growth rate and capital cost (which may be identical to Lines 5.a and 6.b, respectively). A 25-year project life is assumed.

Line 6.c, Present value of total added cost: Multiply 365 by the initial year total daily added costs (Line 5.d), the initial year present value multiplier (Line 6.d), and the present worth factor (Line 6.c). The result is the current dollar value of total added cost over the assumed 25-year period of the relocation project.

Worksheet HU-6

AIR POLLUTANT VARIATIONS

(Alternative 0 , Neighborhood SOUTH OF CBD)

Data Year: 1973

Reference Year: 1980

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
		Carbon Monoxide						Hydrocarbons					
	Year Factor (Figure 17)	CO Slowing Factor (Figure 18)	Slowing HU2E x B	CO Stop Factor (Figure 18)	Stop HU2D x D	Idle HU2D x HU2A x 0.00119	Total A x (C+E+F)	HC Slowing Factor (Figure 19)	Slowing HU2E x H	HC Stop Factor (Figure 19)	Stop HU2D x J	Idle HU2D x HU2A x 0.0000087	Total A x (I+K+L)
1.	.60	.008	7280	.006	.540	.21420	4.82052	.0000004	.00036	.000005	.00045	.001566	.001426
2.	↓	.001	.188	.003	.036	.02856	.15154	0.0	0.0	0.0	0.0	.000210	.000126
3.	↓	.006	62790	.006	6.210	2.46330	42.87798	.0000004	.00455	.000005	.005175	.018009	.016640
4.	↓	.005	.235	.005	.015	.00714	.15428	0.0	0.0	0.0	0.0	.000052	.000031
5.													
6.													
7.													
8.													
9.													
10.													
11.													
12.													
13.													
14.													
15.													
16.													
GRAND TOTAL							48.00432						.018223

DATE: 2/6/74 INITIALS: SGW

Worksheet HU-6 Instructions

This worksheet is used to estimate increased air pollutants that occur as a direct result of railroad grade crossings. The pollutants, carbon monoxide (CO) and hydrocarbons (HC), are estimated on a daily basis for each specified neighborhood and reflect the change in daily emissions for these pollutants. Insufficient information is available for estimating the changes in oxides of nitrogen (NO_X) levels that are due to speed reductions or stoppages at the railroad grade crossing. Figures 17, 18, and 19 are used to provide the emission estimates per vehicle and to convert these values to values in the year of interest.

Column (A), Year Factor: Select the year factor from Figure 17 for the initial year of the study and enter in Column (A). This factor is used to convert emission estimates in a reference year, for which the curves in Figures 18 and 19 and the idle factors in this worksheet have been developed, into the daily emissions for the year of interest based on an assumed distribution of vehicles by engine size and age. (NCHRP Report No. 133 indicates the underlying assumptions as to vehicle mix by age and vehicle type.)

Column (B), CO Slowing Factor: Refer to Figure 18, using appropriate values for the vehicular approach speed, SA, and the roughness index, RI, to find the carbon monoxide reference year emission factor.

Column (C) Added CO Emissions from Slowing (ΔCO_{SL}): Multiply the CO slowing factor [Column (B)] by the average daily number of vehicles that reduce speed but do not stop at the crossing [Worksheet HU-2, Column (E)]. This is the amount of added daily CO emissions that result from vehicles slowing for the grade crossing, based on reference year emission factors.

Column (D), CO Stop Factor: Determine the carbon monoxide reference year emission factor from the "STOP" curve in Figure 18 for the approach speed SA.

Column (E), Added Emissions from Stopping (ΔCO_S): Multiply the CO stop factor [Column (D)] by the average daily number of vehicles stopped that results from vehicles stopped [Worksheet HU-2, Column (D)]. This is the amount of added daily CO emissions that results from vehicles stopping at the grade crossing.

Column (F), Added CO Emissions for Idling (ΔCO_I): Multiply the reference year idle emission factor of .00119 pounds/vehicle-minute by the number of vehicles stopped [Column (D) of Worksheet HU-2] and the average idle time [Column (A), of Worksheet HU-2]. This is the added daily CO emissions that result from vehicles stopping at the grade crossing.

Column (G), Total Added CO Emissions (ΔCO_T): Add the slowing, stopping, and idling values for the reference year, i.e., Columns (C) + (E) + (F), and multiply by the reference year factor, Column (A). This is the total added CO emissions in pounds per day for the initial year of the project that result from the existence of the grade crossing.

Column (H), HC Slowing Factor: From Figure 19, determine the hydrocarbon reference year emission factor based on the vehicular approach speed, SA, and the roughness index RI.

Column (I), Added HC Emissions from Slowing (ΔHC_{SL}): Multiply the HC slowing factor [Column (H)] by the average daily number of vehicles that reduce speed but do not stop at the crossing [Worksheet HU-2, Column (E)]. This is the amount of added daily HC emissions resulting from vehicles slowing for the grade crossing, based on reference year emission factors.

Column (J), HC Stop Factor: Refer to Figure 19 for the "STOP" curve and the vehicular approach speed, SA, to determine the hydrocarbons reference year emission factor.

Column (K), Added HC Emissions from Stopping (ΔHC_S): Multiply the HC stop factor [Column (J)] by the average daily number of vehicles stopped [Worksheet HU-2, Column (D)]. This is the amount of added daily HC emissions that results from vehicles stopping at the grade crossing.

Column (L), Added HC Emissions from Idling (ΔHC_I): Multiply the reference year idle factor of 0.0000087 pounds/vehicle-minute by the number of vehicles stopped--Column (D) of Worksheet HU-2--and by the average idle time--Column (A) of Worksheet HU-2. This is the amount of added daily HC emissions from vehicles stopped at grade crossings.

Column (M), Total Added HC Emissions (ΔHC_T): Add the slowing, stopping, and idling values for the reference year, i.e., Columns (I), (K), and (L), and multiply by the reference year factor, Column (A). This is the total added HC emissions in pounds per day for the initial year of the project that result from the existence of the grade crossing.

Worksheet HU-7

Data Year: 1973
Present Year: 1974
Initial Year: 1980

SUMMARY OF HIGHWAY USER IMPACT ON NEIGHBORHOODS
(Alternative 0)

(A) Neighborhood Identification	(B) Daily Added Operating Cost (HU5, line 1f)	(C) Daily Added Time Cost (HU5, line 2c)	(D) Daily Added Accident Cost (HU5, line 3b)	Total Added Cost: (E) Data Year [365 x (B + C + D)]	Total Added Cost: (F) Present Value (HU5, line 6e)	Daily Emissions: (G) CO Pounds (HU6G, total)	Daily Emissions: (H) HC Pounds (HU6M, total
SOUTH OF CBD	$ 61.85	$ 124.42	$ 7.05	$ 70,562.	$ 427,000.	48.00	0.01822
NORTH OF CBD	97.10	130.60	7.12	85,708.	519,000.	65.15	0.12208
CBD	270.21	342.53	118.09	266,753.	1614,000.	335.67	0.52050
EAST OF CBD	309.84	443.45	68.97	300,126.	1816,000.	341.17	0.57558
GRAND TOTAL ADDED COSTS				$ 723,149.	$ 4,376,000.		
GRAND TOTAL ADDED EMISSIONS						789.990	1.23638

DATE: 2/6/74 INITIALS: SLJ

Worksheet HU-7 Instructions

Where highway user costs and air pollution effects are computed neighborhood-by-neighborhood, this worksheet provides a format for summarizing the neighborhood costs and impacts to gain a total for each alternative. Show the alternative designation in the space provided at the top of the worksheet, and the grand total costs and grand total emissions at the bottom.

Column (A): Enter the neighborhood designation for each neighborhood analyzed.

Column (B) through (H): Enter the appropriate values from the previous worksheets or previous columns of this worksheet, as noted.

XII NEIGHBORHOOD IMPACT

Just as dropping a rock in a pond causes ripples to spread, so changing the community face by altering railroad facilities will cause ripples that are felt throughout the community in complex ways. As the ripples are larger near the point the rock enters the pond, so are the impacts of railroad changes on those nearest the change. To facilitate the discussion, we first describe those impacts that are felt by the stakeholders nearest the railroad. Together these impacts will be referred to as neighborhood impact, and the stakeholders are: residents and other tenants of property abutting the railroad; owners of land abutting the railroad; residents, other tenants, and owners of property not directly abutting the railroad, but who feel an influence from the railroad due to inaccessibility, neighborhood isolation, or the limitation of business trade areas; and the regular visitors to the neighborhoods such as employees, customers or clients, and students.

The remainder of the community also feels the effects of the railroad, but to a lesser degree. Many of the effects are the reverse of the effects on the physically affected area--for example, in business activity and land values--because a sale of either shopping goods or real estate not made in one area will be made in another, assuming total demand does not change.

Many of the early proposals for solving a community's railroad problem can be screened out in the preliminary assessment and initial appraisal, without defining neighborhood impacts; such proposals will be found to be impractical because of either railroad operations or construction constraints. Detailed planning and evaluation of alternative proposals, however, require more attention to how much benefit one neighborhood experiences, perhaps at the expense of another neighborhood, and to the description of exactly who the stakeholders in the neighborhoods are.

Types of Neighborhood Impact

Neighborhood impacts may conveniently be analyzed by dividing them into physical, social, and economic effects. The physical effects--noise and vibration, barrier, danger, pollution, and visual intrusion--lead to social effects--neighborhood cohesion or isolation, definition of social status, attitude toward the railroad, and attitude toward improvement projects. These physical and social effects are translated into economic effects because of the way people value land and because of customers' desire to patronize establishments in more attractive, higher status neighborhoods that are readily accessible. Effects on businesses have corollary effects on land values because rents that can be charged depend on sales potential. The land value change may result in intensification of the social effects already experienced and additional social effects, such as loss of neighborhood pride, poor maintenance of buildings and grounds, and increased crime.

Figure 20 shows that there are complex relationships between actions and results, and that some stakeholders (e.g., landowners) may benefit while others (e.g., tenants) may lose. The planning should be carried out to minimize the number of persons who lose and the intensity of their losses. For example: planning should include land use planning to minimize neighborhood disruption by assuring that compatible development occurs if higher and better uses develop, and to provide housing for those displaced.

This example points out an important reason for quantifying and measuring neighborhood impacts--the identification of remedial measures that will reduce the intensity of unfavorable impacts. In methodically assessing the impacts and estimating the numbers of people affected, early-warning signals can be generated that will allow the stakeholders and the planners to work out solutions to minimize the impacts that are unfavorable. The cost of the measures to minimize unfavorable impacts is then added to the capital cost and the impact is reanalyzed. Moving and other disruptions to individual households and businesses are estimated and become part of the project cost.

In the following pages physical effects of railroads in neighborhoods are discussed first, then social effects, and finally economic effects. Then a method for assessing neighborhood impacts is described and worksheets to assist in the assessment are provided.

Physical Effects

Physical effects are those that impinge on any of the five senses, that interfere with movement, or that cause physical damage to persons or property. They include noise and vibration, visual intrusion, air pollution, and danger of accidents. If the physical effects of railroad

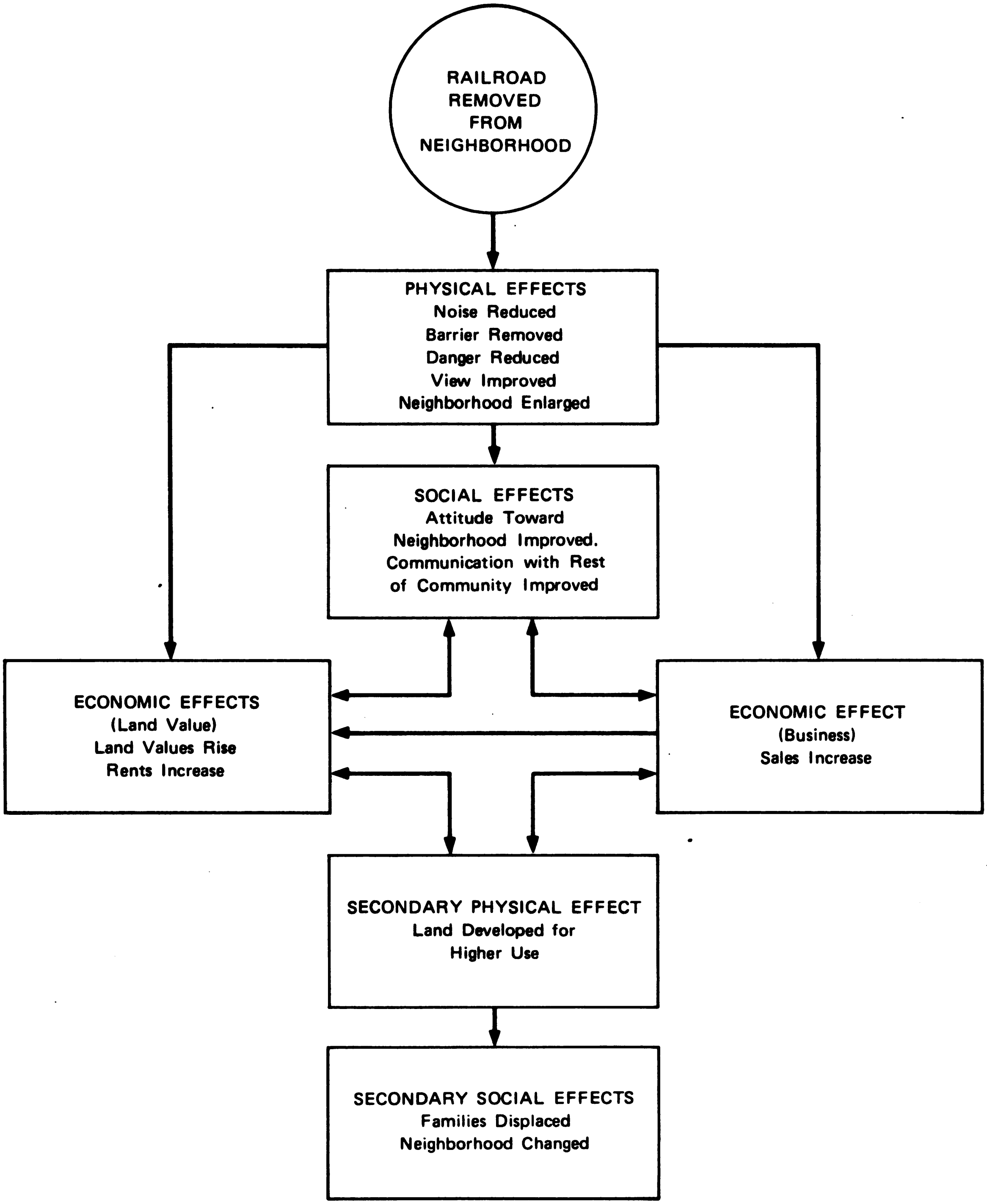


FIGURE 20 INTERRELATIONSHIPS BETWEEN SELECTED NEIGHBORHOOD EFFECTS OF REMOVING A RAILROAD

operations can be reduced, both social and economic benefits should accrue to the neighborhood. The degree of impact varies with many factors:

- The distance of affected persons from the railroad.
- The volume, scheduling, and type of railroad operations.
- The topography of the surrounding area.
- The general condition of the right-of-way.
- The design and maintenance of the railroad's rolling stock.
- The level of maintenance of roadbed, track, and structures.
- The type of grade crossings.
- The use of the land subject to the physical impact.
- The quality of construction and condition of buildings in the neighborhood.

Noise--Noise, together with its attendant vibration, is the characteristic of trains most generally found to be annoying to persons in nearby properties. Train horns and crossing protection bells, the squeal of the train's brakes and of steel wheels negotiating a curve, and switching and shunting operations--particularly where retarders are used in classification yards--all contribute to the obtrusiveness of the train.

The noise profile around the rail corridor varies with the topography of the surrounding area, the location of grade crossings with warning bells, the design of the railroad cars and the roadbed, the level of track maintenance, and weather conditions. For example, depressing the track or building structures around it will damp the noise, whereas elevating the track on a steel trestle will amplify and distribute the sound more widely.* Deep setback of buildings from the tracks together with screening shrubs lessens the perceived effect of the train operations, although tests have shown that shrubs have very little actual effect on sound transmission. A relatively high noise level in the surrounding area will tend to mask the noise of the train, so that the railroad effect will be less in industrial and heavy commercial districts.

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*W. A. Jack, "Noise in Rail Transportation," Chapter 32 in C. M. Harris, ed., Handbook of Noise Control, McGraw-Hill, New York (1957).

Some measurements of sound level made in Canada at a distance of 100 feet from a freight train traveling at roughly the same grade as the surrounding land are given below:*

Source	Sound Level (dbA at 100 feet)
Train horn	100-98
Freight train--50 mph	90
Freight train engine--30 mph	92-87
Freight cars--30 mph	85-75

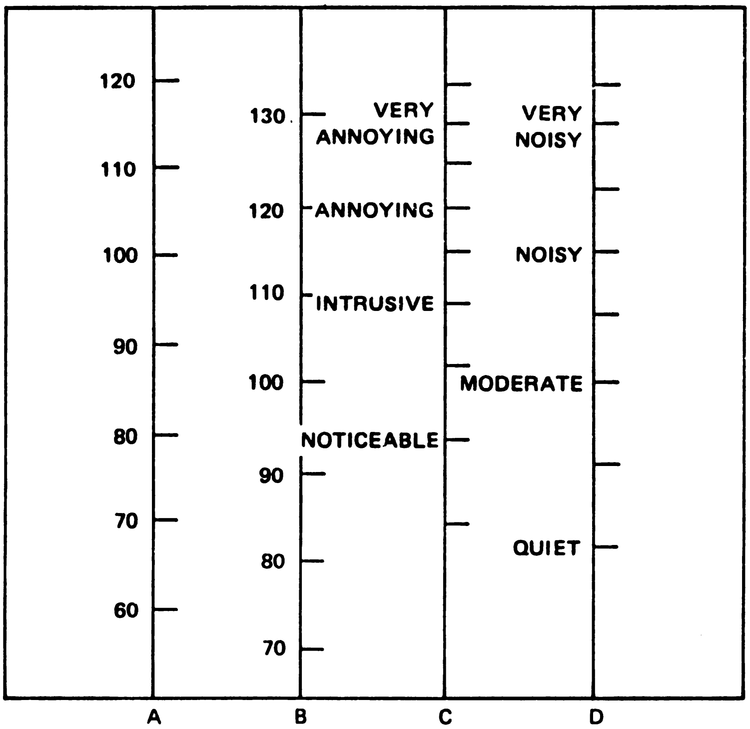
It has been found that a noise level above 90 dbA can cause workers to make significantly more errors than they make otherwise. Noises above about 80 to 84 dbA are considered noticeable or obtrusive. Intermittent noise, such as aircraft and trains, has different effects than steady noise.

Figure 21 is included to enable the reader to interpret sound level readings (dbA) in terms of annoyance and loudness. Figure 22 indicates how the sound pressure level (a slightly different measurement from the "sound level" in dBA) varies with the distance from the railroad tracks for the train horn and the train noise.

Grade crossings are a cause of noise--train horn and crossing bells--that is reducible only by elimination. As a matter of fact, even the high level of noise of the horn and bells is inadequate for audible warning to drivers in closed, air-conditioned vehicles. Train horn noise can therefore be expected to be a principal source of public complaints about noise if relocated lines include grade crossings.

In accordance with P.L. 92-574, the Noise control Act of 1972, the Environmental Protection Agency is committed to publish noise emission

* Serendipity, Inc., "Train System Noise," Arlington, Virginia (November 1970).



LINE A = SOUND LEVEL (dBA)
B = PERCEIVED NOISE LEVEL (PNdB)
C = SUBJECTIVE INTRUSIVENESS
D = SUBJECTIVE NOISINESS

SOURCE: Final Report of the Committee on the Problem of Noise, Parliament of United Kingdom, HMSO, London, England (Cmnd. 2056, 1966).

FIGURE 21 RELATIONSHIP BETWEEN THE SOUND LEVEL, NOISE LEVEL, INTRUSIVENESS, AND NOISINESS

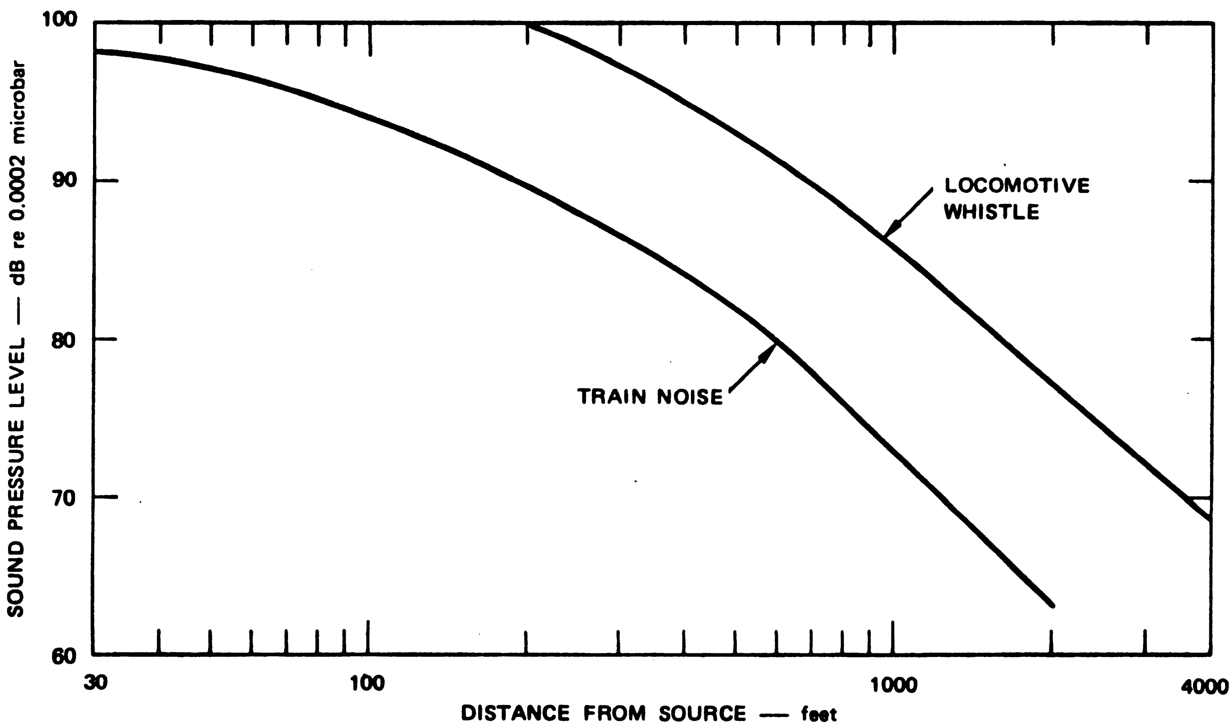


FIGURE 22 NOISE FROM TRAINS AT DIFFERENT DISTANCES

regulations for railroads, but such regulations are not yet available. While detailed methodology for the analysis of railroad noise impacts of alternative relocation plans is beyond the scope of this study, the planner should be aware of federal, state, and local requirements for noise impact filings. The reader is referred to Wyle Laboratories Report No. WCR 73-5, "Assessment of Noise Environments Around Railroad Operations" (July 1973), for more thorough guidelines on noise impact analysis.

Danger--Danger to persons in a neighborhood consists primarily of the danger to those who cross the tracks, whether they are highway users (see Section XI), bicyclists, or pedestrians. The danger is a special concern of neighborhood residents, employees, and customers--the people who are more frequently exposed than those who do not cross the tracks on a regular basis. Most accidents to pedestrians happen to children playing on or taking short cuts across the tracks.

Other kinds of danger are associated with railroads but are usually not so important as danger to pedestrians, unless the community has experienced particular kinds of accidents. Hazardous materials are sometimes carried by rail; they may constitute a danger in areas where the loaded cars are parked--in a freight yard or at a dock, for instance. Trains occasionally are derailed, but the effects of the derailment are often more serious in rural areas where speeds are higher than in urban areas.

Visual Intrusion--Unless a railroad line is depressed below grade or buffered by buildings or landscaping, it is quite visible and usually unattractive. First, the equipment is designed for durability, not for appearance. Dirt, rust, and lubricants frequently mar the ground along the right-of-way. Even when painted, rail cars seem like rolling billboards to many. The motion of the train and its attendant noise attract attention.

Railroad structures have not had the architectural attention that newer mass transit and highway structures are now receiving; consequently, they are frequently austere and functional, and often in need of paint.

Railroad rights-of-way are also maintained for functional, rather than visual reasons. Weed control is not as good as in other parts of the community. Wind-borne paper litter is an added burden to the usual litter of spilled lading and discarded railroad equipment along the right-of-way. This unsightliness prompts local citizens to discard even more junk in the right-of-way.

Finally, the railroad is frequently in an older part of town. The age and decay of older structures makes them visually blighting and intensifies right-of-way appearance problems.

Air Pollution from Railroad Locomotives--Railroad locomotives are powered by diesel engines that emit smoke and polluting gases during their operation. The effects of pollution from locomotives are likely to be more localized than those from highway vehicles.

The smoke from the locomotives will contribute to local visual intrusion, both as it is emitted and as it blackens buildings and structures. A well tuned and maintained diesel engine does not normally emit smoke except under periods of heavy load, such as acceleration. Thus areas where the locomotives accelerate or where switching operations are conducted will be especially subjected to smoke particles. The amount of the emission from a switch engine is approximately .02 pounds of particulate per mile, and from a fully loaded train it is up to 0.3 pounds per mile.*

To help visualize what this means, a heavy diesel truck emits .003 pounds of particulates per mile. Of course, the truck carries perhaps 15 tons, while the train carrying 40 tons per car--although actually emitting less per unit of load--produces greater concentrations of particulates.

Another annoyance from diesel engines is the smell and irritation of unburned or partially burned hydrocarbon fuel. The average emissions of the fuel are 0.12 pounds per mile for switching service and up to about one pound per mile for fully loaded trains, using average emission factors.† Comparable diesel truck emissions, at .007 pounds per mile, are substantially greater per unit of load but are not so concentrated. Again, the hydrocarbon emission increases under acceleration or hillclimbing, and the emissions will be concentrated around these locations for both trucks and locomotives.

Air Pollution from Motor Vehicles--As motor vehicles slow down or stop for grade crossings, then accelerate back to speed, they emit more pollutants than they would were they to continue along the same distance

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*Computed from average factors of 25 lb/1,000 gallons of particulates and the fuel consumption data given in Appendix B.

†EPA, "Compilation of Emission Factors," Second Edition, publication No. AP-42, Research Triangle Park, North Carolina (April 1973).

at steady speed. Therefore, changes to the railroad system that eliminate grade crossings will eliminate these excess emissions.

The effects of the emissions at grade crossings are felt in some measure all over the air basin, but the effects are most pronounced near the sources of the emissions. Therefore this emission problem is both a neighborhood and a community impact. However, because of similarities in the computations, estimating of automotive air pollution has been included in Section XI, "Highway User Impact."

Physical Barrier--The railroad presents a barrier to travel that may range from complete impassability to only a slight irritation. The degree of impassability also depends upon whether pedestrian or vehicular travel (both bicycles and motor vehicles) is being considered. For pedestrians, the roughness of the crossing as well as the danger of accidents may present a barrier at an established grade crossing--especially for handicapped, infirm, or aged persons. Railroads that pass through school district boundaries may require children to walk longer distances to cross at an established crossing, or to trespass on the railroad property--exposing themselves to danger. When accidents do happen, the railroad is pressured into fencing the right of way, further adding to the barrier. Depressed or elevated railroads present additional obstacles and dangers.

The railroad barrier effect on vehicular traffic is the blocking of crossings and the roughness of the crossing, and the potential danger that makes for slowing down, stopping, and delays. Additional barriers are created where streets are not provided with grade crossings, requiring the motorist to detour to an open crossing if he wants to continue in that direction.

Social Effects

Many of the social effects of projects designed to alleviate railroad problems in urban areas grow out of the physical effects. The social effects common in such projects can be discussed under the headings of attitudes of residents, relocation, neighborhood disruption, and perception of accessibility.

Attitude of Residents--The attitudes of the neighborhood residents toward their property and toward proposed solutions to a railroad problem are brought about by their view of the railroad and their feelings about the way their lives may change if something is done about it. Persons living near railroad tracks are frequently less concerned about the noise and vibration than persons who don't live so close. Attitudes of nearby residents have been expressed as: "We are used to the trains and they don't bother us anymore," while those who don't live nearby express attitudes such as: "I wouldn't like to live next to those dirty, noisy old tracks." Thus, while the noise, vibration, and visual intrusion may disturb sleep and speech for a while, many residents can ignore the effects. However, the attitude of outsiders may influence the residents to feel that their homes are inferior to those in other locations, and this attitude may be manifested in poor maintenance of the homes.

Because of the "getting used to" nature of the effects, dynamic situations are likely to be more severe than static ones: moving a railroad to an area where there was none before will likely stir up all sorts of apprehensions among residents in the new area, and while their worries may not be well founded, it may not be possible to convince them of this. On the other hand, the residents in neighborhoods where the railroad was removed may be slower to react, and be less intense in their joy to see the railroad go--especially if they foresee secondary effects such as those depicted earlier in Figure 20.

Relocation--Families or businesses may have to move if a right-of-way is to be established for a new railroad line or if land is to be made available for a grade separation structure. Even though the families are compensated for moving their goods, moving may have a severe impact on their lives. The move will require that new relationships be established with new neighbors, and the degree of ease in establishing these new relationships and the need for such relationships vary widely among people. Further, moving from a long-time home can be injurious to a person's sense of identity. In general, younger persons are better able to adapt to new surroundings than older ones, and upper- and middle-class families are more likely to have relationships outside the neighborhood than do poorer families. Racial minorities will in general have more difficulty adapting to new neighborhoods.

In many railroad relocation projects, older neighborhoods are affected, with residents occupying older and hence lower cost housing. Availability of low cost housing is therefore very critical for those who are forced to move.

Neighborhood Disruption--Those who live around a new right-of-way and those who live in the neighborhood of abandoned rights-of-way will see their neighborhoods disrupted in different ways.

If a new right-of-way creates a physical barrier, transportation and hence communication among the residents will be impaired. The division of neighborhoods by railroads and the differences in socioeconomic indicators between neighborhoods divided by existing railroads indicate the degree to which this reduction in communication can affect neighborhood boundaries. The severity of the social effect depends upon the needs of the residents to maintain the relationships with their neighbors. The people most in need of such relationships are the elderly and the racial minorities. In addition, the neighborhood may be more or less cohesive, depending upon whether the residents have common interests or backgrounds. For example, in Lafayette, Indiana, one neighborhood predominantly made up of retired railroad employees is more cohesive than others because of the opportunity and need of the residents to relate to one another. Cohesiveness can develop when residents are faced with common problems or challenges.

The effects of neighborhood disruption can be minimized by following existing boundaries (freeways, natural features) in the design of the new railroad, and by working with the residents to devise solutions, such as crossings, to minimize the effects of incursion.

Less obvious and more slow moving are the impacts on a neighborhood of removing an existing railroad. The barrier that delineated neighborhoods for many years is removed, and if the scar is healed and accessibility restored, new relationships may develop between neighborhoods that were divided. This may or may not be favorable. An increase in the value of the land due to removal of the physical effects of the railroad may result in social and then economic changes that create new land use patterns in the neighborhood. Commercial development, for example, may occur near the old right of way and force relocation of families. Heavier street traffic around the development may create a barrier as insurmountable as the railroad once was.

Accessibility--Accessibility is a state of mind as well as a physical thing. The railroad creates time delays and increased travel costs for highway users (see Section XI). Moreover, the perception of these problems also governs behavior--the degree of irritation at being delayed at a grade crossing, or the expected irritation that might lead to avoiding a trip to an area across the tracks.

Economic Effects

As shown earlier in Figure 20, the way that people are affected by the physical aspects of projects will influence their behavior in ways that result in economic consequences. The attitudes that influence the economics of the community most directly are the feeling about accessibility and attitude of people toward property. Improving these factors may result in favorable impact on landowners. Unfavorable economic impacts may also result from the project--business disruption and damage to land values.

Land Values--Changing people's attitudes about the value of land and changing their perception of the accessibility of the land may significantly influence the value of land in certain areas. Appraisers usually consider a railroad near a piece of property a negative factor when they estimate the value of land parcels. This is usually a reflection of the attitudes of persons toward the damaging effects of the railroad on the property. The effects are more pronounced on residential property than commercial property, since remedies such as soundproofing or selection of compatible uses can offset the negative effects of a railroad for other than residential uses. Higher-valued residential property is likely to be more than proportionately affected by the presence of a railroad.

Economic theory tells us that land value is related to its accessibility--the easier it is to get to, the more valuable it is for retail use or for use by employers of large numbers of people. Traditionally this has meant that urban centers are more accessible than other areas of a community. However, freeways and automobiles have modified this traditional relationship and freeway interchanges on circumferential loops may provide higher accessibility to retail centers. Downtown retail and commercial centers are seeking to counter this trend by eliminating the railroad and thus improving their accessibility. The degree of increase in value of the more accessible land depends again on the uses--retail stores that require traffic through the store for profitability will benefit from improvement more than a shop whose unique products alone draw customers to it.

Likewise, employers of large numbers of relatively unskilled workers, such as insurance companies, benefit more from accessibility than those who require fewer and more highly skilled personnel.

Economic theory also tells us that the demand for land is a constant for a particular community, if the community is broadly defined. Therefore, increases in land value at one location will usually result in decreases in other locations. Exceptions to this rule occur if the land under consideration is unique (for example, the only flat land for many miles in any direction), if it is otherwise uniquely located (for example, near transportation facilities that provide good access), or if it will attract an industry from a community outside the trade area.

Business Relocation and Disruption--Businesses that relocate suffer some of the same pains that families do when they move: they are identified with a location and they have relationships with people based on that location. Disturbing these relationships disturbs the business and its profitability. The actual cost of the moving and the time lost may be only a part of the total impact on the business.

Businesses in neighborhoods that are disrupted are themselves vulnerable to economic impact owing to the disruption of the neighborhood. This is again because of the relationship between the business and its customers, and also because of a change in accessibility.

Describing and Quantifying Neighborhood Impacts

Neighborhood impacts are different for different kinds of changes in the local railroad system. Five changes in railroad system have been identified that may have a significant impact on a neighborhood:

(1) Removing a railroad from a neighborhood

(2) Adding a railroad to a neighborhood

(3) Reducing the level of traffic on an existing railroad

(4) Increasing the level of traffic on an existing railroad

(5) Adding a grade separation structure.

The general procedure for neighborhood impact assessment is to identify how each alternative introduces one of the above changes into each uniquely-affected neighborhood in the study area, to analyze the impact of the changes on the neighborhood, and then to summarize the neighborhood impact of each alternative.

Identifying Neighborhoods and Stakeholder Groups for Analysis

For the purposes of this guidebook, a neighborhood is defined as a group of people who have characteristics that distinguish them from other groups in adjacent areas. The definition is broader than usual since it can include a group of businesses in a geographical area as well as a group of residences. In the analysis we are concerned only with neighborhoods that are uniquely affected by one or more of the railroad alternatives being studied, so the identification of neighborhoods for analysis is related to the changes in the rail system listed above. The criteria for selection of a neighborhood for analysis are that the railroad actually goes through or borders the neighborhood, or the railroad otherwise affects the neighborhood directly--such as by reducing access of motor vehicle traffic.

The stakeholders in these neighborhoods are (1) the owners and tenants of property that abuts the railroad, and (2) the owners and tenants of property not directly abutting the railroad but who are affected by it.

The definition of a neighborhood as a group of occupants with similar characteristics is the criterion for delineation of census tracts, land use zones, traffic zones, or areas defined for the collection and analysis of data by government agencies and utility companies. Other neighborhoods can be identified by their emergent organizations that make themselves heard in community affairs.

It is suggested that a map of the community be marked with the railroad alternatives so as to define affected neighborhoods initially. The neighborhoods should then be coded appropriately for easy reference. If available, Sanborn maps are convenient base maps because they provide delineation of land parcel boundaries as well as streets and other features. Assessor's parcel maps may also be used.*

Worksheet NI-1 provides a way of breaking down the alternatives into their effects on the neighborhoods to be analyzed. The neighborhoods affected by each of the five kinds of physical changes in the railroad system can be identified. Subsequent analysis will measure the neighborhood impacts for each of the five kinds of changes, then the neighborhood impacts for each of the alternatives will be summarized.

For neighborhoods in which the new land uses are critical to the project, detailed studies and maps should be prepared, and back-up economic and traffic analyses proposed.

Assessing Neighborhood Impacts

The planner has to be aware of the kinds and intensities of impacts that can fall to members of individual neighborhoods throughout the study area. A recognition of these kinds of impacts and a feeling for their identification are the primary requisites for assessing impacts. The worksheets at the end of this section (page XII-19) together with instructions for using them, are supplied as an aid to--but not a substitute for--this sensitivity to social impacts. Experience has shown that a block-by-block or neighborhood-by-neighborhood study can be very time-consuming and costly, but that this kind of detail may be necessary if the social impacts are the crucial issues in the project. In other urban areas, such issues may be salient only for a few limited neighborhoods and only they need be analyzed in detail.

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*Figure 23 illustrates the neighborhoods identified for the example city.

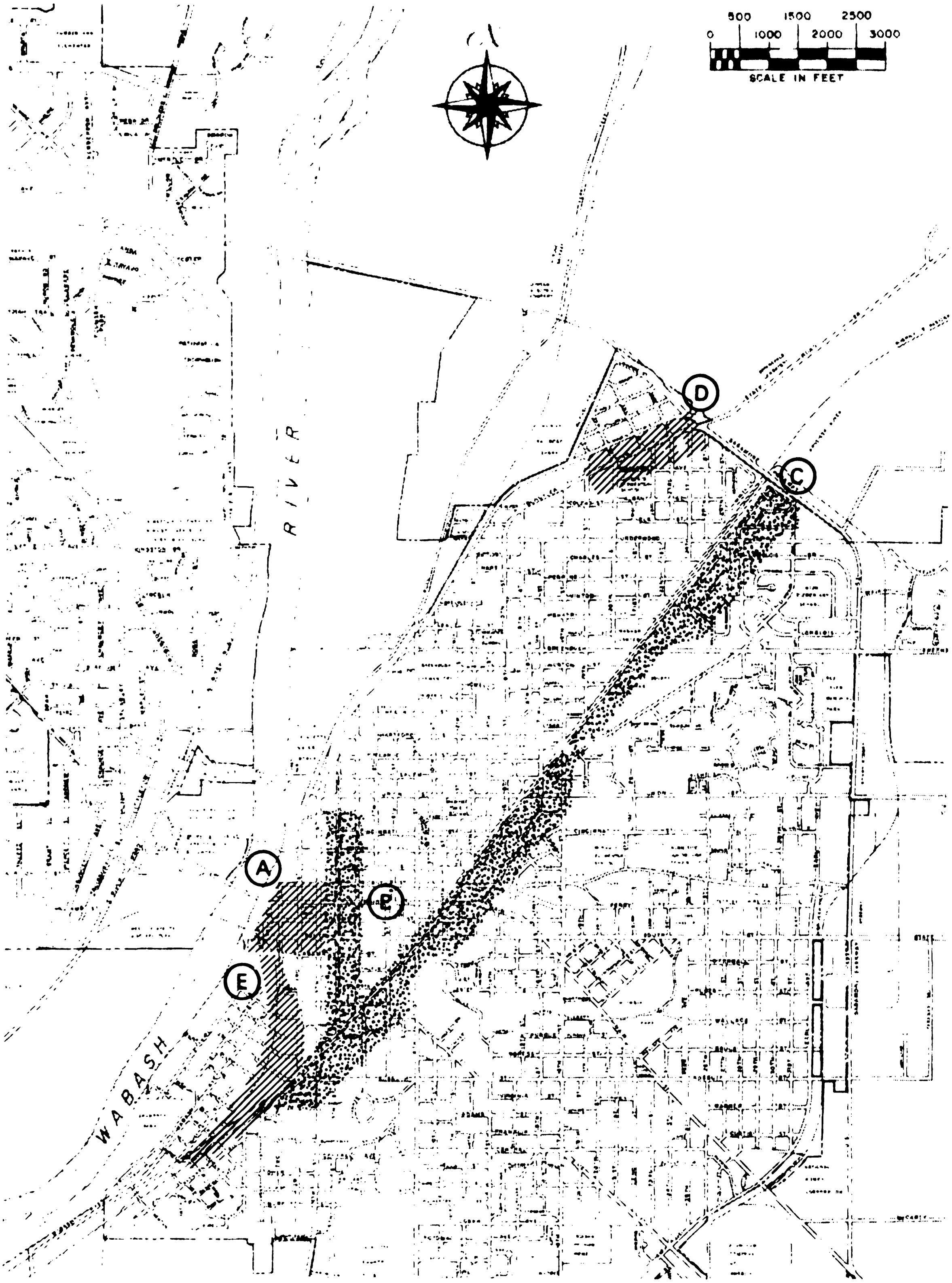

FIGURE 23 IMPACT AREAS

Railroad Removed from Neighborhood--Worksheet NI-2 is provided to facilitate inventory of the railroad facilities in the neighborhood that is being analyzed. One copy of the worksheet should be used for each neighborhood identified in Worksheet NI-1, lines 1b and 1d. Worksheets NI-3 and NI-4 are provided to compute the impacts on the tenants and owners of property abutting the railroad and on tenants and owners of property affected by the railroad but not abutting it.

Railroad Added to Neighborhood--Worksheet NI-5 provides a way of inventorying property in and around the path of a proposed railroad alignment. These day are translated into relocation expenses in Worksheet NI-6, right-of-way acquisition impact in Worksheet NI-7, and neighborhood disruption impact in Worksheet NI-8.

The assessment of values of land and improvements, and damages to property, are best done by real estate professionals--appraisers or brokers. However, a detailed appraisal may not be necessary, since uncertainties in other factors may make great precision in the estimation of land impacts unwarranted. Therefore, a "windshield" survey of the area will frequently be sufficient for field work by the appraiser. Of course, in the implementation phase, when exact cost estimates for right-of-way and project activities are needed, more careful estimating will be required.

Reduced Traffic on Existing Railroad--Reduction of traffic on an existing railroad occurs in railroad improvement projects when a main line is rerouted and the former main line is downgraded to a spur or industrial lead, serving only local switching traffic. The impact of the traffic reduction will depend upon the traffic on the line before the modification. Worksheet NI-2 may be used to inventory the conditions that currently exist, and Worksheet NI-3 may be used to describe the impact of the reduction. When these worksheets are used for this purpose, they should be numbered and be referred to as Worksheets NI-2r and NI-3r. Where the impact is only on the abutting property, attention to line 3 in Worksheet NI-4r may be minimized, but where the accessibility of an area is significantly improved by train traffic reduction, careful attention should be given to this data line.

Increase in Railroad Traffic--Where there are already through trains operating over a segment of railroad that is planned for increased traffic in one of the alternatives, the increase in traffic may not be significant. However, if the line is changed in character--for example, from an industrial spur or lead that has only occasional switching movements to carrying several through trains per day--the impcat may be substantial. (This part of the analysis assumes that no new right-of-way is needed; if new right-of-way is needed, use the procedure for "Railroad Added to Neighborhood," Worksheets NI-5 through NI-8.)

Use Worksheet NI-2, redesignated NI-2i, to collect data on the existing neighborhood and railroad situation. Then use Worksheet NI-9 to assess the impact of the additional traffic. This assessment will depend largely on the judgment of the project specialists and the real estate appraiser. It is not possible to offer firm guidelines on, for example, what constitutes a significant increase in train traffic.

Highway Grade Separation--A highway grade separation will increase access to some neighborhoods while decreasing access to others, especially to property located near the intersection of the railroad and the street to be separated.

For this assessment, use Worksheet NI-2, redesignated NI-2s ("s" standing for "separation" analysis), to collect data about the property and the railroad. Then use Worksheet NI-4s to identify impact on neighborhoods that benefit from improved accessibility, and Worksheets NI-5s, -6s, and -7s, to identify the impact on surrounding land and occupants.

Summarizing Neighborhood Impacts, by Alternative

Worksheet NI-10 provides a means for summarizing neighborhood impacts by alternative, using data from Worksheets NI-2 through NI-8 and their derivatives for each neighborhood.

Worksheet NI-1

IDENTIFICATION OF NEIGHBORHOODS AFFECTED
BY BASIC RAILROAD CHANGES

	Alt. 0	RIVER-FRONT Alt. 1	C-3 Alt. 2	etc.
1. Railroad Removed from Neighborhood				
a. Initial year of significant impact		1980	1980	
b. Neighborhoods affected		A,B,C	A,B	
c. Subsequent landmark year				
d. Neighborhoods affected				
2. New Railroad Corridor Added to Neighborhood or Existing Corridor Widened				
a. First landmark year		1980	1980	
b. Neighborhoods affected		A,B,D	C	
c. Second landmark year				
d. Neighborhoods affected				
3. Railroad Traffic Reduced				
a. First landmark year				
b. Neighborhoods affected				
c. Second landmark year				
d. Neighborhoods affected				
4. Railroad Traffic Increased				
a. First landmark year		1980		
b. Neighborhoods affected		E		
c. Second landmark year				
d. Neighborhoods affected				

Worksheet NI-1
Page 2

	Alt. 0	Alt. 1	Alt. 2	etc.
5. Highway Grade Separation Added				
a. First landmark year		1980	1980	
b. Neighborhoods affected		A,B,C, D,E	C	
c. Second landmark year				
d. Neighborhoods affected				

DATE: 3/1/74 INITIALS: JAH

Worksheet NI-1 Instructions

Worksheet NI-1 is provided to designate the way that neighborhoods are affected by each of the alternatives under consideration. The alternatives are assumed to consist of combinations of removing or adding railroads to neighborhoods, increasing or decreasing traffic on existing railroads, or adding grade separations.

Line 1: For each alternative, enter the year in which the plan for the alternative calls for removing railroads (including tracks, ties, and ballast). If the alternative calls for removing railroads in stages, use lines a and b for the first stage, then c and d for a later stage. Enter the designation of the neighborhoods that are affected by the removal in lines b or d, depending on the stage of removal.

Lines 2 through 5: Repeat the process described for line 1 for neighborhoods affected by adding a new railroad corridor or increasing the width of the right-of-way, reducing railroad traffic, increasing railroad traffic, or adding a grade separation.

Worksheet NI-2

INVENTORY OF EXISTING CONDITIONS AROUND RAILROAD

1. Neighborhood Identification C

2. Railroad: N&W; segment from NEAR SMITH ST. to SAGAMORE PKWY.

3. Railroad Data

   a. Right-of-way

      (1) Length: 1.95 MI

      (2) Width: 100.0 FT

      (3) Area: 23.6 AC

      (4) Relation to grade (above, at, below) AT GRADE

      (5) Curvature STRAIGHT

      (6) Condition (litter, weeds, etc.) JUNK & LITTER FROM FERRY TO 18th — WEEDS THROUGHOU

   b. Railroad facilities

      (1) Number of tracks 2

      (2) Other equipment PIGGYBACK FACILITY NEAR FERRY

      (3) Type and condition of structures 3 OLD SAND BRICK BLDGS.

      (4) Fencing (condition, access, etc.) FENCE ADJACENT TO MARKET SQUARE SHOPPING CENTER — O.K.

   c. Railroad operation

      (1) Approximate total number of trains per day 30-40

      (2) Average train speed 20 MPH

Worksheet NI-2
Page 2

4. Abutting Property

a. Estimated lot sizes

(1) Width by depth: 140 FT x 50 FT

(2) Parcel area 7000 SF

(3) Frontage of railroad ______

b. Land use

(1) Family residences

a) Number of structures or units 970 UNITS

b) Description/condition SOUND TO DETERIORATING

c) Number of families 900

(2) Use Number 2 PROFESSIONAL/COMMERCIAL

a) Number of structures or other units 26 BUSINESSES

b) Description/condition of structures SOUND

(3) Use Number 3 SHOPPING CENTER

a) Number of structures or other units ABOUT 30 UNITS

b) Description/condition of structures SOUND

DATE: 3/5/74 INITIAL: JAH

Worksheet NI-2 Instructions

Worksheet NI-2 suggests field inventory data to be gathered to assess the impact on property and people in and around the railroad right-of-way. Multiple worksheets may be needed to inventory the designated neighborhoods.

Line 1: Enter the designation of the neighborhood under analysis.

Line 2: The railroad should be identified by segments that correspond to operations analyzed under Railroad Company Impact (Section IX) which also conform to neighborhood or impact area boundaries. Enter the beginning and end points of the railroad segment associated with the neighborhood. It is preferable to identify segments by physical landmarks, such as cross streets, than by railroad mileposts.

Line 3: Enter the dimensions of the right-of-way, its area, relation to the grade of the surrounding property, curvature (enter straight, moderate, or tightly curved), and condition: poor drainage, weeds, littered, etc. In line 3.b, describe the rail facilities: number of tracks, other equipment, structures or buildings and their condition, and the height, type and condition of fencing along the right-of-way, together with access points. In line 3.c, enter the total number of through, local, and switching trains per day along the segment(s), and the average train speed.

Line 4: Estimate the width and depth, and the parcel size of the properties abutting the railroad. In line 4.b, first identify the number of residential units, describe their condition, and estimate the number of families in them. Repeat such data for other land uses, such as commercial or industrial structures.

Worksheet NI-3

IMPACT OF RAILROAD REMOVAL
ON ABUTTING PROPERTY OCCUPANTS AND OWNERS
(Alternative 1 : RIVERFRONT OR C-3)

1. Neighborhood Identification B – ALONG 5th ST.

2. Railroad: L&N ; segment from JCT. 5th ST. to UNION ST.
from ____ to ____
from ____ to ____

3. How will neighborhood change as a result of project?
RR NOW RUNS IN MIDDLE OF 5th ST. REMOVAL WILL PERMIT HIGHER DEVELOPMENT NORTH & SOUTH OF CBD.

4. Land Use

	Now	First Landmark Year	Second Landmark Year
		1980	1990
a. Right-of-way use	R.R. R-O-W	STREET →	→
(1) Estimated demand for this use: sq. ft. or acres		STREET CAPACITY NOT CRITICAL	
(2) Amount of land freed	1 AC →	→	→
(3) Unit value	UNKNOWN →	→	→
(4) Total value: (4a2 × 4a3)	NO SIGNIFICANT CHANGE IN VALUE IS EXPECTED FROM THIS USE CHANGE		
b. Abutting property			
(1) Use Number 1	RESIDENTIAL →	→	→
a) Number	539 DUS →	→	→
b) Description			UPGRADED SINGLE AND MULTIPLE
c) Estimated demand	MARKET RELATIVELY TIGHT	NO CHANGE	WILL NEED ABOUT 200 NEW MF UNITS

	Now	First Landmark Year	Second Landmark Year
b. Abutting property (continued)			
d) Unit value	$7,000-$10,000	$7,500-$10,000	→
e) Total value (4b1a X 4b1d)	$4,206,000	$4,400,000	→
(2) Use Number 2	COMMERCIAL	→	→
a) Number			
b) Description			
c) Est. demand			
d) Unit value			
e) Total value (4b2a X 4b2d)	NO CHANGE EXPECTED		
(3) Use Number 3			
a) Number			
b) Description			
c) Est. demand			
d) Unit value			
e) Total value (4b3a X 4b3d)			
c. Total [4a4 + 4b1e + 4b2e + 4b3e]	$4,206,000	$4,400,000	→
d. Change from present		$194,000	→
5. Economic Impacts			
a. Land value			
(1) Gross increase (line 4d)		$194,000	→
(2) Displaced from elsewhere in community		7,000*	→
(3) Net increase		$187,000	→
b. Business	LITTLE CHANGE EXPECTED		

*COMPUTED FROM RELATIVE ACCESSIBILITY TO MAJOR ACTIVITY CENTERS COMPARED WITH COMPETING LOCATIONS.

Worksheet NI-3
Page 3

6. Physical Impacts

a. Noise FAVORABLE — NOISE ELIMINATED

b. Danger FAVORABLE — DANGER FROM COLLISION & HAZARDOUS MATERIAL ELIMINATED

c. Visual FAVORABLE — VISUAL INTRUSION ELIMINATED

d. Pollution REDUCED BUT EFFECT NOT SIGNIFICANT

e. Barrier ELIMINATED

7. Social Impacts

a. Attitude EXPECTED IMPROVEMENT

b. Relocation } PROPOSED USES WILL PROBABLY

c. Disruption } NOT AFFECT RESIDENTS

d. Accessibility MUCH IMPROVED

8. Plans to Mitigate Unfavorable Impacts IMPACTS FAVORABLE OR NEUTRAL

9. Key Issues in this Neighborhood and Their Significance

1. IMPROVED ATTRACTIVENESS OF NEIGHBORHOOD.
2. MULTI-FAMILY DEVELOPMENT WILL AID CBD AND CENTRALIZE CITY.

NEITHER OF ABOVE CRITICAL TO PROJECT.

DATE: 3/11/74 INITIALS: JAH

Worksheet N1-3 Instructions

Worksheet NI-3 guides impact analysis of neighborhoods abutting the railroad that is to be removed under one of the alternative solutions to the problem.

Line 1: Enter the designation for the neighborhood.

Line 2: Identify the railroad and segment(s) in the neighborhood.

Line 3: Describe briefly how the neighborhood can be expected to change over the next 20 to 25 years as a result of removing the railroad.

Line 4: To quantify the description in line 3, first enter the current year and years in which significant changes are expected. (These may be the years identified in Worksheet NI-1, or they may be later years in which the effects of removing the railroad are likely to be felt.) Then in line 4a, enter the use of the right-of-way expected in each of the years and, in line 4a1, the estimated demand for this type of use. Enter in line 4a2 the amount of land provided by the relocation. Then estimate the value per acre or square foot for each use specified, using available economic data on the community and the judgment of a real estate appraiser. In line 4a4, enter the value per unit multiplied by the number of units as indicated.

For each projected land use of the abutting property (4b), identify the use, estimate the number of parcels or other units, describe the units, and estimate the demand and total value of property in this land use. If the land use remains the same, estimate the number of units for which the values will be changed by the project.

In line 4c, summarize the land values above for the current year, the first landmark year, and the second landmark year. Then, in line 4d, subtract the total value of the present land uses from the first landmark year and from the second landmark year, to show the overall changes expected in the land use values.

Line 5: Enter in line 5a1 the total gross increase expected in land values estimated for the landmark years. Then estimate the dollar value of the demand for the various land uses that will be taken from elsewhere in the community, and enter the difference in line 5a3. In line 5b, note any economic effects on businesses that the changes in land use may have.

Lines 6 and 7: Describe the physical and social impacts that occur in each of the landmark years as a result of the land use changes between these years. As appropriate, indicate the impacts as favorable, unfavorable, or reduced or increased.

Line 8: Describe plans to mitigate unfavorable any impacts noted under lines 5, 6, and 7. Such descriptions might include provision for families to be moved, and planning to guide land use development.

Line 9: Identify the key issues related to this neighborhood under the proposed alternative. Estimate their significance relative to other impacts of the project alternative.

Worksheet NI-4

IMPACT OF RAILROAD REMOVAL
ON NON-ABUTTING PROPERTY OCCUPANTS AND OWNERS
(Alternative 1 : RELOCATE RR)

1. Neighborhood Identification EAST WHEELING *

2. How Will Railroad Removal Affect this Neighborhood?
WILL ALLOW CONSTRUCTION OF A REGIONAL SHOPPING CENTER TO REPLACE PRESENT MIXED RESIDENTIAL/COMMERCIAL USES.

	Land Use No. 1	Land Use No. 2	Land Use No. 3
3. Land Uses			
a. Present use	RESID.	COMM/INDUST.	INSTITU./TRANS.
(1) Present utilization for this use	150-175 DUS	SEVERAL SMALL ESTAB.	STREETS
(2) Estimated supply without project	REPLACE. LOW-INCOME HOUSE SCARCE	OTHER LOCA. AVAIL.	OTHER FACIL. AVAIL.
(3) Amount of land in this use affected: acres	12	14	11
(4) Unit value: $/acre	$88,000	$44,000	0
(5) Total value (3a3 × 3a4)	$1,056,000	$616,000	0
b. Future use in year 1980	REGIONAL SHOPPING CTR.		
(1) Estimated demand for this use	SMSA SHOPPER GOODS SALES $100.1 MILL.		
(2) Estimated supply without project	SMALL SUBURB. CENTERS WILL DEVELOP		
(3) Amount of land in this use affected: acres	37		
(4) Unit value: $/acre	$220,000		
(5) Total value (3b3 X 3b4)	$8,140,000		

* NOT PART OF DEMONSTRATION CITY -- DATA WAS DERIVED FOR ANOTHER STUDY.

	Land Use No. 1	Land Use No. 2	Land Use No. 3
c. Future use in year ______			
(1) Estimated demand for this use	______	______	______
(2) Estimated supply without project	______	______	______
(3) Amount of land in this use affected: acres	______	______	______
(4) Unit value: $/acre	______	______	______
(5) Total value (3c3 x 3c4)	______	______	______

4. Grade Crossings Serving Neighborhood

   a. Number removed 3

   b. Value of removal (HU-5, line 6e) NOT APPLICABLE (SHOPPING CENTER TRAFFIC MUCH GREATER THAN EXISTING).

5. Physical Impacts:

   a. Noise FAVORABLE

   b. Danger FAVORABLE

   c. Visual FAVORABLE

   d. Pollution PROBABLY FAVORABLE--SHOPPING CENTER MUST BE ANALYZED.

   e. Barrier ELIMINATED

6. Social Impacts

   a. Attitude SHOULD IMPROVE

   b. Relocation 150 FAMILIES

   c. Disruption POTENTIALLY UNFAVORABLE, BUT WHOLE NEIGHBORHOOD MOVED.

   d. Accessibility IMPROVEMENT MAKES PROJECT POSSIBLE.

Worksheet NI-4
Page 3

		In Year	In Year
7.	Economic Impacts:	1980	______
a.	Total land value increase (or decrease) [sums of lines (5) under 3b or c less 3a]	$6,468,000	______
b.	Demand diverted from other parts of community	5,148,000*	______
c.	Net total land value change (7a-7b)	1,320,000	______
d.	Highway user value (line 4b)	N/A	______
e.	Insurance saving (or cost)	NOT ESTIMATED	
f.	Net economic change (7c-7d+7e; zero if change is negative)	$1,320,000	______

8. Plans to Mitigate Unfavorable Impact ______

1. NEED REPLACEMENT HOUSING FOR 150 FAMILIES.
2. INVESTIGATE SHUTTLE BUS TO TIE NEW CENTER TO PRESENT DOWNTOWN AREA 3/4 MILE AWAY.

* COMPUTED FROM ANALYSIS OF SALES PATTERNS WITH AND WITHOUT THE NEW CENTER.

DATE: 10/2/73 INITIALS: JHC

Worksheet NI-4 Instructions

Worksheet NI-4 provides guidance for assessing impacts on neighborhoods that would enjoy improved accessibility or other positive effects if the proposed alternative includes removal of the railroad. Separate sheets may be prepared for each neighborhood affected by each alternative.

Line 1: Enter the neighborhood identification.

Line 2: Briefly narrate the expected impact of the railroad removal on the neighborhood, covering a span of about the next 20 to 25 years.

Line 3a: Enter the existing land uses in the neighborhood under the three columns provided, and the amount of land or number of units in each use. Then estimate the community's supply of land for each use in the appropriate column. Enter in line 3a3 the amount of land in each use and, in line 3a4 the estimated unit value for the land: the assistance of an appraiser will usually be needed to make these estimates, although a land value map is available for some neighborhoods. Compute the total value of land in the existing uses.

Lines 3b and 3c: In subsequent years, the land uses may change as a result of the project. Enter the significant year in lines 3b and 3c, and enter the data for the forecast uses in each of these future landmark years.

Line 4: To avoid double counting, the value of increased accessibility to highway users must be deducted from the increases in value determined in line 3. From Worksheet HU-1 (Section XI of the report), count the number of crossings serving the neighborhood that would be removed. For these crossings, enter the present value from Worksheet HU-5 of the road user cost saving.

Lines 5 and 6: Note major physical and social impacts foreseeable in the "landmark years" of railroad removal.

Line 7: Determine the change in land values between the present landmark years by summing lines 5 in 3b or c and subtracting line 3a. Enter on line 7a. From this total subtract the value of the demand that would be diverted from other parts of the community using the judgment of local planners and real estate professionals, together with results from any economic studies for the area: enter on line 7c. Then on line 7d enter the value of removing grade crossings as shown in line 4b (a highway user saving). Then estimate any changes in insurance rates that will result from, e.g., better accessibility for emergency services (with the assistance of an insurance professional) applying the change in rates to the insured valuation and enter the savings in line 7e. Subtract this value to obtain the net economic change. Enter the net change on line 7f, showing zero if the difference is negative.

Line 9: Note possible planned action that can remedy potential adverse impacts on the neighborhood.

Worksheet NI-5

INVENTORY OF LAND
ON AND NEAR PROPOSED NEW RAILROAD ALIGNMENT
(Alternative 1 : RIVERFRONT)

1. Neighborhood Identification D-NORTHWEST OF MONON AVE.

2. Railroad: N&W; segment from McDOEL to SAGAMORE PKWY.

3. Data on Railroad

a. Right-of-way

(1) Length of segment 1,900 FT.

(2) Width 100 FT.

(3) Area 4.36 AC.

b. Railroad facilities

(1) Number of tracks 2

(2) Grade SLIGHT (0.5%)

(3) Relation of grade to surrounding land IN CUT

(4) Curvature STRAIGHT

c. Other facilities STREET OVERPASS AT 21st ST.

d. Total number of trains per day 50

4. Right-of-Way Acquisitions

	Land Use No. 1	Land Use No. 2	Land Use No. 3
a. Present use	SINGLE FAM. RES.	COMM.	
b. Number of units (or area)	30	2	
c. Improvements	RES.	OLD BLDGS	
d. Unit value	$12,500	$10,000	
e. Total value (4b X 4d)	$375,000	$20,000	
f. Total acquisition value		$395,000	

Worksheet NI-5
Page 2

5. Description of Damages to Property

		Number	Unit	Total
a.		1	$4,000	$4,000
b.				
c.				
d.				
e.	Total damages			$4,000

DATE: 3/5/74 INITIALS: JAH

Worksheet NI-5 Instructions

This worksheet provides a guide for field data collection in in neighborhoods where a railroad would be introduced under one of the alternatives. Each neighborhood identified by Worksheet NI-1, line 2, should be analyzed.

Line 1: Enter the designation of the neighborhood being analyzed.

Line 2: Identify the beginning and ending points of the proposed railroad segment.

Line 3: Enter the appropriate data on the railroad facilities and operation from the description of the alternative.

Line 4: In the columns, enter the predominant land uses of property that would be acquired for right-of-way. Under each land use, enter the quantities and values associated with property in that use, and sum the values.

Line 5: Describe the kinds of damages to property incurred by the right-of-way acquisition, the estimated unit value of the damages, the total for each type of damage, and the total for all damages.

Worksheet NI-6

RELOCATION OF FAMILIES AND BUSINESSES
(Alternative 1 : RIVERFRONT)

1. Neighborhood Identification D-NORTHWEST AT MONON AVE.

2. Household Relocation

a. Number 31

b. Estimated moving cost per household $200

c. Total moving cost (2a X 2b) $6,200

d. Average household rent in neighborhood $125/MO

e. Average value of owner-occupied dwellings $12,500

f. Locations of comparable available housing 1) SEVERAL VACANT LOTS WITHIN 1-5 BLOCKS SOUTH & EAST, 2) ELSEWHERE IN NORTH END OF CITY AT COMPARABLE PRICES.

3. Business Relocation

a. Larger businesses (use Worksheet RU-2)

(1) Number of establishments to be moved N/A

(2) Moving and disruption expense (total of lines 4g in all RU-2s) ________

(3) Community impact ________

a) Land (total of lines 7 in all RU-2s) ________

b) Jobs (Total of lines 5e in all RU-2's) ________

b. Smaller businesses

(1) Number 2

(2) Unit relocation cost $1,500

(3) Total relocation cost $3,000

(4) Number of employees 15

Worksheet NI-6
Page 2

b. Small businesses (continued)

(5) Relocation sites

a) In community: percent ___100%___

b) Outside community: percent ___0___

(6) Community impact

a) Land value change ___0___

b) Job number change ___0___

DATE: 3/5/74 INITIALS: JAH

Worksheet NI-6 Instructions

This worksheet provides guidance for estimating the numbers of families and businesses that will have to be moved in adding a railroad to a neighborhood or constructing a grade separation. A separate worksheet should be prepared in each neighborhood where there are families or businesses affected.

Line 1: Enter the designation of the neighborhood being analyzed.

Line 2: Estimate the total number of families (households) to be moved from data in Worksheet NI-5, line 4b, and the moving cost per family. The latter estimate should be based upon the approximate size of household and be prepared with the assistance of a moving contractor. Average rent and average value of owner-occupied dwellings can be obtained from Census data; they are to be recorded to help determine if replacement housing exists. The locations of such potential replacement housing should be identified and entered in line 24.

Line 3: For businesses employing more than 25 persons, Worksheet RU-2 (Section X of the report) should be filled out. Enter the number of establishments and (from Worksheet RU-2) the estimated moving/disruption cost for all the establishments moved from this neighborhood, the community land values lost from the community from all establishments, and the jobs lost by moving these establishments to other locations. (The value of the impact on the owner is not counted here, since it is included in the ROW acquisition or damage estimate in Worksheet NI-5.) For smaller businesses (those employing 25 or fewer people), estimate the number and the average moving cost for each. Then estimate the likely proportion that will remain in the community. Apply this fraction to the value of the land occupied by the establishments and enter as community land value change, and apply the fraction to the number of jobs and enter as job number change.

Worksheet NI-7

SUMMARY OF RIGHT-OF-WAY
ACQUISITION IMPACTS ON NEIGHBORHOODS
(Alternative 1 : RIVERFRONT)

(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
			Relocation Cost				Community Impacts	
Neighborhood	Value of Land and Improvements Taken (NI-5, line 4f)	Value of Damages to Property (NI-5, line 5e)	Households (NI-6, line 2c)	Businesses (NI-6, line 3a2 and 3b3)	Number of Households Moved (NI-6, line 2a)	Number of Businesses Moved (NI-6 line 3a1 and 3b1)	Land Values (NI-6, line 3a3 and 3b6a)	Jobs (NI-6, line 3a3b and 3b6b)
B	$235,000	$67,000	$3,000	$15,000	15	10	0	0
D	395,000	4,000	6,200	3,000	31	2	0	0
E	112,000	47,000	2,000	1,500	10	1	0	0
Total:	$742,000	$118,000	$11,200	$19,500	56	13	0	0

DATE: 3/11/74 INITIALS: JAH

Worksheet NI-8

NEIGHBORHOOD DISRUPTION
(Alternative 1 : RIVERFRONT)

1. Neighborhood Identification D-NORTHWEST OF MONON AVE.

2. Physical Impact of Project:
ISOLATES ABOUT 70 HOMES BETWEEN INDUSTRIAL PLANT, HIGHWAY, AND RAILROAD CORRIDOR. ONLY 1 OVERPASS TO ENTER.

3. Number of Families affected ABOUT 70.

4. Characteristics of Neighborhood:

	This Neighborhood	Whole Community
a. Mean household income	$8,838	$8,935
b. Percent minority households	0.7%	1.3%
c. Mean age	31	24
d. Other characteristics		

5. Estimated Disruptive Impact:
ISOLATION OF FAMILIES FROM PEDESTRIAN ACCESS.

6. Plans to Mitigate Unfavorable Impacts:
1. ADD PEDESTRIAN LANE TO OVERPASS ON SAGAMORE PARKWA
2. PLAN TO INDUSTRIALIZE AREA.

DATE: 3/5/74 INITIALS: JAH

Worksheet NI-8 Instructions

This worksheet guides the analysis of neighborhoods that would likely be disrupted by one or more of the alternatives.

Line 1: Enter the designation of the neighborhood under analysis.

Line 2: Briefly narrate how the proposed alternative would disrupt the neighborhood: include such information as whether the railroad is above or below grade, whether it will be fenced, and what other barriers to communication or travel it presents, such as closing existing streets.

Line 3: Enter the total number of families (households) affected by the disruption that results from the project.

Line 4: Determine the information on income, age, and race from Census publications for the tract or block being analyzed and for the community as a whole. From local knowledge enter other factors that may distinguish the neighborhood from others in the community.

Line 5: Estimate the seriousness of the disruption from the data provided above and the discussion earlier in this section of the report.

Line 6: Describe what measures are planned to minimize serious disruptive impacts. Include such actions as moving houses to vacant lots nearby, providing pedestrian overcrossings, or timing the project to fit foreseeable changes in the neighborhood character.

Worksheet NI-9

IMPACT OF INCREASED RAIL TRAFFIC ON NEIGHBORHOODS
(Alternative 1 : RIVERFRONT)

1. Neighborhood Identification E

2. Railroad: ALL ; segment from LAFAYETTE JCT. to MAIN ST.

3. Railroad Operation

a. Trains per day

	Now	Anticipated
(1) Switching and local	1	19
(2) Through	8	41

4. Estimated Impact on Neighborhood

a. Physical Impact ACCESSIBILITY DECREASED BY ELIMINATION OF GRADE CROSSINGS. IMMEDIATE AREA AROUND TRACKS IS PRIMARILY INDUSTRIAL, SO NOT MUCH OTHER IMPACT IS EXPECTED.

b. Social Impact MINIMAL.

c. Economic Impact

	Land Use No. 1	Land Use No. 2	Land Use No. 3
(1) Present Use	INDUSTRIAL		
(2) Number of units			
(3) Area: total acres			
(4) Estimated unit change in value			
(5) Total value change	NOT SIGNIFICANT		

5. Plans to Mitigate Negative Impacts:

N/A

DATE: 3/6/74 INITIALS: JAH

Worksheet NI-9 Instructions

This worksheet guides the assessment of the impact of increased rail traffic on the neighborhoods identified by Worksheet NI-1, line 4.

Line 1: Enter the designation of the neighborhood being analyzed.

Line 2: Identify the starting and ending points of the railroad segment that affects the neighborhood.

Line 3: Enter the existing and anticipated rail traffic on the segment that affects the neighborhood.

Line 4: Narrate the expected physical impacts of the increased rail traffic, starting with the most significant, e.g., increased noise, increased danger, and so on. Note especially changes in the use of the line. For example, switching adds more noise and barrier effect than through trains. Enter the significant social impacts likely to result from physical impacts. Identify the predominant land uses in the neighborhood and enter the designation of each at the headings of the columns provided. Enter the number of units, the number of acres, the estimated unit value change resulting from the increased traffic, and the total change in value.

Line 5: For adverse social or economic impacts, describe plans to minimize them.

Worksheet NI-10

SUMMARY OF NEIGHBORHOOD IMPACTS
(Alternative 1 : RIVERFRONT)

(A)	(B)	(C)					(D)	(E)	(F)	(G)	(H)
		Physical Impact					Economic Impact (thousands of dollars)				
Neighborhood or Impact Area	Nature of Change	Noise	Danger	Visual	Pollution	Barrier	Gross	Dis-placed	Net	No. of Families Affected by Disruption	Remedial Action/Comments
A	RR ADDED	U	O	U	O	U	NOT QUANTIFIED			0	DEPRESSION & ARCHITECTURAL TREATMENT MINIMIZE IMPACT
B	GS ADDED RR REMOVED	(E)	E	(E)	E	(E)	$194	$7	$187	0	
C	RR REMOVED	(E)	E	(E)	E	(E)	$1,400	$210	$1,190	0	
D	RR ADDED	U	O	U	O	(U)	INSIGNIFICANT			70	DEPRESSION & ADDITIONAL PEDESTRIAN CROSSING MINIMIZE NOISE & BARRIER
E	ADDED RR TRAFFIC	O	O	O	O	O	NO CHANGE			0	ALREADY INDUSTRIAL & RR PROPERTY
Totals							$1,594	$217	$1,377	70	

(INCLUDES NO SIGNIFICANT CHANGE IN BUSINESS LEVELS).

Worksheet NI-10 Instructions

Worksheet NI-10 provides a way of summarizing the impacts on the individual neighborhoods that were analyzed in Worksheets NI-3, -4, -8 and -9.

Column (A): Enter the designation of each neighborhood or area analyzed.

Column (B): Note the nature of the change to the neighborhood, such as railroad added, railroad removed, grade separation, or other change described in Worksheet NI-1.

Column (C): Summarize favorable or unfavorable impact described in line 6 of Worksheet NI-3 or line 5 of NI-4, or in Worksheets NI-8 or NI-9 by entering an F for favorable, a U for unfavorable, or an O for no impact. Circle the significant F and U impacts that are likely to be an issue in the project.

Columns (D), (E), and (F): Enter the economic impact data in these three columns from line 5 of Worksheet NI-3, line 7 of Worksheet NI-4, or line 4c5 of Worksheet NI-9, and total them.

Column (G): Enter the number of families affected by the disruption from line 3 of Worksheets NI-8, and total.

Column (H): Enter the significant impacts from Worksheets NI-3, -4, -8, or -9 and the proposed actions to minimize the unfavorable impacts.

XIII COMMUNITY IMPACT

In contrast to the neighborhood impacts, which uniquely relate to identifiable subsections of the community, other impacts of a railroad improvement project will spread throughout the community. These effects include changes in the competitive position of the rest of the community relative to the affected neighborhoods, in the community's tax base and taxes, in air pollution, in local government costs, in employment, and in the character of the central business district. Also a part of the total community effect, but described separately (see Section XI) is much of highway user impact, since the highway users are predominantly local people.

Competitive Balance

It was noted in the discussion of neighborhood impact (Section XII) that land values are a result of demand for land in the community, and that most of the demand is constant. As a result, increased values in one location may result in decreases somewhere else. Exceptions to this effect come when a specific neighborhood has land that is unique for certain uses, or when there is a clear opportunity and commitment to use the railroad project as a focus to compete with other communities for certain types of activity. Except for such instances, land values are "rearranged" within the community--a rise in land value in one neighborhood will be reflected in declines in other neighborhoods--and such rearrangements may have political and other consequences for the community as a whole.

Tax Base and Taxes

The gaining of a major new industry for a town or the losing of a major rail user to another community constitute community-wide effects, for the increase or decrease in taxable property affects the taxes that all must pay.

The community will probably have to pay a part of the railroad improvement project cost, and its share will have to come from taxation or from successful competition for external revenue sources that are substitutes for local taxes. While in some places the project may be expected eventually to increase the tax base, so that additional taxes are not needed, for a time the taxes will increase even in these locations. Thus the planner must help the community to decide how to share the tax increases on an equitable basis.

Air Pollution

Particulate and gaseous pollutants emitted from trains and motor vehicles in the neighborhoods around the railroad will be transported and diffused throughout the community by atmospheric processes. If the community is having difficulty meeting legal standards for clean air, it may be considering drastic measures for reducing emissions--such as the limitation of vehicular travel or restrictions on parking--that have potentially serious results in the local economy. Under these conditions, the elimination of grade crossings is a very important alternative, for it can reduce emissions from vehicles. However, if the community is having no difficulties in meeting the standards by the required deadline, the importance of motor vehicle emissions at grade crossings is minimal.

Employment

A railroad relocation project can affect local employment in many ways. For example: the employment provided by the construction project itself, the change in the number of employees of displaced railroad users, changes in locally based railroad personnel, the potential increase in construction jobs in areas to be redeveloped as a result of the railroad improvement, and finally, the employment provided by new industries attracted to the community from outside by the provisions of land or other unique services made possible by resolving the railroad problem.

The value of the increased employment depends on the economic conditions of the community. If there are serious shortages of labor, particularly workers with the skills needed to perform the construction projects or to man the new industries that could be attracted, some way must be found to obtain these skills. If this must be done rapidly, skilled workers will have to be attracted from outside the community; its housing, schools, and other services will be important for these new residents, whether they are temporary or permanent. The new workers will in turn spend money in the community for shelter, food, clothing, and other consumer items, adding to its economy.

An example of the process of attracting labor is supplied by Wheeling, West Virginia, one of the case study cities. Currently about 5 percent of Wheeling's work force is unemployed--down from very high levels only few years ago--partially because of out-migration of workers. The population of the city has been declining for several decades. Under one of the railroad relocation alternatives that Wheeling is considering, land would be used for a shopping center development that would provide new jobs. The community leaders feel that younger people have left Wheeling for the better job opportunities in large nearby cities--Pittsburgh, Akron, Cleveland--and that expanded opportunity in Wheeling would induce many of these younger workers to return. If it is possible to attract these workers back, Wheeling's population and its economy will likely enjoy a substantial rebound.

Local Government Cost

Alteration of rail facilities may reduce government costs by decreasing the costs of emergency services, by lowering unemployment (and crime), and reducing maintenance costs for streets and signals.

Emergency service costs--including police, fire, and ambulance--can be reduced with better vehicle accessibility resulting from railroad removal or grade separations. In addition, eliminating the possibility of a train blocking an emergency vehicle may mean that fewer fire stations can provide adequate coverage for the community.

Reduction in unemployment, revitalization of neighborhoods, and improved quality of life in the community may result in lower crime through increased pride and self-respect of the residents. While almost impossible to quantify, this kind of a result is one that can be very valuable to the community.

The elimination of grade crossings will obviate some of the road maintenance cost for the community, because the community must maintain the street outside the limits of the ties and because the effects of the rails in the street may set up vehicle motions that cause road deterioration for a considerable distance from the rail. Further, removal of the grade crossings may eliminate complex interlocking signals that coordinate rail and road traffic: to the extent that these maintenance costs are not borne by the railroad, they can be credited as a community saving to the railroad improvement program.

Character of Central Business District

The decay of central business districts resulting from the flight of residents and businesses to the suburbs is well documented. Since the railroads often served the first residents of the CBD, the property adjacent to the railroad in the CBD is likely to be the oldest and most blighted in the community. Doing something to resolve the present railroad problem will likely have a direct and positive effect on this old property either through incremental upgrading or major renewal.

The railroad improvement project also may be used as a major catalyst to uniting the community in a widespread improvement program, giving the residents a sense of pride, and the community an image of being "on the move." Such an image may be a valuable part of a marketing program to attract merchants and industries from other communities.

Again, these kinds of effects are very difficult to quantify, but may be of vital importance in improving the local economy.

Assessment and Quantification of Community Impacts

The "CI" worksheets on the following pages can be used to determine the land value impact, the tax implications, and the other community impacts described in the previous pages. An initial financial analysis (Worksheet CI-1), bond service estimation (Worksheet CI-2), and tax implications (Worksheet CI-4) can be done roughly by following the instructions for the worksheets, but expert advice will ultimately be required, particularly to determine the rates at which the bonds can be sold.

Worksheet CI-1

INITIAL FINANCIAL ANALYSIS FOR COMMUNITY
(THOUSANDS OF DOLLARS)

Item	Alt. 1	Alt. 2	etc.
1. Project Costs			
a. Capital cost			
(1) Railroad expense (Worksheet CC-2, line 13)	$37,700.	$28,787	
(2) Other			
b. Relocation expense			
(1) Families (Worksheet NI-7, column D total)	11.2	50.	
(2) Business (Worksheet NI-7, column E total)	19.5	33.	
c. Railroad user impact (Worksheet RU-4, line 1, total)	10.0	10.	
d. Payments to railroad company	--		
e. Other payments	--		
f. Total (sum of 1a through 1e)	$37,741	$28,880.	
2. Estimated Financial Contributions			
a. By federal government			
(1) Trust funds			
(2) Other (PROGRAM "X")	$5,000	$5,000	
b. By state government			
(1) Highway funds	10,000	10,000	
(2) Other	0	0	
c. By other organizations or individuals			
d. By railroad company	100	500	
e. Total (sum of 2a through 2d)	$15,100	$15,500	
3. Local Government Share of Project Cost (1f minus 2e)	$22,641	$13,380	

DATE: 3/12/74 INITIALS: AEM

Worksheet CI-1 Instructions

This worksheet summarizes the approximate financial impact of the project alternatives to estimate roughly the community's share of the project cost.

Line 1: Enter the capital cost estimate for railroad construction from Worksheet CC-2 (Section VIII of this report), for each alternative. If there are other construction costs, such as highway, enter as shown. Enter the prescribed relocation expense data from Worksheet NI-7 (Section XII) and the rail user impact from Worksheet RU-4 (Section X). Enter estimated payments to the railroad (if a lump-sum settlement for increased operating costs is expected) and to other agencies not otherwise counted. Do not include recurring administrative cost. Sum the capital cost and the various expenses and payments to arrive at a total project cost.

Line 2: Enter expected federal and state contributions under existing programs and legislation. These should be segregated by program, separating highway trust funds from other sources (specify the latter). If the railroad agrees by negotiation or is required by statute to provide funds for the project, enter its expected contribution. Enter contributions from other institutions, or individuals and sum the contributions from all sources.

Line 3: Estimate the local government share of the project cost as the difference between the project costs and the financial contributions.

Worksheet CI-2

BOND SERVICE REQUIREMENTS FOR ADMINISTRATION
AND COMMUNITY SHARE OF PROJECT COSTS

(A) Calendar Year	(B) Project Year	(C) Alternative 1 Costs: Admin	(D) Alternative 1 Costs: Share of Project	(E) Alternative 2 Costs: Admin	(F) Alternative 2 Costs: Share of Project	(G) Alternative 3 Costs: Admin	(H) Alternative 3 Costs: Share of Project
1974	1	—	—	—	—		
75	2	$25	—	$25	—		
76	3	↓	$1,092	↓	$1,609		
77	4	↓	6,926	↓	6,506		
78	5	↓	11,864	↓	3,730		
79	6	↓	2,759	↓	1,535		
80	7						

1. Total Local Share (THOUSANDS) — Alternative 1: $22,641; Alternative 2: $13,380; Alternative 3: ______

2. Bond Issue Requirements

	Alternative 1	Alternative 2	Alternative 3
a. Term and year of issue	30 YRS, 1976	30 YRS, 1976	
b. Interest rate	6%	6%	
c. Factor	0.07265	0.07265	
d. Service	$1,645,000	$972,000	

3. Total Annual Revenue to be Raised

	Alternative 1	Alternative 2	Alternative 3
a. years: 1975 through ______	$25,000	$25,000	
b. years: 1976 through 1979	1,670,000	997,000	
1980 through 2005	1,645,000	972,000	

DATE: 3/12/74 INITIALS: SLW

Worksheet CI-2 Instructions

This worksheet provides a way of estimating the annual cost of administering and servicing a bond issue to pay for the local share of project costs.

Columns (B) through (H): Use Figure 7 (Section VIII) to estimate how the local share of the project cost will be spread over the construction period (this assumes that the local share will be distributed in proportion to the expenditures). If more detailed information is available, distribute the costs according to such information.

Line 1: Sum the total of bond issues needed over the years to finance the project costs as scheduled for each alternative.

Line 2: Estimate the expected availability and marketability of bonds and assume a term for the bonds; then note the prevailing interest rate for obligations of comparable quality and determine the capital recovery factor for the bond term and interest rate. Multiply the capital recovery factor by the amount of bonds to be sold (line 1) to determine annual bond service needed (line 2d).

Line 3: Determine the annual cost of administration and bond service by adding the administrative cost either to the local share of project cost (if the construction cost is financed in those years from current revenue) or to the bond service cost (after the bond payments begin). Where there is a change in service or administration cost over time, add additional lines under line 3 to the time period and amount of revenue required annually for the period.

Worksheet CI-3

COMMUNITY LAND VALUE CHANGE
(THOUSANDS)

	Alt. 1		Alt. 2		Alt. 3	
	Year: 1980	Year: --	Year: 1980	Year: --	Year:	Year:
1. Railroad User Moves (Worksheet RU-4, line 5 total)	0		0			
2. Right of Way Acquisition (Worksheet NI-7, column H total)	0		0			
3. Neighborhood Land Value (Worksheet NI-10, column F total)	$1,377		$187			
4. Net Land Value Change (1 + 2 + 3)	$1,377		$187			
5. Redistribution of Values						
a. Impact of right-of-way acquisition (Worksheet NI-7, sum of columns B and C minus column H total)	$860		$4,568			
b. Neighborhood land values (Worksheet NI-10, column E total)	217		7			
c. Land values redistribution (a + b)	$1,077		$4,575			

DATE: 3/12/74 INITIALS: JAH

Worksheet CI-3 Instructions

This worksheet is provided to summarize the community land value impacts in two ways: (1) the net change in value in the community, for tax valuation purposes, and (2) the value lost or gained by the remainder of the community as a result of the changes in the neighborhoods. Two columns are provided for each alternative so that the impacts of phased construction projects or expected delays in impacts can be handled. Enter the applicable year at the head of each column.

Line 1: This is the net loss to the community land value from railroad users who move outside the community. Enter the appropriate values from Worksheet RU-4.

Line 2: Property taken by right-of-way acquisition will not be lost to the tax base because the demand will shift elsewhere, unless the values move outside the community or the land is used in a much lower-valued way. The values lost from the community as a result of such moves are entered here, as summarized in Worksheet NI-7.

Line 3: Values gained in neighborhoods, net of the portions drawn from other parts of the community, are entered here, as summarized in Worksheet NI-10 but adjusted for changes in business levels that may have been included in the Worksheet NI-10 figure from Worksheet NI-3, line 5b.

Line 4: Enter the total of lines 1 through 3 for each year. Line 1 will normally be a decrease, line 2 a decrease, and line 3 an increase, so caution about the direction of the change is indicated.

Line 5: Parts of the neighborhood impact not counted in the neighborhood changes described above apply uniformly and non-specifically to the community as a whole. These redistributions may impact specific land owners and may benefit such groups as developers and brokers, but do not count in the overall community economics. The magnitude of the redistribution is estimated here. Enter the specified totals from Worksheets NI-7 and NI-10. Sum lines a and b for each year, again being careful to note and correctly record the direction of change.

Worksheet CI-4

COMMUNITY TAX CHANGES REQUIRED

	Alt. 0	Alt. 1	Alt. 2	etc.
1. Tax Source: PROPERTY TAX				
2. Tax Base (THOUSANDS)				
a. Current to 1977	$86,600			
b. From 1977 to 1979		$123,008	$123,008	
c. From 1980 to 2005		123,177	121,811	
3. Amount of Taxes (THOUSANDS)				
a. Currently budgeted	$3,187	$3,187	$3,187	
b. Needed for new debt service and administration — 1975		25	25	
1976-1979		1,670	997	
1980-2005		1,645	972	
c. Total (a + b) — 1975		$3,212	$3212	
1976-1979		4,857	4,184	
1980-2005		$4,832	$4,159	
4. Tax Rate (PER HUNDRED)				
a. From 1975 to — (3c ÷ 2a)		$3.71	$3.71	
b. From 1976 to —		5.61	4.83	
c. From 1977 to 1979		3.95	3.40	
1980 – 2005		3.92	3.41	

5. Other Tax Information

1.) INDUSTRIAL PROPERTY TAX AGREEMENT ON $36,408 THOUSAND VALUATION EXPIRES IN 1977.

2.) CHANGE IN VALUE OF RR PROPERTY INCLUDED 1980 – 2005.

DATE: 3/13/74 INITIAL AEM

Worksheet CI-4 Instructions

This worksheet guides the analysis of the tax changes necessary to raise money for the bond service and administrative costs associated with financing the local share of the project cost. The worksheet is designed to be useful for many tax sources: property tax, sales tax, or income tax; however, the following instructions assume that it is being prepared for property taxes as the source. If more than one source is being considered, fill out a worksheet for each.

Line 1: Enter the tax source.

Line 2: Enter the current tax base (total) for the source designated above. Noting the significant project dates from Worksheet CI-3, show the significant tax base dates. Under each alternative, for the appropriate period, enter the current base, plus increases or decreases in values (from Worksheet CI-3, line 4, for property tax) multiplied by the ratio of assessment to market value.

Line 3: Enter the current or projected budget, the amount needed for administration and debt service, and the total taxes under each alternative.

Line 4: The tax rate is determined by dividing the taxes to be collected by the tax base for each period of analysis.

Line 5: Briefly narrate any qualifying factors or foreseeable changes that may affect the data entered on earlier lines.

Worksheet CI-5

OTHER COMMUNITY IMPACTS

	Alt. 0	Alt. 1	Alt. 2	etc.
1. Air Pollution				
a. Can community meet air quality standards? (If yes, go to 2.)	YES	→	→	___
b. Contribution of railroad project: pounds per day (Worksheet RU-7, differences from Alt. 0)				
(1) CO, in year 1980		___	___	___
(2) HC, in same year		___	___	___
c. Total daily emission (from local authority, minus 1b)				
(1) CO	___	___	___	___
(2) HC	___	___	___	___
d. Is air quality improvement an issue?	NO	NO	NO	___
2. Employment				
a. Construction				
(1) Labor force	___			
(2) Unemployment	___			
(3) Project requirements		___	___	___
(4) Impact significant?		NO	NO	___
(5) Measures to minimize unfavorable impact: Alternative ___	___			
b. Other jobs lost or gained				
(1) From relocation of railroad users (Worksheet RU-4, line 7)		0	0	___
(2) From ROW acquisition (Worksheet NI-7, column I)		0	0	___
(3) Other		0	0	___
(4) Impact significant		NO	NO	___
(5) Measures to minimize unfavorable impact: Alternative ___	___			

	Alt.0	Alt.1	Alt.2	etc.
3. Services				
a. Migration		0	0	
b. Housing		0	4	
c. Schools		0	4	
d. Other services				

4. Other Community Issues:

UNFAVORABLE HOUSING IMPACT IN ALT. 2 RESULTS FROM NEED TO RELOCATE 250 FAMILIES IN A COMMUNITY WHERE THERE ARE ONLY 600–700 VACANT UNITS.

DATE: 3/13/74 INITIALS: JAH

Worksheet CI-5 Instructions

This worksheet guides the analysis of community impacts--air pollution, employment, services, and other issues--not covered in earlier worksheets.

Line 1: Determine from the local air pollution control authority whether the community is expected to meet required air quality standards for automotive-origin pollutants (carbon monoxide, hydrocarbons, and oxides of nitrogen). If there is a problem in meeting the standards, enter "yes" and continue the entries (if there is no problem, enter "no" and disregard the remainder of this line). From Worksheet HU-7, enter the total emissions of carbon monoxide (CO), and hydrocarbons (HC); then determine from the pollution control authority the daily emissions of these pollutants for the community as a whole and discuss with the agency the significance of the contribution from motor vehicles at grade crossings.

Line 2a: Estimate the construction labor force in the community and the unemployment, after consulting with local and state labor agencies. Estimate the number of construction jobs created by the project and determine whether this added employment will be significant in the local job market. Identify steps to be taken if, for example, the labor market becomes too tight.

Line 2b: Enter specified losses in jobs from Worksheets RU-4 and NI-7, and other significant employment gains or losses brought about by changes in land use described on Worksheet NI-4. Assess the total impact of these losses or gains in jobs in relation to the community labor force, unemployment, and growth potential in these employment sectors. Identify measures that need to be taken to mitigate unfavorable impacts.

Line 3: Determine the total number of workers and the number of households that will be lost or gained from the employment impacts in line 2. From community averages, estimate the needs for various kinds of housing, schools, and other government services and compare with the existing or programmed supply to determine the impact.

Line 4: Identify and describe other significant community impacts that may result from the alternatives.

XIV STATE AND NATIONAL IMPACTS

The impacts of a local railroad system improvement may reach far beyond the boundaries of the community. These effects, described in succeeding pages, include impacts on:

- Natural resources
- National resources
- Highway improvement funds
- National goals
- Federal and state institutions.

Many of these impacts cannot be readily quantified and therefore Worksheet SN-1, included at the end of this section, is largely a judgmental description.

Natural Resources

Field investigations and case studies have shown that railroad relocation can have favorable impacts on flood control projects and on inland navigation. For example, in two locations, a railroad bridge over a river was eliminated by consolidating operations of two railroads over the trackage of one of them, and removing the remaining bridge. In one case, elimination of one of the railroad bridges enabled ships to navigate the river with greater safety and at higher speed because the bridge was located on a curved section of the river, and passage between bridge abutments on the curve was difficult, especially for larger vessels.

In the second case, the railroad bridge that was eliminated was a restriction to the flow of a stream that drained a wide area. Several times over past years, large areas near the city had been flooded by waters up in this stream. A state-chartered flood control district has jurisdiction over the drainage channels in the area. Significant benefits will be realized by making this very accessible industrial and residential land available for more intensive development.

National Resources

Many of the favorable impacts of a railroad relocation project, especially those that are costable, represent savings in financial or other resources that can be applied to other purposes. This is true of savings in operating costs that may accrue to the railroads, for example. Savings in these costs also indicate a higher degree of efficiency in the railroads, since the amount of freight carried is the same, so the nation benefits from better utilization of its railroad system. It also benefits by collecting more taxes on savings in corporate expenses.

Another national resource, energy, is saved when railroad and highway user costs are reduced.

Highway Improvement Funds

Both the state and the federal governments collect taxes on motor fuel, on tires and other components, and on the whole vehicle. The federal funds so collected are held in a highway trust fund, devoted to highway construction and improvement. Some states have a similar fund. Many of the railroad improvement projects that have been accomplished to date have been funded with contributions of highway trust fund money and, to the extent that railroad improvement projects benefit highway users, such contributions to projects may continue to be authorized.

The favorable impact is that the beneficiaries of the trust fund--the highway users--gain the benefit of the improvements bought by the highway trust fund money, but it should be noted that railroad improvement projects have to compete with other users of the funds.

National Goals

There are implicit or explicit national goals to improve the quality of life in the United States and to maintain viable central cities. To the extent that railroad improvement contributes toward fulfillment of these goals, projects can be counted as having favorable impact in these areas.

Federal and State Institutions

The activities and programs of many institutions can be affected by such projects as large railroad improvements in urban areas. The projects may complement existing programs, and/or add responsibilities to administrative agencies, and/or compete for funds with established programs of agencies. For example, railroad improvement projects conducted by state highway agencies have presented some technical and administrative problems for these agencies who find the construction technology, the interactions with other institutions, and the management-labor relations different from those to which they are accustomed.

Among the agencies that may be affected by a railroad relocation project are:

Federal agencies:	Interstate Commerce Commission Department of Transportation Department of Housing and Urban Development Department of Health, Education, and Welfare Department of Labor
State agencies:	Public utilities regulatory agencies State highway agencies State or regional transportation planning agencies Welfare and social agencies.

Worksheet SN-1

STATE AND NATIONAL IMPACTS

1. Alternative 1 : RIVERFRONT

2. Natural Resources Impact
ELIMINATION OF BROWN STREET BRIDGE WILL INCREASE RIVER FLOW AND REDUCE FLOOD LEVELS.

3. National Resources Impact
WILL SPEED FREIGHT TRAIN MOVEMENT THROUGH CITY.

4. Impact on Highway Improvement Funds (THOUSANDS)

a. Trust fund contribution to project

(1) Federal — 0

(2) State — $10,000

b. Highway user benefits: present value in year 1980 — $7,752 + MAINTENANCE SAVINGS

c. Net highway benefits (4a - 4b) — ($2,248) - MAINTENANCE SAVINGS

5. Impact on National Goals
IMPROVES QUALITY OF LIFE IN LAFAYETTE.
FEDERAL FINANCING OF $5,000,000 IS EXPECTED FROM PROGRAM "X".

6. Impact on Institutions

	Institution	Impact
a.	PURDUE UNIV.	IMPROVE ACCESSIBILITY FOR STAFF & STUDENTS
b.		
c.		

DATE: 3/13/74 INITIALS: HEM

Worksheet SN-1 Instructions

This worksheet is a checklist of potential state and national impacts that should be considered in the analysis.

Line 1: Enter the project alternative under analysis--prepare a separate sheet for each alternative.

Lines 2, 3, and 5: Briefly narrate the expected impacts and indicate how significant they may be if the alternative is adopted.

Lines 4 and 6: Enter the data required, specifying (in line 6) the names and level (e.g., local, regional) of the institution.

XV EVALUATION OF ALTERNATIVES

The analytical portion of planning ends with the presentation of information about the costs and effects of the selected alternatives. The basic purpose of the presentation is to aid in the making of informed judgments. Because of the diversity of the decision-makers, each of whom will be looking at and interpreting the analytical findings in a different way, two evaluation methods are suggested.

The first way of presenting the findings is a distribution of the costs and the impacts across as wide a range of community groups and larger political entities as can reasonably be made. In this presentation, assumptions about the methods of financing and the distribution of costs are shown, as well as a description of all other likely consequences for affected parties. In this distributional analysis, the rigorous avoidance of double counting and other pitfalls important in the benefit-cost analysis (see below) is sacrificed for the sake of effective presentation.

The second mode of presentation is a careful benefit-cost analysis, wherein each alternative solution to the railroad problem is evaluated on the basis of economic, social, and environmental criteria without regard to the source of financing or the final resting place of the benefits. This procedure has long been used by highway engineers and businessmen, and is meaningful to persons of that orientation.

Distributional Analysis

Most communities do not base their decisions solely on a benefit-cost analysis. Rather, leaders in the community discuss and judge the proper course of action for the community and then they convince their fellow citizens of the propriety of the action. However, research in community values* has revealed that the decision-making process can be significantly enhanced if the community participates in it. The distributional analysis is designed to better inform the community members about the impact of the proposed alternatives on their individual lives. In contrast to the rigors of the benefit-cost analysis, double-counting is permitted in

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*Marvin L. Manheim et al., "Community Values in Highway Location and Design: A Procedural Guide," prepared for Highway Research Board, Project 8-8(3), Massachusetts Institute of Technology, Report No. 71-4 (September 1971).

distributional analysis so that all parties affected can be included. Less emphasis is placed on the discounting of the costs and benefits and more on the distribution of the financial and other aspects of the project.

The format for the presentation will vary widely with the community, the objectives of the improvement program, and the way in which the alternatives attack the problems. One way of presenting relevant information is shown in Worksheet E-1,* which includes simplified financial information and summarizes the key issues in the project analysis. Backing up this analysis, a summary of significant neighborhood impacts and the measures planned for minimizing unfavorable impacts will tell the people how the project will affect them individually. Similar presentations for railroad companies and users will help their managements evaluate the impact of the project on their companies.

Benefit-Cost Analysis

The benefit-cost analysis is a way of associating all costs of the alternatives with all their expected impacts, so that the alternatives can be compared directly even if the amount and timing of their costs and effects vary widely. The methodology has been developed to a high degree of sophistication in application to highway transportation problems.† The main steps in the benefit-cost analysis are the selection of benefits and costs for inclusion, the analysis of timing, and the comparison of the projects.

Selection of Benefits and Costs

A principle that distinguishes the benefit-cost analysis from the distributional analysis is the avoidance in the former of double counting and of assigning costs to more than one stakeholder--even though both stakeholders may be involved in a transfer of the benefits. For example, the provision of improved accessibility by building new streets or by eliminating or separating railroad grade crossings is described as a saving in highway user cost. It is true in many instances that the

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*The E worksheets and instructions for them appear at the end of this section, starting on p. XV-7.

†A useful reference is: Robley Winfrey, Economic Analysis for Highways, International Textbook Company, Scranton, Pa. (1969).

highway users do not simply pocket the savings but rather they use the improved accessibility to travel to previously less accessible places for shopping, work, or other purposes. The value of the land in these previously less accessible places thereby becomes higher because employers, merchants, and others compete to use the more accessible land. However, the increase in land value is a manifestation, or transfer, of the user cost; it is not a primary effect of the improved accessibility. Hence the benefit-cost analyst would count the savings in highway user costs as a benefit but would severely question any proposal to include also the benefit of increased land values that might result from the improved accessibility.*

Analysis of Timing

A general principle of economic analysis is that money in hand is more valuable than the sure expectation of the same amount of money to be received at some future date, and, conversely, people would rather avoid spending an equal amount of money at the present time if the expenditure could be delayed. A measure of the difference in money flows at different times is a discount rate, by which cash flows are adjusted to make them equivalent from a time standpoint. The discount rate is a compound interest factor used in subsequent computations.

Discount Rate--Future costs and benefits should be discounted at the rate of 10 percent compounded annually. This discount rate is based on the estimated opportunity cost of capital to the taxpayer, i.e., the estimated average market rate of return that would be achieved if funds required by a public project were left in private hands rather than being paid to the government in taxes. Discount rates of 6 to 10 percent are common in current economy studies of public projects, but the U.S. Office of Management and Budget requires a 10 percent discount rate for most federal government economic studies.† the possible effects of uniform future price increases--inflation--should be ignored.‡

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*For a more thorough discussion of this point, see Eugene L. Grant and W. Grant Ireson, Principles of Engineering Economy, Ronald Press, New York (5th ed., 1970).

†Executive Office of the President, Bureau of the Budget, "Discount Rates to be used in Evaluating Time-Distributed Costs and Benefits," Circular No. A-94, Revised (March, 1972).

‡Robert L. Lee and Eugene L. Grant, Inflation and Highway Economy Studies, Highway Research Record Number 100, Highway Research Board (1965).

Study Period--A limited study period is used in the analysis. This is the period of time over which the costs and benefits are projected. The choice of a study period depends on the expected physical and service life of the components, the project and the limitations on the ability to forecast future economic and hence transportation-related events.

The length of the study period can be selected by the analyst. However, a study period of 25 years after completion of construction is suggested as a guideline.

Residual Values--Since some of the work will still be useful after 25 years of operation, a residual value is credited to the project at the end of the study period. The analyst may estimate the actual useful life of each of the assets created by the project and discount the used portion to the beginning of the project. However, for simplicity, the residual value of a relocation project at the end of the study period is suggested as the full value of any land acquisitions by the project plus 50 percent of the cost of earthwork, grading, and major structures--the relatively permanent features of the project. Zero residual value should be shown for minor or less permanent capital outlays, such as railroad equipment and small buildings.

Worksheet E-2 and its associated instructions outline the procedure for computing residual values.

Schedule of Benefits and Costs--A schedule showing the year in which each project cost is expended and the years in which the various benefits are received will facilitate the analysis. Such a schedule is presented in Worksheet E-3. The present value of the costs and benefits can be determined by applying the appropriate discount factors for the entries in the schedule.

Comparison of Project Benefits and Costs

The discounted present values of the benefits and costs are added to find a net present value of the monetary consequences of each alternative.

At this point the most favorable alternative may or may not be apparent. If one of the alternatives presents a positive net present value, if it has no significant negative impacts, and if its qualitative and quantitative impacts appear to be superior to the other alternatives, the selection may become quite simple, at least in theory. If the results of two alternatives are close in net present value, and especially if the net present value is slightly negative with apparently strong positive and negative impacts that are not costable--then the decision becomes more difficult and must be made by informed judgment based on community goals and objectives. Further analysis for sensitivity of the results to various assumptions and an analysis of trade-offs may be in order to sharpen the differences between the alternative projects.

Sensitivity Analysis--The initial objective of sensitivity analysis is to determine the sensitivity of a decision to possible variations in assumptions or estimates. The derivative and more meaningful purposes are to identify (1) those variables about which more information is needed, in order to narrow a range of estimates and thereby reduce the uncertainty about the decision; (2) those variables or issues that most critically affect the decision; and (3) those variables of low or neutral significance that can be ignored, thereby simplifying the process of reaching a decision.

The complexity of a sensitivity analysis can vary from a simple visual check of the results of an evaluation for matters of high and low significance, to assigning different values to impact measures and observing their effect on the decision. When assigning different values, it is suggested that a range from low probability to high probability (e.g., between .10 and .90 on a cumulative distribution of probabilities) be used to be reasonably certain of covering the possible range of the variable.

Note that only a fairly general sensitivity analysis can be performed unless all values used for measuring each impact are commensurable. This does not usually happen unless a formal weighting scheme is used, in which case it should be possible to identify the proportion of the total positive or negative points for a given alternative that are caused by one or another impact, and the changes in the balance of positive and negative points that are caused by assigning different values to given impacts. Otherwise, the evaluator must rely on his judgment in these matters.

Trade-Off Considerations--Trade-off considerations entail improvement of one aspect or feature of a proposal at the expense of other features. Thus, a barrier wall may reduce the unfavorable railroad noise effects on adjacent residents at the expense of a more favorable aesthetic experience. Such issues should be raised by the evaluator, but it may be difficult to settle the issues without a common basis of valuation between the impacts and the affected interest groups. Again, this common basis can either be provided by a formal scheme of weighting or by the judgment of the evaluator. (Note that such judgments in fact imply a subjective weighting scheme, but a formal "weighting" approach is probably not justified when the results are obvious without it.)

Trade-offs may also be considered in the timing of the project. Variations in the level of investment, and consequent acceleration or delay of impacts, may result in a higher net present value return for the available resources.

A search for trade-off or improvement opportunities should be made among any highly unfavorable impacts of each alternative that has been analyzed in detail and among any high-cost features. It is difficult to achieve a number of diverse goals simultaneously, and it should be understood that solutions which tend to "optimize" one goal by achieving high performance in one respect usually do so at the expense of other goals.

Worksheet E-1

DISTRIBUTIONAL ANALYSIS

	Alt. 1	Alt. 2	etc.
1. Project Cost ($000) (Worksheet CI-1, line 1f)	$37,741	$28,880	
2. Sources of Financing ($000) (Worksheet CI-1, lines 2 and 3)			
a. Federal	$5,000	$5,000	
b. State	10,000	10,000	
c. Other	100	500	
d. Local government	22,641	13,380	
3. Taxes			
1975	$3.71	$3.71	
a. Tax rate in 1976	5.61	4.83	
1977-1979	3.95	3.40	
b. Tax rate in 1980-2005	3.92	3.41	
4. Significant Neighborhood Impacts	CBD & RIVERFRONT DEVELOPMENT	ADVERSE HOUSING IMPACT	
5. Improvement of Traffic Flow			
a. Grade crossings eliminated	38	38	
b. Present value in year 1974 of delay/operation costs and accidents, from yr 1980 ($000)	$4,376	$4,301	
6. Other Community Impacts	MINIMAL	MINIMAL	
7. Railroad Company Impact ANNUAL OPERATING COSTS (OR SAVINGS) N&W	34,383	(110,126)	
L&N	(34,460)	(14,195)	
PC	NEGL.	NEGL.	
8. Comments			

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Worksheet E-1 Instructions

This worksheet summarizes significant parts of the impact analyses for use in communicating the results to the people of the community. The format and emphasis may be changed according to the goals of the community and needs of the project.

Line 1: Enter the total capital cost and other payments from Worksheet CI-1, line 1f, as the total project costs.

Line 2: Again, summarize the appropriate information from Worksheet CI-1.

Line 3: Summarize the results from Worksheet CI-4 in this line.

Line 4: Briefly note significant neighborhood impacts.

Line 5: Enter the number of grade crossings eliminated by each alternative from Worksheet HU-1 and the relevant value of delays and operating costs from Worksheet HU-7, column F.

Line 6: Summarize other significant community impacts from Worksheet CI-5.

Line 7: Summarize the railroad company impact (from Worksheet RR-2) for each railroad operating company affected.

Line 8: Briefly narrate any other points of potential importance to the community.

Worksheet E-2

RESIDUAL VALUE OF PROJECT
(Alternative 1, RIVERFRONT)

	(A) Cost or Value (dollars) (000)	(B) Residual Value (factor)	(C) Residual Amount A × B (dollars) (000)
1. Railroad Construction Cost			
a. Property (Worksheet CC-2, line 1a)	INCL. BELOW	1.00	—
b. Utility relocation and protection (CC-2, line 2b)	515	.5	258
c. Trackwork and structures (CC-2, line 3i)	7179	.5	3,590
d. Railroad buildings and facilities (CC-2, line 5f)	0	.5	—
e. Signals and communications (CC-2, line 6c)	860	.5	430
f. Highway crossing and warning devices (CC-2, line 7c)	17005	.5	8,502
g. Subtotal (total of lines 1a through 1f)		--	12,780
h. Contingency factor (same as used to compute line 10 in Worksheet CC-2)			20%
i. Contingency in above items (line g × h)			2,556
j. Total railroad residual			$15,336
2. Other Construction Costs			
a. Land	$850	1.00	$850
b. Site preparation and structures	1457	.5	728
c. Other ROW PROTECTION	144	.5	72
d. Total other costs (line 2a+2b+2c)		--	$1650
3. Total Residual Value (lines 1j + 2d)		--	$16,986

DATE: 3/15/74 INITIALS: AEM

Worksheet E-2 Instructions

This worksheet provides guidance for estimating the residual values at the end of the project study period.

Column (A): Enter estimated costs in each of the categories from Worksheet CC-2 and estimates of other capital costs not included in Worksheet CC-2, as indicated.

Column (B): The guideline factors suggested earlier for residual value are entered in this column.

Column (C): Multiply columns A and B and enter here.

Worksheet E-3

SCHEDULE OF COSTS AND BENEFITS

(Alternative 1 vs. Alternative 0)

(THOUSANDS)

(A) Calendar Year	(B) Project Year	(C) Discount Factor	(D) Capital Costs (Salvage)	(E) Highway User Saving	(F) Railroad Operating Company Saving	(G) Railroad Users Saving	(H) Community Land Value Increase	(I) Other Community Benefit	(J) Reference Notes
1973	0	1.00							
4	1	.9091		$4,376*					
5	2	.8264							
6	3	.7513	$1,850					$(20)	NI-7 (BUS)
7	4	.6830	11,400					(11)	NI-7 (RES)
8	5	.6209	19,600						
9	6	.5645	4,850			$(10)			
1980	7	.5132			$18.677		$1,377		
↓	8				↓				
↓	—				↓				
↓	—				↓				
2004	31	.0521	(16,986)		18.677				
PRESENT VALUES			$23,199	$3,978	$95.700	$(6)	$707	$(23)	

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* SINCE ALL CROSSINGS ARE SEPARATED UNDER ALT. 1, BENEFITS = TOTAL COST OF ALT. O. BENEFITS BEGIN IN 1980 BUT WERE CALCULATED AS OF 1974.

Worksheet E-3 Instructions

This worksheet guides the processing of the costs and benefits that are expressed in dollar terms.

Column (A): Enter the calendar year in which construction is expected to start opposite year 1 in column B, and fill in the remaining years sequentially.

Column (B): This is a listing of the years in the project analysis period beginning with the construction phase in year 1.

Column (C): This is the single-payment present worth factor for the discount rate selected (the guideline value is 10 percent) and the project year from column B. (See Grant and Ireson, Principles of Engineering Economy, referenced earlier.)

Column (D): Enter expected capital cost expenditures during each of the construction years, beginning in year 1, by applying the portion of cost in each year from Figure 7 to the capital cost (Worksheet CI-1, line 1a). Enter planning and other costs incurred in years before construction start in year 0. Enter such items as the residual value from Worksheet E-3 and proceeds from sale of abandoned right-of-way as credits (minus values) in this column in the appropriate year.

Column (E): Enter the present value of highway user cost saving for the year for which the present value was calculated (from Worksheet HU-7).

Column (F): Enter the annual before-tax railroad operating cost increase (or decrease) from line 28 on RR1 or line 31 on RR-2 in each year they are expected to occur. Enter one-time costs or savings in the year of occurrence. Do not include tax effects, losses of traffic, or interest, since these items will be a gain to someone else if they are lost to the railroad (or vice-versa).

Column (G): Enter the estimated railroad user costs as minus values from Worksheet RU-4 in the year in which the railroad service is expected to be terminated or for years in which added transport costs will occur.

Column (H): Enter expected community economic benefit (from Worksheet NI-10) that is not the result of increased accessibility (already counted in the highway user cost) or does not deprive some other part of the community of an equivalent increase in value.

Column (I): Enter other recurring or one-time monetary costs or benefits accruing to the community, including local agencies, major businesses, and the community as a whole. Examples of these benefits are savings in drainage projects or other public works (excluding highways) that would be rendered unnecessary by the railroad relocation, and savings in insurance premium resulting from improved police and fire protection; cost would include lost payroll to the community. (Compute from Worksheets NI-7 and RU-4.)

Column (J): Enter notes identifying items in column I for ease in referring back to earlier parts of the analysis.

TOTAL PRESENT VALUES: Multiply each of the entries in columns D through I by the discount factor in column C and sum the products for each column. Enter this sum at the foot of each column. For recurring entries, combinations of a uniform annual series factor and single payment present worth factors will simplify the computations. (See Grant and Ireson.)

Worksheet E-4 Present Year: 1973

COMPARISON OF ALL COSTS AND BENEFITS
(As Adjusted Present Values in Thousands of Dollars)

	Alt. 1 vs 0	Alt. 2 vs 0	Alt. 2 vs 1	etc.
1. Impacts Measurable in Dollars ($000)				
a. Highway user benefit	$3,978	$3,910	$(68)	
b. Railroad company saving	96	732	636	
c. Railroad user saving	(6)	(6)	0	
d. Community land value increase	707	96	(611)	
e. Other community benefit	(23)	(59)	(36)	
f. Total dollar benefit	$4,752	$4,673	$(79)	
g. Less capital cost (net of salvage and residual)	23,199	17,875	(5324)	
h. Net present value	$(18,447)	$(13,202)	$5,245	
2. Other Quantifiable Impacts				
a. Families relocated (Worksheet NI-7)	56	250	194	
b. Businesses relocated (Worksheets NI-7 and RU-4)	17	26	9	
c. Number of employees affected (Worksheets NI-7 and RU-4)	0	0	0	
d. Vehicle emissions reduced (Worksheet HU-7)				
(1) HC (pounds per day)	1.24	1.24	0	
(2) CO (pounds per day)	790	790	0	
e. Other:				

3. Qualitative Impacts:

INSUFFICIENT ALTERNATE HOUSING AVAILABLE FOR RELOCATING FAMILIES IN ALT. 2.

DATE: 3/15/74 INITIALS: AEM

Worksheet E-4 Instructions

This worksheet provides guidance for summarizing and comparing the net monetary and other impacts of the alternative projects.

Line 1: Enter the column totals from Worksheet E-3 and sum them for each alternative comparison.

Line 2: Enter the specified quantities in lines a through d, and other important quantifiable impacts in line e.

Line 3: Identify significant neighborhood disruptions, together with the plans for minimizing the disruption. Identify emergency service impacts from Worksheet CI-5, and other significant neighborhood impacts identified on Worksheets NI-3, NI-4, NI-7 and NI-9.

Appendix A

A STUDY CITY

Appendix A

A STUDY CITY

In most of the worksheets in this guidebook, the example data were developed in a planning study for Lafayette, Indiana. (Some of the worksheets are not applicable to Lafayette's problem, in which case ficticious examples or examples drawn from other studies are used on the worksheets.)

Lafayette's railroad problem and the proposed solutions that were analyzed are described very briefly below.

The Problem

Every day, as many as 62 freight trains rumble through the City of Lafayette, blocking virtually every major traffic artery. Altogether, drivers and occupants of automobiles and trucks waste hundreds of hours every day because of delays at the grade crossings. These delays are increased because one of the railroad lines is located at the edge of a hill, flattening the normal slope of the streets and causing a severe bump for the vehicles passing over it. The estimated cost of slowing and stopping the more than 150,000 vehicles that cross the tracks every day reaches thousands of dollars. The potential for accidents adds hazard to the cost of crossing the tracks. The delays, cost, and hazard add up to a major irritant as well as an expense to the motorist.

The railroads also contribute environmental problems. A heavily-traveled route passes through a residential section of the city, and noise from the trains and their horns is an irritant to the residents. Another line occupies the center of a street through the central business district, obstructing traffic and causing noise and vibration. Protective devices--crossing gates, flashing lights, and interconnections with the city traffic signals--guard almost every grade crossing, but they contribute to the city's noise and are a maintenance expense for the railroads. Further railroad expense results from speed limits on trains in the city.

Proposed Solutions

Two proposed solutions have been examined by consultants for Lafayette: the riverfront plan, called Alternative 1 in the analysis, and the "C-3 corridor" plan, called Alternative 2 in the analysis.

Riverfront Relocation Plan

Figure 1 in Section V of this guidebook illustrates the riverfront plan. The two railroads traversing the central portion of town are joined in a common three-track corridor that follows a depressed route near the river shown by the dashed line in Figure 1. Grade separation structures carry all highway traffic over the corridor, and all of the old railroad lines are removed, as shown by the dotted lines, resulting in elimination of all railroad-highway grade crossings in the city.

C-3 Corridor Relocation Plan

The so-called C-3 plan also combines the two railroads that traverse the central portion of the city. But in the C-3 plan, the new common corridor follows the existing route that runs diagonally from points 3 to 17 in Figure 1. The new corridor is partially depressed to allow construction of grade separation structures over the corridor. The only grade crossings that remain are over the lightly-traveled railroad lines in the southwestern part of Lafayette (points 4 and 5 in Figure 1), near the Wabash River.

Appendix B

RAILROAD FUEL CONSUMPTION AND EQUIVALENT RISE CALCULATIONS

Appendix B

RAILROAD FUEL CONSUMPTION AND EQUIVALENT RISE CALCULATIONS

Fuel consumption is an important element of railroad operating costs because, in addition to the cost of the fuel itself, it is such a reliable indicator of locomotive wearout rate that much of total locomotive repair and depreciation may be assumed to vary with fuel use. As of April 1973, fuel related expense was about 10¢ per gallon for the fuel itself and about 30¢ per gallon for locomotive repairs associated with the production of power, assigned on a fuel-consumption basis.

The change in total fuel consumption due to a rail relocation can be determined by the planner with acceptable accuracy using estimating methods, which, if not truly simple, are at least straightforward. Fuel consumption is due to four measurable factors:

(1) Work done overcoming the resistance of straight and level track.

(2) Work done overcoming the resistance due to curvature.

(3) Work done lifting the train through changes in elevation.

(4) Work expended due to changes in train speed.

A few other factors are omitted as being too inconsequential to affect the results significantly.

For convenience in combining the results, the resistance due to straight and level track and the resistance due to curvature are converted into the equivalent amount of vertical rise. It has been determined experimentally that straight and level track has the same resistance to train movement as a grade of 0.3 percent.* This can be stated two other ways for clarity: first, that a descending grade of 0.3 percent is the minimum† on which a rolling train will continue to roll without

---

*Varies with speed from 0.15 to 0.65 percent; 0.30 percent is average.

†Again, varies with speed.

power, neither accelerating nor decelerating; second, that the drag of a train ascending a 0.3 percent grade is double that of a train on straight and level track.

The resistance of straight and level track of 0.3 percent is equivalent to 15.84 feet of rise per mile.

The resistance due to curvature is relatively small. Curves are measured in degrees of central angle, and equivalence to rise computed at the rate of 0.04 feet of rise per degree of central angle.

Total equivalent rise is the sum (by direction) of actual rise plus the equivalent rise due to curvature and the equivalent rise of straight and level track, converted as described, less correction for work which can be salvaged from descending grades. Not all of the potential energy from descending a grade can always be made useful. If the grade is sufficiently steep, it will be necessary to waste energy by braking to prevent excess acceleration. Grades of 16 feet per mile and over (over 0.3 percent) on which a train accelerates due to gravity alone are referred to as "C" grades, and some of the energy available in descending them is treated as lost due to braking. Equivalent rise calculations in Worksheets B-1 and B-2 (at the end of this appendix) show the different treatment of "C" grades adequate to guide the planner; the percentage factors for energy loss and recovery were developed theoretically and confirmed by fuel measurement tests.

The work of the locomotive in moving the train is expressed in thousand foot-tons, where the "foot" is the feet of equivalent rise as determined in Worksheet B-2, and the tonnage is the weight of the entire train, including locomotive(s).

In addition to the work of moving the train at uniform speed, work is done to change the train's speed. Changes to stop and start, or slow down and speed up, may result from changes in rail facilities where speed restrictions owing to grade crossings, curvature, congestion, and other causes are eliminated (or added). The fuel saving or cost from these causes is just as consequential in terms of cost as that due to route length and profile changes.

The basic work-velocity equation is:

$$\text{Work} = \frac{\text{tonnage}\left[(kV_1)^2 - (kV_2)^2\right]}{2g}$$

where

V_1 = the final velocity,

V_2 = the initial velocity,

g = the acceleration due to gravity (the gravitational constant, 32.2 ft/sec^2),

k = is the constant required to convert speeds in miles per hour to feet per second.

Factoring out k^2 and dividing it by 2g gives 0.0334 as the value of the constants:

$$\text{Work} = 0.0334\ (V_1^2 - V_2^2) \times \text{tonnage}$$

where velocities (or speeds) are in miles per hour and work in foot-tons.

This formula should be used to determine the fuel consumed in recovering speed for each instance where the need to recover speed is affected by the proposed relocation project. Often it will be found that substantial fuel savings (and hence large cost savings) result from lifting speed restrictions through congested urban areas.

Since all four factors affecting fuel consumption can now be converted to foot-tons of locomotive work, we need only to know the fuel efficiency of the locomotive. This likewise has been experimentally determined:

Fuel consumption = 0.075 gallons per 1,000 foot-tons.

This factor is approximately correct for average freight service conditions.*

---

*Sometimes it is inconvenient to make all the calculations necessary to determine fuel consumption on a foot-tons basis; this is particularly so in yard and industry switching where the engine has constantly changing tonnage, uncertain route, and much starting and stopping. Consequently, some additional fuel consumption rate indices have been developed as alternates to the above. These are:

Switching service:	10.40 gallons per switch engine-hour
Local train service:	2.50 gallons per 1,000 gross ton-miles (locomotive, cars, contents, and caboose)
Intercity passenger service (AMTRAK-type):	2.97 gallons per 1,000 gross ton-miles
Commuter service:	7.11 gallons per 1,000 gross ton-miles.

These supplementary fuel indices will often not be required, since the cost per switching engine-hour (shown in Table 5 in the main text) includes an allowance for fuel consumption at the standard rate; local train fuel should be handled the same as through train whenever possible, and commute and AMTRAK trains are special cases.

In connection with AMTRAK, it should be noted that fuel and locomotive repair savings accrue to AMTRAK since these costs are borne directly or billed to them. The commute fuel index obviously is inapplicable to electrified districts. The index is relatively high owing to the fuel consumed in frequent starting and stopping.

All fuel consumption indices shown are from data supplied by one major railroad. The rate per 1,000 foot-tons should be nearly uniform for all railroads. The rates per 1,000 gross ton-miles may differ owing to geographical conditions. Gross ton-mile indices can be developed, if necessary, for individual railroads on the basis of ton-mile and fuel consumption statistics by class of service reported to regulatory bodies.

Worksheet B-1

EQUIVALENT RISE DATA

1. Railroad North & South   2. Division Central

3. Line/Segment Corridor   Between Jx Tower and West Jct

Station	Milepost	Elevation	Difference in Elev.	Curvature
Jx Tower	47.3	454		
			+21	133°
	48.0	475		
			+ 6	70°
	49.0	481		
			+ 3	---
	50.0	484		
Centerville			-24	15°
	51.0	460		
			- 3	225°
	52.0	457		
			+34	75°
West Junction	52.9	491		

Worksheet B-2

EQUIVALENT RISE CALCULATION

From Jx Tower to West Jct From MP 47.3 to MP 52.9

Data: Worksheet A-1	___bound	___bound
1. Total Road Miles	5.6	5.6
2. Total ascents: vertical feet	64.0	27.0
3. Total descents: vertical feet (excluding C grades)	3.0	9.0
4. Miles of C grade	1.0	2.0
5. Total degrees of curve (excluding C grades)	503.0	310.0
Computations:		
6. Road miles x 15.84	88.70	88.70
7. Ascents	64.00	27.00
8. Descents on A and B grades x 0.60	(1.80)	(5.40)
9. Miles of C grade x 11.09 (15.84 x 0.70 = 11.09)	(11.09)	(22.18)
10. Resistance due to curvature x .04 (excluding C grades)	20.12	12.40
11. Total equivalent rise: feet	159.93	100.52
12. Equivalent rise: feet per road mile	28.56	17.95

Appendix C

MATHEMATICAL RELATIONSHIPS IN HIGHWAY USER COST COMPUTATIONS

Appendix C

MATHEMATICAL RELATIONSHIPS IN HIGHWAY USER COST COMPUTATIONS

Annual highway user cost can be expressed as:

$$C_{hu} = 0.365 \times ADT \times [C_o + C_T] \quad ,$$

where

C_{hu} = annual highway user cost,

ADT = average daily traffic at the grade crossing,

C_o = operating cost per 1,000 grade crossings,

C_T = time cost per 1,000 grade crossings.

The operating (C_o) and time (C_T) cost components can be expressed as:

$$C_o = C_{\Delta v} \times (1 - \beta) + [C_s + C_I \times (TD - T_x)/60] \times \beta$$

and

$$C_T = VOT_{\Delta v} \times (1 - \beta) + [VOT_s + \nu \times (TD - T_x)/60] \times \beta$$

where

$C_{\Delta v}$ and $VOT_{\Delta v}$* = operating and time costs per 1,000 grade crossings, respectively, associated with reduced speeds when crossing the railroad line--depends on roughness of crossing,

---

*Operating and time costs associated with both speed reductions and stops, including the added costs of returning to the initial speed again.

C_s and VOT_s = operating and time costs, respectively, per 1,000 vehicle stops associated with stopping at a grade crossing--depends on vehicle approach speed,

C_I = idling cost per hour per 1,000 vehicle stops associated with vehicles stopped at grade crossing,

ν = value of time (dollars per hour),

TD = average vehicle delay time to stop and wait at grade crossing (minutes)--depends on train length and speed,

T_x = excess time for stopping above that time required to travel the stopping distance at the initial speed (minutes)--depends on the initial speed of the vehicle,

β = probability of any one vehicle having to stop at the grade crossing for a passing train--depends on number of trains per day, cars per train, and train speed.

Now, the time during which a train blocks a grade crossing, appropriately termed the blocking time, can be determined from:

$$TB = L/(V \times 88) + 0.5 \quad ,$$

where

TB = blocking time in minutes,

L = train length in feet,

V = train speed in mph.

The constant 88 converts mph to ft/min and 0.5 is an allowance to account for delay after the last car clears. The train length can be estimated from the following relationship to the number of cars in the train, CPT:

$$L = [CPT + (\log_{10} CPT)^2] \times 50 \quad .$$

The term $(\log_{10} CPT)^2 \times 50$ is an estimate of the length of the locomotive and caboose. An average freight car length of 50 feet is assumed.*

If vehicles are assumed to arrive uniformly over time at the grade crossing, then the average vehicular delay time can be estimated by:

$$TD = 0.5 \times TB + 0.3 \quad ,$$

including an allowance of 0.3 min. for queue dissipation. An estimate of excess stopping time can be obtained from:

$$T_x = 0.003 \times SA \quad ,$$

where

SA = average vehicular approach speed, i.e., the initial average speed of traffic in the vicinity of crossing excluding the effect of the crossing.

Finally, the probability of being stopped can be estimated from the number of trains per day, TPD, and the blocking time, TB, according to:

$$\beta = TPD \times TB/1440 \quad .$$

---

*Includes allowance for some shorter freight cars still in use.

Appendix D

BLANK WORKSHEETS

Worksheet RO-1

TRAIN AND ENGINE MOVEMENTS ON A RAILROAD LINE SEGMENT

1. Railroad ____________ 2. Line Segment from ________ to ________ 3. MP____ to MP____

4. Interview with ________________ 5. Title ____________ 6. On (date) ______

7. General Description of Line:

8. Typical Daily Train Data:

Switch or Freight	Time (A or P)	Direction	Loads/ Empties/ Tonnage	Origin/ Destination	Length (feet)	Number of Locomotive Units	Speed or Schedule	Remarks
			/ /	/				

9. Other Information Supplied by Interviewee:

DATE: ________ INITIALS: ________

Worksheet RO-2

PHYSICAL CHARACTERISTICS OF A RAILROAD LINE SEGMENT

1. Railroad ____________________ 2. Segment from ________ to ________

3. MP _____ to MP _____ 4. Interview with ________________

5. Title ____________________ 6. On (date) ____________________

7. General Description of Line:

8. Specific Description of Line:

a. Main tracks: number _____ rail weight ____________________

allowable speed __________ curvature ____________________

b. Secondary running tracks: number ______ rail weight __________

allowable speed __________ normal operating speed ____________

c. Name, location, and length of passing tracks and crossovers:

____

____

d. Types of signaling and limits of each type by milepost: _____

____

e. Controlling gradients in each direction: ____________________

f. Total amount of rise and fall: ______________________________

____

g. Curvature (degrees of central angle) between mileposts: _____

____

h. Condition of rails, ties, ballast, structures ______________

____

Clearance and weight restrictions ____________________

Location and volume of industry spurs ____________________

____

(Over)

i. Location and description of other facilities:* ______________

____

____

____

j. Type and location of street grade crossings and protection:

____

____

____

k. Other physical features:† ______________________

____

____

____

____

____

---

*Scales, team tracks, passenger stations, freight houses, intermodal facilities, junctions and interlockings, interchanges, shops, crew change points, train order offices, etc.

†Right-of-way width, land area of yard facilities, flooding potential of adjacent waterways, etc.

DATE: ______________ INITIALS: ______________

Worksheet CC-1

RAILROAD DESIGN CRITERIA

1. Number of Tracks Required (including sidings, crossover requirements, if any) ______________________

____

2. Clearance Requirements: a. Overhead __________ b. Side __________

3. Horizontal Alignment (based on design speed ______________)

   a. Curve criteria ______________________

   b. Track spacing criteria ______________________

   c. Roadbed width ______________________

   d. Right-of-way width ______________________

4. Vertical Alignment (based on train length ______________)

   a. Ruling grades ______________________

   b. Vertical curve criteria ______________________

5. Drainage Requirements (including permissible location, depth, and frequency of flooding) ______________________

____

6. Ballast Type and Section ______________________

7. Cross Tie Size, Spacing, and Type ______________________

8. Rail and Turnouts

   a. Weight and section of rail ______________________

   b. Frog angle of turnouts ______________________

9. Type of Signaling Required (CTC, ABS, etc.) ______________________

10. Crossing Protection (type, standards) ______________________

11. RR Bridges

   a. Type (steel, pre-stressed concrete, timber, etc.) ______________

____

   b. Cooper's E rating required ______________________

DATE: ______________ INITIALS: ______________

APPROXIMATE RAILROAD CONSTRUCTION COSTS

(Alternative______: ____________)

Item	Quantity	Unit	Unit Price	Amount
1. Property Acquisition and Related Costs				
a. Right-of-way acquisition	______	____	_____	_____
b. Assemblage costs	______	____	_____	_____
c. Severance damages	______	____	_____	_____
d. Damages to improvements	______	____	_____	_____
e. Total				=====
2. Site Preparation Costs				
a. Demolition costs	______	____	_____	_____
b. Utility relocation and protection	______	____	_____	_____
c. Grading	______	____	_____	_____
d. Riprap	______	____	_____	_____
e. Total				=====
3. Track Work and Track Structure Costs				
a. Temporary relocation	______	____	_____	_____
b. Track, complete including ballast (single track)	______	____	_____	_____
c. Turnouts	______	____	_____	_____
d. Tunnels and subways	______	____	_____	_____
e. Bridges and trestles	______	____	_____	_____
f. Elevated structures	______	____	_____	_____
g. Culverts	______	____	_____	_____
h. Other: ______________	______	____	_____	_____
i. Total				=====

Item	Quantity	Unit	Unit Price	Amount
4. Right-of-Way Protection				
a. Fences	____	____	____	____
b. Signs	____	____	____	____
c. Total				____
5. Railroad Buildings and Facilities				
a. Stations and office buildings	____	____	____	____
b. Roadway buildings	____	____	____	____
c. Water stations	____	____	____	____
d. Fuel stations	____	____	____	____
e. Shops and enginehouses	____	____	____	____
f. Total				____
6. Signals and Communications Systems				
a. Automatic block signals (single track)	____	____	____	____
b. Centralized traffic control (single track)	____	____	____	____
c. Interlocking plants	____	____	____	____
d. Communications systems	____	____	____	____
e. Total				____
7. Highway Crossing and Crossing Warning Devices				
a. Flashing light signals	____	____	____	____
b. Automatic gates	____	____	____	____
c. Grade crossings	____	____	____	____
d. Grade separation	____	____	____	____
e. Total				____

Item	Quantity	Unit	Unit Price	Amount
8. Total Construction Cost Estimate (1e + 2e + 3i + 4c + 5f + 6e + 7e)				______
9. Engineering (________________)				______
10. Contingencies (________________)				______
11. Railroad Removal Cost	______	____	_____	______
12. Track Salvage	______	____	_____	______
13. GRAND TOTAL				======

DATE: ________________ INITIALS: ________________

Worksheet RR-1

APPROXIMATE ANNUAL RAILROAD OPERATING COSTS

1. Railroad________________________ 2. Line/Segment Corridor______________

	Alt. 0	Alt. 1	Alt. 2	etc.
3. Route Miles				
a. Through train	____	____	____	____
b. Local train	____	____	____	____
c. Switching assignment	____	____	____	____
4. Track Miles				
a. Main line	____	____	____	____
b. Branch line	____	____	____	____
c. Yard	____	____	____	____
5. Maximum Grade: percent				
a. On division	____	____	____	____
b. On project____bound	____	____	____	____
c. On project____bound	____	____	____	____
6. Vertical Rise: total ascents (in feet)				
a. ____bound on grades > .3% but < max. on div.	____	____	____	____
b. ____bound on grades > max. on div.	____	____	____	____
c. ____bound on grades > .3% but < max. on div.	____	____	____	____
d. ____bound on grades > max on div.	____	____	____	____
7. Train Movements: per day				
a. Through trains____bound	____	____	____	____
b. Through trains____bound	____	____	____	____
c. Total through trains (7a + 7b)	____	____	____	____
d. Local trains____bound	____	____	____	____
e. Local trains____bound	____	____	____	____
f. Total local trains (7d + 7e)	____	____	____	____
g. Switching assignments____bound	____	____	____	____
h. Switching assignments____bound	____	____	____	____
i. Total switching assignments (7g + 7h)	____	____	____	____
8. Maximum Prevailing Speed: mph	____	____	____	____

(Over)

	Alt. 0	Alt. 1	Alt. 2	etc.
9. Speed Reductions Below Prevailing Speed: number	____	____	____	____
10. Speed Reduction: average mph below prevailing speed	____	____	____	____
11. Number of Trains Affected by Speed Reduction: per day	____	____	____	____
12. Train Running Time: hours/train to traverse segment				
a. Through train	____	____	____	____
b. Local train	____	____	____	____
c. Yard engine time (switching or industry work)	____	____	____	____
13. Manned Signal or Interlocking Positions: number	____	____	____	____
14. Estimated Carload Traffic Lost (or Gained): carloads per year		____	____	____

<u>Annual Costs (or Savings)</u>

	Alt. 0	Alt. 1	Alt. 2	etc.
15. Train Delay or Running Time: dollars				
a. Through train: average (7c x 12a x \$16 x 365)	____	____	____	____
b. Local train: average (7f x 12b x \$75 x 365)	____	____	____	____
c. Switching: average (7i x 12c x \$70 x 365)	____	____	____	____
d. Total cost (or saving)	____	____	____	____
16. Route Length or Distance Costs				
a. Through train: average (3a x 7c x \$14 x 365)	____	____	____	____
b. Local train: average (3b x 7f x \$2.75 x 365)	____	____	____	____
c. Switching: average (3c x 7i x \$2.75 x 365)	____	____	____	____
d. Main line track maint.: average (4a x \$8,000)	____	____	____	____
e. Branch line track maint.: average (4b x \$2,400)	____	____	____	____

	Alt. 0	Alt. 1	Alt. 2	etc.
f. Yard track maint.: average (4c X $2,400)				
g. Total cost (or savings) (sum of lines 16a through 16f)				
17. Grade crossing maintenance cost (use Table 5 and HU-1 from Section XI)				
a. Crossbuck sign				
b. Wigwag signal				
c. Flashing light				
d. Gates				
e. Total cost (or saving) (sum of lines 17a through 17d)				
18. Manned Signal of Interlocking Cost (or Saving): average (line 13 × $40,000)				
19. Speed Reduction Costs (lines 9 × 11 × Table 4 factor × 365)				
20. Gradient Cost (or Saving) vs. Alt. 0 (approximate cost or saving resulting from changes in vertical alignment).				
a. ____bound grades > .3% but div. max. ([7a + 7d + 7g] X $.16 X Δ6a X 365)				
b. ____bound grades > div. max. ([7a + 7d + 7g] X $.20 X Δ6b X 365)				
c. ____bound grades > .3% but div. max. ([7b + 7e + 7h] X $.16 X Δ6c X 365)				
d. ____bound grades > div. max. ([7b + 7e + 7h] X $20 X Δ6d X 365)				
e. Total (20a + 20b + 20c + 20d)				
21. Traffic Lost (or Gained): (average $ of profit) ($150 X Δline 14)				

(Over)

Recapitulation and Comparison of Annual Costs (or Savings)

	Alt. 1 vs. 0	Alt. 2 vs. 0	Alt. 2 vs. 1	etc.
22. Train Delay or Running Time Cost (or Saving) (Δline 15d)				
23. Route Length or Distance Cost (or Saving) (Δline 16g)				
24. Grade Crossing Maintenance Cost (Δline 17e)				
25. Manned Signal or Interlocking Cost (or Saving) (Δline 18)				
26. Gradient Cost (or Saving) (line 20e)				
27. Speed Reduction Cost (or Saving) (Δline 19)				
28. Total Operating Costs (or Saving) (sum of lines 22 through 27)				
29. Traffic Lost (or Gained) (line 21)				
30. Total Cost before Taxes (or Saving) (lines 28 plus 29)				
31. Income Tax Expenses (or Saving)				
32. Total Annual Costs (or Saving) (lines 30 plus 31)				

DATE: ____________ INITIALS: ____________

DETAILED ANNUAL RAILROAD OPERATING COSTS

1. Railroad____________________ 2. Line Segment/Corridor___________________

   a. Proportion railroad-owned cars____________

   b. Proportion shipper-owned cars_____________

	Alt. 0	Alt. 1	Alt. 2	etc.
3. Train Miles: per year				
a. Through train miles (Worksheet RR-1, lines 3a X 7c X 365)	______	______	______	______
b. Local train miles (Worksheet RR-1, lines 3b X 7f X 365)	______	______	______	______
c. Total	______	______	______	______
4. Locomotive Unit Miles: per year				
a. Ave. no. loc. per through train (Worksheet RO-1)	______	______	______	______
b. Ave. no. loc. per local train (Worksheet RO-1)	______	______	______	______
c. Through train loc. miles (3a X 4a)	______	______	______	______
d. Local train loc. miles (3b X 4b)	______	______	______	______
e. Total (4c + 4d)	______	______	______	______
5. Equivalent Rise: feet				
a. Equivalent rise--____bound (Worksheet B-2)*	______	______	______	______
b. Equivalent rise--____bound (Worksheet B-2)*	______	______	______	______

*In Appendix B.

(Over)

	Alt. 0	Alt. 1	Alt. 2	etc.
6. Average Tonnage Per Train Per Day (incl. locomotives)				
a. Avg. ____bound through train tonnage (Worksheet RO-1 or other survey data)	____	____	____	____
b. Avg. ____bound through train tonnage (Worksheet RO-1 or other survey data)	____	____	____	____
c. Avg. ____bound local train tonnage (Worksheet RO-1 or other survey data)	____	____	____	____
d. Avg. ____bound local train tonnage (Worksheet RO-1 or other survey data)	____	____	____	____
e. Avg. ____bound switch train tonnage (Worksheet RO-1 or other survey data)	____	____	____	____
f. Avg. ____bound switch train tonnage (Worksheet RO-1 or other survey data)	____	____	____	____
7. Average Carloads per Train				
a. Avg. carloads per through train (Worksheet RO-1 or other survey data)	____	____	____	____
b. Avg. carloads per local train (Worksheet RO-1 or other survey data)	____	____	____	____
c. Avg. carloads per switch train (Worksheet RO-1 or other survey data)	____	____	____	____
8. Gallons of Fuel Consumed (see Appendix B)				
a. Fuel consumed due to changes in equivalent rise				
(1) Gallons per ___bound through train per day $\left(\frac{.075 \times 5a \times 6a}{1000}\right)$	____	____	____	____

	Alt. 0	Alt. 1	Alt. 2	etc.
8. Gallons of Fuel Consumed (continued)				
(2) Gallons per ____bound through train per day $\left(\frac{.075 \times 5b \times 6b}{1000}\right)$	____	____	____	____
(3) Gallons per ____bound local train per day $\left(\frac{.075 \times 5a \times 6c}{1000}\right)$	____	____	____	____
(4) Gallons per ____bound local train per day $\left(\frac{.075 \times 5b \times 6d}{1000}\right)$	____	____	____	____
(5) Total gallons: per year [(8a1 × RR-1, line 7a) + (8a2 × RR-1, line 7b) + (8a3 × RR-1, line 7d) + (8a4 × RR-1, line 7e)] × (365)	====	====	====	====
b. Fuel consumed due to slowing down and speeding up of trains (changes in train speed)				
(1) Gallons per ____bound through train $\left[\frac{.075 \times 6a \times .0334 (V_1^2 - V_2^2)}{1000}\right]$	____	____	____	____
(2) Gallons per ____bound through train $\left[\frac{.075 \times 6b \times .0334 (V_1^2 - V_2^2)}{1000}\right]$	____	____	____	____
(3) Gallons per ____bound local train $\left[\frac{.075 \times 6c \times .0334 (V_1^2 - V_2^2)}{1000}\right]$	____	____	____	____
(4) Gallons per ____bound local train $\left[\frac{.075 \times 6d \times .0334 (V_1^2 - V_2^2)}{1000}\right]$	____	____	____	____

(Over)

	Alt. 0	Alt. 1	Alt. 2	etc.
8. Gallons of Fuel Consumed (continued)				
(5) Total gallons: per year [(8b1 × RR-1, line 7a) + (8b2 × RR-1, line 7b) + (8b3 × RR-1, line 7d) + (8b4 × RR-1, line 7e)] × (365)				
c. Total gallons of fuel consumed [8a(5) + 8b(5)]				
9. Gross Ton-Miles per Year:				
a. Gross ton-miles per day--through trains [(6a × RR-1, line 7a) + (6b × RR-1, line 7b)] × [RR-1, line 3a]				
b. Gross ton-miles per day--local trains [(6c × RR-1, line 7d) + (6d × RR-1, line 7e)] × [RR-1, line 3b]				
c. Gross ton-miles per day--switch trains [(6e × RR-1, line 7g) + (6f × RR-1, line 7h)] × [RR-1, line 3c]				
d. Total ton-miles per year [(9a + 9b + 9c) × 365]				
10. Switch Engine Hours per Year (from sample, survey, and/or judgmental data)				
11. Car Hours of Railroad-Owned Cars per Year				
a. Through trains (7a × RR-1, line 7c × 365 × RR-1, line 12a × 1a)				
b. Local trains (7b × RR-1, line 7f × 365 × RR-1, line 12b × 1a)				
c. Switch trains (7c × RR-1, line 7i × 365 × RR-1, line 12c × 1a)				
d. Total (11a + 11b + 11c)				

	Alt. 0	Alt. 1	Alt. 2	etc.
12. Car Miles of Railroad-Owned Cars per year				
a. Through trains (7a X RR-1, line 7c X 365 X RR-1, line 3a X 1a)	____	____	____	____
b. Local trains (7b X RR-1, line 7f X 365 X RR-1, line 3b X 1a)	____	____	____	____
c. Switch trains (7c X RR-1, line 7i X 365 X RR-1, line 3c X 1a)	____	____	____	____
d. Total (12a + 12b + 12c)	====	====	====	====
13. Car Miles of Shipper-Owned Cars per Year				
a. Through trains (7a X RR-1, line 7c X 365 X RR-1, line 3a X 1b)	____	____	____	____
b. Local trains (7b X RR-1, line 7f X 365 X RR-1, line 3b X 1b)	____	____	____	____
c. Switch trains (7c X RR-1, line 7i X 365 X RR-1, line 3c X 1b)	____	____	____	____
d. Total (13a + 13b + 13c)	====	====	====	====

Annual Costs - "Average Cost Level"

14. Linehaul Costs				
a. Train and engine crew wages (3c × \$2.60)	____	____	____	____
b. Train mile expense (dispatching) (3c × \$1.15)	____	____	____	____
c. Locomotive cost assigned to miles (4e × \$.07)	____	____	____	____
d. Locomotive cost assigned to fuel (8c × \$.32)	____	____	____	____
e. Cost of fuel consumed (8c × \$.20)	____	____	____	____
f. Maintenance of way (variable portion) $\frac{(9d \times \$.55)}{1000}$	____	____	____	____

(Over)

	Alt. 0	Alt. 1	Alt. 2	etc.
14. Linehaul Costs (continued)				
g. Total (14a + 14b + 14c + 14d + 14e + 14f)				
15. Terminal Costs--switch engine service (line 10 X $70)				
16. Freight Car Costs				
a. Time rental--railroad cars (11d X $.18)				
b. Mileage rental--railroad cars (12d X $.030)				
c. Mileage rental--private cars (13d X $.065)				
d. Total (16a + 16b + 16c)				
17. Joint Facility Expenses				
18. "Fixed" Plant Expenses				
a. Maintenance of way--branch line and yard [(RR-1, line 4b + RR-1, line 4c) X $2,000]				
b. Maintenance of way--main line (RR-1, line 4a X $7,000)				
c. Manned signals, bridges, etc. (RR-1, line 18)				
d. Total (18a + 18b + 18c)				
19. Grade Crossing Maintenance				
a. Crossbuck sign (RR-1, line 17a)				
b. Wigwag signal (RR-1, line 17b)				
c. Flashing light (RR-1, line 17c)				
d. Gates (RR-1, line 17d)				

	Alt. 0	Alt. 1	Alt. 2	etc.
19. Grade Crossing Maintenance (continued)				
e. Total (19a + 19b + 19c + 19d)	____	____	____	____
20. Profit Change from Traffic Lost or Gained (RR-1, line 21)		____	____	____
21. Interest expense (or saving) (% of capital cost or savings from Table 5)		____	____	____
22. Administrative Expense (Table 5)		____	____	____
23. Income Tax Expense (or saving) (Table 5)				
a. Tax on operating cost or saving: percent		____	____	____
b. One-time tax saving from retirement		____	____	____

(Over)

Recapitulation and Comparison of Annual Costs

		Alt. 1 vs. 0	Alt. 2 vs. 0	Alt. 2 vs. 1	etc.
24.	Linehaul Cost (or Saving) (Δline 14g)				
25.	Terminal Cost (or Saving) (Δline 15)				
26.	Freight Car Cost (or Saving) (Δline 16d)				
27.	Joint Facility Cost (or Saving) (Δline 17)				
28.	"Fixed" Plant Expense (or Saving) (Δline 18d)				
29.	Grade Crossing Maint. Cost (or Saving) (Δline 19e)				
30.	Administrative Cost (Δline 22)				
31.	Operating Cost (or Saving) (sum of lines 24 through 30)				
32.	Traffic Revenue Loss (or Profit) (line 20)				
33.	Interest Expense (or Saving) (line 21)				
34.	Net Cost (or Saving) Before Taxes				
35.	Income Tax Expense (Saving) (line 23a)				
36.	Total Cost after Taxes (Saving)				
37.	One-time Tax Cost (or Saving) (line 23b)				

DATE: ____________ INITIALS: ____________

Worksheet RU-1

RAILROAD USER DATA

1. Railroad User ________________ 2. Interview with ______________

3. Title ________________________ 4. On (date) ________________

5. Business Description

 a. Business ____________________

 b. Industry ____________________

 c. Main product(s) ____________________

 d. Approximate annual sales ____________________

 e. Number of employees ____________________

 f. Annual payroll ____________________

 g. Inventory: Commodity ____________________

  Number of units ____________________

  Pounds ____________________

 h. Annual transportation cost:

  (1) Railroad ____________________

  (2) Other modes ____________________

6. Facility Description

 a. Land area ____________________

 b. Building area ____________________

 c. Building construction and age ____________________

 ____

 d. Equipment type ____________________

 e. Special features: Railroad siding ____________________

  Truck dock ____________________

 ____

(Over)

g. Estimated total value of facilities ______

h. Ownership (tenant or other) ______

7. Railroad Usage

a. Name of railroad serving ______

b. Commodities for which railroad service used ______

c. Annual number of carloads

(1) This year ______

(2) Last year ______

(3) Five years ago ______

d. Average tons per carload ______

8. User Preference

a. Move ______

b. Change transport mode(s) ______

c. Grace period ______

d. Other ______

9. Comments

DATE: ______ INITIALS: ______

RAILROAD USER MOVING AND DISRUPTION COSTS

(Alternative ____)

1. Railroad User ______________________________

2. Moving Cost

   a. Units of move ____________

   b. Cost per unit ____________

   c. Total ____________

3. Disruption Cost

   a. Equivalent days production (or service) lost ____________

   b. Expense per day lost ____________

   c. Value of lost production ____________

   d. Other disruption expenses ____________

   e. Total ____________

4. Tax Impact on User

   a. Total disruption expense (line 3e) ____________

   b. Total moving expense (line 2c) ____________

   c. Unamortized leasehold improvements ____________

   d. Total before-tax expense (4a+4b+4c) ____________

   e. Marginal tax rate ____________

   f. Tax credit for expense (4d × 4e) ____________

   g. Net expense after tax (4d - 4f) ____________

5. Community Impact

   a. Potential relocation site ____________

   b. Is relocation site outside community? (if <u>no</u>, go to line 6a) ____________

   c. How far? ____________

   d. Will present employees retain jobs after move? ____________

(Over)

e. Estimated loss of jobs: number ____________

f. Estimated payroll loss: $____________

6. Land Owner Impact

a. Is present land use compatible with planned use? ____________

b. Appraised value of property as is:

(1) Land ____________

(2) Improvements ____________

(3) Total ____________

c. Estimated value of property after relocation:

(1) Land ____________

(2) Improvements ____________

(3) Total ____________

d. Net land owner impact [6b(3) - 6c(3)] ____________

7. Community Land Value Loss

(0 if 5b is no, 6d if 5b is yes) ____________

8. Comments

DATE: ____________ INITIALS: ____________

Worksheet RU-3

RAILROAD USER TRANSPORTATION COSTS
(Alternative____)

1. Railroad User____________________________

2. Annual Railroad Use

   a. Number of carloads
      (Worksheet RU-1, line 7c) ____________

   b. Average tons per carload
      (Worksheet RU-1, line 7d) ____________

   c. Annual tonnage (2a X 2b) ____________

   d. Annual railroad transportation cost
      (Worksheet RU-1, line 5h1) ____________

   e. Cost per ton (2d ÷ 2c) ____________

3. Alternate Mode(s)

   a. Rate per ton ____________

   b. Alternate mode cost (3a X 2c) ____________

4. Additional Transportation Cost
   (or Saving) (3b - 2d) ____________

5. Savings

   a. Inventory reduction: $ per year ____________

   b. Inventory carrying cost ____________

   c. Annual inventory saving (5a X 5b) ____________

   d. Other savings (or costs) ____________

   e. Total savings ____________

6. Tax Impact ____________

   a. Net cost difference (4 - 5e) ____________

   b. Marginal tax rate ____________

   c. Annual tax decrease (or increase) ____________
      (6a X 6b) ____________

   d. Net increase after tax (6a - 6c) ____________

7. Annual Relative Cost Increase
   (6d ÷ total net profit) ____________%

DATE:____________ ______ INITIALS:____________

Worksheet RU-4

SUMMARY OF RAILROAD USER COSTS
(Alternative ____)

	User 1	User 2	User 3	etc.	Total
1. Moving/Disruption Expense (Worksheet RU-2, line 4d)	____	____	____	__	____
2. Additional Transport Cost (Worksheet RU-3, line 6a)	____	____	____	__	____
3. Total Railroad User Costs	====	====	====	==	====
4. Net Land Owner Cost (Gain) (Worksheet RU-2, line 6d)	____	____	____	__	____
5. Community Land Value Loss (Worksheet RU-2, line 7	____	____	____	__	____
6. Community Payroll Lost (Worksheet RU-2, line 5f)	____	____	____	__	____
7. Community Jobs Lost (Worksheet RU-2, line 5e)	____	____	____	__	____

DATE: ________________ INITIAL: ________________

Worksheet HU-1

GRADE CROSSING INVENTORY
(Alternative _____, Neighborhood _______________)

Data Year: ______
Initial Year: ______

(A) Grade Crossing Identification	(B) Roughness Index	(C) Number of Crossings	(D) ADT	(E) Approach Speed	(F) Trains per Day	(G) Cars per Train	(H) Train Speed	(I) Crossing Protection
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
11.								
12.								
13.								
14.								
15.								
16.								

DATE: __________ INITIALS: __________

Worksheet HU-2

ADDED HIGHWAY USER OPERATING COSTS
(Alternative ______, Neighborhood ________)

Data Year: ______
Initial Year: ______

	(A) Delay Time (Figure 9)	(B) Probability of Stop (Figure 12)	(C) Total Vehicles NX × ADT (HU1C × HU1D)	(D) Stopped Vehicles β × NX × ADT (B × C)	(E) Slowed Vehicles (1 − β) × NX × ADT (C − D)	(F) Slowing Cost (Figure 10)	(G) Stop/Idle Cost (Figure 11)	(H) Expected Added Cost [(D × G) + (E × F)]
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
11.								
12.								
13.								
14.								
15.								
16.								
GRAND TOTAL								$

DATE: ____________ INITIALS: ____________

Worksheet HU-3

Data Year: ______

Initial Year: ______

ADDED HIGHWAY USER TIME COSTS

(Alternative _____, Neighborhood ______________)

	(A) Slowing Time Cost (Figure 13)	(B) Stop/Idle Time Cost (Figure 14)	(C) Total Expected Added Time Cost [(A x HU2E) + (B x HU2D)]
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
GRAND TOTAL			

DATE: ______________ INITIALS: ______________

Worksheet HU-4

Data Year: ______

Initial Year: ______

ADDED HIGHWAY USER ACCIDENT COSTS*

(Alternative_____, Neighborhood______________)

	(A) Protection Factor (Figure 15.a)	(B) Accident Costs (0.000088 × A × HU1F × HU2C)
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
GRAND TOTAL		

DATE: ______________ INITIALS: ______________

*If type of grade crossing protection is not specified in Column I of Worksheet HU-1, enter the accident costs directly from Figure 15.b in Column (B) above without completing Column (A).

Worksheet HU-5

Data Year:______
Present Year:______
Initial Year:______

TOTAL ANNUAL HIGHWAY USER COST SUMMARY
(Alternative_____, Neighborhood______________)

1. Data Year Added Operating Costs

   a. Added operating cost (Grand total from Worksheet HU-2) $__________

   b. Data year fuel C.P.I. ______ X .003346 = __________

   c. Data year tires C.P.I. ______ X .003106 = __________

   d. Data year maintenance C.P.I. ______ X .002073 = __________

   e. Operating cost factor (b+c+d) __________

   f. Data year added operating cost (a X e) __________

2. Data Year Added Time Cost

   a. Added time cost (Grand total from Worksheet HU-3) __________

   b. Data year C.P.I. factor ______ ÷ 125.3 __________

   c. Data year added time cost (a X b) __________

3. Data Year Added Accident Cost

   a. Added accident cost (Grand total from Worksheet HU-4) __________

   b. Data year added accident cost (a X 2b) __________

4. Data Year Total Daily Added Costs (1f + 2c + 3b) __________

5. Initial Year Total Daily Added Costs

   a. Years (N) from data year until initial year ______

   b. Annual traffic growth rate (G) ______%

   c. Future worth factor $[(1.00 + G/100)^N]$ __________

   d. Initial year total daily added costs (4 X 5c) $__________

6. Present Value of Total Added Cost

   a. Years (Y) from present until initial year ______

   b. Capital cost rate (CC) ______%

   c. Present worth factor $[1.00/(1.00 + CC/100)^Y]$ __________

   d. Initial year present value multiplier for ________% annual traffic growth rate and _____% capital cost over a 25-year period (Fig. 16) __________

   e. Present value of total added cost (365 X 5d X 6c X 6d) $__________

DATE:____________ INITIALS:____________

Worksheet HU-6

AIR POLLUTANT VARIATIONS

(Alternative ______, Neighborhood ____________)

Data Year: ________

Reference Year: ________

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
		Carbon Monoxide						Hydrocarbons					
	Year Factor (Figure 17)	CO Slowing Factor (Figure 18)	Slowing HU2E × B	CO Stop Factor (Figure 18)	Stop HU2D × D	Idle HU2D × HU2A × 0.00119	Total A × (C+E+F)	HC Slowing Factor (Figure 19)	Slowing HU2E × H	HC Stop Factor (Figure 19)	Stop HU2D × J	Idle HU2D × HU2A × 0.0000087	Total A × (I+K+L)
1.													
2.													
3.													
4.													
5.													
6.													
7.													
8.													
9.													
10.													
11.													
12.													
13.													
14.													
15.													
16.													
	GRAND TOTAL												

DATE: ____________ INITIALS: ____________

Data Year: ______
Present Year: ______
Initial Year: ______

Worksheet HU-7

SUMMARY OF HIGHWAY USER IMPACT ON NEIGHBORHOODS
(Alternative ____)

(A) Neighborhood Identification	(B) Daily Added Operating Cost (HU5, line 1f)	(C) Daily Added Time Cost (HU5, line 2c)	(D) Daily Added Accident Cost (HU5, line 3b)	Total Added Cost (E) Data Year [365 x (B + C + D)]	Total Added Cost (F) Present Value (HU5, line 6e)	Daily Emissions (G) CO Pounds (HU6G, total)	Daily Emissions (H) HC Pounds (HU6M, total)
GRAND TOTAL ADDED COSTS							
GRAND TOTAL ADDED EMISSIONS							

DATE: ________ INITIALS: ________

Worksheet NI-1
Page 1 of 2
IDENTIFICATION OF NEIGHBORHOODS AFFECTED
BY BASIC RAILROAD CHANGES

	Alt. 0	Alt. 1	Alt. 2	etc.
1. Railroad Removed from Neighborhood				
a. Initial year of significant impact		_____	_____	_____
b. Neighborhoods affected	_____	_____	_____	_____
c. Subsequent landmark year		_____	_____	_____
d. Neighborhoods affected	_____	_____	_____	_____
2. New Railroad Corridor Added to Neighborhood or Existing Corridor Widened				
a. First landmark year		_____	_____	_____
b. Neighborhoods affected	_____	_____	_____	_____
c. Second landmark year		_____	_____	_____
d. Neighborhoods affected	_____	_____	_____	_____
3. Railroad Traffic Reduced				
a. First landmark year		_____	_____	_____
b. Neighborhoods affected	_____	_____	_____	_____
c. Second landmark year		_____	_____	_____
d. Neighborhoods affected	_____	_____	_____	_____
4. Railroad Traffic Increased				
a. First landmark year		_____	_____	_____
b. Neighborhoods affected	_____	_____	_____	_____
c. Second landmark year		_____	_____	_____
d. Neighborhoods affected	_____	_____	_____	_____

(Over)

	Alt. 0	Alt. 1	Alt. 2	etc.
5. Highway Grade Separation Added				
a. First landmark year		____	____	____
b. Neighborhoods affected	____	____	____	____
c. Second landmark year		____	____	____
d. Neighborhoods affected	____	____	____	____

DATE: ____________ INITIALS: ____________

Worksheet NI-2

INVENTORY OF EXISTING CONDITIONS AROUND RAILROAD

1. Neighborhood Identification ______________________________

2. Railroad: ____________; segment from ______________ to ______________

3. Railroad Data

   a. Right-of-way

      (1) Length: ____________________

      (2) Width: ____________________

      (3) Area: ____________________

      (4) Relation to grade (above, at, below) ____________________

      (5) Curvature ____________________

      (6) Condition (litter, weeds, etc.) ____________________

   b. Railroad facilities

      (1) Number of tracks ____________________

      (2) Other equipment ____________________

      (3) Type and condition of structures ______________________________

      ____

      (4) Fencing (condition, access, etc.) ______________________________

      ____

   c. Railroad operation

      (1) Approximate total number of trains per day ____________________

      (2) Average train speed ____________________

(Over)

4. Abutting Property

a. Estimated lot sizes

(1) Width by depth: ____________

(2) Parcel area ____________

(3) Frontage of railroad ____________

b. Land use

(1) Family residences

a) Number of structures or units ____________

b) Description/condition ____________

____

c) Number of families ____________

(2) Use Number 2 ____________

a) Number of structures or other units ____________

b) Description/condition of structures ____________

____

(3) Use Number 3 ____________

a) Number of structures or other units ____________

b) Description/condition of structures ____________

____

DATE: ____________ INITIAL: ____________

Worksheet NI-3

IMPACT OF RAILROAD REMOVAL ON ABUTTING PROPERTY OCCUPANTS AND OWNERS

(Alternative_____: _____________)

1. Neighborhood Identification ______________________________

2. Railroad:___________; segment from___________to___________

   from___________to___________

   from___________to___________

3. How will neighborhood change as a result of project?

4. Land Use

	Now	First Landmark Year	Second Landmark Year
a. Right-of-way use	R.R. R-O-W	______	______
(1) Estimated demand for this use: sq. ft. or acres		______	______
(2) Amount of land freed	______	______	______
(3) Unit value	______	______	______
(4) Total value: (4a2 X 4a3)	______	______	______
b. Abutting property			
(1) Use Number 1	______	______	______
a) Number	______	______	______
b) Description	______	______	______
c) Estimated demand	______	______	______

(Over)

	Now	First Landmark Year	Second Landmark Year
b. Abutting property (continued)			
d) Unit value			
e) Total value (4b1a X 4b1d)			
(2) Use Number 2			
a) Number			
b) Description			
c) Est. demand			
d) Unit value			
e) Total value (4b2a X 4b2d)			
(3) Use Number 3			
a) Number			
b) Description			
c) Est. demand			
d) Unit value			
e) Total value (4b3a X 4b3d)			
c. Total [4a4 + 4b1e + 4b2e + 4b3e]			
d. Change from present			

5. Economic Impacts

	First Landmark Year	Second Landmark Year
a. Land value		
(1) Gross increase (line 4d)		
(2) Displaced from elsewhere in community		
(3) Net increase		

b. Business ______________________________

6. Physical Impacts

   a. Noise ______________________________

   b. Danger ______________________________

   c. Visual ______________________________

   d. Pollution ______________________________

   e. Barrier ______________________________

7. Social Impacts

   a. Attitude ______________________________

   b. Relocation ______________________________

   c. Disruption ______________________________

   d. Accessibility ______________________________

8. Plans to Mitigate
   Unfavorable Impacts ______________________________

____
____
____
____
____
____

9. Key Issues in this Neighborhood
   and Their Significance ______________________________

____
____
____
____
____
____

DATE: ______________ INITIALS: ______________

IMPACT OF RAILROAD REMOVAL ON NON-ABUTTING PROPERTY OCCUPANTS AND OWNERS

(Alternative____: __________________)

1. Neighborhood Identification____

2. How Will Railroad Removal Affect this Neighborhood?

	Land Use No. 1	Land Use No. 2	Land Use No. 3
3. Land Uses			
a. Present use	______	______	______
(1) Present utilization for this use	______	______	______
(2) Estimated supply without project	______	______	______
(3) Amount of land in this use affected: acres	______	______	______
(4) Unit value: $/acre	______	______	______
(5) Total value (3a3 X 3a4)	______	______	______
b. Future use in year_______	______	______	______
(1) Estimated demand for this use	______	______	______
(2) Estimated supply without project	______	______	______
(3) Amount of land in this use affected: acres	______	______	______
(4) Unit value: $/acre	______	______	______
(5) Total value (3b3 X 3b4)	______	______	______

(Over)

	Land Use No. 1	Land Use No. 2	Land Use No. 3
c. Future use in year_______	______	______	______
(1) Estimated demand for this use	______	______	______
(2) Estimated supply without project	______	______	______
(3) Amount of land in this use affected: acres	______	______	______
(4) Unit value: $/acre	______	______	______
(5) Total value (3c3 x 3c4)	______	______	______

4. Grade Crossings Serving Neighborhood

a. Number removed ______

b. Value of removal (HU-5, line 6e) ______

5. Physical Impacts:

a. Noise ______

b. Danger ______

c. Visual ______

d. Pollution ______

e. Barrier ______

6. Social Impacts

a. Attitude ______

b. Relocation ______

c. Disruption ______

d. Accessibility ______

	In Year ____	In Year ____
7. Economic Impacts:		
a. Total land value increase (or decrease) [sums of lines (5) under 3b or c less 3a]	____	____
b. Demand diverted from other parts of community	____	____
c. Net total land value change (7a-7b)	____	____
d. Highway user value (line 4b)	____	____
e. Insurance saving (or cost)	____	____
f. Net economic change (7c-7d+7e; zero if change is negative)	____	____

8. Plans to Mitigate Unfavorable Impacts ____________________

DATE: ____________ INITIALS: ____________

Worksheet NI-5

INVENTORY OF LAND
ON AND NEAR PROPOSED NEW RAILROAD ALIGNMENT
(Alternative________: ________________)

1. Neighborhood Identification ______________________________

2. Railroad:____________________; segment from _________to____________

3. Data on Railroad

   a. Right-of-way

      (1) Length of segment ________________

      (2) Width ________________

      (3) Area ________________

   b. Railroad facilities

      (1) Number of tracks ________________

      (2) Grade ________________

      (3) Relation of grade to surrounding land ________________

      (4) Curvature ________________

   c. Other facilities ____________________________________

   d. Total number of trains per day______________________________

4. Right-of-Way Acquisitions	Land Use No. 1	Land Use No. 2	Land Use No. 3
a. Present use			
b. Number of units (or area)			
c. Improvements			
d. Unit value			
e. Total value (4b X 4d)			
f. Total acquisition value			

(Over)

5. Description of Damages to Property

		Number	Unit	Total
a.	________	______	______	______
b.	________	______	______	______
c.	________	______	______	______
d.	________	______	______	______
e,	Total damages			______

DATE: ________ INITIALS: ________

Worksheet NI-6

RELOCATION OF FAMILIES AND BUSINESSES

(Alternative_____: _____________)

1. Neighborhood Identification ______________________________

2. Household Relocation

   a. Number ____________

   b. Estimated moving cost per household ____________

   c. Total moving cost (2a X 2b) ____________

   d. Average household rent in neighborhood ____________

   e. Average value of owner-occupied dwellings ____________

   f. Locations of comparable available housing ______________________________

   ____

3. Business Relocation

   a. Larger businesses (use Worksheet RU-2)

      (1) Number of establishments to be moved ____________

      (2) Moving and disruption expense (total of lines 4g in all RU-2s) ____________

      (3) Community impact ____________

         a) Land (total of lines 7 in all RU-2s) ____________

         b) Jobs (Total of lines 5e in all RU-2's) ____________

   b. Smaller businesses

      (1) Number ____________

      (2) Unit relocation cost ____________

      (3) Total relocation cost ____________

      (4) Number of employees ____________

(Over)

b. Small businesses (continued)

(5) Relocation sites

a) In community: percent ____________

b) Outside community: percent ____________

(6) Community impact

a) Land value change ____________

b) Job number change ____________

DATE: ____________ INITIALS: ____________

Worksheet NI-7

SUMMARY OF RIGHT-OF-WAY
ACQUISITION IMPACTS ON NEIGHBORHOODS
(Alternative ______ : __________)

(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
			Relocation Cost				Community Impacts	
Neighborhood	Value of Land and Improvements Taken (NI-5, line 4f)	Value of Damages to Property (NI-5, line 5e)	Households (NI-6, line 2c)	Businesses (NI-6, line 3a2 and 3b3)	Number of Households Moved (NI-6, line 2a)	Number of Businesses Moved (NI-6 line 3a1 and 3b1)	Land Values (NI-6, line 3a3a and 3b6a)	Jobs (NI-6, line 3a3b and 3b6b)
Total:								

DATE: __________ INITIALS: __________

Worksheet NI-8

NEIGHBORHOOD DISRUPTION
(Alternative____: ____________)

1. Neighborhood Identification ______________________________

2. Physical Impact of Project:

3. Number of Families affected ______________________________

4. Characteristics of Neighborhood:

	This Neighborhood	Whole Community
a. Mean household income	________	________
b. Percent minority households	________	________
c. Mean age	________	________
d. Other characteristics	________	________
	________	________
	________	________

5. Estimated Disruptive Impact:

6. Plans to Mitigate Unfavorable Impacts:

DATE: ______________ INITIALS: ______________

Worksheet NI-9

IMPACT OF INCREASED RAIL TRAFFIC ON NEIGHBORHOODS
(Alternative________: ________________)

1. Neighborhood Identification ____________________________

2. Railroad:__________; segment from _____________to_____________

3. Railroad Operation

a. Trains per day	Now	Anticipated
(1) Switching and local		
(2) Through		

4. Estimated Impact on Neighborhood

a. Physical Impact ____________________________

b. Social Impact ____________________________

c. Economic Impact	Land Use No. 1	Land Use No. 2	Land Use No. 3
(1) Present Use			
(2) Number of units			
(3) Area: total acres			
(4) Estimated unit change in value			
(5) Total value change			

5. Plans to Mitigate Negative Impacts:

DATE: ____________ INITIALS: _______________

Worksheet NI-10

SUMMARY OF NEIGHBORHOOD IMPACTS

(Alternative________: ______________)

(A)	(B)	(C) Physical Impact					(D) Economic Impact (thousands of dollars)	(E)	(F)	(G)	(H)
Neighborhood or Impact Area	Nature of Change	Noise	Danger	Visual	Pollution	Barrier	Gross	Dis-placed	Net	No. of Families Affected by Disruption	Remedial Action/Comments
Totals											

Worksheet CI-1

INITIAL FINANCIAL ANALYSIS FOR COMMUNITY

Item	Alt. 1	Alt. 2	etc.
1. Project Costs			
a. Capital cost			
(1) Railroad expense (Worksheet CC-2, line 13)	____	____	____
(2) Other	____	____	____
b. Relocation expense			
(1) Families (Worksheet NI-7, column D total)	____	____	____
(2) Business (Worksheet NI-7, column E total)	____	____	____
c. Railroad user impact (Worksheet RU-4, line 1, total)	____	____	____
d. Payments to railroad company	____	____	____
e. Other payments	____	____	____
f. Total (sum of 1a through 1e)	====	====	====
2. Estimated Financial Contributions			
a. By federal government			
(1) Trust funds	____	____	____
(2) Other	____	____	____
b. By state government			
(1) Highway funds	____	____	____
(2) Other	____	____	____
c. By other organizations or individuals	____	____	____
d. By railroad company	____	____	____
e. Total (sum of 2a through 2d)	====	====	====
3. Local Government Share of Project Cost (1f minus 2e)	====	====	====

DATE: ____________ INITIALS: ____________

BOND SERVICE REQUIREMENTS FOR ADMINISTRATION
AND COMMUNITY SHARE OF PROJECT COSTS

(A) Calendar Year	(B) Project Year	(C) Alternative 1 Costs: Admin	(D) Alternative 1 Costs: Share of Project	(E) Alternative 2 Costs: Admin	(F) Alternative 2 Costs: Share of Project	(G) Alternative 3 Costs: Admin	(H) Alternative 3 Costs: Share of Project
	1						
	2						
	3						
	4						
	5						
	___						
	___						
	___						
	___						
	___						
	___		___		___		___

1. Total Local Share ______ ______ ______

2. Bond Issue Requirements
   a. Term and year of issue ______ ______ ______
   b. Interest rate ______ ______ ______
   c. Factor ______ ______ ______
   d. Service ______ ______ ______

3. Total Annual Revenue to be Raised
   a. years:______through______ ______ ______ ______
   b. years:______through______ ______ ______ ______

DATE:__________ INITIALS:__________

Worksheet CI-3

COMMUNITY LAND VALUE CHANGE

	Alt. 1		Alt. 2		Alt. 3	
	Year:	Year:	Year:	Year:	Year:	Year:
	____	____	____	____	____	____
1. Railroad User Moves (Worksheet RU-4, line 5 total)	____	____	____	____	____	____
2. Right of Way Acquisition (Worksheet NI-7, column H total)	____	____	____	____	____	____
3. Neighborhood Land Value (Worksheet NI-10, column F total)	____	____	____	____	____	____
4. Net Land Value Change (1 + 2 + 3)	____	____	____	____	____	____
5. Redistribution of Values						
a. Impact of right-of-way acquisition (Worksheet NI-7, sum of columns B and C minus column H total)	____	____	____	____	____	____
b. Neighborhood land values (Worksheet NI-10, column E total)	____	____	____	____	____	____
c. Land values redistribution (a + b)	____	____	____	____	____	____

DATE: ______________ INITIALS: ______________

Worksheet CI-4

COMMUNITY TAX CHANGES REQUIRED

	Alt. 0	Alt. 1	Alt. 2	etc.
1. Tax Source: ________				
2. Tax Base				
a. Current to ________	________			
b. From _____ to _____		________	________	________
c. From _____ to _____		________	________	________
3. Amount of Taxes				
a. Currently budgeted	________	________	________	________
b. Needed for new debt service and administration		________	________	________
c. Total (a + b)		________	________	________
4. Tax Rate				
a. From _____ to _____ (3c ÷ 2a)		________	________	________
b. From _____ to _____		________	________	________
c. From _____ to _____		________	________	________

5. Other Tax Information

DATE: ________________ INITIAL ________________

Worksheet CI-5

Page 1 Of 2

OTHER COMMUNITY IMPACTS

	Alt. 0	Alt. 1	Alt. 2	etc.
1. Air Pollution				
a. Can community meet air quality standards? (If yes, go to 2.)	____	____	____	____
b. Contribution of railroad project: pounds per day (Worksheet KU-7, differences from Alt. 0)				
(1) CO, in year ________		____	____	____
(2) HC, in same year		____	____	____
c. Total daily emission (from local authority, minus 1b)				
(1) CO	____	____	____	____
(2) HC	____	____	____	____
d. Is air quality improvement an issue?	____	____	____	____
2. Employment				
a. Construction				
(1) Labor force	____			
(2) Unemployment	____			
(3) Project requirements		____	____	____
(4) Impact significant?		____	____	____
(5) Measures to minimize unfavorable impact: Alternative ________	________			
b. Other jobs lost or gained				
(1) From relocation of railroad users (Worksheet RU-4, line 7)		____	____	____
(2) From ROW acquisition (Worksheet NI-7, column I)		____	____	____
(3) Other		____	____	____
(4) Impact significant		____	____	____
(5) Measures to minimize unfavorable impact: Alternative ________	________			

(Over)

	Alt.0	Alt.1	Alt.2	etc.
3. Services				
a. Migration		____	____	____
b. Housing		____	____	____
c. Schools		____	____	____
d. Other services		____	____	____

4. Other Community Issues: ____________________

DATE: __________ INITIALS: __________

Worksheet SN-1

STATE AND NATIONAL IMPACTS

1. Alternative ________________ : ________________

2. Natural Resources Impact

3. National Resources Impact

4. Impact on Highway Improvement Funds

   a. Trust fund contribution to project

      (1) Federal ______________________________

      (2) State ______________________________

   b. Highway user benefits: present value in year ______ ______________________________

   c. Net highway benefits (4a - 4b) ______________________________

5. Impact on National Goals ______________________________

6. Impact on Institutions

Institution	Impact
a. ______________________	______________________________________
b. ______________________	______________________________________
c. ______________________	______________________________________

DATE: ____________________ INITIALS: ____________________

Worksheet E-1

DISTRIBUTIONAL ANALYSIS

	Alt. 1	Alt. 2	etc.
1. Project Cost (Worksheet CI-1, line 1f)	____	____	____
2. Sources of Financing (Worksheet CI-1, lines 2 and 3)			
a. Federal	____	____	____
b. State	____	____	____
c. Other	____	____	____
d. Local government	____	____	____
3. Taxes			
a. Tax rate in ____	____	____	____
b. Tax rate in ____	____	____	____
4. Significant Neighborhood Impacts	____	____	____
	____	____	____
	____	____	____
5. Improvement of Traffic Flow			
a. Grade crossings eliminated	____	____	____
b, Present value in year ____ of delay/operation costs and accidents, from yr ____	____	____	____
6. Other Community Impacts	____	____	____
	____	____	____
7. Railroad Company Impact	____	____	____
	____	____	____
8. Comments	____	____	____

DATE: ____ INITIALS: ____

Worksheet E-2

RESIDUAL VALUE OF PROJECT
(Alternative______, __________)

	(A) Cost or Value (dollars)	(B) Residual Value (factor)	(C) Residual Amount A X B (dollars)
1. Railroad Construction Cost			
a. Property (Worksheet CC-2, line 1a)	________	1.00	________
b. Utility relocation and protection (CC-2, line 2b)	________	.5	________
c. Trackwork and structures (CC-2, line 3i)	________	.5	________
d. Railroad buildings and facilities (CC-2, line 5f)	________	.5	________
e. Signals and communications (CC-2, line 6e)	________	.5	________
f. Highway crossing and warning devices (CC-2, line 7e)	________	.5	________
g. Subtotal (total of lines 1a through 1f)		--	________
h. Contingency factor (same as used to compute line 10 in Worksheet CC-2)			________
i. Contingency in above items (line g X h)			________
j. Total railroad residual			________
2. Other Construction Costs			
a. Land	________	1.00	________
b. Site preparation and structures	________	.5	________
c. Other________________	________	.5	________
d. Total other costs (line 2a+2b+2c)		--	________
3. Total Residual Value (lines 1j + 2d)		--	________

DATE:____________ INITIALS:____________

Worksheet E-3

SCHEDULE OF COSTS AND BENEFITS
(Alternative ___ vs. Alternative _____)

(A) Calendar Year	(B) Project Year	(C) Discount Factor	(D) Capital Costs (Salvage)	(E) Highway User Saving	(F) Railroad Operating Company Saving	(G) Railroad Users Saving	(H) Community Land Value Increase	(I) Other Community Benefit	(J) Reference Notes
	0	1.00							
	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
PRESENT VALUES									

DATE: ____________ INITIALS: ______________

Worksheet E-4 Present Year: _____

COMPARISON OF ALL COSTS AND BENEFITS
(As Adjusted Present Values in Thousands of Dollars)

	Alt. 1 vs 0	Alt. 2 vs 0	Alt. 2 vs 1	etc.
1. Impacts Measurable in Dollars				
a. Highway user impact				
b. Railroad company saving				
c. Railroad user saving				
d. Community land value increase				
e. Other community benefit				
f. Total dollar benefit				
g. Less capital cost (net of salvage and residual)				
h. Net present value				
2. Other Quantifiable Impacts				
a. Families relocated (Worksheet NI-7)				
b. Businesses relocated (Worksheets NI-7 and RU-4)				
c. Number of employees affected (Worksheets NI-7 and RU-4)				
d. Vehicle emissions reduced (Worksheet HU-7)				
(1) HC (pounds per day)				
(2) CO (pounds per day)				
e. Other:				

3. Qualitative Impacts:

DATE: _____ INITIALS: _____