ISSUE-ORIENTED APPROACH TO ENVIRONMENTAL IMPACT ANALYSIS

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An approach for better organization of significant portions of the urban transportation planning process is presented. A corridor-planning project from the Dallas-Fort Worth region in the form of an environmental impact analysis for a proposed urban tracked air-cushion vehicle facility is used as a case study. The issue-oriented approach is built on 3 broad concepts. First, the early identification and analysis of major impact issues in relation to regional or local goals and objectives should be a major element on which transportation planning studies are structured. Second, the planning and evaluation process should be phased, and each successive phase or cycle should address additional, more detailed service and impact variables, but for a smaller number of alternatives. Third, required environmental impact statements should be viewed as a reorganization of the results of environmental impact analyses already well integrated in the planning process.

•REQUIREMENTS for more effective urban transportation planning have recently increased. For example, corridor planning has emerged as a major new level of transportation planning that attempts to bridge the abstractions and generalities of system plans and the controversy and conflict too often created at the project-planning level (5). As a part of corridor planning, a much wider range of indirect impacts, such as the social, economic, and environmental consequences of transportation, must be considered, but at a fairly detailed, community scale (9, 12). To determine the relative importance of these impacts, one needs to refer to a local-regional goals structure. In addition, a demand exists for much more information about the consequences of transportation plans, and the planning task is made more complex by a parallel need for more alternative plans to be generated and evaluated at both system and corridor levels. Consequently, the urban transportation planning process needs basic strategies of concepts for better organization of the planning process (6). One important strategy for better management of planning, cost-effectiveness analysis, has been stressed recently (14). This paper builds on a goal-achievement or cost-effectiveness approach to add 3 additional concepts for strengthening the planning and evaluation process by using a corridor-planning project from the Dallas-Fort Worth region as a case study based on 3 suggestions.

1. Transportation system planning studies should be organized from the start around the early identification and analysis of major issues as reflected in the goals and objectives of the region and communities within specific corridors.
2. At least 3 cycles or iterations in corridor planning may be necessary to better organize and focus the considerable amount of work involved, and each successive phase or cycle should address more detailed planning and evaluation of fewer alternatives.
3. Required environmental impact statements should be integrated within the corridor-planning process—by careful examination of social, economic, and environmental impacts from the start of corridor planning—rather than be seen as troublesome post hoc justifications of prematurely conceived route-planning decisions.

The issue-oriented approach was recently used in an environmental impact analysis prepared for a proposed urban tracked air-cushion vehicle (UTACV) facility connecting the central areas of Fort Worth and Dallas with the Dallas-Fort Worth Airport and serving the areas lying in between (1). The proposed UTACV system raised important environmental issues with respect to its

1. Technological characteristics (high speed and noise),
2. Right-of-way displacement and relocation requirements, and
3. Effect on transportation and land use relationships.

Analysis of the first issue was limited to the extent that design data on UTACV operating characteristics were available. The second and third issues, relating directly and indirectly to route locations respectively, were a major thrust of the case study environmental impact analysis. The environmental analysis served to identify and then to avoid the major environmental sensitivities of the study area. Reviews of existing reports and literature, contacts with resource specialists, and field investigations were used to identify these sensitivities.

EARLY IDENTIFICATION OF IMPACT ISSUES

Sorting out potential transportation facility impacts that may be more (or less) critical in specific corridors represents the first thrust of the issue-oriented strategy. This is facilitated by the previous identification of both regional- and community-level goals and objectives for transportation and related public facilities and services. Various community interaction techniques, consultation with regional and local decision makers, and analyses of impacts performed by the corridor-planning team (each of which may rely on elements of subjective judgment) can be used to focus on those most significant impacts likely to raise important issues.

In specific corridors, some impacts may be negligible; others may reflect unusual environmental constraints or circumstances. Some apparently significant impacts may be of relatively little importance to local community residents or political decision makers. Still other apparently small-scale impacts, in fact, in terms of local community values, may be regarded by citizens and decision makers as especially critical. Consequently, to anticipate these kinds of issue potentials and to help avoid or reduce major controversies at a later time, one should begin issue identification early in the corridor-planning process.

In the Dallas-Forth Worth case study, the importance of environmental issues in the planning of major regional transportation improvements has been emphasized (13). This policy urges all state, regional, and local agencies to include an environmental analysis as an integral part of the process of planning major new projects. This approach provided further impetus for the framework of the UTACV environmental impact analysis whose major thrust was, therefore, directed toward the early and continuing identification of impact issues that might be avoided or at least minimized.

Relationship to Regional Transportation Goals

Any proposal for a major transportation improvement raises basic issues of cost, energy conservation, and environmental impact as well as service potential. Ten regional transportation goals that were developed in the Dallas-Fort Worth Urban Mass Transportation Administration (UMTA) Regional Public Transportation Study are as follows (4):

1. Plan and develop a transportation system that will provide access to a wide range of social and economic opportunities;
2. Provide a transportation system that will stimulate the development and growth of urban activities that enhance the socioeconomic condition of the region;
3. Provide a transportation system that will enhance the opportunity to develop a

stronger sense of community;

4. Provide a regional transportation system that will be operated efficiently and economically and will minimize costs consistent with available financial resources and implementation capacity;

5. Provide a balance and coordination between land use and transportation system development that will achieve the desired levels of transportation convenience, diversification, safety, and economy;

6. Provide development opportunities consistent with existing land use and coordinated with existing transportation system and land use;

7. Locate and design the regional transportation system to minimize any harmful effects it may have on the surrounding ecology and physical environment and, where possible, to stimulate improvement of the environment;

8. Locate and design the regional transportation system to minimize the noise and air pollution impact on the environment;

9. Provide a regional transportation system plan that will be sufficiently flexible to be staged and adapted to changing conditions and that will provide acceptable performance characteristics; and

10. Provide a regional transportation system based on a maximum level of service and use of existing transportation systems.

(Goals 2, 3, 6, 7, and 8 relate directly or indirectly to environmental issues.) Goals such as these and the more specific objectives related to them were an important guide to the overall planning and evaluation process. More specific objectives related to these environmental goals, as well as associated criteria or measures for quantitatively gauging relative levels of goal achievement, are given in Table 1. These goals, objectives, and criteria formed the basis for subsequent issue identification in the UTACV environmental impact analysis. Although this basic set of goals was identified with the help of community participation (2), initial emphasis in the UTACV corridor study was placed on the sorting out of key issues through the participation of the Study Directors Council (SDC) (representatives from the city of Dallas, city of Fort Worth, and North Central Texas Council of Governments; the Dallas Transit System; and City Transit Service of Fort Worth) for the project.

Both the SDC and professional staff team working on the project recognized that any major transportation project proposal can induce an almost infinite number of environmental impacts if secondary and tertiary effects on the ecosystem are traced. Therefore, the scope of the analysis must be defined in terms of some priority of concerns or issues. These issues then further define the more specific criteria and measures, including subjective or qualitative ratings, to be used in project evaluation. They also indicate those impact areas for which further, more detailed impact analyses eventually may be warranted. Those issues involving direct and indirect route location represent the major thrust of the analysis described in this paper.

Even within these sets of issues, however, priorities have to be established. Thus, to determine the potential location impacts of greatest concern, preliminary discussions should be held with representatives of various government agencies and other organizations familiar with the environmental characteristics of the study area. From these discussions and from review of existing reports and field reconnaissance surveys, the environmental concerns most sensitive to a new route location can be identified. Thus, these sensitivities become the major evaluation criteria for the environmental impact analysis. In short, the issue-oriented approach does not propose to examine each and every environmental concern but, instead, focuses analysis on those already identified issues known to be of high priority.

Technical Feasibility Study of Urban Tracked Air-Cushion Vehicle

A regional public transportation planning program was initiated in the Dallas-Fort Worth area in 1971. It includes a series of subregional planning studies (for Dallas, Fort Worth, and the mid-cities area) and bus operational studies (for Dallas and Fort

Worth). These studies were financed in part through an UMTA technical studies grant and were conducted jointly by the North Central Texas Council of Governments, the cities of Dallas and Fort Worth, and the 2 local bus operators. Included as part of this planning program was the UTACV technical feasibility study. An environmental impact analysis was 1 of 4 major study efforts involved in this technical feasibility study. The other 3 investigations were concerned with preliminary engineering, patronage, and financial feasibility.

Perhaps the 2 most significant aspects of potential UTACV hardware are its speed and guidance characteristics. The vehicle used for evaluation in this study can operate at speeds up to 150 mph (240 km/h). The system has not yet been tested; however, the performance specifications originally established by the U.S. Department of Transportation (DOT) were used as a basis for the feasibility study. Additional data were obtained from Rohr Industries, Inc., and LTV Aerospace Corporation.

Pertinent UTACV technology-related environmental characteristics, such as emissions, energy requirements, and noise, are as follows (10):

1. U.S. DOT specifications call for an electric power source that would avoid the air-polluting characteristics of fossil fuel combustion.
2. Rohr Industries, Inc., has calculated the energy required by using a regenerative-braking, linear-induction motor; 1,290 Btu/passenger-mile (846 kJ/passenger-km) or 822 Btu/seat mile (539 kJ/seat km) are required for an express service (does not stop at all stations), and 2,020 Btu/passenger-mile (1325 kJ/passenger-km) or 919 Btu/seat mile (603 kJ/seat km) are required for local service (stops at all stations).
3. U.S. DOT specifications require UTACV to meet exterior noise levels of 73 dBA measured at 50 ft (15.2 m) to the side for a vehicle cruising at speeds of up to 150 mph (240 km/h) and 63 dBA measured at 50 ft (15.2 m) to the side for a vehicle decelerating with mechanical brakes on.

RECYCLING OF PLANNING-EVALUATION PROCESS

The 3-stage approach to corridor planning and evaluation shown in Figure 1 represents the second broad dimension of the issue-oriented approach to environmental impact analysis. Because of the progression from more generalized to more detailed kinds of impacts to be analyzed, this approach provides an opportunity for stronger linkages with the traditional system level of planning. For example, many of the macrolevel kinds of impacts that might be included in stage 1, such as comparative travel times (including interface with the other elements of the regional highway and transit system), generalized cost characteristics, broad measures of accessibility and land use relationships (such as number of activity centers served, by size), and aggregate socioeconomic characteristics of communities traversed, will typically be important at the overall regional system level of transportation planning. These aggregate impacts also should be used at the corridor-planning level as a means for characterizing, if possible, a fairly large number of route location or generalized alignment alternatives through sketch planning. In this way, some of the important differences between and similarities with other elements of the regional transportation system might become evident.

In stage 2, microlevel planning and evaluation, the geographic scale of impact changes to more detailed kinds of system-facility consequences (from regional to community and neighborhood considerations). In general, the emphasis shifts to small-area units of analysis, such as census tracts or traffic analysis zones. Furthermore, greater consideration should be given to specific major land uses, such as major parks, ecological preserves, identifiable communities, and activity centers. So that the planning and evaluation process can be kept manageable as this kind of microlevel detail is added, the number of alternatives will be subject to further refinement and detailing at this stage, in terms of route, facility, and technology characteristics and associated environmental relationships. A more careful level of planning and evaluation will replace the more generalized sketch planning conducted in stage 1.

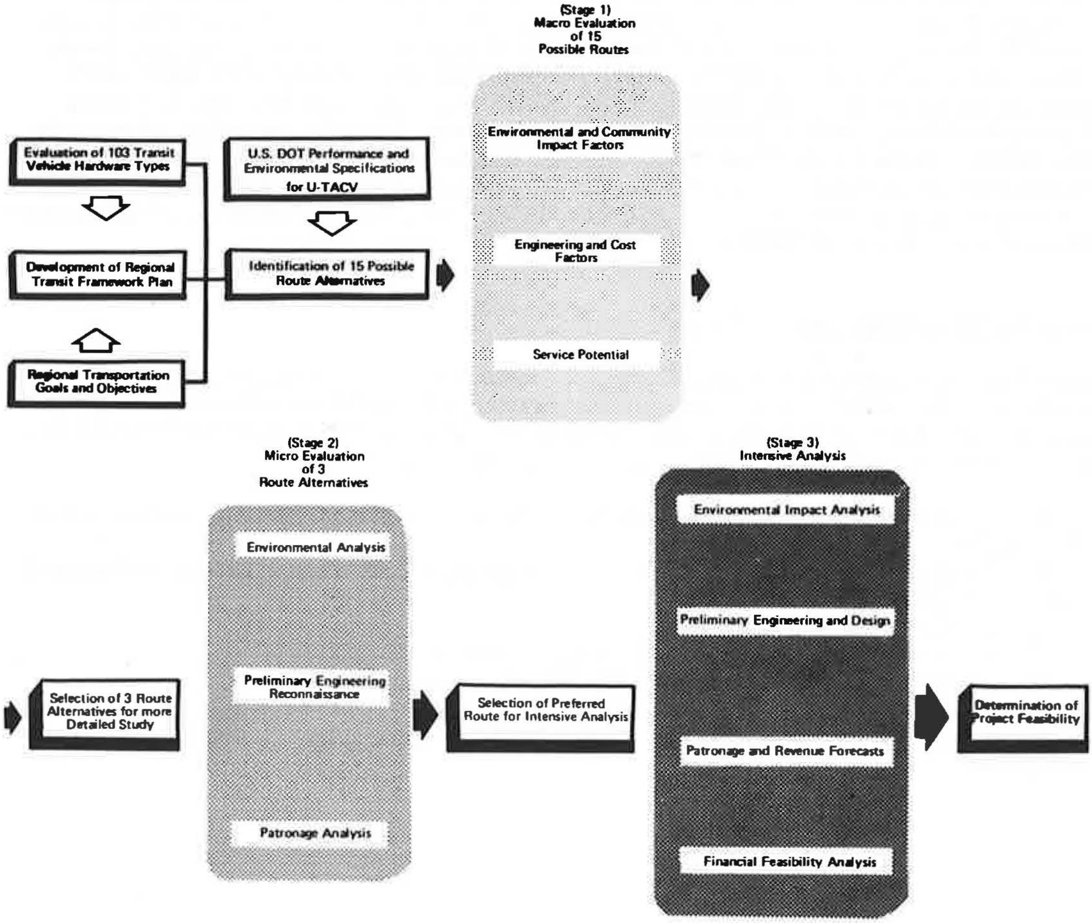
Underlying both stages 1 and 2 in the suggested planning and evaluation process is

Table 1. Objectives and criteria bearing on environmental issues.

Goal	Objectives	Criteria
2	Use transportation system to create new economic development and to strengthen existing economic base of region	Number of new development centers within ¼ mile
	Use regional transportation system to strengthen tax base through community development	Acres of land that can be potentially redeveloped within 1 mile Acres of vacant land that can be developed within 1 mile
3	Plan transportation system to minimize undesirable displacement of existing land uses and activities resulting from system development	Number of families displaced Number of employees displaced
	Use transportation system to strengthen community and neighborhood function and identity	Route miles coincident with community, school, or neighborhood boundaries or existing physical barriers
6	Locate transportation system to reinforce and strengthen existing business and industrial assets	Number of employees within ½ mile of access point
	Plan transportation system to support internal development of all high-activity centers, including central business districts	Route miles coincident with identified high-density corridors
	Use existing transportation system and proposed highway and transit plans to encourage development of high-density development corridors and major multipurpose centers	Number of designated activity centers within ¼ mile of access point Acres of vacant but high-development-potential land within 1 mile
7	Design transportation system to preserve and enhance natural environment and aesthetic quality of region	Route miles of open space, parkland, or environmental corridor intrusion
	Design public transportation system in consonance with environmental constraints, including those in the physiography, geology, pedology, and atmosphere	Acres of floodplains within ¼ mile of access point Number of instances where archaeological resource areas penetrated
	Coordinate design of transportation system and open space to enhance living environment	Number of community recreation centers within ½ mile of access point
	Ensure that form, design, and appearance of manufactured elements of transportation system enhance visual form and image desired for entire region	Number of pleasant scenic vistas Hardware data
8	Design transportation system to minimize noise interference of system on adjoining land uses and user	Route miles adjacent to single-family residential, educational, and health land uses
	Design transportation system so that it will minimize air pollution impact on environment and people of region	Number of vehicle miles reduced

Note: 1 mile = 1.6 km. 1 acre = 0.4 hm².

Figure 1. Planning and evaluation process.



the need to use some form of goal-achievement or cost-effectiveness format to sharpen the comparison among alternatives (11). Several features, such as a matrix format for comparing alternatives (on one axis) against pertinent goals (on the other axis), may be included in this type of approach. Important issues and environmental sensitivities must be directly related to some form of carefully conceived goals and objectives for the region or affected communities. Both quantitative and qualitative measures of impact may serve as criteria of goal achievement or effectiveness. If community participants in the planning process have assigned relative weights to different goals and objectives, these may also be introduced to permit the calculation of summary index scores for each alternative. Given such effectiveness scores, if comparative capital and operating costs for the various corridor alternatives can be generated, cost-effectiveness ratios could also be developed to facilitate the comparison of alternatives.

Environmental Setting: Case Study Area

Before we describe how this 3-stage approach to the planning and evaluation process was used in the Dallas-Fort Worth UTACV case study, we should present additional background on the case study area (Figure 2).

Urban development has been spreading rapidly over the natural landscape of the study area. The largest concentrations of population are located in Dallas and Fort Worth. However, for the past 20 years, the rate of growth in the mid-cities area has been exceeding that of the 2 city centers. This pattern is expected to continue over the next 15 to 20 years, with or without public transportation improvements.

Today, there is an almost unbroken axis of development connecting Dallas and Fort Worth on both sides of the Trinity River West Fork (outside the floodplain). Open spaces are giving way to low-density developments. The recent opening of the Dallas-Fort Worth Airport is expected to lend additional impetus to this suburbanizing trend. In addition, the 3 major activity centers in the region are located within the UTACV study area boundaries: the Dallas central business district, the Fort Worth central business district, and the Dallas-Fort Worth Airport. Thus the expanding suburbanizing trend, together with these major centers, offers significant growth attraction through the availability of jobs and services. Figure 2 shows these 3 activity centers as well as other major attractors in the area (such as schools, hospitals, shopping centers, and employment areas).

Key Environmental Impact Issues

Preliminary examination of the natural and manufactured characteristics of the study area, together with the goals and objectives given, led to a basic categorization of impact areas. Early in the study, the potential key issues focusing on environmental impact sensitivities were identified. These sensitivities include

1. Environmental corridors, such as natural watercourses, stream channels, and floodplains;
2. Parklands and wildlife preserves, such as parks, recreation areas, and natural open space preserves;
3. Residential displacement;
4. Noise and visual impact on adjoining residential areas;
5. Disruption of commercial, industrial, and community facilities;
6. Archaeological and paleontological resource areas; and
7. Urban development opportunities, such as new development potential and redevelopment stimulus.

Evaluation of Route Location Alternatives

Based on the strategy shown in Figure 1, the process of selecting a preferred alignment was accomplished in 3 major stages.

1. Fifteen route possibilities identified by the SDC were considered, and 3 were chosen for more detailed study.
2. These 3 alternatives then were further evaluated so that a preferred location could be selected.
3. The preferred location was analyzed to determine a preferred alignment, appropriate station sites, and preliminary design features.

As the number of alternatives was successively reduced, the impact potentials became clearer, and thus the environmental analysis played a more influential role in the planning and evaluation process.

The original 15 route possibilities represented a broad range of potential alignment opportunities, particularly emphasizing the maximum use of existing transportation rights-of-way and undeveloped land. These 15 routes and the 3 route alternatives that were studied in more detail as part of the stage 2 evaluation are shown in Figure 3.

Stage 1

Evaluation was less formal in stage 1 than in stage 2. Basically, a screening procedure was used; the SDC chose 3 prime candidate alternatives on the basis of early data inputs from the regional transportation study and the collective professional judgment of those conducting the preliminary engineering, ridership, and environmental analyses. Evaluation criteria were based on Table 1, and they also included preliminary estimates of comparative cost and engineering feasibility. Each of the alternatives was informally graded according to Table 1 criteria, and the results were used to guide identification of 3 routes for more detailed study.

Stage 2

In the stage 2 evaluation, the 3 selected route alternatives were studied in considerably greater detail. Early in stage 2, the SDC determined that a connection to the Dallas-Fort Worth Airport should be assumed for any of the final alternatives. The preliminary ridership analysis indicated that the absence of such a connection could seriously jeopardize the economic feasibility of the proposed UTACV system. Thus, the preliminary engineering study examined the feasibility of providing airport connections for the southern alternatives, namely, the Trinity River and Rock Island Routes, by means of a north-south spur line.

The importance of the concept that all alternatives should be considered as connecting to the Dallas-Fort Worth Airport permitted the airport to be assumed as a common point for all alternatives, and thus each route could be divided into 2 parts: (a) the section between the Fort Worth CBD and Dallas-Fort Worth Airport and (b) the section between the Dallas CBD and the airport.

The stage 2 environmental impact analysis not only clarified the major impact potentials given above but also explored the possibilities of modifications and multiple combinations of alternatives, additional location options, and mitigation measures to avoid possible adverse effects. As a result of this search, an additional route alternative appeared particularly promising and eventually played a major role in selection of the preferred route. It was clear that intrusion into regional environmental corridors was a significant impact problem in the selection of an acceptable route location. The Elm Fork branch of the Trinity River posed a particularly difficult impact problem because it would have to be crossed if Love Field (the airport in north Dallas) was to be served by UTACV (Figures 2 and 4). The solution to this problem appeared to be in locating a

Figure 2. Major activity centers.

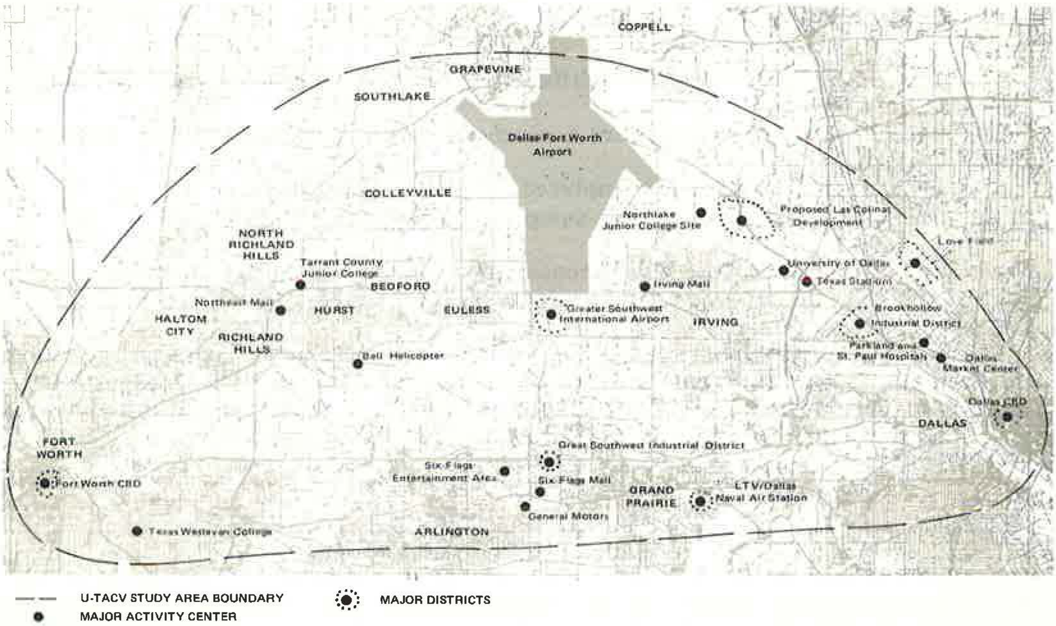
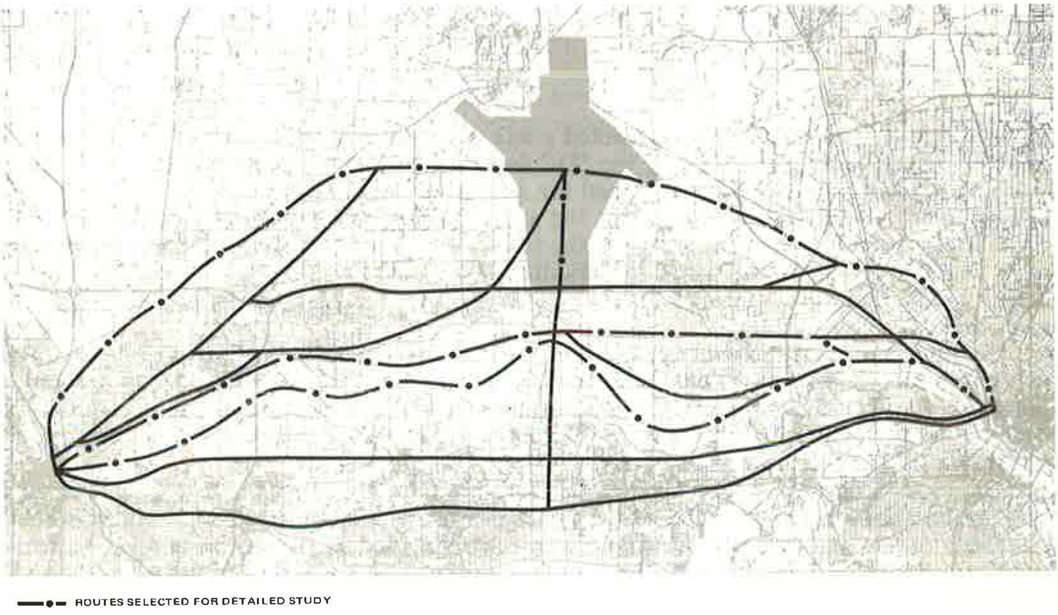


Figure 3. Original route alternatives.



UTACV crossing adjacent to an existing bridge to minimize the encroachment on existing and proposed parklands. The one existing crossing not included in the previously identified alternatives was the Texas 183-114 bridge.

This modified route, the Modified North Route, had several important advantages; it avoided

1. The nature study area and the California-crossing historical area of Elm Fork Park,
2. Displacement and potential disruption in central Irving, and
3. Any violation of the West Fork environmental corridor.

On the other hand, the Modified North Route would eliminate a station proposed at Love Field and would encroach on lands of the University of Dallas. However, from an environmental standpoint, these problems were considered substantially less serious than the impacts of the other alternatives.

Explorations of ways to avoid the negative impact potentials of the alternative routes for the Fort Worth-to-airport segment did not prove so fruitful; rather, for this segment, the key to minimizing any undesirable effects was determined to be in careful planning of alignment and stations and in implementing mitigation measures. Thus the evaluation proceeded on the basis of the original 3 major candidate locations plus the Modified North Route alternative; this represented a total of 12 alternative combinations.

A somewhat more rigorous procedure was then followed in evaluating the 4 major alternative route locations. First, with the help of the SDC and based on the unique characteristics of the study corridor, the goals and objectives given previously were sifted and reorganized according to the key environmental impact issue areas mentioned earlier. In particular, the various criteria associated with each objective were realigned according to the issue-oriented impacts to which they were most closely related. As indicated by the data given in Tables 2 and 3, a reduced set of critical environmental sensitivities was produced. When various impact measures were entered into comparison tables matching the alternatives against these environmental sensitivities, these tables (such as Tables 2 and 3) tended to contain too much information measured in different units.

Consequently, to simplify communication with the SDC, a reinterpretation of impact measures in terms of subjective ratings was used, as indicated in Tables 2 and 3. This facilitated subjective trade-offs between different kinds of environmental sensitivity. Though, at the subregional planning level, relative goal weights had been assigned and a systematic cost-effectiveness methodology had been developed (3), relative weights were not applied to the different environmental impacts. Instead, members of the SDC were encouraged to assign their own weights if they desired. This effort did not significantly affect the outcome of the evaluation.

Note that the relative magnitudes of impacts in Tables 2 and 3, based on judgmental ratings, are indicated both with and without potential mitigation measures. Impacts are not directly related to goals and objectives nor are any weights attached to the impacts in this comparison. Summary index scores for each alternative could be easily calculated but were purposely omitted to encourage members of the SDC to examine each of the key impact areas more thoroughly. Judgmental weights were subsequently offered informally when the environmental criteria were combined with other criteria for the overall corridor evaluation. The preferred routes, Rock Island Route from Table 2 and Modified North Route from Table 3, were recommended on environmental grounds and, when evaluated from engineering and patronage perspectives, were eventually selected for the preferred route location combination by the SDC.

INTEGRATING ENVIRONMENTAL IMPACT STATEMENTS WITHIN THE PLANNING PROCESS

The third and final dimension of the suggested issue-oriented approach is taking more meaningful advantage of the effort necessary to prepare an environmental impact state-

Figure 4. Major environmental impact areas.

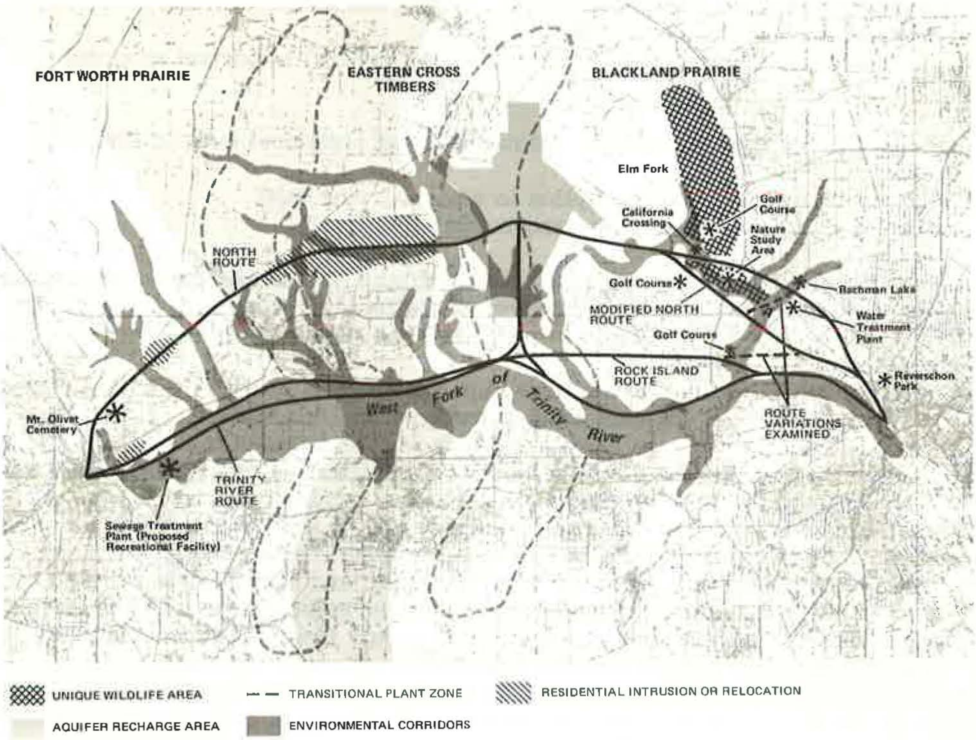


Table 2. Environmental evaluation of route location alternatives, Fort Worth to Dallas-Fort Worth Airport.

	Impacts					
	Trinity River Route[a]		Rock Island Route		North Route	
Environmental Sensitivities	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Environmental corridors						
Intrusion into West Fork floodplain	3	2	2	1	0	0
Others, little existing development	2	1	0	0	2	1
Others, existing development	0	0	2	1	0	0
Park and recreation areas						
Existing	3	1	0	0	0	0
Proposed	2	1	2	1	2	1
Residential areas						
Displacement	0	0	2	1	2	1
Noise, visual, and other proximity impacts	1	0	2	0	3	2
Other community values						
Disruption of commercial, industrial areas	0	0	2	1	2	1
Disruption of other community facilities	0	0	2[b]	1	2[b]	1
Aquifer recharge area						
Stimulus to additional development	0	0	1	1	2	2
Archaeological-paleontological resource areas	1	0	1	0	1	0
Urban development opportunities						
New community development	0	0	1	1	2	2
Redevelopment stimulus	2	2	2	2	2	2

Note: Severity or strength of impact potential symbols are as follows: 0 = no effect, not applicable; 1 = minor; 2 = moderate; and 3 = major.

[a] Assumes worst case, i.e., that proposed. [b] Trinity River limited access route would not be built before UTACV was operational.

ment (EIS) on the preferred route alignment (8). Such an EIS would be required as part of any application for federal capital grant subsidies. Because, in the future, one will have to consider the full range of social, economic, and environmental impacts typically required in an EIS (7) as part of the original planning of route location, efficiency dictates that this more comprehensive approach to corridor planning and evaluation produce, as a natural by-product, all of the raw materials for subsequent preparation of an EIS. In other words, the environmental impact statement should be seen as a routine reorganization and perfunctory restatement of the results of planning work that is already completed. Ideally, nothing new should be necessary to prepare an environmental impact statement.

The EIS would be based largely on the results of stage 3 of the corridor planning and evaluation process (Figure 1). Two kinds of information on social, economic, and environmental consequences would be considered here: comparative characteristics of alternatives carried down from previous stages and additional, more detailed, and intensive analyses of environmental sensitivities for the single preferred alternative. These more intensive analyses would, in part, represent a refinement or double check on a certain key system of facility characteristics, such as noise levels, displacement aesthetics, construction staging, localized air quality, and joint development potentials. If, after the conclusion of stage 3, project feasibility is determined, a smooth transition to final project planning, engineering, and design should be possible. The suggested macrolevel, microlevel, and intensive analysis stages of planning and evaluation can consequently provide for stronger links between traditional regional system planning and detailed project planning, engineering, and environmental impact statements.

The SDC selected a preferred route for stage 3 of the feasibility study based on stage 2 evaluation, which included the results of the preliminary engineering, ridership, and environmental analyses. As stated previously, the selected location combined the Rock Island Route between Fort Worth and the Dallas-Fort Worth Airport, and the Modified North Route between Dallas and the airport (Figure 5). Additional details were then developed for the proposed horizontal and vertical alignment and for station sites. A more intensive examination of these features of the UTACV route was conducted in stage 3 of the environmental impact analysis; however, the proposed route specification still must be considered preliminary. Considerable additional planning and design will be necessary during the final engineering phase.

Both direct and indirect route location impacts were considered at the stage 3 level of analysis. In general, direct location impacts relate to the more localized physical effects of the alignment and access features of the route. Those more general implications associated with the corridor location of the facility that involve broader economic and transportation and land use relationships are termed indirect impacts.

Direct Impact Potentials

In the UTACV study, the 2 more critical environmental concerns involved direct impacts on parklands and environmental corridors and displacement impacts. The most serious impact would occur at the crossing of the Elm Fork of the Trinity River. Such a crossing is unavoidable if service is to be provided to the airport from downtown Dallas. Lands adjacent to the Elm Fork are either developed or proposed as parks and recreational areas; however, the proposed Elm Fork UTACV crossing is parallel to and approximately 100 ft (30 m) south of the existing highway bridge. It was recognized that the least impact would result from a river crossing that was adjacent to existing structures.

A second critical impact concerns residential and business displacements. Sixty-one residential units would be displaced by the selected route. The occupants are likely to be low-income families. Replacement housing, supplemental payments, and personalized relocation assistance may be required, as provided for in the federal uniform relocation assistance act.

Displacement of business establishments would be required for construction of a single station. The total number of employees involved is estimated to be 40. The pros-

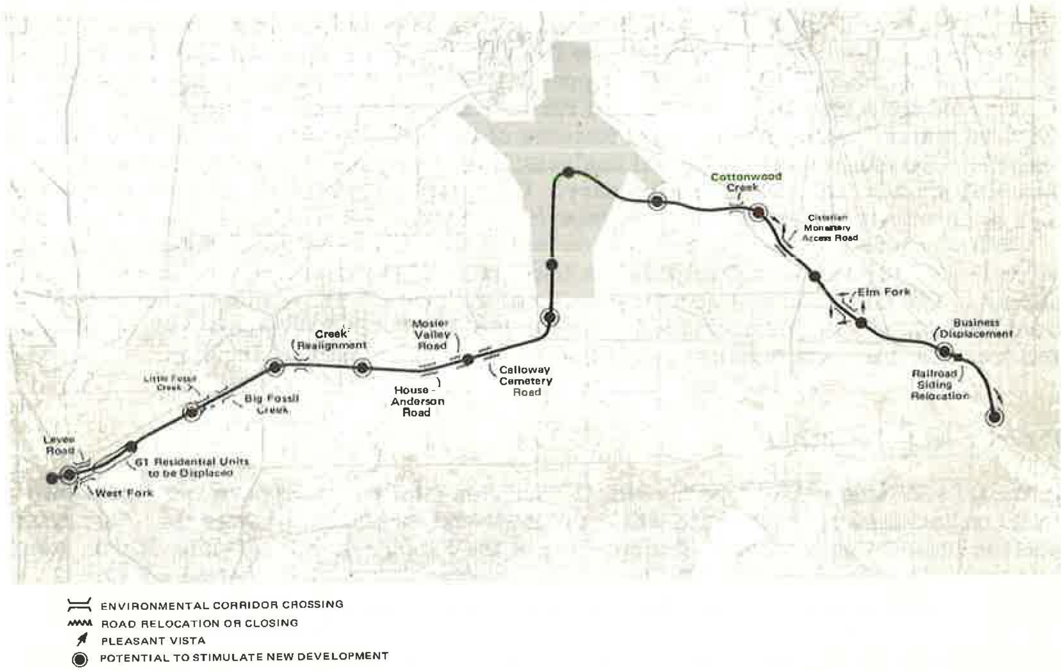
Table 3. Environmental evaluation of route location alternatives, Dallas to Dallas-Fort Worth Airport.

	Impacts							
	Trinity River Route[a]		Rock Island Route		North Route		Modified North Route	
Environmental Sensitivities	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Environmental corridors								
Intrusion into Elm Fork floodplain	0	0	2	1	3	2	2	1
Intrusion into West Fork floodplain	3	2	0	0	0	0	0	0
Others, little existing development	2	1	2	1	2	1	2	1
Others, existing development	0	0	1	0	0	0	1	1
Park and recreation areas								
Elm Fork Park	0	0	0	0	3	2	0	0
Others	0	0	0	0	0	0	0	0
Proposed	2	1	2	1	2	1	2	1
Nature study area	0	0	0	0	3	3	0	0
Residential areas								
Displacement	0	0	2	1	0	0	0	0
Noise, visual, and other proximity impacts	2	1	3	2	2	1	2	1
Other community values								
Disruption of commercial, industrial areas	0	0	3	2	0	0	0	0
Disruption of other community facilities	0	0	3[b]	2	3[c]	2	2[d]	1
Archaeological-paleontological resource areas	1	0	1	0	1	0	1	0
Urban development opportunities								
New community development	0	0	0	0	2	2	2	2
Redevelopment stimulus	0	0	2	2	0	0	0	0

Note: Severity or strength of impact potential symbols are as follows: 0 = no effect, not applicable; 1 = minor; 2 = moderate; and 3 = major.

[a]Assumes worst case, i.e., that proposed. [b]Irving government offices. [c]Dallas water treatment facilities, Bachman Lake. [d]University of Dallas lands.

Figure 5. Potential alignment and station impacts.



pects for these businesses to relocate successfully are good; however, in the event that they cannot be successfully relocated, relief is provided for under the federal uniform relocation assistance act.

Indirect Impact Potentials

In addition to the direct effects discussed, the proposed UTACV system can have important indirect locational impacts resulting from decisions on station sites. These indirect impact potentials arise in at least 2 ways. First, to the extent that travel on a UTACV can be substituted for automobile trips, some changes (improvements) in air quality will result. Second, land development and redevelopment decisions will be influenced by the new accessibility relationships created by UTACV station sites.

The most significant effect on air quality would result from a reduction in automobile trips and total vehicle miles (kilometers) of travel in the region. Further analyses indicated the reduction in vehicle miles (kilometers) or travel (and hence air pollutants) that would occur if a UTACV were constructed. In the 2-county area, a reduction of approximately 1.6 percent, or 1,230,000 vehicle miles (1 968 000 km)/day in 1990, could be attributed to patrons using the UTACV system. If the 1975 vehicle emission standards set by the U.S. Environmental Protection Agency (EPA) (under authority of the Clean Air Amendments of 1970) are met, there would not be a large reduction in air pollutants. However, if, as is likely, the standards are not achieved, the air quality benefits would be greater.

To achieve the EPA ambient air quality standards for the region may necessitate imposing transportation controls such as parking restrictions in the central business districts. In that case, UTACV and other public transportation facilities might attract additional riders, thus further reducing automobile travel and improving air quality.

With respect to land use, the UTACV system should have a positive impact on development if land uses adjacent to stations are planned in a compatible manner. Because of the undeveloped nature of the area adjacent to the proposed alignment, the opportunity exists to carry out coordinated transit and land use planning.

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