New Directions
FOR DALLAS AREA RAPID TRANSIT

# TRANSIT DESIGN POLICY MANUAL

EDC DOC# BR6Y-001-00-0000

APPROVED BY THE DART BOARD
DECEMBER 12, 1989

## TABLE OF CONTENTS

## INTRODUCTION

This Transit Design Policy Manual is intended to guide the DART Board and staff in the development of the DART Transit System Plan and its many components. The purpose of the Manual is to clearly define the roles and responsibilities of both the Board and the staff in developing the system. The primary role of the Board is to set overall policy; the responsibility of the staff is to execute policy through implementation.

The development of design policies begins with the **Guiding Principles** established in two documents: the Work Program for Developing the New Transit System Plan (approved by the Board on August 23, 1988); and the Work Program for Implementing the Starter System (approved by the Board on July 25, 1989).

The Work Program for Developing the New Transit System Plan included the following Guiding Principles related to design issues:

- Ensure maximum community participation.
- Develop an evaluation framework to include mobility indicators, land use objectives, and environmental impacts.
- Fit technologies to the size and nature of the need within each corridor.
- Develop a long-term plan to provide public transit to the most people at the least cost.
- Develop short-range and long-range solutions incrementally, in order to take advantage of changes in mobility patterns and advances in technologies.
- Upon approval of the new DART System Plan, and within five years, implement an operational fixed guideway starter line in the service area.

In addition, the Work Program for Implementing the Starter System included the following relevant Guiding Principles:

- Reliability, operating cost, and maintenance will be the primary considerations in project design and equipment selection. Strict standards of cost justification for design changes will be enforced.
- To the extent possible, only proven transit technologies will be used.
- System design criteria will be established before beginning project engineering.
- Board involvement should be focused on policy rather than technical decisions.

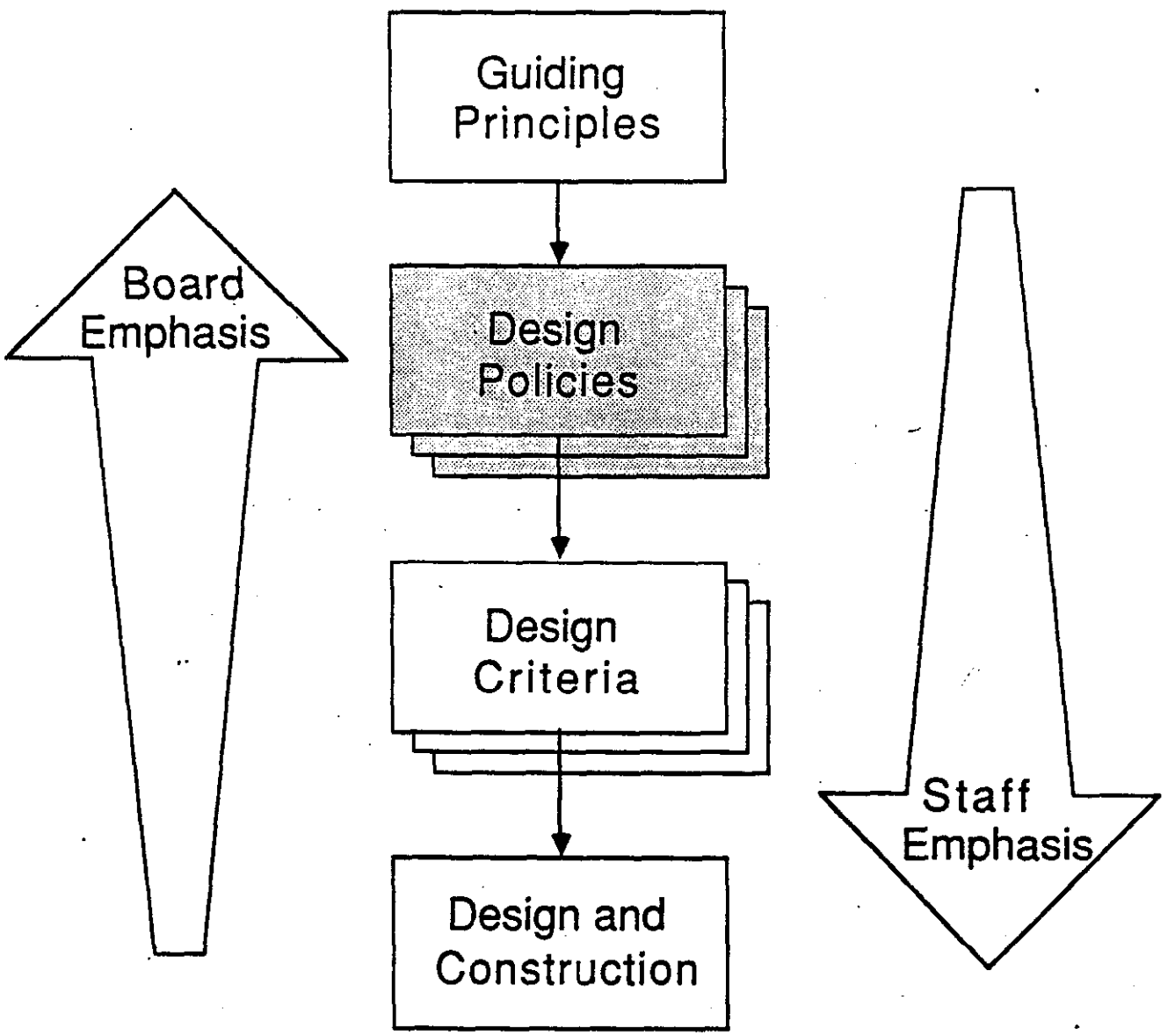
The **design policies** contained in this manual are based on these Guiding Principles and provide overall direction to the staff by the Board. Once design policies are approved, the staff develops very detailed **design criteria** to provide additional technical and engineering specifications for the more general design policies. Finally, after development of the design criteria, staff begins actual **implementation** of the projects through the design and construction phases.

Figure 1 illustrates the complementary roles and responsibilities of the Board and staff in developing the system, beginning with the Board-approved Guiding Principles and design policies and culminating in staff's development of design criteria and actual design and construction activities.

The design policies contained in this Manual represent the next step in the development of the DART transit system after the approval of the Guiding Principles. The Manual is divided into several major categories of design policies, with individual policies for specific subject areas within the categories.

This document is in a loose-leaf format so that it can be expanded as additional design policies are established and proposed for Board consideration.

# FIGURE 1
# Board/Staff Roles



# RECOMMENDED TRANSIT DESIGN POLICIES FOR TYPICAL OUTLYING SURFACE LIGHT RAIL AND COMMUTER RAIL STATIONS

## Introduction

The Transit System Plan approved by the DART Board of Directors on June 27, 1989, includes 66 miles of light rail transit service by 2010, with 20 miles to be in operation by 1996. The System Plan also calls for 18 miles of commuter rail service to be in operation by 1996.

The light rail and commuter rail projects have diverse engineering and planning needs that must be met to allow their successful implementation. Guideways, systems, and vehicles can be substantially different for the two types of transit technologies. However, both light rail and commuter rail can share a basic design feature: passenger stations.

These design policies have been developed with that overall principle in mind. DART's light rail and commuter rail systems can have many station design elements in common, and in the interest of standardization and cost efficiencies, staff has developed design policies along these lines. While individual stations may vary in subtle ways according to their unique locales, passenger needs, and operational constraints, staff has tried to incorporate station design features that can be as universally applicable as possible in the interest of design and construction cost savings.

## Rail Transit Stations in the Starter System

The 20-mile light rail Starter System will have approximately twenty stations, broken down into the following categories:

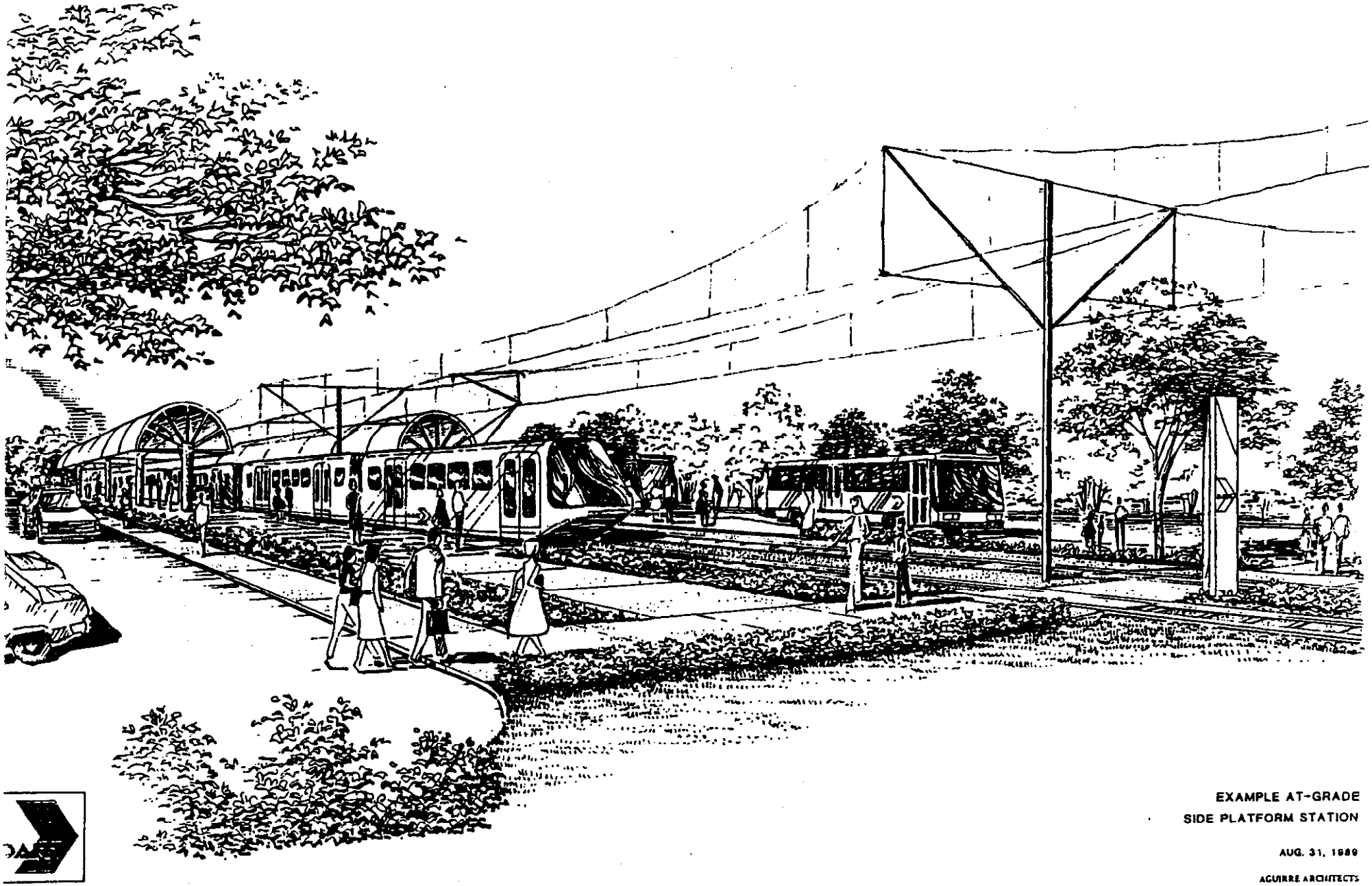
| Type | Number | Location |
|---|---|---|
| CBD Transitway Mall | 3 | On Pacific Ave. and Bryan St. |
| Underground | 1 | CityPlace |
| Special | 1 | Convention Center |
| Surface | 15 | Remainder of System |
| TOTAL | 20 | |

Planning for the 18-mile commuter rail system envisions a minimum of five stations: Union Station; Stemmons/Medical Center; South Irving Transit Center; Centreport; and D/FW International Airport. Other stations may be added as community and passenger demand warrant.

These transit design policies have been developed primarily for all the commuter rail stations and for the fifteen surface stations planned for the light rail system in "outlying" (non-CBD or CityPlace) areas. While many design elements may be applicable to the five "non-standard" light rail stations planned for the Starter System, those stations have their own unique design characteristics that will be handled separately.

## Function of Rail Transit Stations

The principal role or function of a rail transit station is to provide for the convenient and efficient movement of passengers between the rail system's trains and the passengers' mode of access (such as walking; bicycling; buses; taxis; or automobiles, either by way of "kiss-and-ride" drop off points or park-and-ride lots). The station itself consists of a platform (where the passengers board or deboard the train) and numerous other features that support and enhance the movement of passengers onto and off of the trains. Figure 1 is an illustration of a typical DART light rail transit station.



EXAMPLE AT-GRADE
SIDE PLATFORM STATION

AUG. 31, 1989

AGUIRRE ARCHITECTS

FIGURE 1

## Need for Rail Transit Station Design Policies

There are several approaches to planning and designing typical surface rail transit stations that fit into the functional definition described above. These approaches differ primarily in their relationship to:

- o system performance (passenger capacity and speed of passenger boarding and deboarding);
- o amenities (the level of passenger comfort and convenience); and
- o capital and operating costs.

Policies on the design features of rail transit stations are needed to allow DART staff to establish fundamental design parameters. These design parameters will support the development of station design guidelines and technical design criteria that will result in a station design that properly balances performance, amenities, and cost at a level appropriate to DART's Transit System Plan and its budget.

## Approach to Development of Recommended Station Features

The general approaches used in the development of the recommended station design features were as follows:

- o To meet the primary and supporting functional and performance requirements of the rail transit stations;
- o To provide the essential functions in an environment of enhanced comfort, convenience, safety, and security;
- o To provide the essential functions in a manner acceptable to the community, neighborhood, and environment;
- o To build and operate rail transit stations that are affordable; and
- o To build and operate rail transit stations that are cost-effective.

## Recommended Station Design Features

Table 1 lists 35 station design features divided into seven functional categories. It shows whether the specific design feature is applicable to all or only selected stations, and provides current capital and operating budgets for each feature.

The seven functional categories are listed below, along with a brief description of the major design features presented.

### I. Rail Station Access

This category describes station design features related to a passenger's ability to enter and exit the overall station facility to and from the immediate vicinity. All stations will have:

- Pedestrian walkways;
- Bicycle facilities such as lockers or racks depending on need (as specified by a Board resolution approved on June 11, 1985);
- Transfer facilities such as turn-in lanes and bus bays to allow easy passenger transfer from bus to rail and vice versa;
- Kiss-and-ride dropoff facilities, with the size of individual facilities to be determined by site and demand analysis; and
- Free parking spaces for the mobility-impaired, to be provided at all stations.

Depending on site-specific criteria such as land availability, ridership projections, and other factors, several design features are planned only where appropriate at selected stations. They are:

- Elevators or escalators that would be used only where site constraints inhibit walkway and ramp access to station platforms;
- Taxi stands where such transportation is common and utilized; and
- Park-and-ride lots.

## II. Rail Vehicle Access

There are two basic options for providing access to rail vehicles by passengers at rail transit stations: high-platform; and low-platform. At high-platform stations, passengers board directly from a raised platform (approximately three feet above the track) onto the vehicle at floor height. This type of platform is typically associated with heavy rail systems characterized by such factors as heavy peak hour passenger volumes, controlled station access, prepaid fare collection, and long train lengths. The primary justification cited for use of high platforms is to minimize dwell times of vehicles in stations, especially stations with heavy passenger volumes.

Low platforms entail the use of steps inside the vehicle for passenger boarding and deboarding. Low platforms typically are 8 to 10 inches above the level of the track, and are generally associated with light rail systems that have moderate peak hour passenger volumes, open station access, barrier free fare collection systems, and relatively short train lengths (fewer than four cars).

Staff conducted a detailed analysis of projected dwell times at stations utilizing NCTCOG ridership forecasts. The results of that analysis clearly show that the DART system will not have the high peak hour passenger volume that would warrant high platforms.

Low-level primary platforms would provide access to DART trains for over 99% of the rail system's projected users. They provide adequate performance at lower cost than high-level platforms for the projected level of DART patronage. Therefore, low-level primary platforms are recommended for all outlying surface stations.

A high-level special-use platform is also recommended to allow mobility impaired passengers and others requiring boarding assistance (such as those using strollers or carrying luggage racks or shopping carts) to easily board and exit the vehicle. This high-level special-use platform is typically accessible by a ramp extending from the primary low-level platform. (However, a mechanical lift may be required in selected stations due to site-specific constraints.) Utilizing special-use high-level platforms for boarding mobility impaired passengers is quicker, less expensive, and more reliable

than the use of mechanical lift devices. This approach also allows non-mobility-impaired passengers to use high-level boarding when necessary. The special-use platform will have a shelter or canopy for protection from the elements for passengers using the platform.

## III. Fare Collection

On January 8, 1985, the Board adopted a policy of utilizing a self-service barrier-free (SSBF) system in the DART rail transit system. This policy implies the use of self-service fare dispensing machines and ticket validators along with "roving" inspectors to check that passengers have purchased the correct fares.

Self-service fare collection is the standard fare collection method used in all new light rail systems in the United States. Its principal advantages are faster boarding times for passengers and reduced capital, operating and maintenance costs compared to conventional on-vehicle or turnstile fare collection systems.

## IV. Passenger Information and Safety

The purpose of passenger information is to direct and assist passengers as they move into, out of, and through the station site, to the platform, onto the transit vehicle, and through the transit system.

All types of passenger information should include the following characteristics:

- They should be of consistent modular design, with standardized graphics and low-maintenance materials, for cost containment purposes and to allow easy recognition of transit information by the public.
- They should be placed at convenient points in the line of sight of passengers for easy access.
- They should provide easily-understandable and concise information that facilitates the passenger's movement into, out of, and through the station and onto the various modes of transportation available at the station (rail, bus, autos, taxis, pedestrian

walkways). They should also include braille translations for the benefit of blind passengers.

- o They will conform to the local jurisdiction's signage regulations.

In addition, DART rail stations will be designed to promote safety and security by utilizing both passive and active design elements. Passive design features that can be incorporated into all stations emphasize high visibility areas with no limited lines of sight. This can be accomplished through a minimal use of pillars or columns, the use of materials that reflect rather than absorb light, and the use of translucent building materials for partitions and wind screens.

With these characteristics in mind, the following design features are recommended for all stations:

- o General system information, including system maps and schedule and fare information;
- o Orientation signage, including street maps of the surrounding neighborhoods to identify points of interest;
- o Off-site and on-site guide signs to direct passengers between stations and nearby streets, highways, and developments, facilitate connections between transportation modes, and clearly define pathways between rail platforms, light rail stops, and bus stops;
- o Emergency signage to encourage quick movement of passengers out of stations when required; and
- o Adequate lighting for both security and passenger comfort and convenience.

In addition, the following features are recommended for selected stations depending on need:

- o A real-time train status display (This feature has been successfully installed in many of the newer rail systems around the country. It displays the expected arrival

time of the next train, its destination, and other information designed to reduce the uncertainty or anxiety of waiting passengers about the status of the system. It can also provide useful information on delays, emergencies, and other unexpected factors impacting the system.);

- o A public address system to allow system personnel to communicate with waiting passengers to inform them of delays, emergencies, or other occurrences; and

- o Fencing to be provided at selected stations based on site requirements. Fencing would keep passengers and others away from potentially dangerous track areas or other features and would guide pedestrians to safe paths through or around such areas.

Staff will examine additional security measures for use at rail stations, including a cost-benefit analysis of using electronic surveillance as compared to staffing of all stations with DART Public Safety personnel.

V. Passenger Convenience

Passenger convenience features are those features that, while not absolutely essential to meeting the basic requirements of the rail station, nevertheless increase the attractiveness of using the system to the passenger.

- o Pay telephones are recommended at all stations. In addition to providing convenience for passengers, they are revenue sources for DART.

- o Advertising will be provided at all stations in accordance with a Board policy approved on February 23, 1988. Advertising and its design will be prepared and placed to avoid conflict with system information and signage.

- o Vending machines, ATM machines, vendor and retail spaces, and restrooms provided and maintained by vendors are recommended at selected stations based on passenger volumes. A Board policy approved on February 23, 1988, established guidelines

for developing retail opportunities at transit centers. This policy should be re-examined to ensure that it meets the needs of rail transit stations. The aim of retail development at specific stations should be to tailor the facility to the nature of the surrounding area and the anticipated patronage. In addition, implementation of retail features must be coordinated at a very early stage of the facility's design to ensure that space and utility provisions are made in the most cost-effective manner possible. As with bus transit centers, staff will develop specific retail plans for each rail station where retail development is deemed appropriate.

## VI. Passenger Comfort

Passenger comfort features, like the convenience features mentioned above, are amenities that improve the attractiveness of the system to its users but are not absolutely essential to the function of the stations. They enhance the station environment and can often provide a means for community participation in the design and appearance of the station.

Several passenger comfort features are recommended for all stations:

- A canopy to cover at least one-third of the total length of the platform and which will vary in width according to the platform width. It will be constructed of durable and low-maintenance materials and will be compatible with the overall design of the system. In many cases, the canopy design can be modified to reflect the specific environment of the neighborhood in which it is located. Staff will study the barrel-vault design already in use at transit centers, along with other canopy designs, for application at rail stations.

- Wind screens to provide passenger protection from the wind, located at strategic points throughout the station.

- Seating in waiting areas.

- Landscaping for purposes other than that required by local ordinances or environmental mitigation and that can enhance and "soften" the station environment. Indigenous and low-maintenance landscaping will be used as much as possible to minimize maintenance costs.

- Artwork that reflects the adjacent station vicinity through community participation projects, as required by a Board resolution approved December 8, 1987. The current policy sets a budget of $50,000 per station for art projects. The Board's Art Committee is to examine this policy to determine the proper level of funding for arts projects at each station.

In addition, drinking fountains are proposed for selected stations where site design allows.

## VII. Neighborhood Mitigation

Efforts to mitigate any off-site impacts of the rail stations and their site developments will be undertaken as part of the overall site planning process in cooperation with local jurisdictions and neighborhoods. Specific mitigation warrants and methods are under development based on guidance of a Board resolution approved June 13, 1989. That resolution authorized the development of policies regarding system-wide standards for mitigation for the system. The policies are to identify:

- Potential impacts needing mitigation;

- Criteria for implementation of mitigation measures; and

- A range of techniques that can be used to mitigate potential adverse impacts of the system.

General mitigation measures that will be developed for adaptation at selected stations depending on need include:

- Traffic improvements to improve vehicular flow into and around the stations;

- "Induced parking" mitigation to deal with passengers who park their private automobiles in surrounding neighborhoods because either the DART park-and-ride lot (if provided) is full or no parking has been provided by DART at all;

- Visual screening and enhancement through landscaping, walls, or other means; and

- Noise screening using similar measures.

## TABLE 1

### RECOMMENDED TRANSIT DESIGN POLICIES FOR TYPICAL OUTLYING SURFACE LIGHT RAIL AND COMMUTER RAIL STATIONS

(All budget figures are in 1989 dollars)

(A=All; S=Selected)

| Category | Feature | Current Budget Capital | O&M |
|---|---|---|---|
| **STATION ACCESS** | | | |
| | 1. Pedestrian walkways (A) | $19,000 | $2,600 |
| | 2. Bicycle facilities (A) | $ 5,000 | $ 800 |
| | 3. Bus transfer facilities (A) | TBD | TBD |
| | 4. Kiss-and-ride facilities (A) | TBD | TBD |
| | 5. Mobility impaired parking (A) | TBD | TBD |
| | 6. Elevators or escalators (S) | TBD | TBD |
| | 7. Taxi stands (S) | TBD | TBD |
| | 8. Park-and-ride facilities (S) | TBD | TBD |
| | SUBTOTAL | $24,000 | $3,400 |
| **VEHICLE ACCESS** | | | |
| | 9. Low-level platforms (A) | $64,000 | $3,000 |
| | 10. High-level special-use platform with ramp and cover (A) | $20,000 | $2,000 |
| | SUBTOTAL | $84,000 | $5,000 |

| Category | Feature | Current Budget Capital | O&M |
|---|---|---|---|
| **FARE COLLECTION** | | | |
| | 11. Self-service ticket dispensers (A) | $49,000 | $15,000 |
| | 12. Self-service ticket validators (A) | $49,000 | $ 2,700 |
| | SUBTOTAL | $98,000 | $17,700 |
| **PASSENGER INFORMATION AND SAFETY** | | | |
| | 13. General system info (A) | $ 1,000 | $ 800 |
| | 14. Orientation signage (A) | $ 2,000 | $ 400 |
| | 15. Off-site and on-site guide signs (A) | $ 1,000 | $ 400 |
| | 16. Train status display (S) | $30,000 | $ 3,500 |
| | 17. Emergency signage (A) | $ 5,000 | $ 300 |
| | 18. Public address system (S) | $62,000 | $ 2,000 |
| | 19. Lighting (A) | $47,000 | $ 3,000 |
| | 20. Fencing (S) | $12,000 | $ 900 |
| | SUBTOTAL | $160,000 | $11,300 |

| Category | Feature | Current Budget Capital | O&M |
|---|---|---|---|
| **PASSENGER CONVENIENCE** | | | |
| | 21. Pay telephones (A) | N/A | N/A |
| | 22. Advertising space (A) | N/A | N/A |
| | 23. Vending/ATM machines (S) | N/A | N/A |
| | 24. Vendor/retail spaces (S) | N/A | N/A |
| | 25. Vendor-provided restrooms (S) | N/A | N/A |
| **PASSENGER COMFORT** | | | |
| | 26. Canopies (A) | $100,000 | $2,400 |
| | 27. Wind screens (A) | $ 8,000 | $1,300 |
| | 28. Seating (A) | $ 8,000 | $1,200 |
| | 29. Landscaping (A) | $30,000 | $6,000 |
| | 30. Art projects (A) | $50,000 | $ 300 |
| | 31. Drinking fountains (S) | $ 2,000 | $ 450 |
| | SUBTOTAL | $198,000 | $11,650 |

| Category | Feature | Current Budget Capital | O&M |
|---|---|---|---|
| **NEIGHBORHOOD MITIGATION** | | | |
| | 32. Traffic improvements (S) | $61,000 | $ 500 |
| | 33. Induced parking mitigation (S) | $ 5,000 | $ 700 |
| | 34. Visual screening (S) | $25,000 | $ 700 |
| | 35. Noise screening (S) | $15,000 | $ 700 |
| | SUBTOTAL | $106,000 | $2,600 |
| | TOTAL FOR ALL FEATURES | $670,000 | $51,650 |

Notes: (1) Costs for land, parking, allowances, and special construction conditions are not included.

(2) All costs are current estimated budgets as of the date of this report and are subject to further Board review and refinement as design proceeds.

# RECOMMENDED TRANSIT DESIGN POLICIES FOR TYPICAL OUTLYING LIGHT RAIL GUIDEWAYS

## I. Introduction

The Transit System Plan approved by the DART Board of Directors on June 27, 1989, includes 66 miles of light rail transit to be in service by 2010, with 20 miles to be in operation by 1996 as the light rail Starter System. A key component of the DART light rail system is the design of the guideway, which is commonly defined as the surface or track and its supporting structure on or in which transit vehicles travel.

The guideway's primary function is to provide a "clear zone" for the movement of rail transit vehicles:

- It supports the vehicle;
- It guides the vehicle; and
- It accommodates vehicle passage within required safety, speed, and comfort limits.

DART's light rail transit system consists of guideways that are at the surface, elevated, or below grade. Light rail guideways typically consist of features that literally guide the vehicle (with trackwork and roadbed and way structures), that provide passenger safety and security, and that mitigate potential adverse impacts of the light rail system's passage through the various parts of the DART Service Area.

This document presents transit design features and treatments for all of DART's "outlying" guideways, or those not in the Dallas Central Business District. Guideways for the CBD will have their own unique design characteristics and will be handled separately.

## II. Guideway Treatments for the DART Light Rail System

Table 1 lists three categories of guideway treatments that are likely to be used in DART's 66-mile light rail transit system.

### 1. Surface Treatments

Approximately 80% of DART's light rail transit system will consist of guideways that are at-grade or on the surface of

the surrounding topography. Most of the surface guideways will be located in existing railroad rights-of-way, with virtually exclusive light rail use in all corridors (in other words, DART's light rail transit will in most cases not be forced to share its right-of-way with railroad freight traffic). Some guideways may be located within or adjacent to arterial roadways; this is possible particularly in the South Oak Cliff Corridor, where the federal Alternatives Analysis/Draft Environmental Statement (AA/DEIS) process will determine the actual location of the guideway in that area. In addition, a small segment of guideway may be located on the surface in other miscellaneous areas, such as utility rights-of-way. Again, this is a possibility in the South Oak Cliff corridor and will depend on the results of the AA/DEIS process.

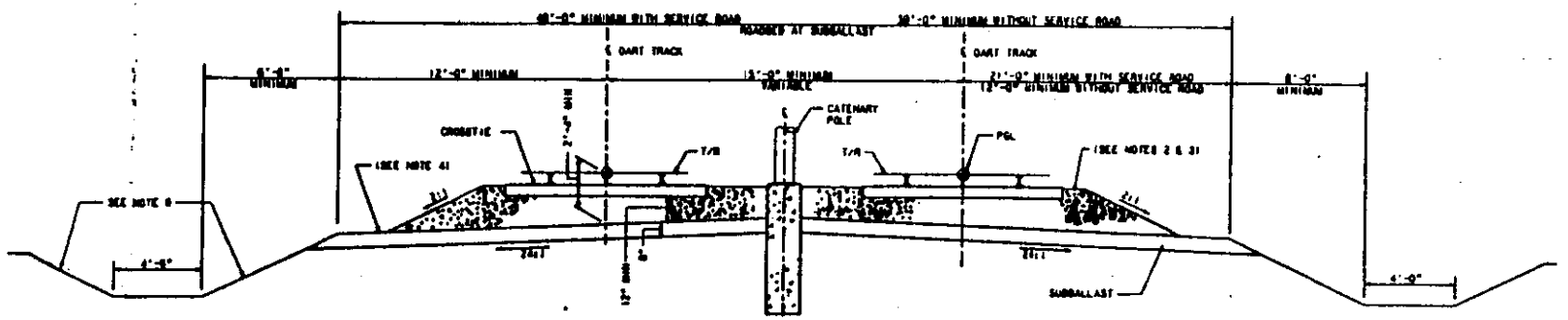
Surface guideways are generally the least expensive to construct, with capital costs budgeted at approximately $13 million per mile (this cost and other costs mentioned in this document are in 1989 dollars and include the per-mile costs of civil and structural construction, trackwork, stations, systems, and associated contingencies; they exclude the costs of vehicles, maintenance facilities, and associated contingencies). Their neighborhood, visual, and noise impacts are less than those of elevated guideways but also require special considerations for mitigating impacts on cross-street vehicular traffic. Elevated or grade-separated alternatives will be used only when corridor-specific constraints, safety, traffic volumes, and community and neighborhood preferences make a surface guideway unattractive or undesirable.

Figure 1 is a cross-section drawing showing a typical surface guideway in an exclusive right-of-way.

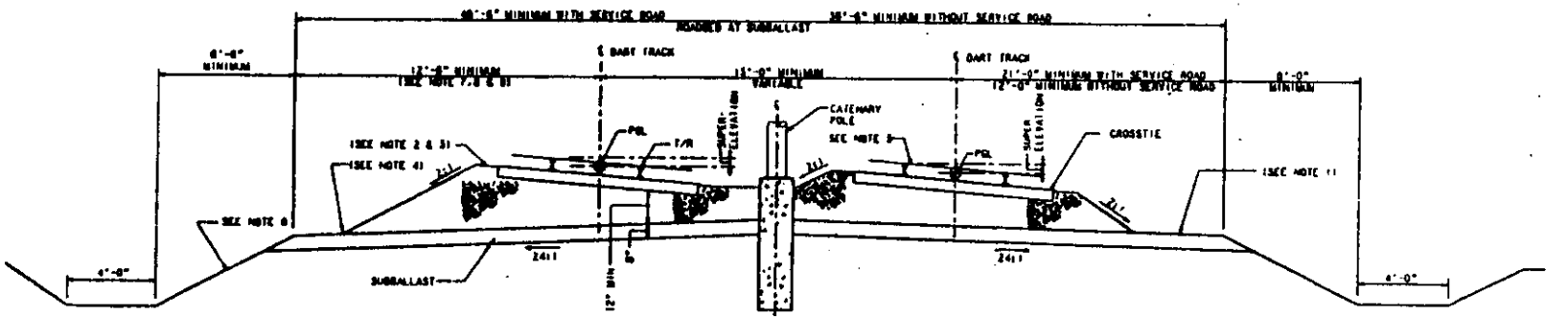
## 2. Elevated Treatments

Elevated guideway treatments are usually preferred over below-grade treatments when grade separation of the guideway is required. While elevated guideways result in greater noise and visual impacts than below-grade solutions, the elevated treatment is less costly than below-grade guideways. Elevated guideways comprise only 12% of the overall DART light rail system and are budgeted in the DART system at approximately $28 million per mile.

Elevated guideways may be built on retained fill or an embankment, the lowest-cost elevated structure. However, retained fill construction may result in "visual intrusion,"




TANGENT PRIMARY TRACK
AT-GRADE




CURVED PRIMARY TRACK
AT-GRADE

NOTES:

1. A SERVICE ROAD IS DESIRABLE, IT NEED NOT BE CONTINUOUS NOR ALWAYS ON A SAME SIDE OF TRACK. SERVICE ROAD FEASABILITY SHALL BE EVALUATED FOR EACH LOCATION. SERVICE ROADS SHALL BE CONNECTED TO THE PUBLIC ROAD SYSTEM.
2. TOP OF BALLAST SHALL BE -" BELOW BASE OF RAIL.
3. BALLAST SHOULDER SHALL EXTEND 12" MINIMUM BEYOND END OF TIE.
4. SUBBALLAST SHOULDER SHALL BE A MINIMUM OF 2'-0".
5. SUPERELEVATION IS APPLIED BY HOLDING THE TOP OF THE INSIDE RAIL AT THE PROFILE GRADE LINE ELEVATION AND RAISING THE OUTSIDE RAIL BY THE REQUIRED AMOUNT OF SUPERELEVATION. SUPERELEVATION SHALL BE APPLIED AT A UNIFORM RATE OVER THE LENGTH OF THE TRANSITION SPIRAL.
6. THE TRANSITION FROM THE ROADBED AND BALLAST SECTION SHOWN FOR TANGENT TRACK TO THE ROADBED AND BALLAST SECTION SHOWN FOR SUPERELEVATED TRACK MAY BE MADE THROUGH THE LENGTH OF THE SPIRAL. SUBGRADE WIDTH TRANSITIONS SHALL BEGIN AT THE TANGENT SIDE OF THE TANGENT-SPIRAL POINT AND BE EQUAL OR SHORTER IN LENGTH THAN THE SPIRAL.
7. THIS DIMENSION SHALL BE AT LEAST 12'-0" PLUS 3.5 TIMES THE AMOUNT OF SUPER-ELEVATION IN THE OUTSIDE TRACK. (USUALLY ROUND UP TO NEAREST 3")
8. IF SERVICE ROAD IS ON HIGH SIDE OF CURVE THIS DIMENSION SHALL BE A MINIMUM OF 21'-0" OR 9'-0" GREATER THAN THAT DETERMINED IN NOTE 8.
9. SIDE SLOPES TO BE DETERMINED BY GEOTECHNICAL CONSULTANT.

NOT AN APPROVED DRAWING

CONTRACT SHEET No.

DART PROJECT

DART

TRACKWORK DIRECTIVE
PRIMARY TRACK
AT GRADE IN EXCLUSIVE RIGHT-OF-WAY

CONTRACT DWG NO. 405-2228 REV

DESCRIPTION | BY | DES | CHK | APP | REV | DATE | DESCRIPTION | BY | DES | CHK | APP

FIGURE 1

especially in residential neighborhoods. It also requires special considerations to accommodate cross-flow vehicular traffic. Figure 2 is a cross-section drawing showing a typical guideway on retained fill construction.

Elevated guideways may also be built on aerial structures, which represent the most common method of elevated treatments in the DART system. While slightly more expensive than retained fill construction, aerial structures are much more visually attractive and provide opportunities for cross-flow of vehicular traffic under the guideway. Aerial structures generally can be used for spans no longer than 100 feet. On April 21, 1987, the Board approved a "standard aerial structure" for use in the DART system, as shown in perspective in Figure 3. However, as design of the system progresses, staff may request that this standard structure be modified.

Bridges are needed to span specific topographic features like waterways (such as the Trinity River in the South Oak Cliff corridor), and major highways. These structures are typically the most expensive and are designed to meet the needs of specific sites.

3. Below Grade Treatments

Below-grade treatments are the least-used types of guideway structures in the DART light rail system, comprising approximately 8% of the total system. They are obviously the least intrusive visually and acoustically of all guideway treatments, but are also by far the most expensive to construct. Below-grade guideways in the DART system are budgeted at approximately $50 million per mile. Below-grade treatments also introduce additional capital, operations and maintenance cost concerns to take into account ventilation, emergency evacuation, and security considerations. Most below-grade construction in the DART system will occur in conjunction with the North Central Expressway transitways under the freeway's service roads.

Retained cut construction (depressed with an open top) is generally the least-expensive of below-grade guideways. Like its elevated complement, retained fill, the retained cut guideway also impedes cross-flow vehicular traffic. However, its reduced visual impact and lack of requirements for ventilation and emergency evacuation facilities make retained cut an attractive below-grade option compared to a fully enclosed tunnel. Figure 2 also shows a cross-section view of a typical retained cut construction.

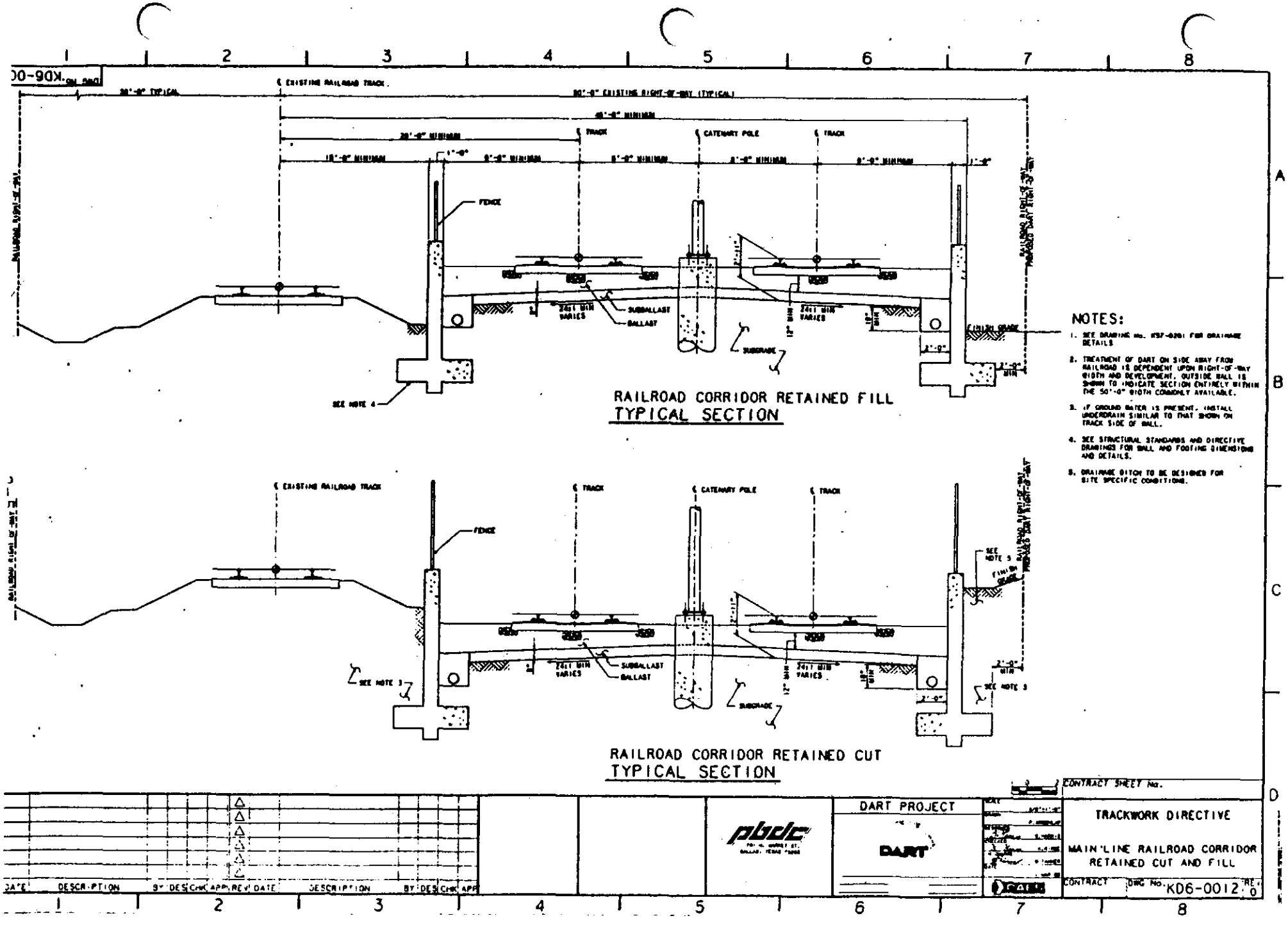
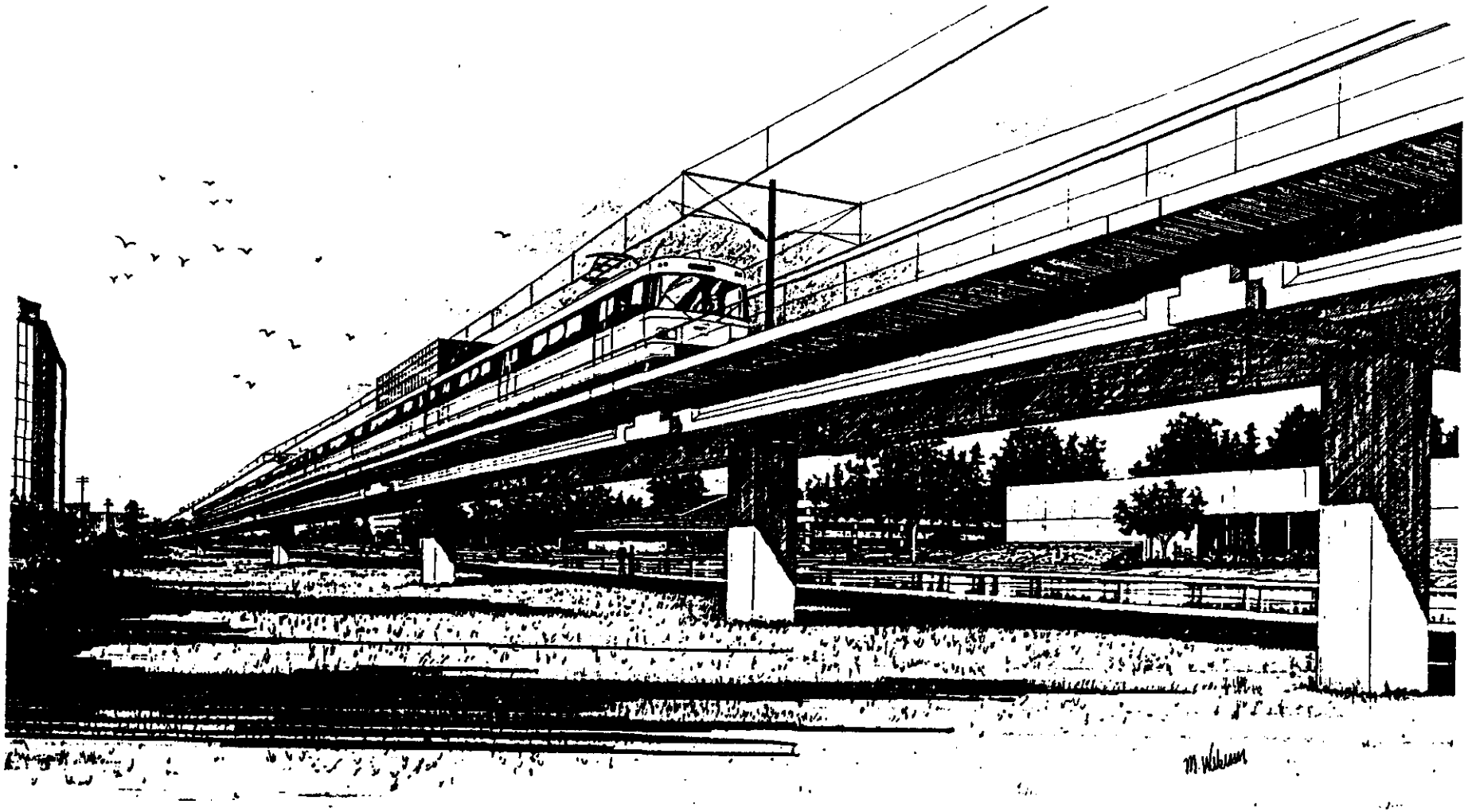

℄ EXISTING RAILROAD TRACK
50'-0" EXISTING RIGHT-OF-WAY (TYPICAL)
℄ TRACK
℄ CATENARY POLE
℄ TRACK
FENCE
SUBBALLAST
BALLAST
SUBGRADE
SEE NOTE 4
RAILROAD CORRIDOR RETAINED FILL
TYPICAL SECTION
NOTES:
1. SEE DRAWING No. 937-0201 FOR DRAINAGE DETAILS
2. TREATMENT OF DART ON SIDE AWAY FROM RAILROAD IS DEPENDENT UPON RIGHT-OF-WAY WIDTH AND DEVELOPMENT. OUTSIDE RAIL IS SHOWN TO INDICATE SECTION ENTIRELY WITHIN THE 50'-0" WIDTH COMMONLY AVAILABLE.
3. IF GROUND WATER IS PRESENT, INSTALL UNDERDRAIN SIMILAR TO THAT SHOWN ON TRACK SIDE OF WALL.
4. SEE STRUCTURAL STANDARDS AND DIRECTIVE DRAWINGS FOR WALL AND FOOTING DIMENSIONS AND DETAILS.
5. DRAINAGE DITCH TO BE DESIGNED FOR SITE SPECIFIC CONDITIONS.
℄ EXISTING RAILROAD TRACK
℄ TRACK
℄ CATENARY POLE
℄ TRACK
FENCE
SEE NOTE 5
SUBBALLAST
BALLAST
SUBGRADE
SEE NOTE 3
SEE NOTE 3
RAILROAD CORRIDOR RETAINED CUT
TYPICAL SECTION
DART PROJECT
DART
TRACKWORK DIRECTIVE
MAIN LINE RAILROAD CORRIDOR
RETAINED CUT AND FILL
CONTRACT SHEET No.
CONTRACT
DWG No. KD6-0012
REV 0
DATE
DESCRIPTION
BY
DES CHK
APP
REV DATE
DESCRIPTION
BY
DES CHK
APP

FIGURE 2



**AERIAL STRUCTURES**
**CURRENT DESIGN : AASHTO GIRDER, DAPPED ENDS, SQUARE COLUMNS**

DALLAS AREA RAPID TRANSIT
PBDC/HWA

FIGURE 3

Fully-enclosed tunnels are the most expensive below-grade guideways and are used only when no other alternatives are available. These treatments will be used only as a means to shift the guideway from the North Central transitways under North Central itself and Woodall Rodgers Freeway to transition to surface running.

Finally, the primary guideway solution for the section of North Central Expressway between Mockingbird Lane and the Dallas CBD is the transitway under the freeway's service roads. This is a partially-enclosed "box" which is a unique or hybrid solution developed especially for this segment of the Expressway. Figure 4 is a perspective illustration of this below-grade solution, and Figure 5 is a cross-section drawing of the guideway.

## II. Light Rail Transit Guideway Design Features

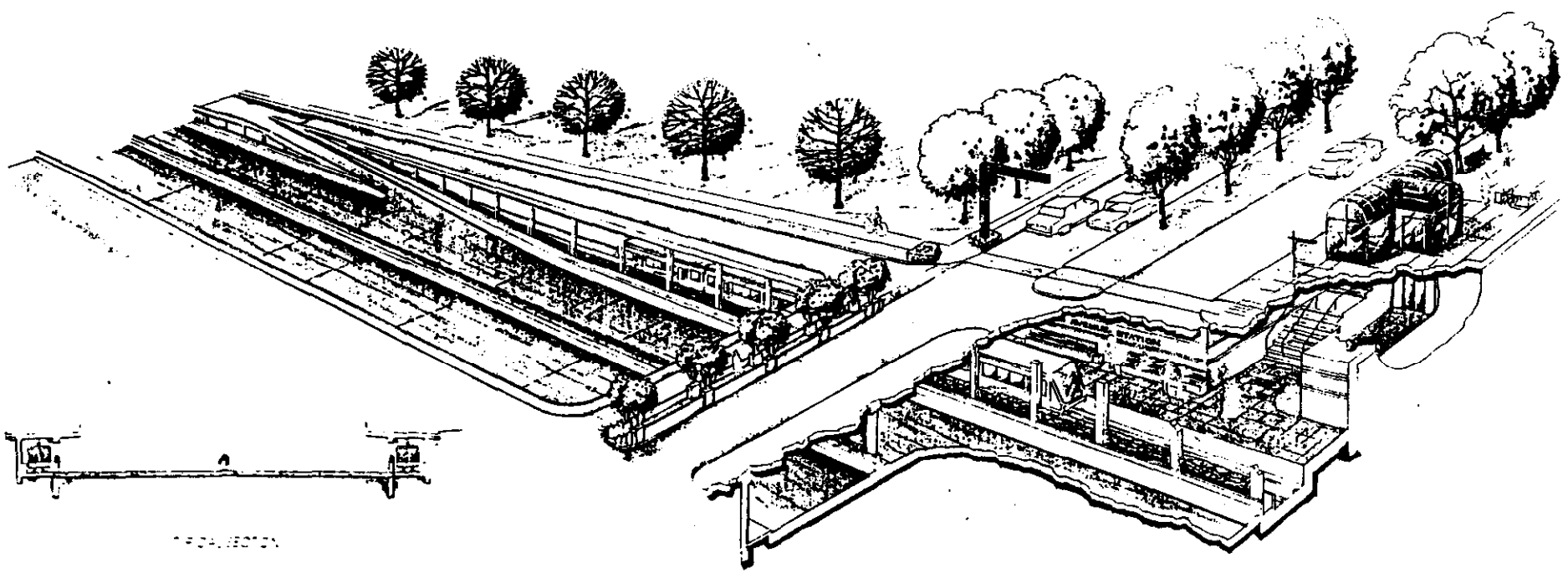
While each of the guideway treatments listed above provides similar levels of performance and comfort to the passenger, they can differ significantly in their impact on the adjacent community. It is the placement of the guideway, more than any other group of light rail system elements, that provides the greatest challenge to system designers.

It is primarily because of the need to establish limits on the complex tradeoffs among cost, performance, and community and neighborhood impacts that policies on guideway design features must be instituted. Their establishment will result in the development of specific design criteria that will result in guideway construction that achieves high-quality system performance levels in a manner that is acceptable to neighborhoods and communities and that is within the constraints of cost-effectiveness.

### Objectives in Developing Recommended Guideway Features

The objectives that guided the development of the recommended light rail transit guideway design features were as follows:

- To achieve the essential functions of the guideway system: the support, guidance, and accommodation of the movement of rail vehicles;
- To provide the essential functions in a comfortable, convenient, and safe environment;

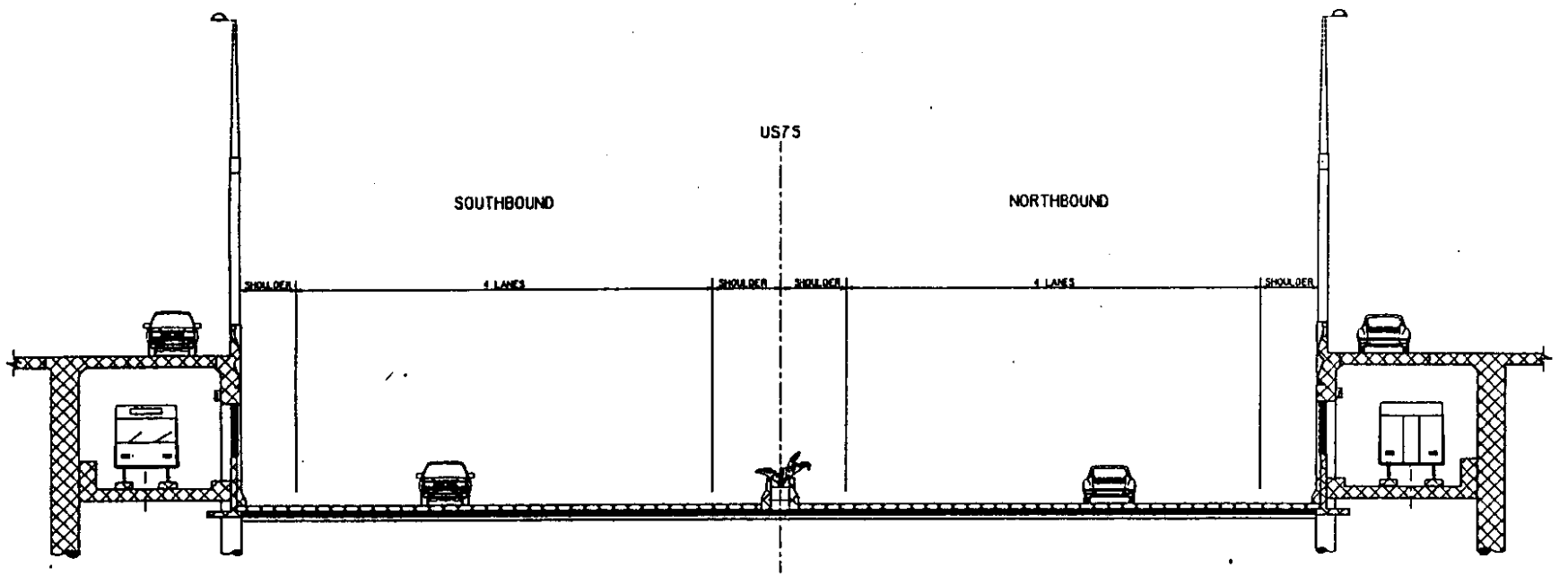


RAPID TRANSIT UNDER SERVICE ROAD AT FREEWAY GRADE

ALBERT H. HALFF ASSOCIATES, INC.



FIGUR




NOT AN APPROVED DRAWING

CONTRACT SHEET No.

DART PROJECT

K. GREEN

SERVICE ROAD
TRANSITWAY

CONTRACT | DWG No. NRWALL75 | REV

DESCRIPTION | BY | DES | CHK | APP | REV | DATE | DESCRIPTION | BY | DES | CHK | APP

FIGURE 5

- To provide the essential functions in a manner acceptable to the community, adjacent neighborhoods, and the environment;
- To build and maintain a guideway system that is affordable; and
- To build and maintain a guideway system that is cost-effective.

Recommended Key Guideway Features

Table 2 lists 12 features in three functional categories (train guidance, passenger safety and security,. and optional mitigation measures) that are recommended for the design of the DART light rail transit guideway system. The table shows whether the specific design feature is applicable to all or only selected portions of the guideway, and clarifying remarks are provided where appropriate.

The three functional categories are listed below, along with a brief description of the major design features presented.

1. Train Guidance

This category describes features that are absolutely necessary for meeting the essential functions of the guideway system.

- Track geometry consists of the curvature and grade of the track to ensure maximum train speed, maximum passenger comfort, and minimum noise to the passenger and the environment.
- A roadbed provides support for the trackwork. It can consist of a ties-and-ballast roadbed, the standard approach found in the majority of the system, or a direct fixation roadbed, to be used in special cases for direct attachment to the surface (such as on elevated, below-grade, or paved areas).
- Way structures provide support for the trackwork in grade-separated situations such as aerial construction.

## 2. Passenger Safety and Security

Overall passenger safety and security will be enhanced by several guideway design features.

- Emergency walkways will be provided along all guideway segments for safe, rapid evacuation of trains between stations during emergency situations.

- Fencing will be provided along selected segments to prevent potentially dangerous guideway intrusion involving pedestrians, vehicles, or objects.

- Vehicle crossing protection such as gates and signals will be constructed at all at-grade crossings with roadways to prevent collisions between rail and motor vehicles.

- Pedestrian crossing protection consists of under-passes or overpasses to separate foot traffic from the guideway at high-volume pedestrian traffic locations.

- An emergency communications system will be established along selected, restricted guideway segments to provide quick response to operational, safety, and security problems.

## 3. Optional Mitigation Measures

Efforts to mitigate potential adverse impacts of the light rail transit guideway on the adjacent environment will be undertaken as part of the overall guideway location and design development process. Specific mitigation warrants and methods are under development in accordance with a Board resolution approved June 13, 1989. That resolution authorized the development of policies regarding system-wide standards for mitigation of adverse impacts of the entire light rail system. Those policies are to identify:

- Potential impacts requiring mitigation;

- The criteria for implementing mitigation measures; and

- A range of techniques that can be used to mitigate potential adverse impacts of the system.

Measures will be developed to specifically mitigate potentially adverse impacts of the light rail system's guideway elements in each of the following areas.

- Grade separations will be used to separate the guideway from cross streets. Use of grade separations will be determined based on traffic volumes and neighborhood considerations. They will be used only where no other mitigation measures are available to solve the traffic impacts of the guideway.

- Visual screening will be required at selected locations along the guideway based on its proximity to neighborhoods or other sensitive areas.

- Noise and vibration screening and other noise reduction techniques will be required at selected guideway locations to bring the system's sound and vibration levels within environmentally acceptable amounts.

- Electromagnetic interference screening and similar techniques will be used where necessary in certain guideway segments.

- Other mitigation measures for the guideway will be developed as required.

TABLE 1
LIST OF TYPICAL GUIDEWAY TREATMENTS LIKELY TO BE USED IN DART LIGHT RAIL SYSTEM
(Does not apply to CBD Transitway Mall)

| Guideway Treatment | Approx. % of System | Approx. Cost Per Mile(1) |
|---|---|---|
| A. Surface: | 80% | $13 million |
| 1. Exclusive railroad right-of-way | | |
| 2. Shared railroad right-of-way | | |
| 3. Guideway along arterial | | |
| 4. Other (i.e., utility right-of-way) | | |
| B. Elevated: | 12% | $28 million |
| 5. Retained fill | | |
| 6. Aerial structure | | |
| 7. River bridge | | |
| C. Below Grade | 8% | $50 million |
| 8. Retained cut | | |
| 9. Tunnel | | |
| 10. Semi-enclosed "box" under expressway service roads | | |

Note: (1) All costs are in 1989 dollars. Includes civil and structural work, trackwork, stations, systems, right-of-way, and associated contingencies. Excludes vehicles, maintenance facilities, and associated contingencies.

**TABLE 2**
**SUMMARY OF RECOMMENDED KEY FEATURES FOR OUTLYING LIGHT RAIL GUIDEWAY**
**(Does not apply to CBD Transitway Mall)**

| Guideway Features | Applicability | Remarks |
|---|---|---|
| **I. TRAIN GUIDANCE** | | |
| 1. Trackwork geometry | All | Track curvature and grade to increase passenger comfort and minimize noise. |
| 2. Roadbed | | |
| a. Ties-and-ballast | Selected | Used in most of system. |
| b. Direct fixation | Selected | Used in special cases for direct attachment to surface (such as on paving or elevated or below-grade guideways). |
| 3. Way structure | Selected | To support grade-separated trackwork. |
| **II. PASSENGER SAFETY AND SECURITY** | | |
| 4. Emergency walkway | All | To permit safe, rapid evacuation of trains and guideways between stations. |
| 5. Fencing | Selected | To prevent intrusion onto guideway by pedestrians, vehicles, etc. |

| Guideway Features | Applicability | Remarks |
|---|---|---|
| 6. Vehicle crossing protection | Selected | At grade crossings only; to deter rail vehicle collisions with motor vehicles. |
| 7. Pedestrian crossing protection | Selected | Pedestrian underpasses or overpasses at high-volume locations. |
| 8. Emergency communications system | Selected | For direct access to DART Public Safety personnel from restricted guideway segments. |
| **III. OPTIONAL MITIGATION MEASURES** | | |
| 9. Grade separations | Selected | Used at guideway crossings where no other mitigation measures will solve traffic impacts. |
| 10. Visual screening | Selected | As required. |
| 11. Noise and vibration screening | Selected | As required. |
| 12. Electromagnetic interference screening | Selected | As required. |
| 13. Other measures | Selected | As required. |

# RECOMMENDED KEY FEATURES FOR TYPICAL DART LIGHT RAIL TRANSIT VEHICLES

## I. Introduction

The Transit System Plan approved by the DART Board of Directors on June 27, 1989, includes 66 miles of light rail transit to be in service by 2010, with 20 miles to be in operation by 1996 as the light rail Starter System.

A key component of the light rail system is the rail vehicle fleet. The vehicles provide mobility for the passengers over the light rail network and form the environment in which the passengers spend most of their time while using the DART system.

The principal purpose of the vehicles is to provide transportation to riders that is:

- safe;
- fast;
- convenient;
- dependable;
- comfortable;
- acceptable to the surrounding neighborhoods;
- affordable; and
- cost-effective.

The purpose of this document is to describe the key features recommended for DART's typical light rail vehicle to allow the staff to develop the final functional and technical specifications of the vehicle and to proceed with its procurement.

Requests for Statements of Interest (RSOI) were sent to light rail vehicle manufacturers and suppliers in the Fall of 1989 to obtain comments on the draft technical requirements and specifications for the basic DART light rail vehicle. The next step in the vehicle procurement process, distribution of Requests for Technical Proposals (RFTP), is planned for early Spring of 1990

and will only be sent to firms that responded satisfactorily to the RSOI.

## II. Background

On May 23, 1989, the DART Board of Directors approved the basic design concept for the DART light rail vehicle. The key features of that basic vehicle are as follows:

- Articulated vehicle (see Figure 1), with married-pair vehicle to be investigated as an alternative (see Figure 2).
- Six axles (with eight axles for married pair).
- Standard light rail vehicle width (8'6" to 9'6").
- Approximate length of 90' to 95'.
- Maximum speed of at least 55 to 60 miles per hour.

The recommended features described in this document are an expanded list of vehicle features built upon the initial five characteristics shown above.

These recommended key features (and any numeric values associated with the features) are subject to revision and refinement as the analysis of the vehicle's specific technical requirements progresses.

## III. Recommended Key Features for Typical Vehicles

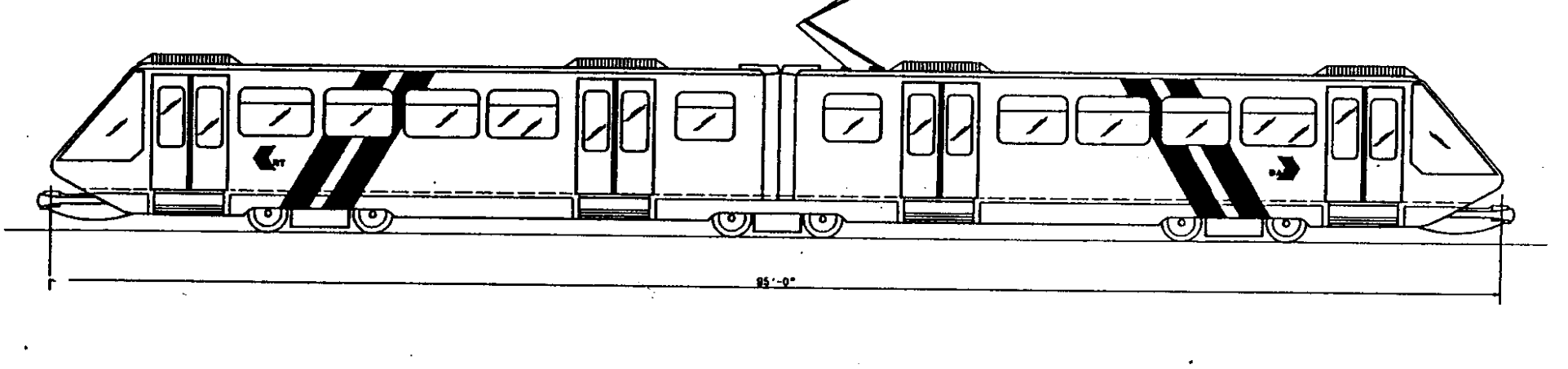
Table 1 lists 40 features that are recommended for the typical DART light rail transit vehicle. Those features are divided into seven major categories:

- General Performance;
- Systems;
- Passenger Comfort;
- Passenger Safety;
- Passenger Information;

11/27/89

3-3

# ARTICULATED VEHICLE



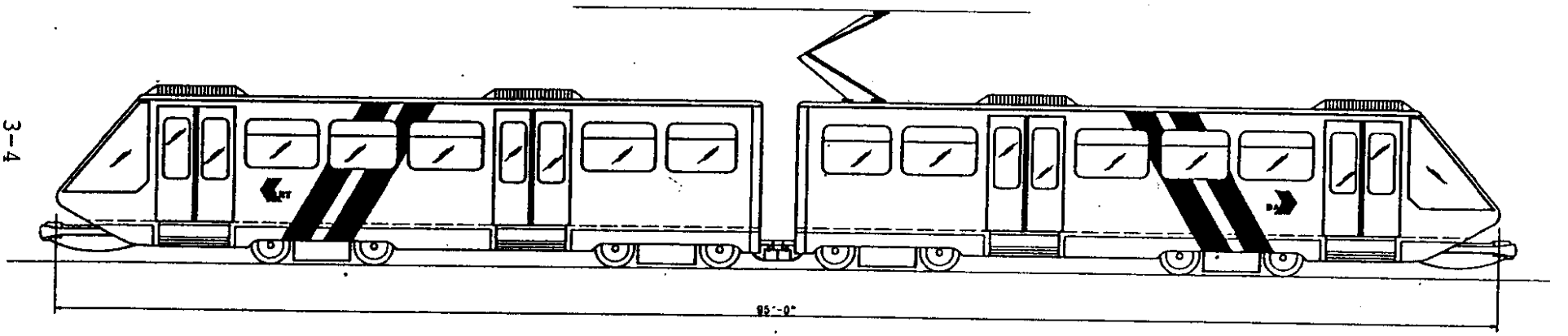

DRAWN BY
DART CADD
DEPARTMENT

CADD

FIGURE 1

DART

# MARRIED PAIR VEHICLE

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DEPARTMENT

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FIGURE 2

DART

- Aesthetics; and
- Neighborhood Mitigation.

The following text briefly describes each of the recommended features by major category.

1. General Performance

Fifteen features are recommended under the general vehicle performance category. The first five features shown on the table were previously adopted by the DART Board:

- The vehicle type will be an articulated or married-pair car.
- The vehicle will have six axles if it is articulated, or eight if it is a married-pair vehicle.
- The vehicle's maximum speed will be at least 55 to 60 miles per hour.
- The vehicle will be approximately 90 to 95 feet long as measured over the coupler faces.
- The vehicle will be a "standard" light rail vehicle width of 8'6" to 9'6".

The other features listed in this category include:

- Interior height of vehicle body: A height of 7'1" at the vehicle's center line ensures adequate vertical clearance for passengers inside the car.
- Vehicle capacity: Passenger capacity varies based on car width, number of seats, and seating arrangement. The planned DART light rail vehicle is expected to have at least 175 "spaces" (75 seats plus 100 standee spaces), with adequate room for mobility-impaired passengers. This amount of passenger spaces in a vehicle of the recommended size provides a high level of seating comfort, an important factor in attracting passengers to the DART system.

- Vehicle boarding characteristics: The value shown for the level of the vehicle's floor, one meter, is the maximum permitted under the basic DART specifications. The floor must be high enough to accommodate auxiliary equipment under the vehicle. The special-use boarding platform for mobility-impaired passengers must be constructed at the same height as the vehicle floor.

  The primary boarding method will be through the use of steps in the vehicle doorwell from the low-level platforms described in the station design policies. However, mobility-impaired passengers will utilize high-level boarding at the front door of the first vehicle in each train from the special-use platform at all stations.

- Doors: The typical DART light rail vehicle will have four doors on each sides of the car. The front door will permit entry from the special-use high-level platform as noted above, while the remaining three doors will accommodate standard low-level boarding.

- Minimum turning radius: The recommended minimum turning radius for the DART light rail vehicles is 100 feet. While no curves this small are anticipated on the running sections of the system, a turning radius of 100' will be needed in maintenance and storage yards as well as turnbacks and crossovers on the running lines. Most standard light vehicles already meet or exceed this minimum requirement.

- Wheel gauge: The DART light system is planned around the standard track gauge in the United States (4'8.5").

## 2. Systems

The vehicle systems category includes those major features and capabilities that directly relate to the safe and efficient operation of the rail vehicles.

- Vehicle operating orientation: Vehicle orientation is either unidirectional (can only be operated in one direction and must be turned around to reverse direction) or bidirectional (can be operated in both directions by simply reversing, not turning around). The DART light rail vehicle will be designed for bidirectional operation with operator cabs on both ends of each car.

  This feature improves operating flexibility for train makeup and breakup, eases turnbacks at the end of lines, and quickens short turns prior to the end of lines. It also allows emergency maneuvering in abnormal operational situations. Bidirectional capability with dual cabs is a normal feature for light rail systems similar to DART's.

- Multi-car train capability: DART's light rail vehicles will be equipped to permit multiple-car trains to be operated by a single operator in the cab of the leading vehicle. This feature is typical for light rail systems similar to DART's.

- Power pickup: A light rail system with at-grade crossings (such as DART's) requires overhead power pickup using roof-mounted pantographs.

- Communications: DART's light rail vehicles will be equipped with two-way communications between the operator and the control center as well as between the operator and the passenger compartments. This is an essential feature of any rail transit system.

- Signaling: Signals display speed and track occupancy ("stop/go") instructions to the train operator. Planning for DART's light rail vehicle envisions a mixture of cab signal capabilities (i.e., the signal aspect is displayed in the operator's cab) and wayside (beside-the-track) signals.

- Automatic Train Protection (ATP): The DART train protection strategy, which is still under development, recommends wayside "trip stop" equipment at selected locations to

automatically stop a train without operator intervention. This feature will prevent a train from entering occupied or protected "blocks" (sections) of track and will accommodate expansion in the future as the frequency of trains increases. The ATP will also automatically activate signals and gates at grade crossings with public roadways.

3. Passenger Comfort

Vehicle comfort features enhance both the vehicle's interior environment and the ride quality for the passenger.

- Climate control: The interior climate of the DART light rail vehicle will be enhanced with ventilation, air conditioning, heating, and humidity control capabilities. These features are considered standard for a light system with the trip length characteristics and climate of Dallas.

- Lighting: Adequate lighting will be provided in vehicles, both for comfort and for safety. Special emergency lighting will be provided as well.

- Noise control: The interior noise levels will be held within acceptable limits using a number of strategies, including equipment design, sound shielding materials, and sound absorbing and damping materials. Some of these measures will also serve to reduce external noise levels as well.

- Ride Quality: The three general vehicle requirements associated with ride quality (acceleration/jerk limiting, vibration, pitch/yaw/sway) will be satisfied at all times except during emergency stopping situations. Maintaining a high level of ride quality is very important in a "choice rider" travel marketplace such as DART's.

## 4. Passenger Safety

Safety is the primary concern in the implementation of DART's light rail system as well as in the implementation of any DART program or project. The light rail vehicles will contribute to the overall safety effort with a number of safety-related features.

- Systems-related safety features: These system features support efficient and reliable vehicle operations, but also play a key role in ensuring safety. Automatic train protection will prevent trains from entering selected "blocks" of track and will also activate grade crossing signals and gates. A "dead man's" train safety feature will automatically stop a train if the operator releases his/her power control due to inattention or health problems. Vehicles will also be equipped with electromagnetic track brakes for use in emergencies.

- Communications: The basic communications system will also include special emergency communications capabilities to ensure swift, effective detection of and response to incidents. The communications system, like other elements of the "systems" group of features, is still under development.

- Materials: Safety will be further enhanced with the careful specification of materials to be used in the vehicles. Flame resistance and a low or non-toxicity level during exposure to heat or flame will be key requirements of the vehicle specifications. Shatter resistance (for materials such as glazing) is another example of enhancing safety through careful selection of materials.

## 5. Passenger Information

This category includes information requirements typical for rail transit vehicles. This effort must be coordinated with the station information displays and with the overall information and graphics strategy for the system.

- Exterior signing: Large, highly visible exterior destination and route signing is important to assist the passengers with directional orientation at the station and correct selection of trains on a line with branches or short turns. This signage can consist of electronic or manual systems.

- Interior signing: Well-designed interior signing is required to confirm the passenger's choice of vehicle, to clearly indicate the sequence of stations, and to prompt the passenger of the correct moment to prepare for deboarding. General information, fare, passenger conduct, and emergency procedures should also be properly displayed.

- Public address system: All vehicles will be equipped with a public address system so that routine information (such as "next station stop") as well as exceptional information (such as on system delays or emergency situations) can be quickly relayed to the passengers.

6. Aesthetics

Vehicle appearance, like ride quality, is an important factor in attracting the "choice" rider in the DART travel market as well as for maintaining a positive image within the community. Equipment design as well as finishes, colors, etc., should be carefully chosen to reflect a futuristic, high-tech image while remaining relatively low in maintenance costs.

Vehicle design experts with a sensitivity to the special emphasis on vehicle appearance will be available to assist both the Board and the staff in developing the vehicle's visual appearance. The Board will have ample opportunities to participate in the visual design development effort.

7. Neighborhood Mitigation

This category contains the usual list of mitigation impact areas ranging from noise to traffic and safety. Details regarding the warrants for and treatments of adverse effects of the vehicle's operations will be presented in the mitigation warrant reports currently under development.

**TABLE 1**
**SUMMARY OF RECOMMENDED KEY FEATURES FOR TYPICAL DART LIGHT RAIL VEHICLE**

| Feature | Remarks/ Typical Value(s) |
|---|---|
| **I. GENERAL PERFORMANCE** | |
| 1. Vehicle type | Articulated or married pair. |
| 2. Axles | Six for articulated; eight for married pair. |
| 3. Maximum speed | At least 55 to 60 miles per hour. |
| Dimensions: | |
| 4. Length | Approximately 90 to 95 ft. |
| 5. Width | Approximately 8'6" to 9'6" |
| 6. Height | At least 7'1" interior height at center line of vehicle. |
| Capacity: | |
| 7. Seating | At least 75 seats. |
| 8. Standing | At least 100 spaces. |
| 9. Space for wheelchairs | At least one at each end of vehicle. |
| Boarding-Related: | |
| 10. Vehicle floor height | One meter (39.4") maximum. |
| 11. Standard boarding | Via low-level steps. |
| 12. Mobility impaired boarding | High-level via wayside ramp and platform. |

Other:

| | |
|---|---|
| 13. Doors | On both sides of vehicle, 4 per side. |
| 14. Minimum turning radius | 100 feet. |
| 15. Track/wheel gauge | Standard gauge, 4'8.5". |

**II. SYSTEMS**

| | |
|---|---|
| 16. Vehicle operating orientation | Bidirectional, with cab at both ends. |
| 17. Multiple car train capability | Can operate in multiple-car trains with one operator. |
| 18. Power pick-up | Overhead via pantograph. |
| 19. Communications | Operator communications with passengers and to and from control center. |
| 20. Signaling | In cab and wayside. |
| 21. Automatic train protection | Wayside trip stops to prevent collisions between trains. |

**III. PASSENGER COMFORT**

Environment:

| | |
|---|---|
| 22. Climate control | Air conditioning, heating, ventilation, humidity control. |
| 23. Lighting | Adequate for passenger comfort and for security purposes. |
| 24. Noise control | To keep interior noise at comfortable levels. |

Ride Quality:

| | |
|---|---|
| 25. Acceleration/jerk limiting | Within industry standards for comfortable limits. |
| 26. Vibration | Same as above. |
| 27. Pitch, yaw, sway, etc. | Same as above. |

**IV. PASSENGER SAFETY**

| | |
|---|---|
| 28. Systems-related safety features | Enhanced by signaling and train protection features. |
| 29. Communications-related safety features | Special emergency communications capabilities, including two-way communications between operator and passengers. |
| 30. Vehicle materials | Limits on flammability, toxicity, shattering, etc. |

**V. PASSENGER INFORMATION**

| | |
|---|---|
| 31. Exterior destination and route signs | Large, highly-visible signs on front and sides of vehicle. |
| 32. Interior destination, route, system, fare, and conduct signs and information | On display in each car. |
| 33. Interior emergency conduct signs and information. | Same as above. |
| 34. Public address system | To call out station stops and to relay other essential information. |

## VI. AESTHETICS

| | |
|---|---|
| 35. Exterior hardware | Futuristic, high-tech appearance. |
| 36. Interior hardware | Sleek, attractive. |
| 37. Finishes, colors, textures, etc. | Bright, durable, low-maintenance, graffiti- and vandal-resistant. |

## VII. NEIGHBORHOOD MITIGATION

| | |
|---|---|
| 38. Noise mitigation | Through use of resilient wheels, vehicle skirts, and other measures as required per separate mitigation warrants. |
| 39. Vibration mitigation | Same as above. |
| 40. Safety measures | Features such as exterior lights and reflectors and horns and bells to prevent collisions with pedestrians and other vehicles. |

## RECOMMENDED KEY DESIGN FEATURES FOR CBD TRANSITWAY MALL

| Feature | Remarks/ Typical value(s) |
|---|---|
| **I. AMENITIES** | |
| 1. Landscaping | Above that required by city codes; to help mall "blend in" and enhance local area. Indigenous where possible. |
| 2. Art projects | Community-based art projects as required by Board 12/8/87. Exact budget to be determined by Arts Committee. |
| 3. High-quality paving materials | For architectural enhancement, pedestrian and motor vehicle traffic flow, delineation of track areas, etc. |
| 4. Miscellaneous design features | Water features such as fountains or water sculptures; innovative street furniture; plazas; well-designed trash receptacles and drinking fountains; lighting fixtures above that required for security; and others. |
| **II. PASSENGER ACCESS** | |
| 5. Pedestrian walkways | Grade-level paths to lead pedestrian movement to platforms, intersections, etc. |

| | |
|---|---|
| **III. RAIL VEHICLE ACCESS** | |
| 6. Low-level platform | 8-10 inches above track. |
| 7. High-level special-use platform with ramp and shelter | For mobility-impaired and other boarding, located to align with front door of first car. Canopy or shelter for protection from the elements. |
| **IV. FARE COLLECTION** | |
| 8. Self-service ticket dispensers | Self-service barrier-free fare collection system adopted by Board 1/8/85. |
| 9. Self-service ticket validators | Machines to ensure that passengers have enough fare to get to final destination. Fare is then checked by "roving" ticket inspectors. |
| **V. PASSENGER INFORMATION** | |
| 10. General system information | Easy-to-read maps and schedule information in convenient locations. |
| 11. Orientation signage | Street maps of immediate area to identify points of interest and public facilities. |
| 12. Off-site and on-site guide signs | Signage to direct pedestrians or bus riders between mall and nearby streets. |
| 13. Train status display at stations | Real-time electronic display to show expected arrival of next train, destination, emergencies, delays, etc. |

| | |
|---|---|
| 14. Emergency signage | To guide passengers out of stations and off mall in an emergency. |
| 15. Public address system | Primarily in stations, to allow system personnel to communicate with waiting patrons to inform them of delays, emergencies, etc. |
| **VI. PASSENGER CONVENIENCE** | |
| 16. Pay telephones | In convenient locations. |
| 17. Advertising space | In accord with Board policy of 2/23/88; prepared and placed to avoid conflict with system information and signage. |
| 18. Vending/ATM machine(s) | If warranted; in accord with Board policy of 2/23/88. |
| 19. Vendor/retail space/ vendor-provided restrooms | Same as above. |
| **VII. PASSENGER COMFORT** | |
| 20. Canopies | To cover portion of platform; to enhance and be architecturally-compatible with immediate area. |
| 21. Wind screens | Translucent or solid screens; architecturally-compatible with immediate area and overall design scheme. |
| 22. Seating | Low-maintenance seating primarily in stations but also in other convenient locations along mall. |

## VIII. SAFETY AND SECURITY

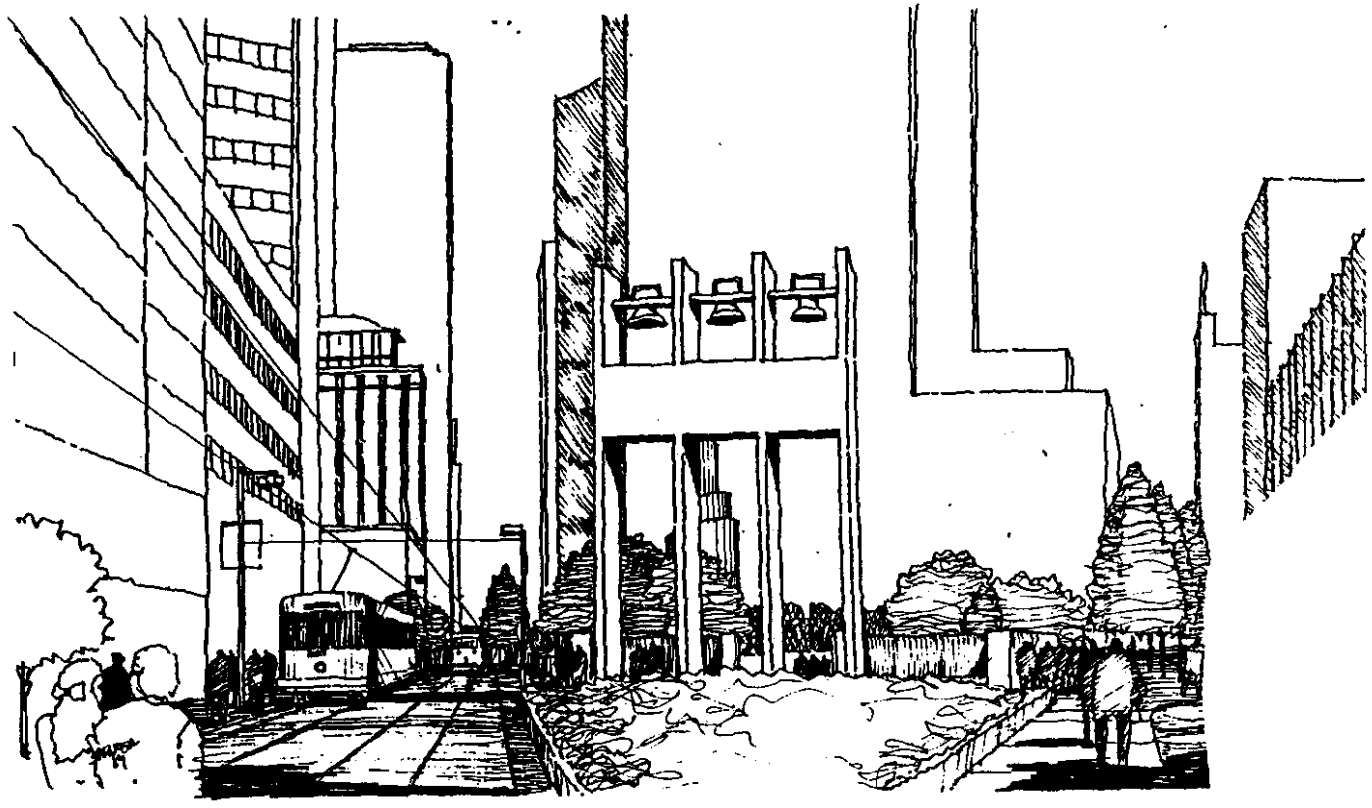
| | |
|---|---|
| 23. Lighting | For safety and for passenger convenience; to be architecturally-compatible with immediate area. |
| 24. Vehicle crossing protection | Signs, signals, or other means at grade crossings to deter rail vehicle collisions with motor vehicles. |
| 25. Pedestrian crossing protection | Signs, signals, special paving materials, etc. |
| 26. Signals coordination | Synchronization of traffic signals to promote smooth traffic flow and deter collisions. |
| 27. Emergency vehicle access | To allow access for emergency vehicles at all times. |

## IX. MITIGATION

| | |
|---|---|
| 28. Traffic improvements | Signs, signals, and special construction to promote smooth motor vehicle flow and to mitigate impacts as necessary. |
| 28. Visual screening | Landscaping, walls, or other means to enhance immediate area around mall and to mitigate any potential adverse visual impacts in sensitive areas. |
| 30. Noise and vibration screening | Landscaping, sound walls, or other means to enhance immediate area around mall and to mitigate any potential adverse noise or vibration impacts in sensitive areas |

## X. TRAIN GUIDANCE

| | |
|---|---|
| 31. Track gauge | Standard gauge, 4'8.5". |
| 32. Minimum turning radius | 100 feet |
| 33. Roadbed | Direct fixation in paved areas; standard tie-and-ballast elsewhere. |
| 34. Overhead power source | Overhead catenary, designed to be architecturally-compatible with immediate area and overall design scheme. |



# DOWNTOWN TRANSITWAY MALL

## THANKS-GIVING SQUARE VICINITY CONCEPT PLAN

PARSONS BRINCKERHOFF-TRANSIT
SASAKI ASSOCIATES, INC.-URBAN DESIGN

AUGUST 1, 1985

**RECOMMENDED KEY DESIGN FEATURES FOR COMMUTER RAIL SYSTEM**

(Note: station features already covered in previous design policies)

| Feature | Remarks/ Typical Value(s) |
|---|---|
| **I. TRAIN GUIDANCE** | |
| 1. Shared right-of-way | In existing railroad corridor with coordinated freight traffic. |
| 2. Trackwork | Standard gauge, 4'8.5". |
| 3. Roadbed | Upgraded tie-and-ballast. |
| **II. SAFETY AND SECURITY** | |
| 4. Fencing | As required, especially in high-density areas. |
| 5. Vehicle crossing protection | At all grade crossings; to deter rail vehicle collisions with motor vehicles. |
| 6. Pedestrian crossing protection | Pedestrian underpasses or overpasses at high-volume locations as required. |
| 7. Emergency communications system | For direct access to DART Public Safety personnel from restricted guideway segments. |

**III. MITIGATION**

| | |
|---|---|
| 8. Grade separations | Used at guideway crossings where no other mitigation measures will solve traffic impacts. |
| 9. Visual screening | As required. |
| 10. Noise screening | As required. |
| 11. Vibration mitigation | As required. |

**IV. PASSENGER VEHICLE**

| | |
|---|---|
| 12. Type | Standard push-pull or self-propelled commuter vehicle. |
| 13. Maximum speed | Approximately 80 mph. |
| <u>Dimensions:</u> | |
| 14. Length | 85'to 90'. |
| 15. Width | 9'10" to 10'6". |
| 16. Exterior height | 12'6" to 16' |
| <u>Capacity:</u> | |
| 17. Seating | 130 to 168 |
| 18. Standing | None |
| 19. Space for wheelchairs | At least one at each end of vehicle. |
| <u>Boarding capabilities:</u> | |
| 20. Vehicle floor height | 2' to 4'6" |
| 21. Standard boarding | Via low-level platform |
| 22. Mobility-impaired boarding | High-level via wayside ramp and platform. |

| | |
|---|---|
| **Environmental Controls:** | |
| 23. Climate control | Air conditioning, heating, ventilation, humidity control. |
| 24. Lighting | Adequate for passenger comfort and security; with overhead reading lamps. |
| 25. Noise control | Insulation to keep interior noise at comfortable levels. |
| **Ride quality:** | |
| 26. Acceleration | Within industry standards for comfortable limits. |
| 27. Vibration | Same as above. |
| 28. Pitch/yaw/sway, etc. | Same as above. |
| **Safety features:** | |
| 29. Systems-related | Signaling and train protection |
| 30. Vehicle materials | Limits on flammability, toxicity, shattering, etc. |
| **Other:** | |
| 31. Doors | 2 on each side of vehicle, operable from one location. |
| 32. Exterior finish and appearance | Futuristic, high-tech appearance within budget limitations; low-maintenance materials. |
| 33. Interior finishes | Similar to express buses, such as attractive but low-maintenance reclining seats, skid-resistant flooring, overhead luggage racks. |

## V. SYSTEMS

| | |
|---|---|
| 34. Vehicle operating orientation | Push-pull, with locomotive at one end and passenger vehicle at the other. |
| 35. Multiple car train capability | Can operate in multiple-car trains. |
| 36. Power | Diesel locomotives. |
| 37. Communications | Operator communications with passengers and to and from control center. |
| 38. Signals | Wayside. |
| 39. Train protection | Central corridor control to prevent collisions between trains. |

## VI. PASSENGER INFORMATION ON VEHICLE

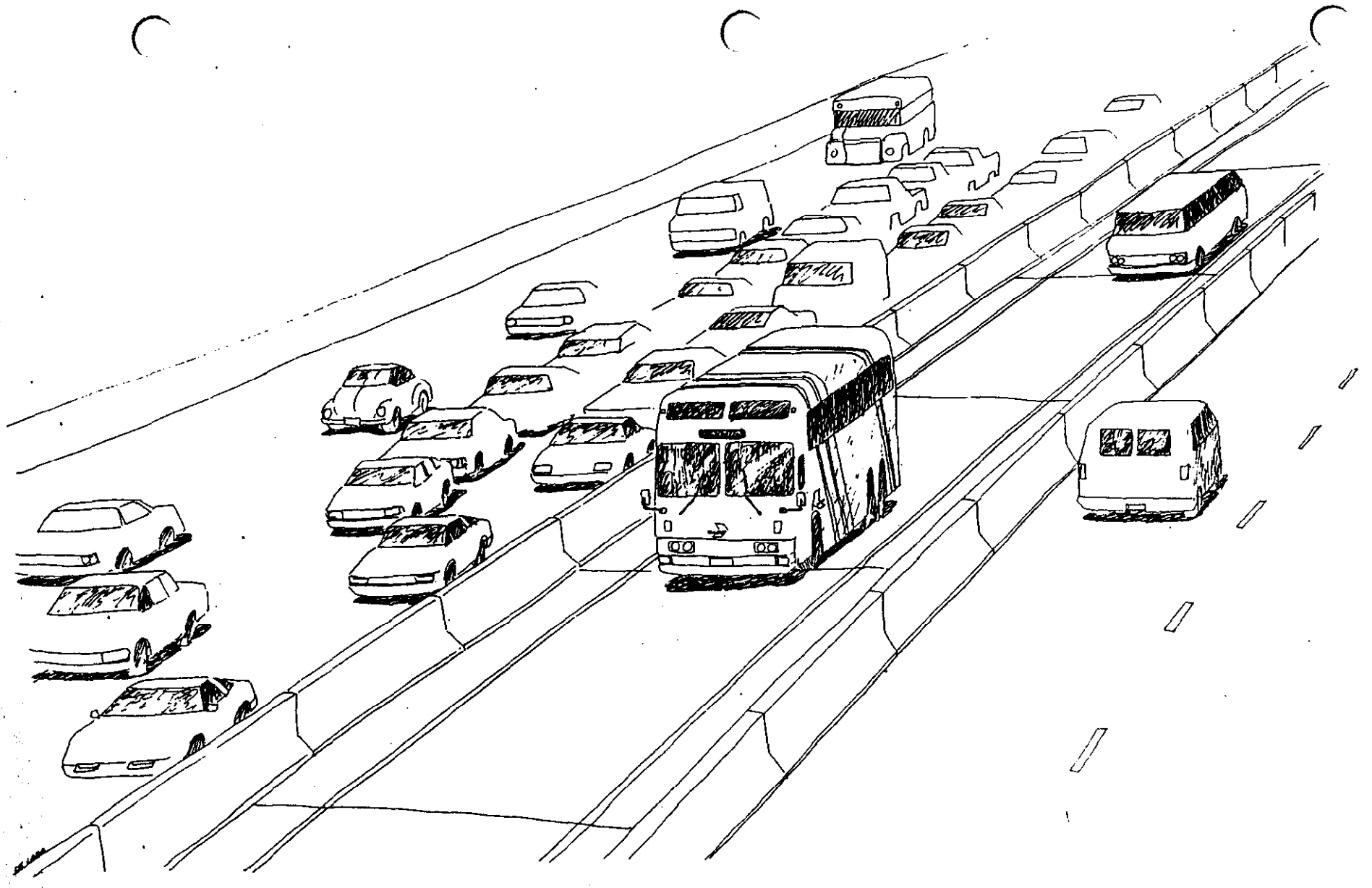
| | |
|---|---|
| 40. Exterior signage | Large, highly-visible destination and route signs. |
| 41. Interior signage | Destination, route, system, fare, and conduct signs on display in each car. |
| 42. Interior emergency signage | On display in each car. |
| 43. Public address system | To allow operator or on-board personnel to call out station stops and relay other essential information to passengers. |

## RECOMMENDED KEY DESIGN FEATURES FOR HOV LANES

| Feature | Remarks/ Typical value(s) |
|---|---|
| **I. PASSENGER ACCESS** | |
| 1. Bus transfer facilities | Pulse points that may be needed in selected locations near entrances and exits of HOV lanes. |
| 2. Park-and-ride lots | Special lots that may be needed based on passenger demand, built near entrances and exits and upstream of HOV lanes. |
| **II. HIGH-OCCUPANCY VEHICLE ACCESS** | |
| 3. On/off ramps | To allow vehicles to enter HOV lanes from streets and highways. |
| 4. Signs and signals | To guide vehicles on and off HOV lanes. |
| **III. VEHICLE GUIDANCE** | |
| 5. Traffic lane construction | Standard highway lanes built to accommodate HOV vehicles, usually within highway rights-of-way. |
| 6. Way structures | Aerial structures to support grade-separated lanes. |
| 7. Traffic barriers | To keep HOV traffic separated from regular vehicular traffic. |
| 8. Lane markings | To ensure safe flow of HOV traffic. |

## IV. SAFETY AND SECURITY

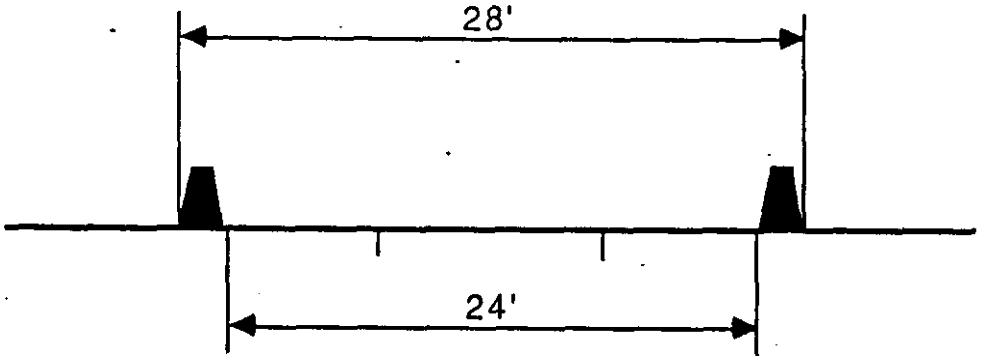
| | |
|---|---|
| 9. Shoulders | To allow emergency evacuation of passengers from HOV vehicles and for emergency parking of disabled vehicles. |
| 10. Emergency vehicle access | To allow emergency vehicles easy access at all times to HOV lanes. |



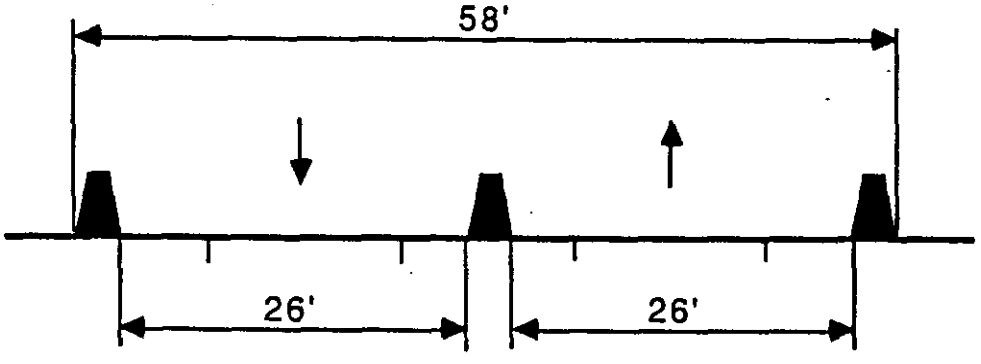
HOV Transitway

# HOV TRANSITWAY

## TYPICAL SECTIONS




**ONE WAY**




**TWO WAY**

# DALLAS AREA RAPID TRANSIT
# MITIGATION POLICIES

The Dallas Area Rapid Transit (DART) Transit System Plan (DART, July 1989) and its predecessor plans were prepared in recognition of the tremendous benefits rail and other transit improvements would have for the Dallas region. Regional benefits will include:

- Reduced traffic congestion and improved mobility.
- Improved air quality.
- Reinforcement of the continued attractiveness of the DART Service Area for new economic development.

Along with the tremendous regional benefits of a major new transportation system comes local change. A thoughtfully conceived and designed transit system can both maximize benefits and minimize any adverse effects to the quality of the urban and natural environment. DART carefully weighed the potential for positive and negative effects on urban and natural environmental quality when developing its Transit System Plan. It is DART's intent to maintain a high level of sensitivity to environmental quality issues. DART intends to identify, measure, and determine the significance of the changes brought about by the implementation of its System Plan. In addition, where it can be determined that a significant adverse effect on environmental quality is likely to occur, means to mitigate such effects will be selected and incorporated into the project.

The task of assuring a high level of urban and natural environmental quality is made easier by the overall environmental sensitivity of advanced Light Rail Transit (LRT) technology. During recent years, a dozen new, or extensively upgraded, LRT lines have been built, or are currently under construction, in North American cities. For most of these projects, Federal Environmental Impact Statements, or the often more rigorous state environmental effects reports, have been prepared. While there have been environmental quality concerns in unique situations, in the final analysis, there have been very few cases where extensive mitigation programs have been required. Table 1 summarizes the extent of mitigation required for seven recently built or planned LRT systems, as identified in their Environmental Impact Statements. The limited need for mitigation has been a testimony to the environmental sensitivity of advanced LRT technology, especially when compared to the thousands of highway mitigation programs that have had to be implemented in recent years.

Table 1
MITIGATION NEED OF RECENT LIGHT RAIL TRANSIT PROJECTS

| | Los Angeles Guadalupe 1983 | Baltimore Central 1988 | Long Beach Los Angeles 1984 | Portland Westside 1982 |
|---|---|---|---|---|
| SYSTEM CHARACTERISTICS | | | | |
| Total length (miles) | 19.2 | 27 | 22 | 12–15 |
| % at grade | 100% | 100% | 80–100% | 100% |
| % aerial | 0% | 0% | 7–20% | 0% |
| % subway | 0% | 0% | 0–8% | 0% |
| # at grade crossings | 24 | 48 | 3–8 | 14–19 |
| # grade separations | 0 | 0 | 0 | 0 |
| # of stations | 35 | 35 | 49 | 17 |
| % wayside adjacent to sensitive land use | 57% | 46% | 40% | 60% |
| PRINCIPLE MITIGATION REQUIREMENTS | | | | |
| Traffic | Major street intersection separation | Turning lanes<br>Crossing protection<br>Coordinate signals | Ride sharing to stations<br>Parking mgt plan | Traffic signal modification<br>Parking plan |
| Community | Landscaping<br>Bicycle path | – | Relocation<br>Pedestrian crossings | Relocation plan<br>Vegetation buffers |
| Natural Resources | Flood proofing<br>Bypass channels<br>Erosion control | Wetlands replacement<br>Floodplain fill<br>Stormwater mgt plan | Noise control | Parkland replaced<br>Tree preservation |
| # of Wetlands | 6 | 49 (6 Tidal) | 0 | 1 |
| % of Wayside requiring a noise barrier | 21% | 8% | Under consideration | 0% |
| Construction | Energy efficient practices | – | Detour plan<br>Provide for pedestrian access | Worker parking control<br>Post constuction hrs |

As applicable to specific issues, the background section:

- Describes the regulating law and industry practice on which the objectives, measures, methods, and warrants are based.
- Lists regulating agencies with whom DART will coordinate in assessing environmental impacts, determining mitigation needs, and developing mitigation programs.
- Identifies common mitigation techniques.
- Lists design criteria, specifications, or directive drawings prepared as a part of past DART rail design studies that will be used systemwide to help assure the rail system's sensitivity to environmental quality. In most cases, however, specific mitigation designs and procedures will be prepared on a case-by-case basis.

**POLICY IMPLEMENTATION**

DART will implement its Mitigation Policies within the context of the following three step program:

1. Preparation of an environmental impact assessment that determines potential effects on environmental quality and presents and compares alternative approaches to mitigation where warranted.
2. Evaluation of mitigation alternatives during preliminary design, and selection and commitment to a specific mitigation program.
3. Incorporation of the mitigation program into project plans.

**Environmental Impact Assessment**

Site-specific environmental impacts that need mitigation will be determined for the broad range of social, economic, and natural environmental quality issues. Potential approaches to mitigation will be evaluated. This assessment of impacts and mitigation will occur as a part of each rail corridor's conceptual design.

For Federal new start transit projects, such an assessment is accomplished during the preparation of an Urban Mass Transportation Administration Alternatives Analysis/Draft Environmental Impact Statement (AA/DEIS). The conceptual designs of several promising alternatives are evaluated and compared in an AA/DEIS.

DART will also assess environmental impacts, evaluate alternative approaches to mitigation, and prepare an environmental impact assessment document for its locally funded projects. This local document will address those environmental quality issues addressed by local, state, and federal environmental protection law; the environmental quality issues addressed in this document; and any additional local or site specific concerns identified.

The environmental quality objectives, impact measures, impact assessment methods, and mitigation warrants contained in this document will guide both Federal and local impact assessments. Mitigation alternatives will be evaluated and compared in terms of effectiveness in achieving DART's quality assurance objectives, capital cost, effects on transit operations, operations and maintenance costs, any new impacts created, and acceptability to the community and applicable regulatory agencies.

In whatever context impacts are identified, community involvement will make an important contribution. Community involvement will be used to aid in the identification of critical local issues and to demonstrate to the community how those issues are being given due consideration in the development of the conceptual design. The public will provide important input into DART's understanding of how their communities function, and how DART rail might affect that function. The public will contribute to DART's understanding of the unique and important aspects of community character. A public involvement program will also serve as the forum for the presentation of mitigation alternatives or design options and the receipt of community input.

**Commitment to a Specific Mitigation Program**

Based on conceptual design studies, the findings of the federal or local environmental impact assessment, and community input, the DART Board of Directors will select or affirm a preferred alternative. Mitigation alternatives will be further evaluated based on a more detailed preliminary design. Final decisions related to mitigation will be made and DART will then commit to carry out a specific mitigation program. During federal transit project design, the commitment is made within a Final Environmental Impact Statement. For local projects, this commitment will be made within a mitigation program document that will be based on the results of the local environmental impact assessment. Here public involvement will contribute to the level of emphasis that will be placed on each evaluation factor as mitigation alternatives are compared and the final mitigation program is put together.

## Issues

The DART Mitigation Policies consists of a series of policy statements, each addressing a specific environmental quality issue. These policy statements consider the potential effect of the presence and operation of a rail transit line on traffic, the urban community, and natural resources. Rail transit construction is also considered. Table 2 identifies the full range of issues addressed by the mitigation policy statements.

The depth and specificity of each policy depends on the complexity of each issue and the extent to which it can be measured objectively versus subjectively. For example, noise and vibration objectives and mitigation warrants can be expressed objectively, in terms of specific noise and vibration levels that should not be exceeded. Such a policy also can be very complex because it must take into account a variety of sound producers and receiver settings. On the other hand, visual mitigation warrants must be subjective. They can identify many of the types of things to look for when judging the significance of a change in a visual setting, but in the end the final decision on the need for mitigation will be dependent on the best judgement of the decision maker.

It is also recognized that DART will face unique situations or types of effects that have not been anticipated in the mitigation policies. In those cases, the mitigation decisions made at an issue's first occurrence will set the precedent for a systemwide policy.

## Content

Each mitigation policy statement contains three parts: issues, policy, and background. The issues section defines the environmental quality issue or issues which the policy statement addresses. The policy section:

- Lists DART's environmental quality assurance objectives for each issue.
- Describes how environmental impacts will be measured.
- Presents the methods that will be used to determine if an environmental impact warranting mitigation is likely to occur.
- Defines when mitigation is warranted.

Table 2: Policy Statement Issues

**TRAFFIC**

- Movement
- Parking

**URBAN COMMUNITY**

- Relocation
- Social Interaction and Land Use Planning
- Visual Quality
- Archaeology
- Historic Resources
- Safety
- Security
- Parks
- Airport Clearance Zones

**NATURAL RESOURCES**

- Air Quality
- Noise and Vibration
- Water Resources
- Wetlands and Ecosystems

**CONSTRUCTION**

- Circulation Maintenance
- Construction Site Operation
- Materials Transport
- Utilities Maintenance
- Waste Disposal
- Noise, Vibration, and Air Pollutant Control
- Natural Resources Protection

## POLICY DESCRIPTION

### Focus

The focus of the DART Mitigation Policies is on: 1) environmental quality objectives, 2) impact assessment measures and methods, and 3) mitigation warrants.

The environmental quality objectives define the environmental quality standard DART intends to meet in the construction and operation of its rail system.

The impact assessment measures and methods describe how the potential for environmental impact of each rail project will be determined.

Mitigation is defined as specific positive steps that are taken to assure that an acceptable level of urban and natural environment quality is maintained. Mitigation warrants or criteria define the basis for judging whether a potential impact is significant enough to require mitigation. Mitigation can include:

- Addition or refinement of design features.
- Specification of the performance characteristics of materials and components.
- Specification of construction procedures or performance standards in construction contracts.
- Operating and maintenance procedures.

The policies do not recommend specific techniques that must be used to mitigate environmental effects, although common mitigation techniques are described and illustrated. Objectives and warrants can be applied systemwide; mitigation techniques vary by specific situation.

The determination of where or in what situations mitigation is needed will be made by DART based on an environmental impact assessment, with input from regulatory agencies and the general public. The specific approach to mitigation is also determined as a part of the environmental impact assessment and is later refined as a part of design development, specifications preparation, and operations and maintenance procedures planning.

**Basis**

The environmental quality objectives and mitigation warrants take into account:

- The individual character of the cities, neighborhoods, business communities, and natural areas that comprise the DART service area and the individual concerns of each one.

- The wide variety of environmental quality issues that will need to be addressed.

- The differing perspectives contained within each environmental quality issue, including the potential for direct environmental effects (such as crossing floodplains), indirect effects (such as possible air pollution), long term effects (such as possible increased traffic congestion near stations), short term effects (such as disturbance of residential neighborhoods by materials hauling during construction), operational effects (such as changed noise levels), and effects resulting from a rail line's presence (such as visual changes).

- Existing environmental protection law. For example, DART must comply with federal laws related to waterways, a state law related to archaeological resources, and local floodplain ordinances.

- Adopted DART policy. DART has already adopted a property acquisition and relocation policy and has adopted guidelines for the design of stations and the guideway.

- Industry standards and the example of other light rail systems. For example, the American Public Transit Association (APTA) has developed noise and vibration criteria specifying maximum acceptable levels. It is used industry-wide. The Urban Mass Transportation Administration applies a noise criterion to its projects that specifies a maximum acceptable change in average existing noise levels.

- Sensitive design practice. For example, sensitive design practice dictates that station parking lot entrances should be placed such that the use of local streets by non-neighborhood patrons is not encouraged.

- Community priorities. For example, it is assumed that Dallas places a high priority on not altering the character of a historic resource designated a City Landmark or the character of its setting.

| | Portland Banfield 1980 | San Diego East Urban 1986 | Sacremento 1983 |
|---|---|---|---|
| SYSTEM CHARACTERISTICS | | | |
| Total length (miles) | 14.9 | 11.2 | 18.3 |
| % at grade | 100% | 100% | 100% |
| % aerial | 0% | 0% | 0% |
| % subway | 0% | 0% | 0% |
| # at grade crossings | NA | NA | NA |
| # grade seperations | 1 | NA | 16 |
| # of stations | 29 | 11 | 27 |
| % Wayside adjacent to sensitive land use | 40% | 75% | 75+% |
| PRINCIPLE MITIGATION REQUIREMENTS | | | |
| Traffic | Parking mgt plan | - | Crossing protection<br>Added lighting<br>Street improvement |
| Community | Aquisition plan | Landscaping<br>Carpooling to stations | Relocation plan |
| Natural Resources | Noise barrier<br>Habitat creation<br>Landscaping | - | Revegetation |
| # of Wetlands affected | 0 | 0 | 0 |
| % of Wayside Requiring Noise Barrier | 16% | Limited | 0% |
| Construction | Construction guidelines<br>Dust control<br>Energy efficient practices | Dust control | Constuction guidelines |

NA = Not Applicable

**STATEMENT OF PURPOSE AND CHALLENGE**

This document contains the policies DART will implement in order to fulfill its commitment to remain sensitive to urban and natural environmental quality issues throughout rail project planning and design, a sensitivity that will be reflected during both construction and operation of DART's planned rail system. The purpose of this document is threefold:

1. To provide a guide to project planners and designers for identifying potential effects on environmental quality, judging their significance, and determining an appropriate approach to mitigation.

2. To assure a fiscally sound, balanced, and equitable approach to maintaining environmental quality.

3. To reassure the community that DART is committed to environmental quality, and will actively seek to identify and address those undesirable changes which may result from the construction and operation of transit improvements in its service area.

Implementation of the policies contained in this document will be a challenge to both DART and the community it serves. DART will demonstrate to the community its commitment to fully implement these policies by:

- Listening carefully to the concerns of the public and regulatory agencies and giving them careful consideration as a part of a systematic and comprehensive environmental impact assessment process.

- Actively seeking effective means to mitigate significant environment effects.

- Involving the public and regulatory agencies in the evaluation of concerns and the development of appropriate mitigation.

The challenge to the community will be to actively work with DART to resolve their concerns in a fiscally sound, balanced, and equitable manner.

## Implementation of Mitigation Program

The mitigation program will be incorporated into project plans. As appropriate, it will be incorporated into the:

- Final design.
- Project specifications.
- Contractor contracts.
- Operating and maintenance procedures.

## MITIGATION POLICIES
## Table of Contents

**TRAFFIC POLICY** **1.1**

**MOVEMENT**

## Issue

How will traffic flow be maintained during rail project operation? Will traffic be diverted and/or attracted to local streets? How will circulation patterns and access to adjacent land uses be maintained?

## Policy

### Environmental Quality Assurance Objectives

- Maintain at least level of service "D" on streets and thoroughfares crossing the rail project or, if the level of service would be "E" or "F" without the rail project, take steps to avoid worsening congestion.
- Minimize traffic delay.
- Avoid diversion or attraction of traffic to local streets.
- Avoid the creation of circuitous circulation patterns for local traffic and emergency vehicles.
- Maintain access to adjacent properties.

### Impact Measures

- Thoroughfare level of service.
- Changed circulation patterns.
- The need to alter property access points.

### Impact Assessment Method

1. Flow

    a. Existing average daily and peak hour volumes, street capacity, and level-of-service will be identified for major and minor thoroughfares.

    b. Average daily and peak hour traffic on major and minor thoroughfares with the rail project will be forecast for the year the project opens and the design year. The forecasts will be based in part on the rail project's characteristics.

c. If the peak hour volume on a primary thoroughfare is less than 600 vehicles per lane or the volume on a minor thoroughfare is less than 500 vehicles per lane, it will be assumed that an adequate level of service will be maintained and no further analysis will be made. This criteria is defined in Urban Mass Transportation Administration Circular 5620.1, Guidelines for Preparing Environmental Assessments (October 16, 1979).

d. If the criteria in item c, or a more stringent local government requirement, is not met, a detailed level of service analysis will be conducted. It will be based on the physical and operational characteristics of the street system (approach width, one way or two way operation, and parking conditions), the characteristics of traffic (turning movements and number of trucks and buses), and the traffic control measures in operation (type of control and characteristics of control devices). Any additional traffic analyses required by local government also will be conducted.

2. Circulation.

a. Existing local and collector streets will be identified. The location of emergency services, their service areas, and response time requirements will be identified.

b. Based on the location of planned street closures, at-grade crossings, street improvements, and station and other facility entrances, changes in local and collector street circulation will be determined. The assessment will focus on identifying the potential for: 1) diverting rail project patron traffic on to local streets, 2) increasing the travel distance for local traffic traveling to reach thoroughfares and local community services, and 3) increasing the travel distance from emergency services to individual land uses.

3. Accessibility

a. Current property access points for occupants, visitors and customers, deliveries, refuse collection, repair services, and emergency services will be identified.

b. Engineering plans will be used to identify potential access changes, including new access

points, lost access points, and changes in the convenience of existing access.

c. Alternative approaches for restoration of access will be compared.

**Mitigation Warrants**

- Traffic flow along major or minor thoroughfares, or at intersections, is at level of service E or F.
- Non-local traffic is likely to use local streets to reach stations.
- Travel distance for local traffic traveling to reach thoroughfares and local community services is increased to a point higher than the maximum travel distance now found in the neighborhoods containing the rail project.
- Inconvenient circulation patterns will cause an unacceptable emergency response time, as defined by the municipal jurisdiction in which the rail project is located.
- Partial or full closure of public access to adjacent properties.

**Background**

**Regulating Law and Industry Practice**

"Level of service" defines the quality of traffic flow. Level of service A is defined as free flowing traffic. A stable flow with few restrictions on operating speed is level of service B. Level of service C is also considered a stable flow but with more restrictions on speed and lane changing. A peak hour level of service D is considered the minimum level of service acceptable for urban areas. An unstable flow is being approached and there is little freedom to maneuver. Level of service D is considered to be tolerable for only short periods. Level of service E is an unstable flow characterized by low operating speeds and some momentary stoppage. A forced flow with considerable stoppage is classified as level of service F.

The requirements of municipal codes must be met. The City of Dallas Development Code requires a Development Impact Review when site traffic generation is in excess of 1,000 vehicles per day. An estimate of peak hour turning movements at a development site and within 250 feet of such a site, and an estimate of traffic on adjacent streets must be submitted to the City of Dallas with a site plan. Developers must meet City cost sharing requirements for

street improvements. Texas Manual on Uniform Traffic Control Devices warrants for signalization must be met.

State Department of Highways and Public Transportation design criteria and other policies must be met.

**Regulating Agencies**

State Department of Highways and Public Transportation and municipal government.

**Common Mitigation Techniques**

. Operational measures to improve traffic flow.

  - Improvement of traffic signing and pavement markings.
  - Modification of existing traffic signals.
  - Coordination of signal timing between intersections.
  - New traffic signals.

. Geometric measures to improve traffic flow.

  - Free right turn lanes.
  - New left turn lanes.
  - Double left turn lanes.
  - Additional through lanes.
  - Grade separation.

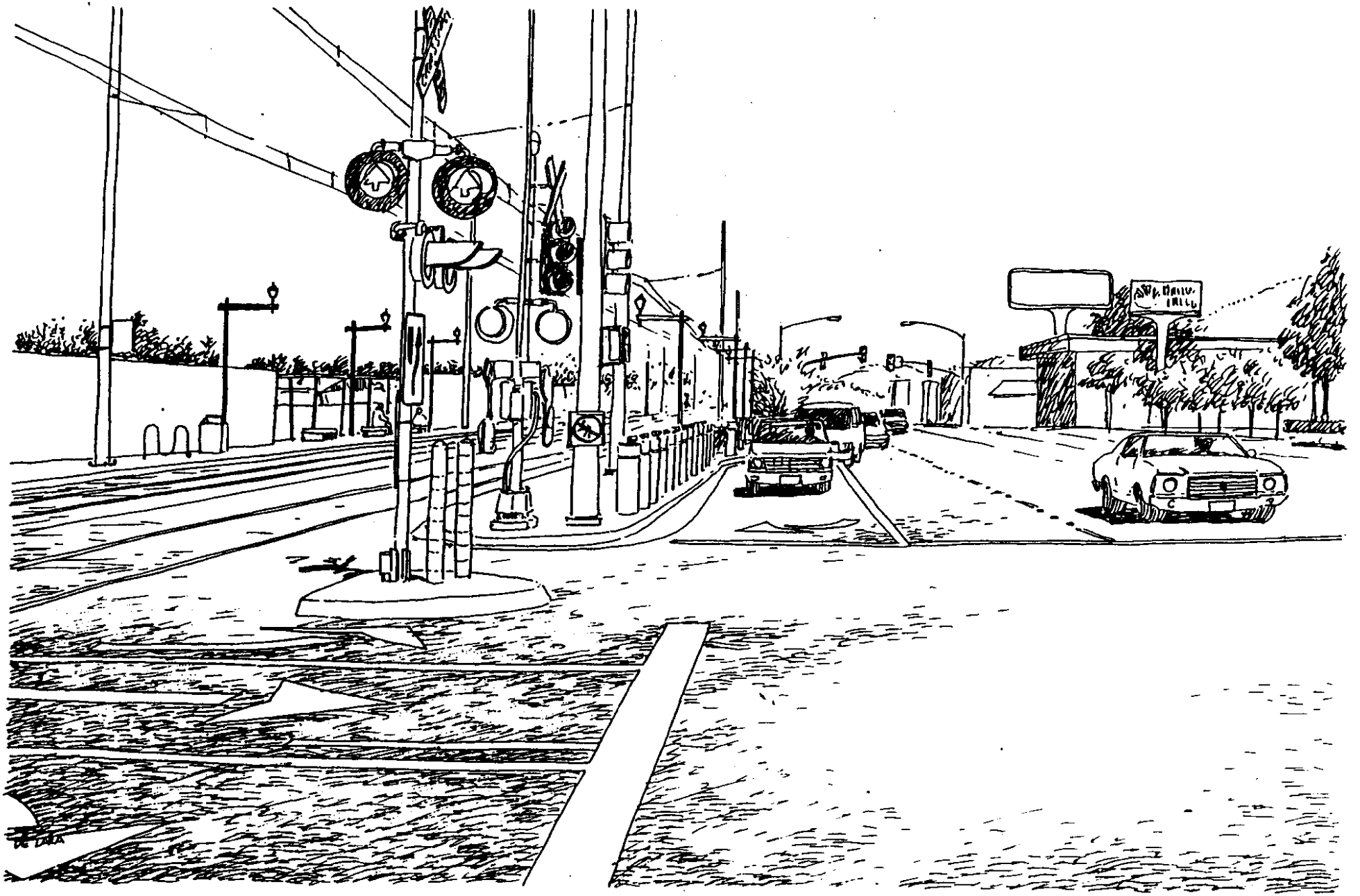
. Circulation and accessibility

  - Relocate planned station or other facility entrances.
  - Close the thoroughfare connection at one end of any local street attracting station traffic.

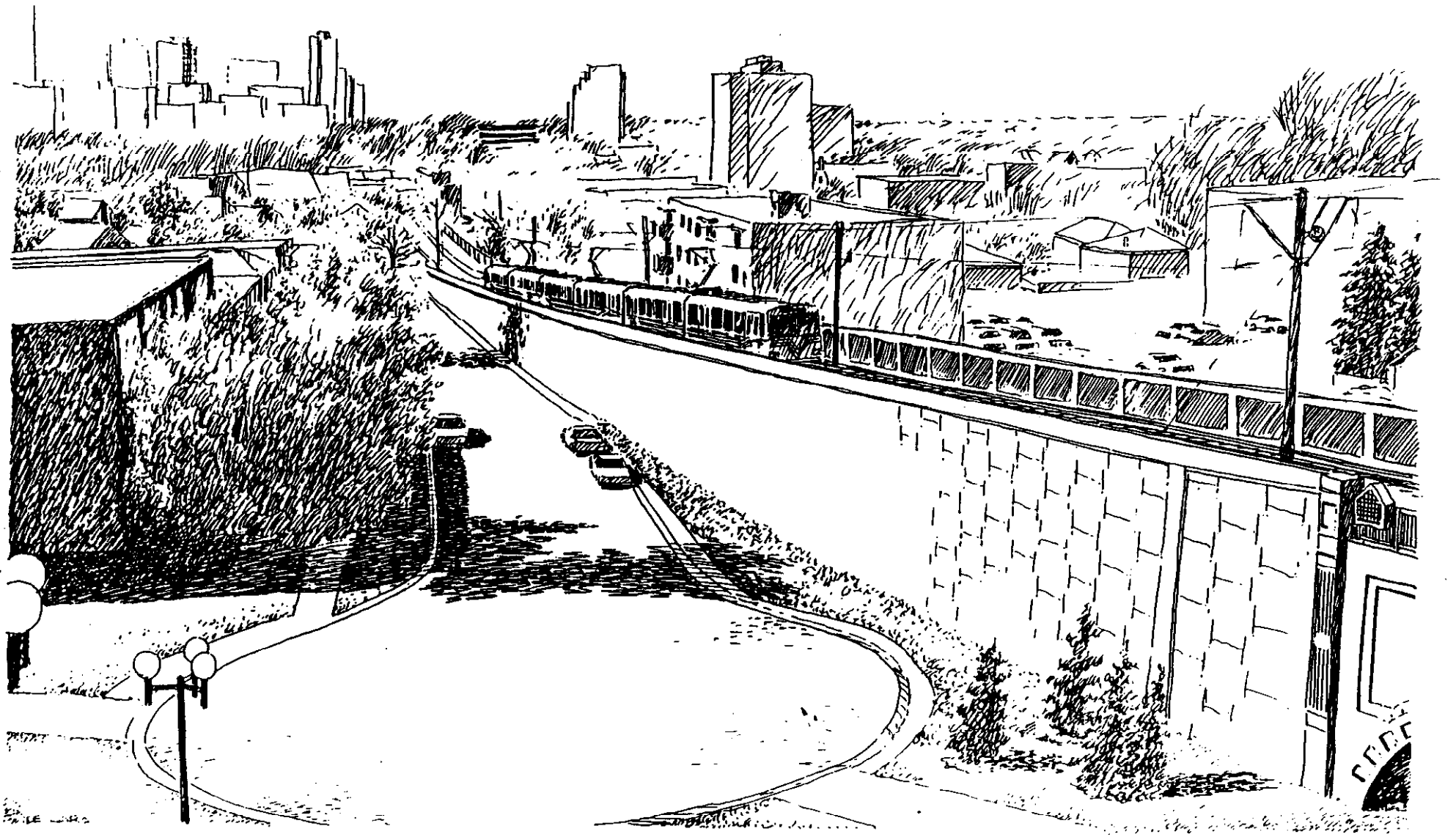
**Applicable Design Criteria, Drawings, and Specifications**

Access to station site facilities is addressed in Chapter 4, "Streets/Highways and Parking," of the Dallas Area Rapid Transit Rail Design Criteria. Traffic control at rail project at-grade crossings is addressed in Chapter 5, "Traffic Control." Joint Dallas Area Rapid Transit/ municipal warrants for grade separation have been developed with the City of Dallas.

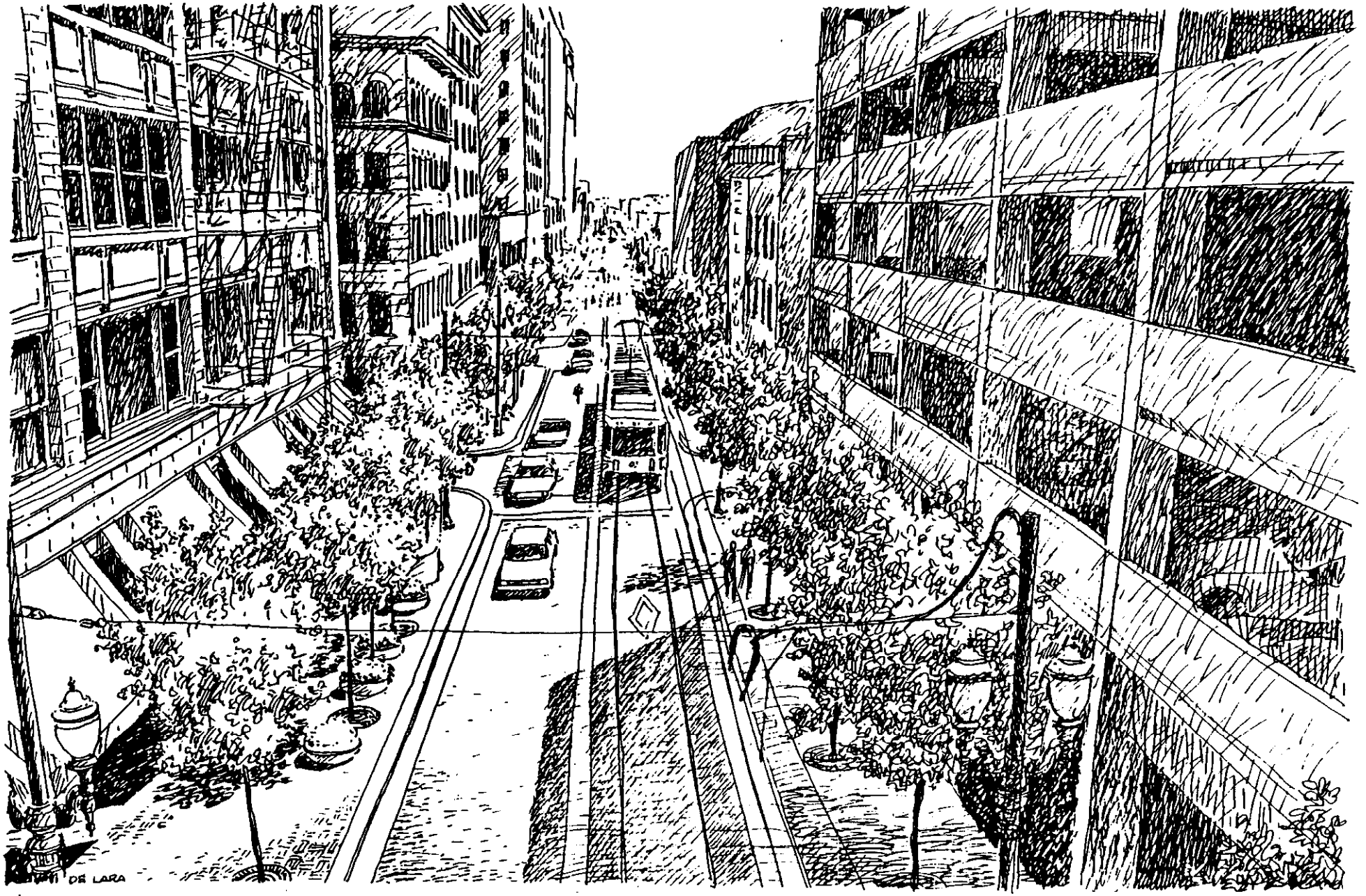
A right turn lane near a station helps keep traffic flowing in San Diego.



Calgary light rail rising to pass over 10th Street, a four lane thoroughfare.



A single traffic lane provides access to adjacent land uses on a street with light rail operations in Portland.



## PARKING

### Issue

How will the parking supply for existing businesses and residences be maintained during operation of a rail project?

### Policy

**Environmental Quality Assurance Objectives**

Avoid diminishing the supply of on- and off-street parking for businesses and residences along rail projects.

**Impact Measures**

Parking supply and demand.

**Impact Assessment Method**

1. Existing parking supply and demand will be identified.

2. Parking demand with the rail project will be forecast taking into account transit patron, employee, and any joint development parking requirements. The number of parking spaces (on- and off-street) eliminated, replaced, and added will be identified based on engineering plans.

3. If fewer than ten existing parking spaces will be eliminated, or fewer than 50 existing spaces will be eliminated and replacement parking will be provided (either new spaces or through the use of underutilized spaces), or over 50 existing parking spaces will be eliminated and comparable replacement spaces will be part of the proposed action, it will be assumed that adequate parking will be provided for and no further analysis of this type of impact will be made. Comparable parking is that which serves the same group of users as the parking eliminated and is no more than an additional 200-foot walk (approximately one-half block) from the parker's destination. This criteria is defined in Urban Mass Transportation Administration Circular 5620.1, Guidelines for Preparing Environmental Assessments (October 16, 1979).

4. If parking can be readily provided for all rail project employees, forecast patron parking demand, and forecast joint development parking demand, it will be assumed

that no impact from increased demand will occur and no further analysis of such impacts will be made.

5. If a detailed analysis of parking impacts is required, the timing of use and purpose of existing parking spaces eliminated by displacement, or by rail project patron or employee use, will be determined. The consequences of not providing comparable replacement parking spaces or meeting project generated parking demand will be addressed, including inconvenience to existing parkers, use of existing parking by transit patrons, and loss of business. Mitigation alternatives will be compared.

**Mitigation Warrants**

Positive steps taken to attain the quality assurance objective is warranted whenever 10 or more existing parking spaces are to be eliminated or new parking demand is created.

**Background**

**Regulating Law and Industry Practice**

Municipal zoning and development codes require that adequate parking be provided.

**Regulating Agencies**

Municipal government.

**Common Mitigation Techniques**

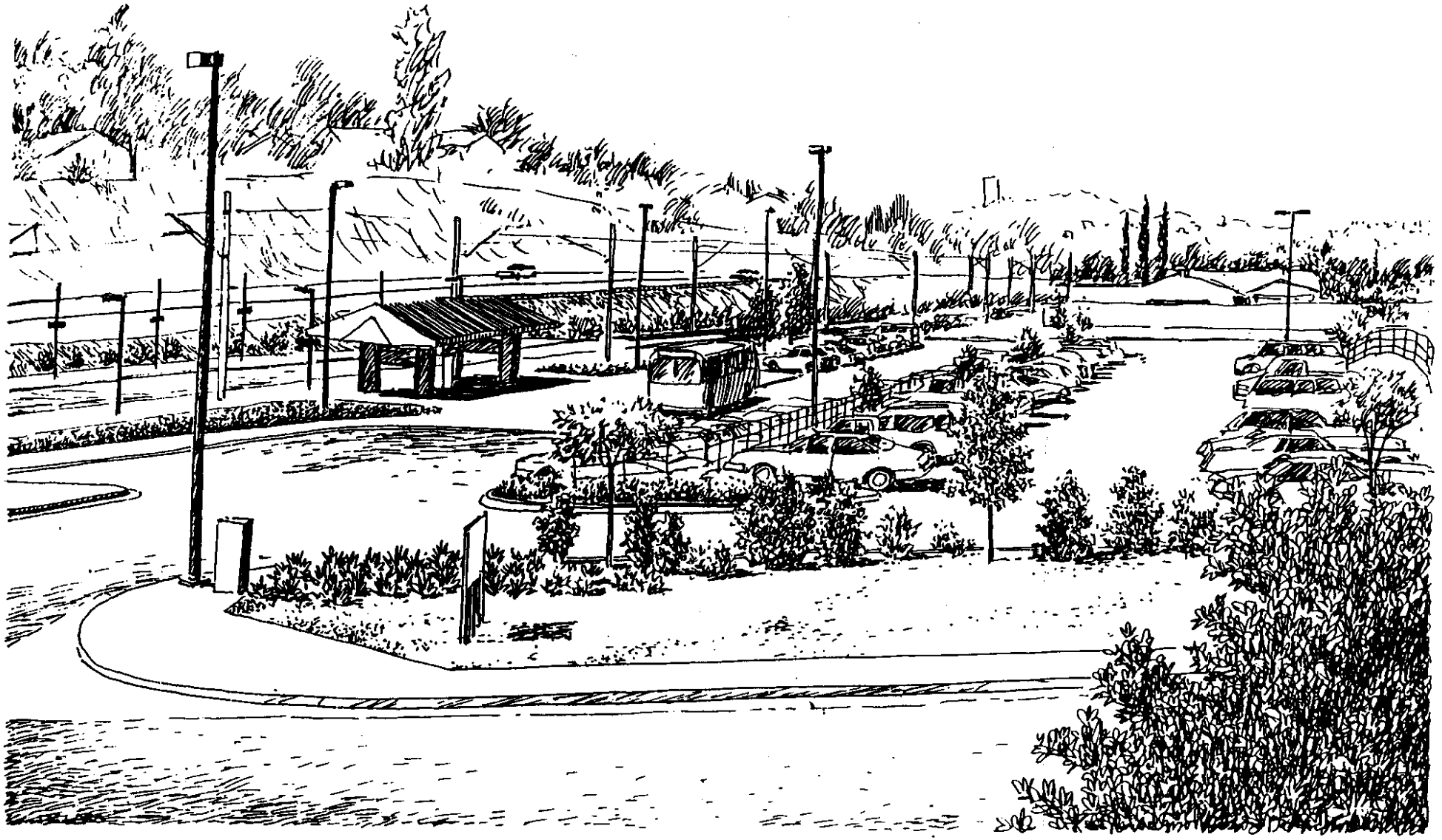
- Improve bus service in order to reduce transit patron parking demand.
- Request the municipal government to adopt controls for parking off the transit site. This could include time limits on on-street parking, parking decals for residents/tenants, and stepped up parking ordinance enforcement.
- Increase the supply of parking at flanking stations beyond what is strictly required in order to shift projected parking demand away from stations where needed parking spaces cannot be readily provided.
- Implement a combination controls on parking off the transit site and increased supply at flanking stations.
- Build a parking garage where land costs are high or the extent of displacement required to assemble land for surface parking is great.

- Set up a shared parking arrangement in situations where the timing of peak rail project, joint development, and surrounding land use parking demand does not coincide.

**Applicable Design Criteria, Drawings, and Specifications**

Parking is addressed in Chapter 4, "Streets/Highways and Parking," and Chapter 19, "Station Site Requirements" of the Dallas Area Rapid Transit Rail Design Criteria. Parking is also addressed in the Transit Design Policy Manual.

Rail transit station parking in San Diego



## RELOCATION

### Issue

What procedures will be followed when relocating households, businesses, farm operations, and non-profit organizations displaced by a rail project?

### Policy

**Environmental Quality Assurance Objectives**

- Minimize the displacement requirements of rail projects.
- Relocate households displaced into housing that is decent, safe, and sanitary; has adequate living space to accommodate the displaced household; and fits the household's financial limits.
- Provide fair and equitable treatment to all persons and organizations affected by rail project property acquisition.

**Impact Measures**

The need for displacement of homes, businesses, farm operations, and non-profit organizations, and the availability of replacement buildings and facilities.

**Impact Assessment Method**

1. A general description of the area or neighborhood where displacement occurs will be prepared. The service areas of community services and neighborhood boundaries, vacancy rates, number of subsidized housing units, and average sales prices and rents will be identified.
2. Population characteristics will be determined, including, average income, household size, percent of rented and owner occupied homes, percent of minorities, and percent of elderly persons. Several of these items will be compared to the DART service area as a whole in order to determine if a greater than normal number of households with special relocation needs, including persons with low incomes, minorities, large households, and the elderly, exist in the neighborhood.

3. The approximate number of individuals, families, businesses, farm operations, and non-profit organizations that would be displaced will be estimated. A windshield or sidewalk survey (observation) will be used in combination with the data gathered in step 1 to determine the likely relocation requirements of those displaced. For homes, this will focus on housing type and size. For businesses and nonprofit organizations, this will include the type of business or organization, specific needs (including building size, parking needs, zoning requirements, access to rail, dock space, and special utility requirements), and needs that impact the timing of the displacement (e.g. seasonal operation, weekend move only).

   No intentional disturbance of land owners or tenants will be made during this effort or until a final alignment or site is selected and acquisition is authorized.

4. The likely availability of decent, safe, and sanitary replacement housing within the financial means of all households that would be displaced will be determined via contacts with real estate brokers, public housing authorities, chambers of commerce, and/or local builders.

5. Other major public works projects in the same area that also may require the use of available replacement lands, structures, or facilities will be identified.

6. The findings of the above studies will be presented in the local or federal environmental assessment document as a conceptual relocation plan.

**Mitigation Warrants**

A project relocation program is warranted whenever homes, businesses, farm operations, and non-profit organizations are displaced by a rail project.

**Background**

**Regulating Law and Industry Practice**

Dallas Area Rapid Transit has adopted Real Estate Policies and Procedures. They are based on the requirements of the federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (42 U.S.C. 4601). They set policies and procedures for property appraisal, property acquisition, relocation, property management, and joint development. Following a decision to acquire property, the DART Real Estate and Development Department will prepare a

displacement analysis in which the needs of individual displacees will be documented and information will be provided to displacees on relocation entitlements. DART will assist those displaced in finding replacement locations.

For federally funded or licensed rail projects the requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 must be followed.

**Regulating Agencies**

Each federal funding and licensing agency, and the local governmental body receiving funding or licensing, are responsible for meeting the requirements of real estate and relocation law.

**Common Mitigation Techniques**

- Provide assistance to displaced households, businesses, farm operations, and non-profit organizations in finding replacement locations, including maintaining lists of replacement properties.

- Provide payments (subject to upper limits) to households for moving costs, costs incurred when purchasing a dwelling, and supplemental payments to cover higher costs of new housing compared to old.

- Provide payments (subject to upper limits) to businesses and non-profit organizations for moving costs; professional services to plan moves; reimbursement for unexpired licenses, permits, or certifications; replacement of stationary supplies; loss of tangible personal property that cannot be moved; and the cost of searching for a replacement location.

**Applicable Design Criteria, Drawings, and Specifications**

Dallas Area Rapid Transit Real Estate Policies and Procedures.

## SOCIAL INTERACTION AND LAND USE PLANNING

### Issue

Will the rail project make a positive contribution to the surrounding community and its future development?

### Policy

**Environmental Quality Assurance Objectives**

- Contribute to community cohesion.
- Integrate stations and other facilities into the communities that surround them.
- Reinforce community planning and development objectives.
- Provide for an equitable distribution of costs and benefits.

**Impact Measures**

A series of subjective observations will be used to identify and measure social interaction and land use planning impacts. The judgement of municipal planners and the general public will play a critical role in this process. The results of noise and vibration, air quality, visual quality, traffic, safety, and security impact assessments also will be important. The following will be identified:

- The degree of support that exists for the rail project from municipal planning agencies and the local community.
- Whether the cohesion of the community would be altered by a physical or psychological separation of residents and/or activities.
- Whether rail project stations would create a new community focal point, or reinforce an existing or planned focal point, thus encouraging community cohesion.
- Whether displacement would alter the stability of a neighborhood or community, or the social or economic character of such an area.

- Whether natural pedestrian, bicycle, or motor vehicle circulation patterns would be disrupted. Whether access to neighbors, centers of activity, or community services would be reduced.

- Whether the level of pedestrian and motor vehicle activity at rail project stations and maintenance facilities would be significantly greater than the level of activity on surrounding lands, both in terms of existing land uses and in terms of the level of activity of new land uses reflected in plans or zoning.

- Whether the rail project would reinforce the objectives of municipal land use, economic development, and community service improvement plans.

- Whether zoning changes would be required at stations, maintenance facilities, and other facility sites. What municipal development review requirements must be met.

- Whether development would be encouraged, development patterns changed, or densities be increased in a manner that would not be in character with or the same scale as the existing community or what is proposed in land use plans.

- Whether the rail project would provide an equitable distribution of costs and benefits.

**Impact Assessment Method**

1. Existing neighborhoods and communities will be defined by identifying:

    - The boundaries of the neighborhoods and communities surrounding the rail project.

    - Neighborhood and corridor socioeconomic characteristics based on available demographic data, including age distribution, social and ethnic composition, degree of dependency on transit, average size and income of families, elderly and handicapped population.

    - Community services provided to surrounding land uses, including schools, community centers, health care facilities, parks, and cultural facilities, and the boundaries of their service areas.

    - Existing community focal points and centers of activity, including community centers, churches or other religious facilities, shopping, and schools.

- Neighborhood groups, clubs, and service organizations that serve the community surrounding the rail project.

- Existing natural patterns of pedestrian, bicycle, and motor vehicle circulation.

- The existing land use of the proposed rail project right-of-way, of station and other facility sites, and of the surrounding community, as well as the characteristics of the activities on those lands.

- The goals, objectives, policies, and plans for action contained in municipal or neighborhood comprehensive land use, economic development, and community service improvement plans.

- Existing zoning on lands proposed for rail project use and on surrounding lands, the location of nonconforming uses, and whether higher density development is permitted under existing zoning and whether it desired by the neighborhood or community.

- Existing community development or redevelopment trends and whether development or redevelopment is being encouraged or discouraged by the municipal government or community groups.

2. Based on the existing conditions data, impacts will be defined using the impact measures.

3. Mitigation alternatives will be identified and compared in close coordination with municipal planning and community representatives. An important part of land use planning and community impact mitigation will be the mitigation programs developed to respond to significant noise and vibration, air quality, visual quality, traffic, safety, and security impacts.

**Mitigation Warrants**

- The rail project or specific components is opposed by municipal planning agencies or by a significant portion of the neighborhood or community population.

- Barriers are created between segments of the neighborhood or community, or their stability will be affected.

- The rail project is a change in land use that is incompatible with surrounding land uses.

- The rail project conflicts with local plans or zoning and the appropriate agencies or community groups do not favor amendment of those plans.

- New development will occur as a result of the rail project that is not in keeping with the character or scale of the surrounding community.

- A particular social group suffers an inequitable distribution of project costs and benefits.

## Background

### Regulating Law and Industry Practice

It is standard industry practice to work with the municipal and community representatives to develop a rail transit system that is an asset to the community it serves and helps support land use, economic development, and community service improvement plans. The requirements of municipal zoning law must be met for stations, maintenance facilities, and other fixed facilities.

### Regulating Agencies

Municipal government.

### Common Mitigation Techniques

The appropriate approach to mitigation of social interaction and land use planning impacts is heavily dependent on the characteristics of each neighborhood or community through which rail projects will pass. Inclusion of an exhaustive list of potential techniques is impossible. The following examples are representative of how particular land use plan and community impacts could be handled:

- Link stations with other community services or focal points, such as community colleges, hospitals, shopping districts.

- Link stations with redevelopment sites.

- Select station components that fit the neighborhood or community into which it is placed. For example, in residential areas with only local street access, avoid stations with facilities used to attract patrons from the broader community, such as large park-and-ride lots and bus transfer centers.

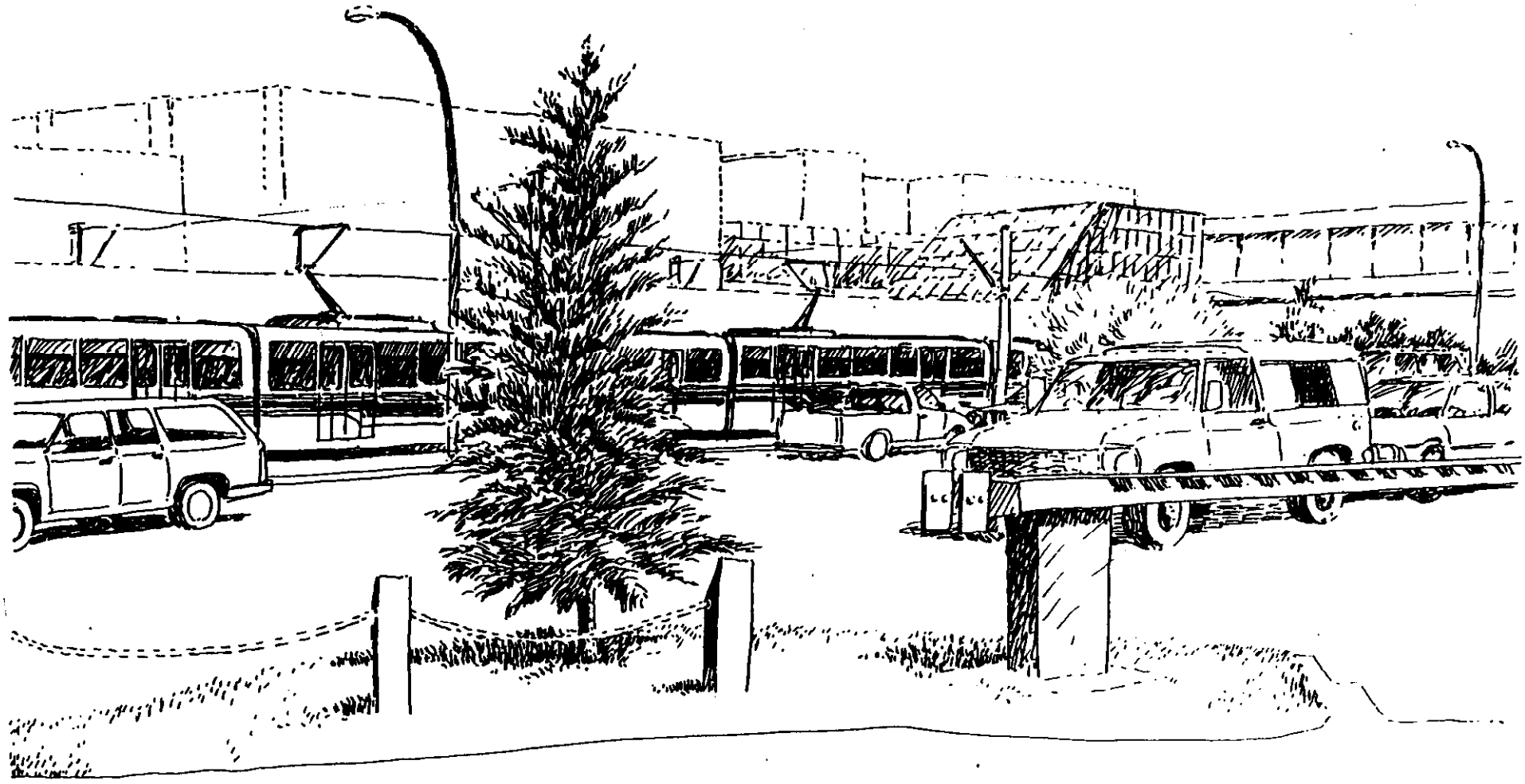
- Take into account the broader issues of social interaction and land use planning impact when developing noise and vibration, air quality, visual

quality, traffic, safety, and security mitigation programs.

**Applicable Design Criteria, Drawings, and Specifications**

The situation of each community and neighborhood will be addressed individually.

A light rail station directly serves a community college in Calgary.



## VISUAL QUALITY

### Issue

Will rail transit system components be compatible with the visual character of the setting into which they will be introduced?

### Policy

**Environmental Quality Assurance Objectives**

- Provide a clean, uncluttered appearance systemwide, including such features as structures, poles, and signs.
- Seek to minimize discordant contrasts in line, form, color, texture, or scale between the project and its surroundings.
- Complement visual resources of recognized local or regional significance through selection of compatible materials and forms for project components.
- Provide opportunities for involvement by community representatives in the evaluation of design and materials options.
- Select materials that are easily maintained.
- Minimize the blocking of high quality views from existing land uses.
- Avoid shading areas where available sunlight is already limited.
- Avoid exposing undesirable views to existing land uses.
- Minimize the creation of direct views into adjacent private spaces.
- Comply with local ordinances related to glare, lighting, screening, open storage, landscaping, and neighborhood protection.

**Impact Measures**

A series of subjective observations will be used to assess perceived visual changes introduced by rail projects. The judgement of the general public will play an important role

in this process. The following will be observed and their significance will be identified, taking into account viewer exposure in terms of distance, number of viewers, duration of exposure, and the speed of the viewer:

- Features lost and their importance to existing views.
- Existing views blocked and their value or desirability.
- Changes introduced in line, form, color, texture, lightness, darkness, dominance, scale, diversity, and continuity by rail project components, and whether they complement or present a discordant contrast with existing visual elements.
- Undesirable views of existing urban features that are opened or private spaces exposed, including both the views of rail patrons and the views from wayside land uses.
- Potential effects on community activities for which the character of their setting or a particular view is important.
- Features required to meet municipal lighting, screening, open storage, landscaping requirements, and neighborhood protection.

**Impact Assessment Method**

The following approach, based in part on the Federal Highway Administration's Visual Impact Assessment for Highway Projects (March 1981), will be used:

1. The existing visual environment will be defined by asking:
    - What are the limits of the visual environment adjoining the rail project and the distance of existing views?
    - What are the components that characterize the visual environment? For example, single family residences, hardwood forest, commercial strip developments, etc.
    - What major viewer groups are likely to see the project and from where? Such groups could include shoppers, tourists, home owners, etc.

2. Key views of significant features will be identified by asking:

   - What visually distinct features or districts can be identified within the project area and from where can they be seen? For example, historic structures, parks, shopping malls etc.)

   - What visual resources and views are recognized as important to the community or region? For example, historic districts, monuments, parks, skyline, etc.

3. The visual appearance of project components in relation to both typical and important views will be illustrated. Renderings, photomontages, models, video simulations, and full scale mock-ups (of individual components) could be used. The locations selected for illustration and the technique used would be dependent on the nature and complexity of the visual issues in each area under study.

4. The nature and significance of visual impacts will be assessed. The impact measures listed above will be used.

5. Alternative ways to mitigate negative visual impacts will be determined and compared. Alternatives will be evaluated in terms of their effectiveness, constructability, maintainability, and cost.

The public involvement program conducted during the environmental impact assessment will provide for public input into each step of this process. The value attached by the community to the existing visual character and its components, concerns expressed related to the introduction of the rail system, any changes in community values and goals expressed because of the proposed rail project, and thoughts on mitigation alternatives and their effectiveness will be sought.

**Mitigation Warrants**

- Project construction requires removal of features that are important to a community's visual character.

- Rail system features disrupt or block locally or regionally significant views.

- Rail components are to be built that will contrast with the existing setting in terms of introducing a distracting character or style to a distinctive surrounding environment, shading areas where available

sunlight is already limited, dominating existing features, or creating a cluttered appearance.

- Placement of the rail project opens up undesirable views or opens views from the trains into previously private spaces.

- A community activity is disrupted by introducing a rail line into the activity's views or setting.

- Standard project design features do not conform to municipal lighting, screening, open storage, landscaping, and neighborhood protection ordinances.

## Background

### Regulating Law and Industry Practice

There are no federal or state visual regulatory requirements which apply to DART rail. Municipalities within the DART service area have the following visual-related requirements in their zoning ordinances or development codes:

| | Open Storage | Glare/ Lighting | Screening | Landscaping | Neighborhood Protection |
|---|---|---|---|---|---|
| Carrollton | X | X | | | |
| Dallas | | X | | X | X |
| Farmers Branch | X | X | | X | |
| Garland | | X | X | X | |
| Irving | | X | X | X | |
| Plano | X | X | | | |
| Richardson | | X | | | |

### Regulating Agencies

Municipal government for lighting, screening, open storage, landscaping, and neighborhood protection.

### Common Mitigation Techniques

The appropriate approach to mitigation of visual impacts is heavily dependent on the characteristics of each area through which rail projects will pass. Potential solutions are dependent upon the set of problems given the designer. Examples of how particular visual impacts could be approached are:

- Break up long horizontal lines of catenary wires with clusters of trees or closely spaced street trees.

- Block views by rail patrons into private spaces by using a fence or freestanding wall.

- Continue landscaping or hardscape features (e.g. walls, paving materials, street furniture) that are present on one side of the rail right-of-way on the other side as well, in order to visually connect areas divided by a rail line.

- Where space is available (that meets the requirements for safe operation), use a landscaped berm, instead of a fence, to improve views and/or reduce noise levels.

- When passing through an area of recognized style or character, such as an historic district, adapt the materials and forms of project structures in order to complement that style or character.

- Reduce the scale and soften the appearance of a retained fill grade separation immediately adjacent to a visually significant area by using landscaped terraces or other architectural treatments.

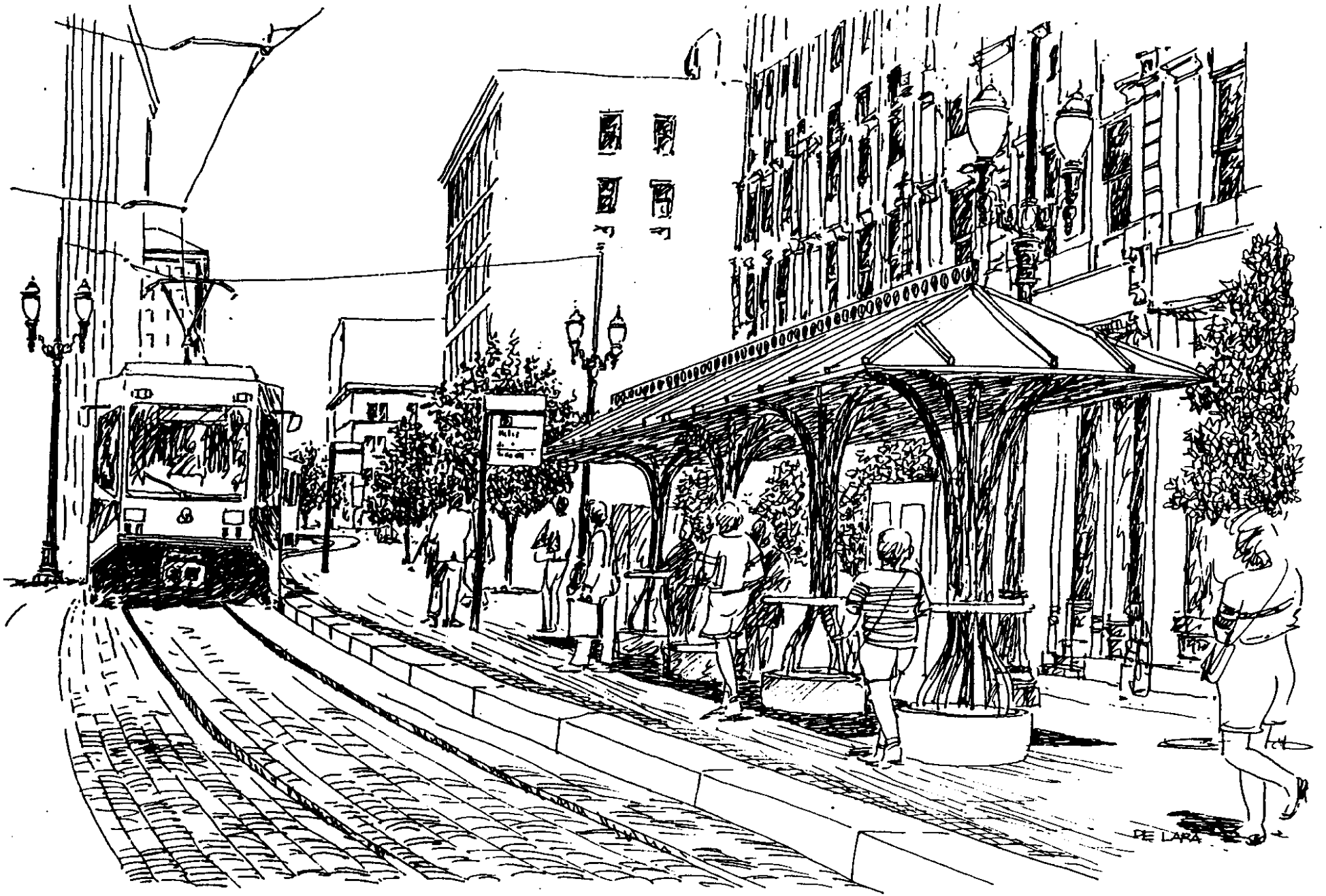
- Reduce the quantity of vertical elements (poles) contained in an area of closely spaced urban features by using existing utility poles or buildings to support the catenary wires.

- Work with neighborhood representatives to select neighborhood-specific architectural design, color, and landscape enhancements that are within project design guidelines and construction budgets.

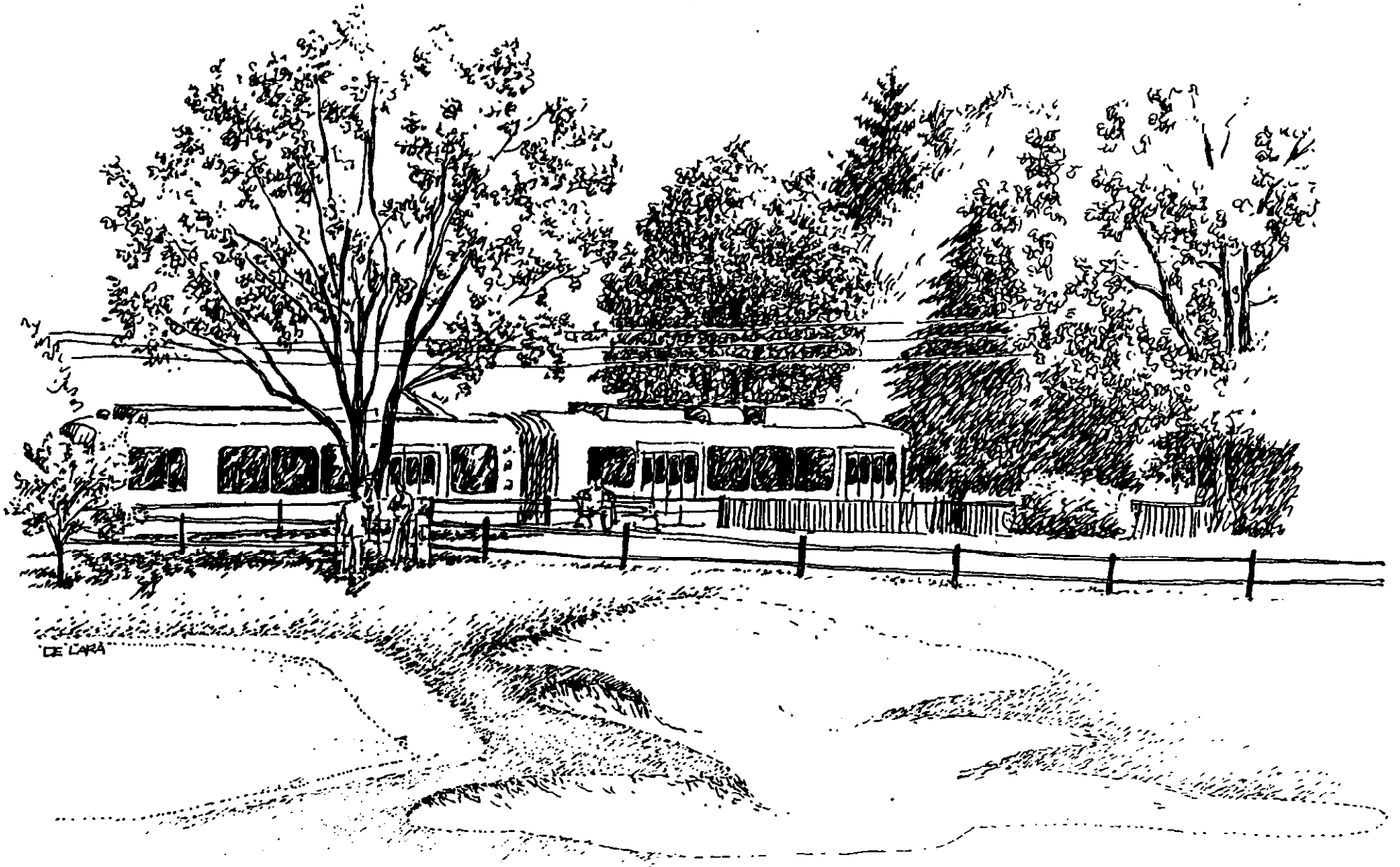
**Applicable Design Criteria, Drawings, and Specifications**

Visual quality related criteria are contained in: chapter 19, section 19.2 "Landscaping" and chapter 26 "Lighting" of the Dallas Area Rapid Transit Rail Design Criteria; DART Architectural Standard Drawings; and DART Architectural Directive Drawings.

Stone pavers, attractive shelters, and old fashioned street lamps to support catenary wires highlight a transit mall in Portland.

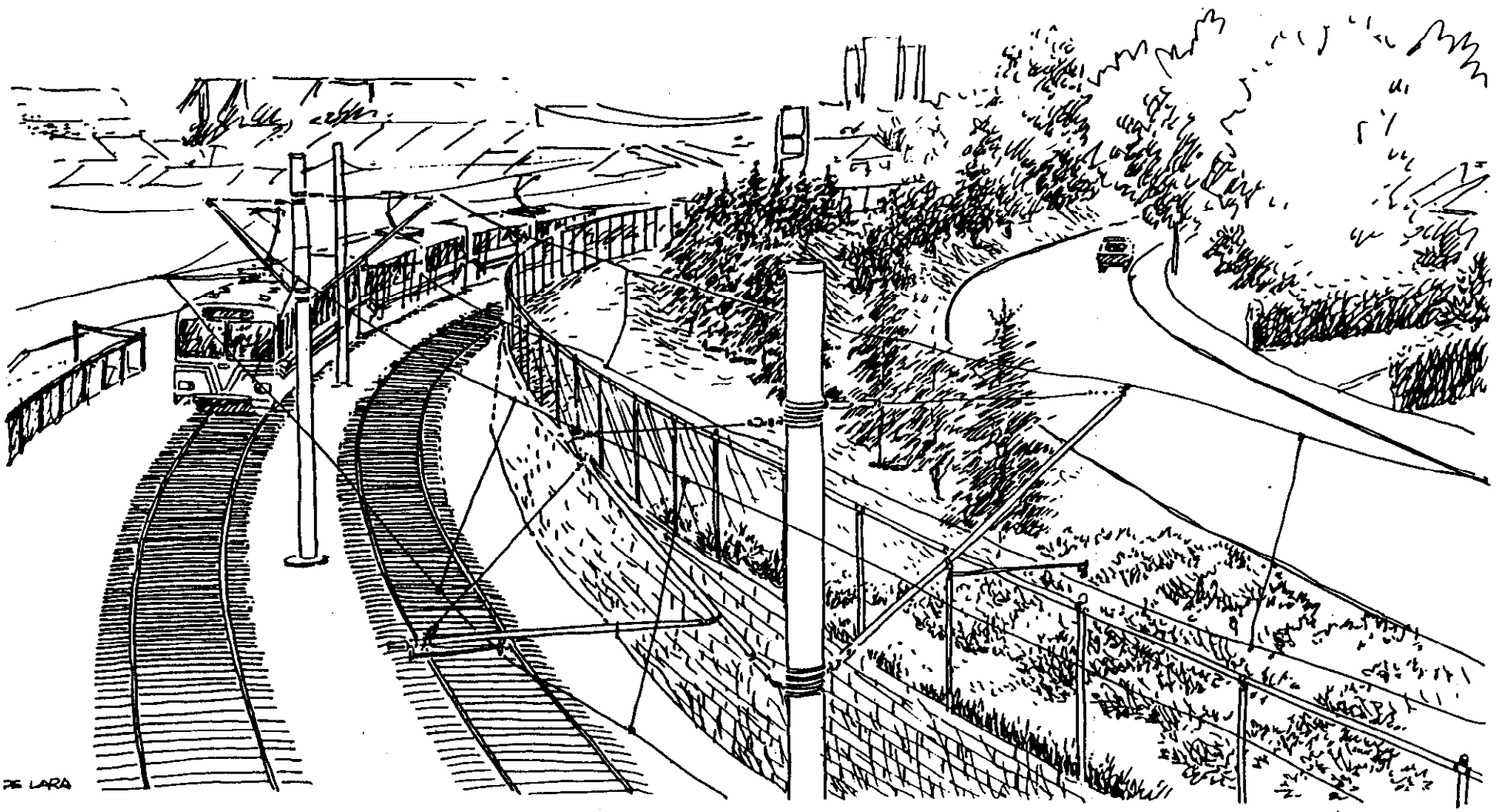


Trees break up the long horizontal lines of catenary wires viewed from a Boston golf course.



A wall blocks the views of Boston rail patrons.

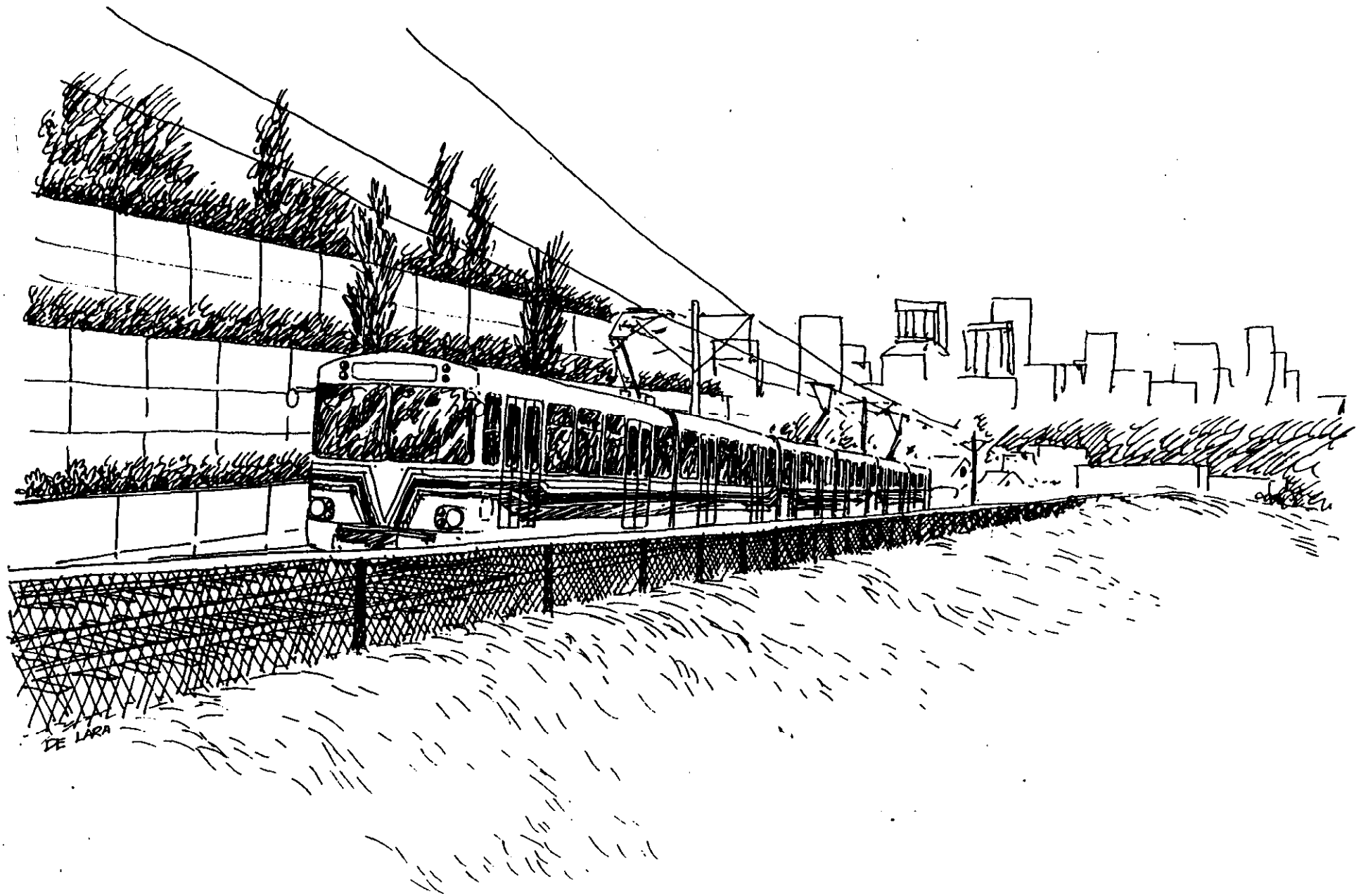
A landscaped berm and wall combination in Calgary.



Wooden horizontal siding on a Calgary station complements the style of adjacent homes.

DE LARA

A retaining wall incorporating landscaped terraces in Calgary.



## ARCHAEOLOGY

### Issue

Will archaeological resources be affected by the proposed rail system?

### Policy

**Environmental Quality Assurance Objectives**

- Fully meet the requirements of state antiquities law and federal historic preservation law.
- Avoid disturbance of historic and prehistoric archaeological resources.
- Work closely with state and federal regulatory agencies in the development of a recovery plan should the disturbance of archaeological resources be required.
- Protect from damage and properly recover archaeological resources found during construction.

**Impact Measures**

The disturbance of archaeological resources.

**Impact Assessment Method**

1. The required reconnaissance or intensive survey permit will be obtained from the Texas Antiquities Committee.
2. Major archives will be consulted to identify known or likely archaeological site locations and, in combination with topographical and geotechnical data, to reconstruct historic settlement patterns. Local preservation societies and individuals also will be contacted for any information they may have on likely historic or prehistoric sites. This background search will focus on identifying intact landscapes capable of containing historic and prehistoric remains.
3. A field reconnaissance will be conducted to support background research findings and eliminate the need for further evaluation of areas found to be void of archaeological resources, particularly because of disturbance by current and past development. As appropriate, a limited program of shovel tests, geomorphological studies, and/or soil borings will be

used to probe the depth and extent of sites and disturbances.

4. Background research and reconnaissance findings will be documented in a permit report and presented to Texas Antiquities Committee staff for review and concurrence.

   For projects where Section 106 of the Historic Preservation Act of 1966 is applicable, inventory information, along with recommendations on the National Register eligibility of the resources identified, will be assembled into a Determination of Eligibility Report. This report will be submitted to the State Historic Preservation Officer (SHPO) with a request for a determination of National Register eligibility for the resources identified.

5. Known and likely archaeological sites that could be affected by project development will be identified based on the archaeological data gathered and the engineering design. For each affected site, the following will be identified: the extent of disturbance, testing warranted during the preliminary design, and mitigation options (including avoidance). The findings will be discussed with Texas Antiquities Committee staff.

   For projects where Section 106 of the Historic Preservation Act of 1966 is applicable, the criteria of effect and criteria of adverse effect, as per Title 36, Part 800 of the Code of Federal Regulations, will be applied. The analysis will be done in coordination with the SHPO for each National Register or National Register eligible site. As per the requirements of Section 106, an Effects Report will be prepared. The findings of the Effects Report will be reviewed with the SHPO.

**Mitigation Warrants**

Positive steps to ensure that the quality assurance objectives are attained are warranted wherever an archaeological resource is disturbed.

**Background**

**Regulating Law and Industry Practice**

Projects using federal funds or requiring a federal license must meet the requirements of Section 106 of the Historic Preservation Act of 1966 (16 U.S.C. 470f). Section 106 requires that the responsible federal agency take into account the effect of a project on resources included in or eligible for inclusion in the National Register of Historic

Places. The determination of National Register eligibility of archaeological resources, the determination of effect and adverse effect, and the development of Memorandums of Agreement on mitigation is done by the federal agency in coordination with the State Historic Preservation Officer. The federal Advisory Council on Historic Preservation is given an opportunity to comment.

Projects using U.S. Department of Transportation funds or requiring a license from its agencies must meet the requirements of Section 4(f) of the Department of Transportation Act of 1966 (49 U.S.C. 303). Section 4(f) requires, in part, that the Secretary of Transportation not approve any program or project which requires use of resources included in or eligible for inclusion in the National Register of Historic Places unless (1) there is no feasible and prudent alternative to the use of such land, and (2) such a program includes all possible planning to minimize harm to the resource affected. When such resources are affected, the documentation of no feasible and prudent alternative, and planning to minimize harm, is included in the federal environmental impact document as an appendix.

The "Antiquities Code of Texas" (Texas Natural Resources Code, Title 9, Chapter 191) protects State Archaeological Landmarks, which includes archaeological sites situated on land owned or controlled by the State of Texas or its political subdivisions. Archaeological resources contained in lands purchased by DART for its rail system will be considered State Archaeological Landmarks.

Under the Antiquities Code, if the environmental assessment finds that archaeological resources would be disturbed, an intensive program of testing and site evaluation must be conducted for determination of resource value and the finalization of recovery plans, if environmental assessment findings are confirmed. This work is done under a Texas Antiquities Committee testing permit. Resource recovery would then be done under a Texas Antiquities Committee excavation permit. Recovered artifacts must be cleaned, conserved, catalogued, and preserved. Processing results are reported to the Texas Antiquities Committee and the artifacts must be appropriately housed or exhibited. All artifacts are the property of the State of Texas.

The Texas Antiquities Committee is to be notified if archaeological sites are discovered during construction. The Committee staff will then issue a permit for mitigative investigations.

Chapter 26 of the Texas Parks and Wildlife Code is similar to Section 4(f) of the Department of Transportation Act of 1966 in its requirements and applies to all DART rail projects.

**Regulating Agencies**

Advisory Council on Historic Preservation and State Historic Preservation Officer (federal projects only), and Texas Antiquities Committee.

**Common Mitigation Techniques**

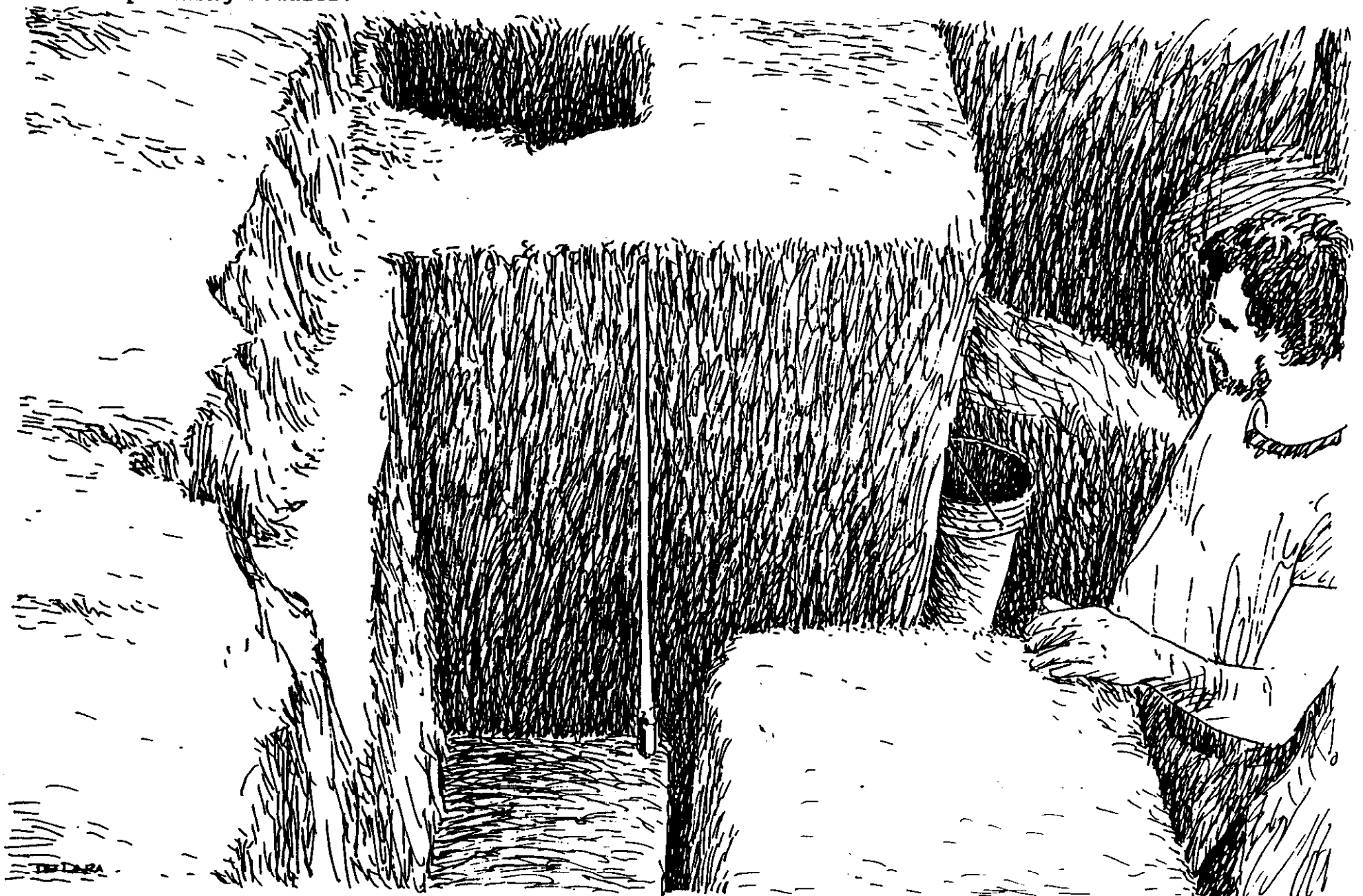
- Recover, analyze, and house or exhibit archaeological resources that would be disturbed.

- State in the project master construction specifications that if a contractor discovers or accidently exposes artifacts or other evidence of archaeological, historical, or scientific value during construction that work is to be halted and transit authority representatives are to be immediately notified. The find is to be protected and work is not to proceed until the find has been assessed and the transit authority gives the notice to proceed.

**Applicable Design Criteria, Drawings, and Specifications**

Procedures related to archaeological resource finds during construction are addressed in section 01560, "Environmental Protection," of the Dallas Area Rapid Transit Master Construction Specifications.

Artifacts from historic Dallas being recovered prior to construction of the entrance to Dallas County's Sixth Floor Museum. The need for artifact recovery was identified based on the findings of DART's Dallas Central Business District transit planning studies.



## HISTORIC RESOURCES

### Issue

Will historic resources be affected by the proposed rail system?

### Policy

**Environmental Quality Assurance Objectives**

- Fully meet the requirements of applicable municipal, state, and federal historic preservation law.
- Minimize adverse effects to historic resources recognized to be of local, state, or national significance by local, state, or federal regulatory agencies and private organizations dedicated to historic preservation.
- Work closely with historic resource agencies and interest groups in the development of appropriate mitigation when adverse effects do occur.

**Impact Measures**

- The project alters characteristics that give the resource its significance. Alterations in location, design, setting, materials, workmanship, feeling, or use could effect an historic resource.
- The project diminishes the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association.

**Impact Assessment Method**

1. An area of potential effect will be determined. Historic resources within that area which are listed in existing public and privately sponsored inventories, and existing lists of officially recognized resources, will be identified. A windshield survey will be conducted to verify the location and condition of listed resources, and confirm whether any other potentially significant resources exist. A Texas Historical Commission Survey Card will be completed for all structures over 40 years old that have potential architectural significance and they will be photographed. The U.S. Department of Interior's standards for evaluation that are described in National

Register Bulletin, No. 16 (September 20, 1986), "Guidelines for Completing National Register Forms," will serve as the basis for evaluation.

For projects where Section 106 of the Historic Preservation Act of 1966 is applicable, the potential eligibility for inclusion in the National Register of Historic Places of the historic resources identified also will be assessed.

2. The inventory information (including inventory forms and photographs) will be assembled into a report. The significance of resources identified that are not officially recognized on government lists will be discussed with applicable government agencies and private organizations.

   For projects where Section 106 of the Historic Preservation Act of 1966 is applicable, inventory information, along with recommendations on the National Register eligibility of the resources identified, will be assembled into a Determination of Eligibility Report. This report will be submitted to the State Historic Preservation Officer (SHPO) with a request for a determination of National Register eligibility for the resources identified.

3. Historic resources that could be affected will be identified. For each resource that could be affected, the nature of the effect and the severity of the effect will be described. Analysis results will be discussed with applicable government representatives and private organizations.

   For projects where Section 106 of the Historic Preservation Act of 1966 is applicable, the criteria of effect and criteria of adverse effect, as per Title 36, Part 800 of the Code of Federal Regulations, will be applied. The analysis will be done in coordination with the SHPO for each National Register or National Register eligible site. As per the requirements of Section 106, an Effects Report will be prepared. The findings of the Effects Report will be reviewed with the SHPO and any applicable municipal or county historic resource commissions.

4. Alternative means for mitigating adverse impacts will be defined. These alternatives will be developed in consultation with the appropriate federal, state, and local regulatory agencies, and private organizations.

**Mitigation Warrants**

- Physical destruction, damage, or alteration of all or part of the property.

- Isolation of the property from its setting or alteration of the character of the property's setting, when that character contributes to the property's historic significance. For example, alteration of an integral or complimentary view, or the introduction of rail project components that present a discordant contrast to the resource.

- Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting. For example, vibration that exceeds DART or municipal maximum permissible vibration levels, or risks damage to a fragile structure.

- Effects would encourage neglect of the property and could ultimately result in its deterioration or destruction. For example, loss or changes in pedestrian or traffic access, or disruption of the activities of historic resource users.

- Effects would encourage the transfer, sale, or lease of the property without adequate restrictions or conditions to ensure preservation of the property's significant historic features.

**Background**

**Regulating Law and Industry Practice**

Projects using federal funds or requiring a federal license must meet the requirements of Section 106 of the Historic Preservation Act of 1966 (16 U.S.C. 470f). Section 106 requires that the responsible federal agency take into account the effect of a project on historic resources included in or eligible for inclusion in the National Register of Historic Places. The determination of National Register eligibility of historic resources, the determination of effect and adverse effect, and the development of Memorandums of Agreement on mitigation is done by the federal agency in coordination with the State Historic Preservation Officer. The federal Advisory Council on Historic Preservation is given an opportunity to comment. Section 110(f) of the Historic Preservation Act of 1966 requires that the responsible federal agency, to the maximum extent possible, undertake such planning and actions as may be necessary to minimize harm to any National Historic Landmark. The analysis process is the same as with Section 106, except for increased participation by the Advisory Council on Historic Preservation.

Projects using U.S. Department of Transportation funds or requiring a license from its agencies must meet the requirements of Section 4(f) of the Department of Transportation Act of 1966 (49 U.S.C. 303). Section 4(f) requires, in part, that the Secretary of Transportation not approve any program or project which requires use of resources included in or eligible for inclusion in the National Register of Historic Places unless (1) there is no feasible and prudent alternative to the use of such land, and (2) such a program includes all possible planning to minimize harm to the resource affected. When such resources are affected, the documentation of no feasible and prudent alternative, and planning to minimize harm, is included in the federal environmental impact document as an appendix.

Laws that apply to all DART projects whether there is federal involvement or not are: municipal historic resource overlay district ordinances; for publicly owned resources, "Protection of Public Parks and Recreation Lands" of the Texas Parks and Wildlife Code (Chapter 26); "Texas Historical Commission" (Texas Civil Statutes, Article 6145); and, for historic resources on the National Register, the "Antiquities Code of Texas" of the Texas Natural Resources Code (Title 9, Chapter 191). The City of Dallas historic resource overlay district ordinance (Dallas Development Code, Section 51-4.501) requires that a certificate of appropriateness be obtained from the Dallas Landmark Commission in order to alter a Dallas historic landmark site or building exterior. Chapter 26 of the Texas Parks and Wildlife Code is similar to Section 4(f) of the Department of Transportation Act of 1966 in its requirements. The "Texas Historical Commission" law, in addition to setting up the State's administration of the federal Historic Preservation Act of 1966, requires that no person may damage the historical or architectural integrity of any structure designated as a Recorded Texas Historic Landmark without giving notice to the Texas Historical Commission. The Antiquities Code protects State Archaeological Landmarks, which includes structures and buildings listed on the National Register. (See policy statement 2.4, "Archaeology.")

**Regulating Agency**

Advisory Council on Historic Preservation (federal projects only), Texas Historical Commission and State Historic Preservation Officer, Texas Antiquities Committee, and municipal government.

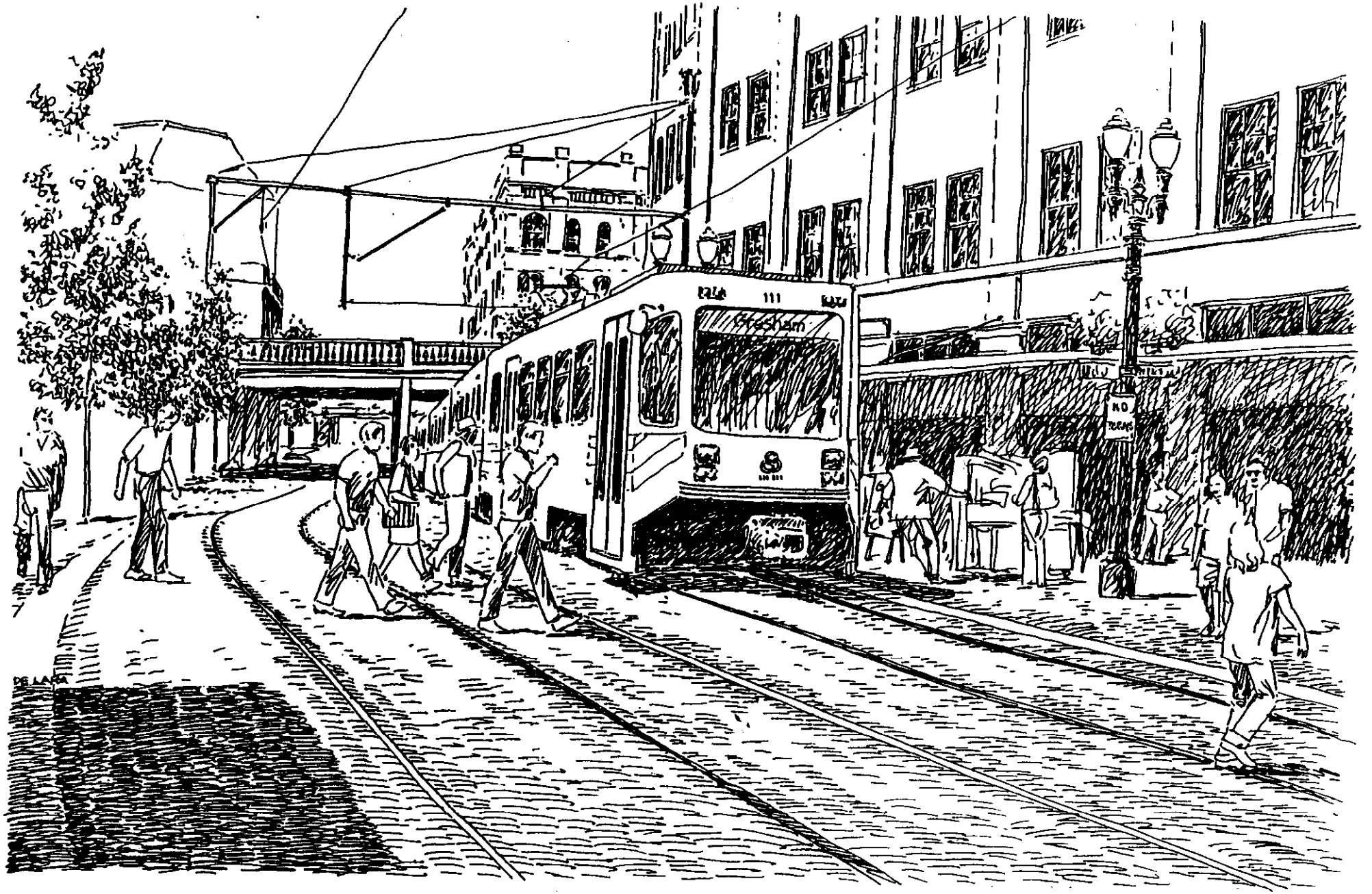
**Common Mitigation Techniques**

- Adapt the materials and forms of rail project structures to complement the style or character of adjacent historic resources.
- Rehabilitate, adapt, and reuse historic structures, such as old trolley stations and maintenance facilities where feasible.
- Use vibration absorbing material in trackwork at locations where a vibration impact would occur. (See Natural Resources Policy 3.2, "Noise and Vibration.")
- Provide alternative access. (See Traffic Policy 1.1, "Movement.")
- Move historic structures to a new location and sell with adequate restrictions or conditions to ensure the preservation of the property's significant historic features.
- Recover unique architectural details of an historic structure that must be demolished.
- Prepare detailed archival records of an historic structure that must be demolished, including: a description of the resource's history; a description of the structure's exterior and interior architectural characteristics and site; and photographs, architectural drawings, and sketches.

**Applicable Design Criteria, Drawings, and Specifications**

The situation of each historic resource will be addressed individually.

Transit in Portland's Skidmore/Old Town Historic District.



## SAFETY

### Issue

How will a high level of patron safety be ensured? Will the project be a hazard to the safe movement of motor vehicles, bicycles, or pedestrians?

### Policy

**Environmental Quality Assurance Objectives**

- Reflect the characteristics of the communities through which the rail line passes when establishing operating speeds, and selecting crossing control devices and other safety features.
- Avoid all single point (component) hazards and control all hazards such that an acceptable level of safety is achieved.
- Ensure that no single failure of a dynamic (moving) element will result in a hazard that could produce severe injury or major property damage.

**Impact Measures**

Safety will be an integral part of project design and operation planning. Rail project impact assessments will focus on safety as it relates to the surrounding community. Impacts will be measured based on the location of the rail project in relation to: 1) the movement of pedestrians and bicycles, particularly movement by children, the elderly, and the handicapped, 2) motor vehicle movement by volume, and 3) places where people congregate, including parks, schools, community centers, and shopping districts.

**Impact Assessment Method**

1. The following community characteristics will be identified:

    a. Principal locations where pedestrians or bicyclists now cross or use the planned rail right-of-way or site to reach community services, such as schools, parks, community centers, shopping, or other activity centers; the volumes involved and their characteristics (e.g. age); and the times of day.

b. Places where people congregate, including parks, schools, community centers, shopping districts.

c. Alleys, streets, bicycle paths, or other formal travel routes adjacent to the right-of-way.

d. The traffic volumes on streets that will be crossed at-grade.

e. The accident history of similar light rail systems in other cities, including auto/pedestrian, transit vehicle/pedestrian, auto/auto, and auto/transit vehicle accidents.

2. Planned system operating characteristics that could influence community safety requirements will be identified, including train frequency by time of day and speed. Proposed system design characteristics that could influence community safety requirements also will be identified, including the sight distance for pedestrians and motor vehicle drivers at at-grade crossings.

3. Based on system design and operating characteristics, the potential for changes in pedestrian travel patterns resulting from rail project development will be identified. Pedestrian inconveniences to be introduced that could encourage pedestrians to cross the rail line between protected crossings also will be identified.

4. Crossing protection requirements, the need for other safety related design features, and operation plan changes needed will then be determined based on items 1, 2, and 3, government regulatory requirements, and industry practice in similar situations. This will be done in conjunction with municipal government and school representatives.

**Mitigation Warrants**

Positive steps to ensure that the safety quality assurance objectives are attained for patrons and the surrounding community are warranted for all rail projects and those steps will be an integral part of project design. In areas where the rail line will cross existing formal and informal travel routes at grade or is adjacent to places where people congregate, any mitigation program will be developed on a case-by-case basis, in conjunction with municipal and school officials.

## Background

### Regulating Law and Industry Practice

Federal, state, and municipal regulating law must be followed. In considering safety in planning and design, the following takes precedence:

1. Design for Minimum Hazard. Seek to eliminate hazards through selection of appropriate safety design concepts.

2. Use Safety Devices. Hazards that can not be eliminated through design selection are reduced to an acceptable level through the use of appropriate safety devices.

3. Use Warning Devices. When it is not possible to preclude the existence or occurrence of an identified hazard, devices are employed to detect the condition and generate an adequate warning signal.

4. Provide Special Procedures. When the magnitude of the hazard cannot be reduced through design or warning devices, special operating procedures are developed.

The project design and operating procedures must comply with all federal, state, county, and municipal statutory requirements and take into account advisory group safety requirements.

Safety optimization is assured in the design process through continuous participation by safety staff or safety design review group in the design of each rail project and safety approval prior to release of each stage of design. During design, safety analyses of a project are carried out so hazards can be identified and resolutions can be incorporated into the design. This includes analysis of subsystems, the interrelationship between subsystems, and operation and maintenance hazards. Decisions regarding identified hazards take into account the likely severity of the hazard and its likelihood of occurring. Special in depth studies are conducted if necessary in special situations. Such studies can include grade crossing policies, emergency evacuation of subways and aerial structures, and sharing right-of-way use with motor vehicles, railroads, power lines, or gas lines. Emergency plans are developed with local fire departments and other emergency services.

Safety tests are integrated into an overall test program of the rail project as it is completed. Operation and maintenance procedures are developed, including safety precautions, warnings, procedural hazard control measures, and procedures for handling emergencies. Operations and

maintenance personnel are trained on safety methods and procedures.

At crossings, pedestrian and traffic control devices, including all signs, signals, markings, communication facilities, and illumination devices, and their supports must be consistent with state standards for uniform control devices. In Texas, this is the Texas Manual on Uniform Traffic Control Devices.

**Regulating Agencies**

Regulating agencies are:

- Occupational Safety and Health Administration (federal).
- National Transportation Safety Board.
- U.S. Department of Transportation.
- State Fire Marshall.
- State Department of Highways and Public Transportation.
- Municipal government.

Advisory groups on safety are the National Fire Protection Association and American Railway Engineering Association.

**Common Mitigation Techniques**

- Crossings.
  - Provide crossing protection at all crossings. The selection of the type of protection takes into account whether a shared right-of-way or exclusive right-of-way is planned; whether a street right-of-way is to be used; the numbers crossing the planned rail line and their characteristics; sight distance; train speed; and train frequency. Protection can include standard railroad control devices and/or traffic signals.
  - Provide under or overpasses for pedestrians at high volume pedestrian locations.
  - Use fences along higher speed sections if a high likelihood exists for frequent crossing of the rail right-of-way between designated crossings.
  - Close streets crossed that do not have a demonstrated need.

- Use zigzag fencing (Z crossing) at exclusive pedestrian/bicycle crossings to force cyclists to slow and pedestrians to look.

Vehicles.

- Purchase vehicles with good operator visibility.

- Use automatic train protection to prevent trains from entering a "block" already occupied by another train.

- Incorporate a "dead man's" feature that will automatically stop the train if the operator releases his/her power control because of inattention or health problems.

- Use flame and shatter resistant materials; use materials with no or a low toxicity level when exposed to heat or flame.

- Provide a two-way emergency communication system between the train operator and passengers.

- Incorporate electromagnetic track brakes for use in emergencies.

Subsystems and Equipment.

- Use a "fail safe" philosophy for designs so operation can be considered safe even after experiencing the first failure. Use redundant components where this is not possible.

- Isolate hazards so the effect of any hazardous event is contained as close to the source as possible.

- Provide means for verifying safe performance and operation, as well as interlocks whenever out of sequence operation could cause a critical hazard.

Emergencies.

- Provide emergency walkways along aerial and subway segments to permit safe, rapid evacuation of trains and guideways between stations.

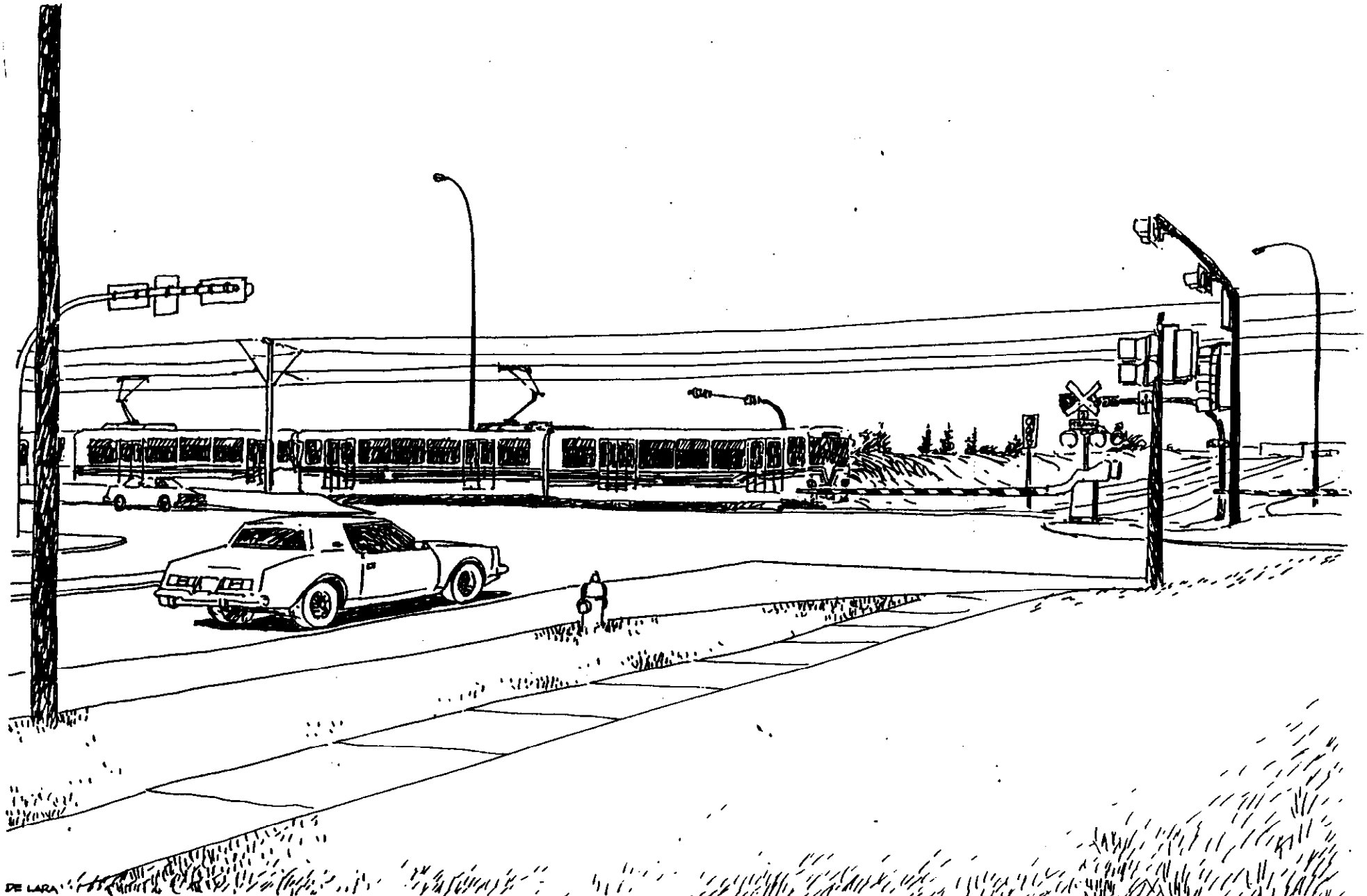
- Prepare an emergency plan with municipal police and fire departments, emergency medical services, and other appropriate civil agencies.

**Applicable Design Criteria, Drawings, and Specifications**

Safety is addressed in Chapter 5, "Traffic Control," of the Dallas Area Rapid Transit Rail Design Criteria and in the Transit Design Policy Manual. System safety program planning is addressed in the DART Systems Assurance Manual. Safety systems are shown in DART Communications Interface Standard Drawings and Signals Directive Drawings.

A student safety patrol assists their classmates at a zigzag pedestrian crossing in Portland.

Crossing gates and flashers protect a street crossing in Calgary.



## SECURITY

### Issue

What steps will be taken to ensure the security of the rail system for patrons and the adjacent community?

### Policy

**Environmental Quality Assurance Objectives**

- Deter criminal activity on the rail system.
- Achieve the perception of a secure rail system for patrons and the adjacent community.
- Optimize protection of property and equipment so as to minimize both the costs of criminal theft and damage, and the cost of protection itself.

**Impact Measures**

The nature and source of threats to rail system security based on the crime characteristics of the communities through which the rail system will be located, and the crime experience on the DART bus system and other light rail systems.

**Impact Assessment Method**

1. Potential threats to security at stations, at other structures, in parking lots, for equipment, within the transit vehicle, and along the rail line will be identified based on discussions with local law enforcement officials, experiences with the DART bus system, and the experience of other systems. Threats will be described as to the source of threat (e.g. type of perpetrator) and the nature of threat (e.g. type of crime).
2. Proposed system operating characteristics that could influence security requirements will be identified, including hours of operation, system access policy, fare collection system, and train frequency.
3. The level and characteristics of community activity adjacent to stations, other structures, equipment, and the rail right-of-way will be identified.

4. Based on items 1, 2 and 3, the potential location for various types of threats within the system will be identified. Potential consequences (e.g. patron injury, increased potential for crime in adjoining communities, property damage, property loss) also will be identified.

5. Operating policy, equipment, materials, and design alternatives, for application system-wide and in unique situations, that address potential threats will be identified and compared in consultation with local law enforcement officials.

**Mitigation Warrants**

Positive steps to ensure that security quality assurance objectives are attained are warranted for all rail projects, but particularly in areas where criminal activity in public areas tends to be higher than average.

**Background**

**Regulating Law and Industry Practice**

The consideration of security is an integral part of project design and operations planning, as is the evaluation of security options in association with local law enforcement agencies. During design, designers responsible for security:

- Contribute designs for systems and hardware that will assist security and other operating personnel in deterring criminal activity on the system.

- Review all other aspects of project design during each phase of the design to ensure that structures, materials, and equipment are inherently resistant to criminal activity.

During operations planning, decisions are made as to:

- The selection of a security force type, and the definition of their responsibilities and operating methods and rules.

- Security related rules and regulations for other transit authority personnel.

- A strict policy of prosecuting offenders.

- Vandalism cleanup and repair policies.

- Development of a program of periodic security reviews and assessments.

**Regulating Agencies**

Coordination with local law enforcement agencies.

**Common Mitigation Techniques**

. Facilities design.

- Design station layouts and planting plans that minimize nooks, crannies, and other hiding places.
- Provide right-of-way fencing in areas with high rates of vandalism.
- Design and light parking lots for high visibility from other locations in station areas.
- Provide visibility of public areas from control facilities and offices.
- Select materials that are difficult to vandalize and easy to clean.
- Incorporate door/gate systems for subway and aerial station entrances, and entrances that lead to non-transit authority facilities.

. Security systems.

- Incorporate a public address system into stations and vehicles.
- Provide radio communications between staff and control centers.
- Provide telephones and police emergency call units at stations.
- Use intrusion detection and alarm systems.
- Use vandal resistant fare collection equipment and money handling via locked coin and bill containers.
- Use a key-lock system that resists duplication.

. Vehicle design.

- Use materials resistant to vandalism and graffiti, and are easy to clean.
- Use windows that provide between-car visibility.

- Provide a system for direct communication between the patron and train operator.

- Adopt security operating procedures that include, but are not limited to, the items listed in "Regulating Law and Industry Practice."

**Applicable Design Criteria, Drawings, and Specifications**

Security is addressed in Chapter 40 of the Dallas Area Rapid Transit Rail Design Criteria and in the Transit Design Policy Manual. System security program planning is addressed in the DART Systems Assurance Manual. Security systems are shown in DART Communications Interface Standard Drawings and Communications Directive Drawings.

An open station design in Portland fosters a high level of patron visibility.

## PARKS

### Issue

How will negative effects on park and recreation lands and facilities be avoided or minimized?

### Policy

**Environmental Quality Assurance Objectives**

- Use park land only if there is no feasible and prudent alternative, and fully meet the requirements of state and, if applicable, U.S. Department of Transportation park land protection law.
- For parks, meet the environmental quality assurance objectives contained in the social interaction and land use planning, visual quality, safety, air quality, noise and vibration, water resources, and wetlands and ecosystems policy statements, taking into account the unique characteristics of parks affected and their users.
- Seek to identify and take advantage of opportunities to improve the accessibility of community park and recreation facilities that have a regional service area.
- Work closely with jurisdictions responsible for park lands when developing a mitigation program to minimize harm to park lands.

**Impact Measures**

- The significance and sensitivity to disturbance of public park lands affected, as defined by the national, state, or local officials having jurisdiction over them.
- Displacement required and its significance, based on the effect on users, the effect on the usefulness of remaining lands and facilities (with a partial displacement), and replacement opportunities.
- The findings of social interaction and land use planning, visual quality, safety, air quality, noise and vibration, water resources, or wetlands and ecosystems impact analyses at park lands.

**Impact Assessment Method**

1. The characteristics of park and recreation lands to be taken or which are adjacent to the rail project will be identified, including: purpose, service area, size, type and location of facilities and equipment, natural features, circulation system, characteristics of activities (e.g. thoughtful contemplation, league sports, children's play, etc.), characteristics of users, and development plans.

2. If displacement of park land is proposed, the following will be determined in conjunction with national, state, local (government and private) park officials: important natural features lost; facilities lost or whose use is disrupted, and where alternate facilities are presently available to park users; changes required in improvement plans; the availability of replacement park lands that could serve the users of park lands and facilities lost; and opportunities for replacement of facilities on remaining lands within the same park. The funding source of land or facilities displaced will be identified.

3. If the rail project is adjacent to park lands, changes in accessibility for users, the potential for an unacceptable contrast between park and rail project visual features, opportunities for park users to accidently stray onto the rail right-of-way while participating in park activities (e.g. chasing balls), and violations of air quality standards or noise and vibration criteria will be determined. The impact assessment methods described in the social interaction and land use planning, visual quality, safety, air quality, and noise and vibration policy statements will be used.

4. If significant public park lands are affected, alternatives will be sought and evaluated. If the only alternatives available would involve exorbitant cost or would present implementation problems of great magnitude, the reasons for judging these alternatives impractical or imprudent will be clearly documented, including detailed cost estimates, the results of technical feasibility studies, and discussions of unique problems.

5. Opportunities to improve accessibility to regional park and recreation facilities will be taken into account when selecting station sites.

6. Mitigation required will be developed in conjunction with national, state, local (government and private) officials having jurisdiction over affected park lands.

The requirements for land and facility replacement made by funding sources will be met.

**Mitigation Warrants**

Mitigation is warranted whenever park lands (public or private) will be displaced. Mitigation warrants defined in the social interaction and land use planning, visual quality, safety, air quality, noise and vibration, water resources, and wetlands and ecosystems policy statements also apply.

Background

**Regulating Law and Industry Practice**

Projects using U.S. Department of Transportation funds or requiring a license from its agencies must meet the requirements of Section 4(f) of the Department of Transportation Act of 1966 (49 U.S.C. 303). Section 4(f) states that "the Secretary (of Transportation) shall not approve any program or project which requires use of any publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, State or local significance as determined by the Federal, State or local officials having jurisdiction thereof, or any land from an historic site of national, State or local significance as so determined by such officials unless (1) there is no feasible and prudent alternative to the use of such land, and (2) such program includes all possible planning to minimize harm to such park, recreation area, wildlife and waterfowl refuge, or historic site resulting from such use." When such resources are affected, the documentation of no feasible and prudent alternative, and planning to minimize harm, is included in the federal environmental impact document as an appendix.

Chapter 26 of the Texas Parks and Wildlife Code is similar to Section 4(f) of the Department of Transportation Act of 1966 in its requirements and applies to all DART rail projects.

**Regulating Agencies**

National, state, or local agencies having jurisdiction over park lands (Chapter 26 and Section 4(f)) and U.S. Department of Transportation funding or licensing agencies (Section 4(f) only).

**Common Mitigation Techniques**

- Provide funds for the purchase of replacement lands and facilities to the agencies having jurisdiction over park lands displaced.

- Use the linear rail right-of-way jointly with a hiking and biking trail, if the right-of-way is wide enough to safely accommodate both.

- Place a wall, fence, vegetation, or berm between the rail right-of-way and park lands when places where people congregate are adjacent to the right-of-way.

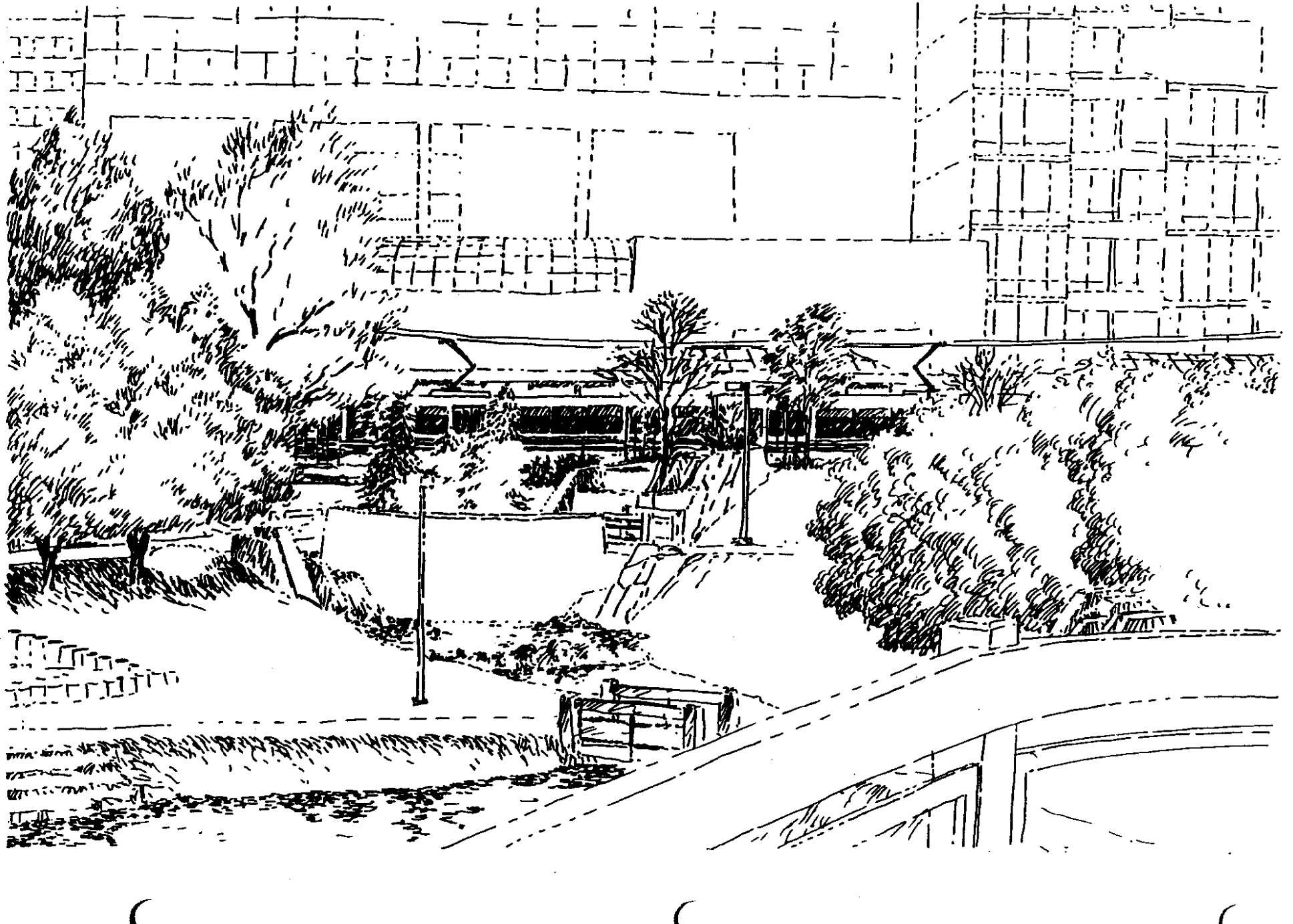
- Complement the visual character of the parks lands when selecting structure materials and landscaping.

- When adjacent to parks providing for passive activities or quiet contemplation, use appropriate noise control techniques to mitigate any significant increases in noise levels.

**Applicable Design Criteria, Drawings, and Specifications**

The situation of each park will be addressed individually.

A transit train makes a stop adjacent to Olympic Plaza in downtown Calgary.



## AIRPORT CLEARANCE ZONES

### Issue

Will the rail project be within a Federal Aviation Administration airport clearance zone?

### Policy

#### Environmental Quality Assurance Objectives

Avoid any penetration of airport clearance zones.

#### Impact Measures

Location of the rail project in relation Federal Aviation Administration airport clearance zones.

#### Impact Assessment Method

1. When a rail project is in the vicinity of an airport, the airport clearance zones for that airport will be requested from the Federal Aviation Administration (FAA).

2. If the rail project is within that zone, approval will be requested from the FAA.

3. If the FAA determines that the presence of the rail project within the zone will be a hazard to aircraft, the rail project design will be altered.

#### Mitigation Warrants

The Federal Aviation Administration does not approve penetration of an airport clearance zone.

### Background

#### Regulating Law and Industry Practice

The Federal Aviation Administration has established standards for determining obstructions in navigable air space near airports (Federal Aviation Regulations, part 77, "Objects Affecting Navigable Air Space," March 4, 1972). Around every airport are a series of imaginary surfaces known as clearance zones. The FAA must issue a determination of encroachment acceptability for any proposed encroachment of these zones. Without FAA approval, the

owner of the encroaching property must assume responsibility for any encroachment related accidents.

**Regulating Agencies**

Federal Aviation Administration.

**Common Mitigation Techniques**

Place the rail line below the clearance zone surface.

**Applicable Design Criteria, Drawings, and Specifications**

The situation of each airport will be addressed individually.

## AIR QUALITY

### Issue

Will the rail corridor's motor vehicle emissions burden be less with the rail project than without it? Will motor vehicle congestion (if any) at station entrances, park-and-ride lot entrances, or at-grade rail crossings, or the convergence of feeder bus lines at stations or park-and-ride lots contribute to local pollutant concentrations that exceed National Ambient Air Quality Standards?

### Policy

**Environmental Quality Assurance Objectives**

- Reduce the motor vehicle emissions burden in each rail corridor from that which would occur without rail transit improvements.
- Avoid the creation of local traffic congestion that generates carbon monoxide concentrations that exceed National Ambient Air Quality Standards.
- Avoid the creation of areas of bus concentration that generate oxides of nitrogen concentrations that exceed National Ambient Air Quality Standards.

**Impact Measures**

- Carbon monoxide, oxides of nitrogen, and nonmethane hydrocarbon emissions burden in the rail corridor measured in kilograms per day.
- Carbon monoxide concentrations during the peak one hour and peak eight hours, measured in parts per million (ppm) at station entrances, park-and-ride lot entrances, and at-grade rail crossings.
- The annual arithmetic mean for oxides of nitrogen concentrations, measured in ppm at points of bus concentration.

**Impact Assessment Method**

Rail Corridor Emission Burden. Emissions from corridor motor vehicle movements will be determined using the U.S. Environmental Protection Agency's Mobile Source Emissions Model (currently MOBILE4) or subsequent upgrades. Traffic on thoroughfares and freeways will be taken into account.

Traffic volumes will be based on City of Dallas or North Central Texas Council of Governments traffic forecasts. Dallas area climatic factors, cold start/hot start percentages, vehicle age distribution (older vehicles have greater emissions), and anti-tampering program credits will be taken into account.

Carbon Monoxide Concentrations. This analysis will be performed in two parts. The first part will use the Texas State Department of Highways and Public Transportation (SDHPT) guideline's (SDHPT, February 1985) "level one" technique. A 5 mph speed will be assumed for all motor vehicles in order to represent worst case traffic conditions. If the calculated concentrations are found to be less than one half of National Ambient Air Quality Standards, then a finding of no impact will be made.

If calculated concentrations are found to be greater than one half of National Ambient Air Quality Standards, then a "level two" analysis will be performed. This analysis will use the California Line Source Model (currently CALINE4) or subsequent upgrades. This is a U.S. Environmental Protection Agency-approved reference model and is recommended by the Texas SDHPT. This model takes into account a larger number of variables and thus produces more refined results than the "level-one" model. A worst case vehicle speed of 5 mph, wind speed of 3 meters per second, atmospheric stability class of D, and a series of 36 wind directions (to identify the worst case) will be assumed. Worst case assumptions are appropriate since National Ambient Air Quality Standards are to be exceeded no more than once a year. Background levels presented in SDHPT's guidelines will be assumed.

This analysis will be performed first for several worst case locations (areas of the greatest new traffic volumes) along the rail line. If a finding of "no impact" results, it will be assumed that there would be no impacts at all other locations along the line. Concentration analyses will be performed at additional locations if impacts requiring mitigation are identified at the worst case locations.

Nitrogen Oxides Concentrations. Nitrogen oxide concentrations will be estimated at the corridor's worst case areas of bus concentration using CALINE4, or a subsequent upgrade, and the same worst case atmospheric characteristics as in the carbon monoxide analysis.

**Mitigation Warrants**

- The kilograms per day of carbon monoxide, oxides of nitrogen, and nonmethane hydrocarbon emissions in the rail corridor are greater with the rail line than without it.

- National Ambient Air Quality Standards for carbon monoxide concentrations are exceeded at locations where traffic volumes or congestion would increase.

- National Ambient Air Quality Standards for oxides of nitrogen concentrations are exceeded at bus concentrations.

## Background

### Regulating Law and Industry Practice

Pollution emissions and concentrations are regulated by the U.S. Environmental Protection Agency under the requirements of the Clean Air Act (42 U.S.C. 7401) and by the Texas Air Control Board under the requirements of the Texas Clean Air Act as amended (Article 4477-5, Vernon's Texas Civil Statutes). The U.S. Environmental Protection Agency has established National Ambient Air Quality Standards. The Texas Air Control Board enforces these standards throughout all parts of Texas (31 TAC Chapter 101, Section 101.21). The National Ambient Air Quality Standards set maximum acceptable concentrations in a given time period. As indicated above, they are not to be exceeded more than once a year. The standards for carbon monoxide concentrations are: 9 parts per million (ppm) during an eight-hour period and 35 ppm during a one-hour period. The standard for nitrogen oxides is an annual arithmetic mean of .05 ppm.

The U.S. Environmental Protection Agency has determined that the Dallas area does not meet National Ambient Air Quality Standards for ozone and is thus a "non-attainment area" for that pollutant. Ozone is produced when oxides of nitrogen and hydrocarbons in the air are catalyzed by sunlight. Since Dallas is a non-attainment area, a long term plan for bringing Dallas into compliance with ozone standards has been incorporated into the State Implementation Plan for air quality improvement. Improved transit service is one aspect of that plan. A reduction in oxides of nitrogen and hydrocarbon emissions by automobiles in a rail corridor will contribute to a reduction in Dallas area ozone levels.

It is accepted industry practice to focus impact assessments for transportation projects on changes in motor vehicle related pollution. As indicated by the issues listed above, the introduction of a transit system in a region can reduce the reliance on the automobile to meet travel needs and as a result reduce motor vehicle pollution emissions (or burden) corridor-wide. Localized air quality issues may arise, however, from implementation of a rail project. Stations or park-and-ride lots attract new traffic, or at-grade rail crossings can delay traffic movement. If severe congestion were to result, additional emissions could be

added to the regional pollution burden and at the specific point of congestion, National Ambient Air Quality Standards for acceptable pollutant concentrations could be exceeded.

To address these two aspects of air quality change, it is accepted industry practice to address motor vehicle pollution impacts first in terms of changes in corridor-wide carbon monoxide, oxides of nitrogen, and nonmethane hydrocarbons burden or amount of emissions. Motor vehicle exhaust is a major source for these three pollutants. Both decreases in corridor motor vehicle use and any increases in local congestion at stations or grade crossings are taken into account. At the localized level (near the source of pollution), it is accepted practice to focus on carbon monoxide concentrations and determine if National Ambient Air Quality standards for that pollutant are being exceeded. Localized oxides of nitrogen concentrations also may need to be examined where there would be a large concentration of diesel powered vehicles, such as buses. With normal automobile/truck/bus vehicle mixes, however, oxides of nitrogen concentrations have been found not to be a localized problem. Nonmethane hydrocarbons are addressed only in terms of the affect to the regional air pollution burden since they are of concern only to the extent to which they contribute to regional levels of ozone.

**Regulating Agencies**

Texas Air Control Board and U.S. Environmental Protection Agency.

**Common Mitigation Techniques**

Since air pollution impacts are generally tied directly to traffic congestion, the techniques described in policy statement 1.1, "Movement," would apply here as well. Impacts from bus concentrations could be resolved by an operations plan that minimizes bus queuing and layover times at the point of concentration.

**Applicable Design Criteria, Drawings, and Specifications**

Traffic movement and control related criteria are contained in chapter 4 "Streets/Highways and Parking" and chapter 5 "Traffic Control" of the Dallas Area Rapid Transit Rail Design Criteria.

## NOISE AND VIBRATION

### Issue

Will noise and vibration generated by rail transit operations adversely affect adjacent properties and activities?

### Policy

**Environmental Quality Assurance Objectives**

- Keep maximum ($L_{max}$) rail transit noise levels at or below the design goals contained in Chapter 11 of the Dallas Area Rapid Transit Rail Design Criteria. Keep noise at fixed facilities at or below municipal maximum permissible levels.

- Keep maximum ($L_{max}$) rail transit vibration levels at or below the design goals contained in Chapter 11 of the Dallas Area Rapid Transit Rail Design Criteria and municipal maximum permissible levels.

- Control community exposure to noise generated by rail transit operations such that average peak hour (1-hour $L_{eq}$) and average daily ($L_{dn}$) community noise levels are not significantly increased, as defined by the Urban Mass Transportation Administration.

**Impact Measures**

Noise Level Control. DART Rail Design Criteria maximum allowable decibel (dBA) levels ($L_{max}$) at 50 feet from rail transit operations or at the nearest sensitive receptor will be used for the assessment of transit noise levels. The maximum allowable levels are more strict near noise sensitive land uses and for rail related operations that involve equipment that emits sound continuously during its operation and/or operates at a fixed location. Maximum permissible decibel limits at the bounding property line that are established by municipal zoning ordinances also will be applied to fixed facilities.

Vibration Level Control. Vibration will be measured in terms of DART Rail Design Criteria maximum permitted vibration levels at the nearest sensitive receptor and municipal zoning ordinance maximum permitted vibration levels at the bounding property line.

Exposure Control. The difference between average community noise levels with a rail project and without a rail project will be measured in terms of the change in average peak hour noise levels and the change in average daily noise levels. One-hour $L_{eq}$, a single noise level with the same energy as the fluctuating level over a one hour period, will be used for peak hour analyses. $L_{dn}$, 24-hour $L_{eq}$ with transit train noise levels between 10 p.m. and 7 a.m. weighted by 10 decibels (dBA) to account for heightened sensitivity to noise at night, will be used for the daily analysis.

**Impact Assessment Method**

1. Inventory. A noise and vibration inventory will be taken. It will consist of:

   a. Identification of Sensitive Receptors. The locations of noise and vibration sensitive land uses that could be affected by transit operations or changed motor vehicle movement will be identified. Building and site characteristics that influence the degree of noise and vibration sensitivity also will be identified.

   b. Measurement of Existing Noise and Vibration Levels. Noise and vibration measurements will be taken within the study area following accepted industry procedures. Measurements will consist of both spot or short-term measurements made at four characteristic times of day and continuous 24-hour surveys. The measurements will be used to characterize and categorize the existing noise and vibration environment. They also will be used in evaluating transit noise and vibration impacts. Tests will be conducted to determine the vibration propagation characteristics of study area soils.

2. Impact Analysis. A noise and vibration impact analysis will be performed. It will consist of:

   a. Predictions of the groundborne noise and vibration and the airborne noise expected from transit and transit related operations will be made for the study area based on design drawings, planned operation characteristics, and forecast traffic volumes. These estimates will be made at sensitive receptors (transit patrons and existing land uses identified as sensitive in the inventory).

   b. The predictions will be compared against DART noise criteria, existing average peak and average daily sound levels, and at fixed facilities to municipal noise standards to determine the

existence and severity of potential noise impact. They will be compared against DART vibration criteria and municipal vibration standards to determine the existence and severity of potential vibration impact.

3. Impact Mitigation. Locations where noise and vibration control (mitigation) measures would be appropriate will be identified. Alternative means for mitigating adverse impacts will be identified and evaluated. These could potentially include design modifications, operating restrictions, and alternative guideway treatments.

**Mitigation Warrants**

Noise or vibration mitigation is warranted if DART maximum noise levels, DART maximum vibration levels, municipal vibration standards, or for fixed facilities, municipal noise standards are exceeded. The specific DART criteria limits that will not be exceeded are contained in Chapter 11 of the Dallas Area Rapid Transit Rail Design Criteria. Mitigation is also warranted at locations where average peak hour ($L^{eq}$) or average daily ($L^{dn}$) noise levels would be increased significantly, as defined by the Urban Mass Transportation Administration in their publication Guidelines for Preparing Environmental Assessments (October 16, 1979).

**Background**

**Regulating Law and Industry Practice**

Level Control. The basis for DART's noise and vibration criteria is the noise and vibration criteria recommended by the American Public Transit Association (APTA), with revisions and additions based experience gained since APTA's guidelines were last published in 1981. APTA's guidelines have been relied on by virtually all new rail transit systems.

The DART rail noise and vibration design criteria addresses:

- Wayside noise and vibration from train operations
  - Maximum airborne noise levels (65-85 dBA)
  - Maximum groundborne noise levels (25-55 dBA)
  - Maximum vibration levels (65-85 dB re 10-6 in/sec)
  - Approaches to vibration isolation
- Maximum wayside ancillary facility noise levels (50-80 dBA)

The criteria vary by specific land use and its setting within the ranges listed above. The more sensitive the land use and the quieter its existing setting, the more stringent the criteria become. Equipment criteria become more stringent as the expected duration of equipment use increases.

For example, Table 1 shows maximum airborne noise permitted from train operations at sensitive receptors. Table 2 shows maximum groundborne vibration permitted from train operations at sensitive receptors.

Table 1

| | Maximum Noise Level | | |
|---|---|---|---|
| Community Category | Single Family Res. | Multi-Family Res. | Commercial |
| Low Density Res. | 70 dBA | 75 dBA | 80 dBA |
| Average Res. | 75 | 75 | 80 |
| High Density Res. | 75 | 80 | 85 |
| Industrial/Highway | 80 | 85 | 85 |

Table 2

| | Maximum Vibration Velocity Level (dB re 10-6 in/sec) | | |
|---|---|---|---|
| Community Category | Single Family Res. | Multi-Family Res. | Hotels/ Motels |
| Low Density Res. | 70 | 70 | 70 |
| Average Res. | 70 | 70 | 75 |
| High Density Res. | 70 | 75 | 75 |
| Commercial | 70 | 75 | 75 |
| Industrial/Highway | 75 | 75 | 75 |

Airborne noise criteria that do not vary by setting are also included for schools, hospitals, churches, and other sensitive uses (65-75 dBA). Groundborne vibration criteria that do not vary by setting are also included for other sensitive uses (65-75 dB), and office, commercial, and industrial uses (75-85 dBA).

In addition, to addressing wayside noise, the focus of this Noise and Vibration policy, the DART Noise and Vibration

Design Criteria also sets standards for patron and employee noise levels. This includes:

. Noise in subway stations

  - Maximum noise levels (50-85 dBA)
  - Absorption material criteria and placement
  - Maximum equipment noise levels

. Noise in above ground stations

  - Maximum noise levels (75-85 dBA)
  - Absorption material criteria and placement

. Maintenance shop noise

Exposure Control. The Urban Mass Transportation Administration (UMTA) established general guidelines for determining acceptable noise exposure in its October 16, 1979 Guidelines for Preparing Environmental Assessments. Those guidelines indicate that changes to existing average noise levels are considered to be not significant if there are no noise sensitive sites in the project area or increases in average noise levels ($L_{eq}$ or $L_{dn}$) are less than or equal to 3 decibels (dBA). Changes are possibly significant if changes in existing average noise levels are no greater than 5 dBA. In this case the need for mitigation would be dependent on what existing noise levels are and the presence of noise sensitive sites. Finally, changes are generally significant if noise standards or ordinances are exceeded, average noise levels increase 6 to 10 dBA in built up areas, or average noise levels increase by more than 10 dBA. In this case mitigation is generally planned.

Both noise levels and noise exposure are addressed in transit noise impact assessment because transit train noise is intermittent, it affects an area only when a train is present. The noise exposure assessment defined by UMTA recognizes that 1) intermittent noises that are higher than background sound levels are a part of daily living and that 2) the introduction of new intermittent sounds, if they are at too high a level or occur too frequently, can be annoying. The noise level assessment based on DART Noise Criteria recognizes that even if a noise occurs for only a brief time, noise levels above certain levels are an unacceptable intrusion.

**Regulating Agencies**

Municipal government.

**Common Mitigation Techniques**

Noise and vibration can be mitigated in three basic ways: 1) selecting quieter system-wide components, 2) changing operation plans, and 3) adding design features at specific locations identified by the environmental impact assessment. System-wide components that affect noise levels are:

- Use of continuous welded rail.
- Use tie and ballast trackwork for surface track.
- Use of resilient wheels on transit vehicles.
- Use of skirts on the vehicle to reduce the transmission of equipment noise.

All of these features are presently planned for use by DART. DART has not yet prepared its vehicle specifications.

Reducing vehicle speed is the principal operation change that can reduce noise and vibration levels. Maintenance procedures that include regular grinding of wheels to eliminate flat spots can also reduce noise levels.

Design features that could be added at specific locations to reduce airborne noise levels include:

- Noise barriers (fences, or earth berms if adequate space is available) between transit operations and the affected sensitive uses.
- Lubrication of track at curves where wheel squeal is predicted to occur.

Vibration and groundborne noise (rumble) impacts most often occur with subways connected to or very close to adjacent buildings. With sufficient distance, the surrounding soil absorbs rail transit vibration and groundborne noise, and keeps it at an acceptable level. For aerial and at-grade sections, it is airborne wayside noise that generally dominates. Design features that could be added to a specific locations to reduce vibration and groundborne noise levels include:

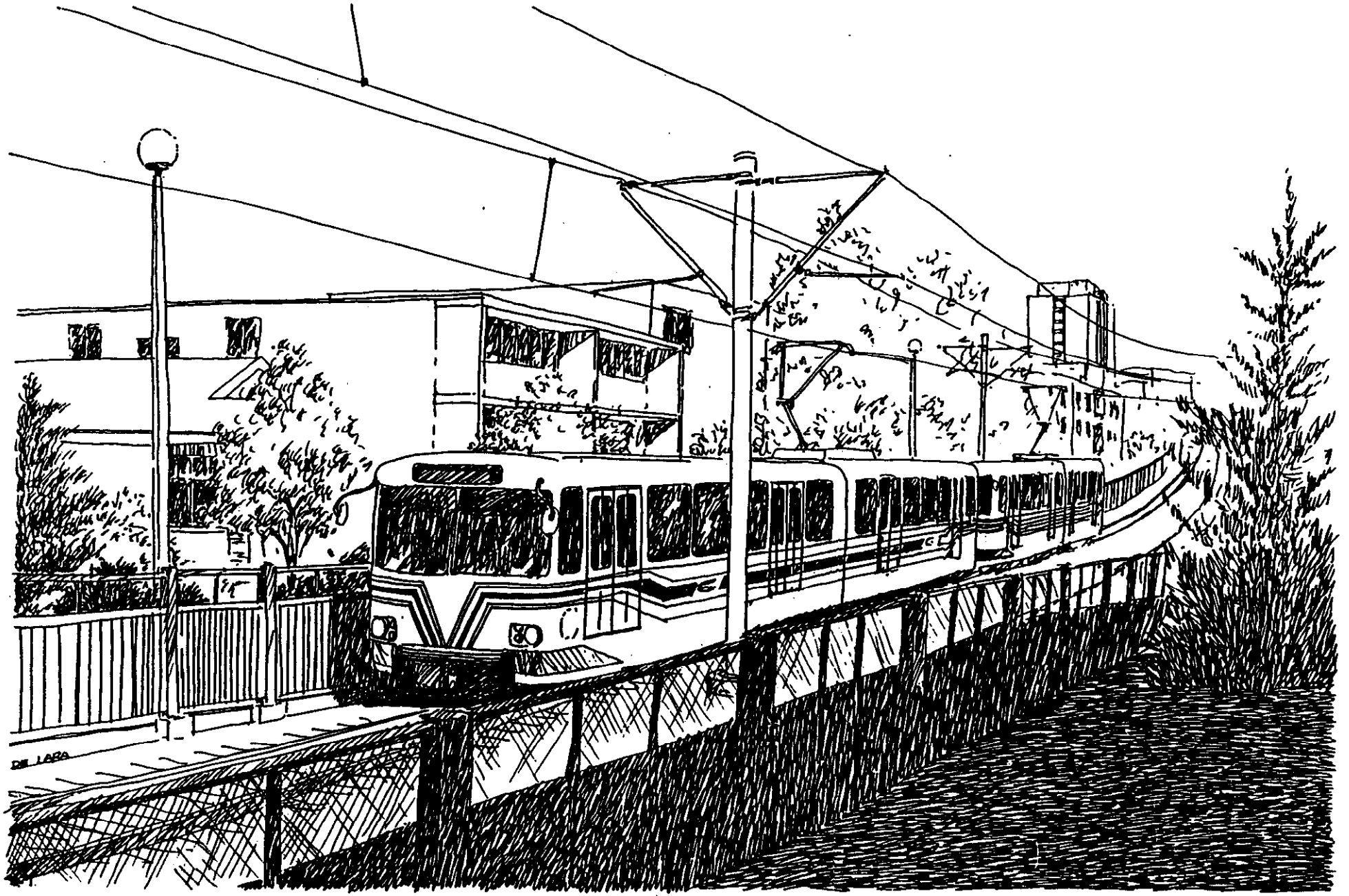
- Vibration absorbing materials that isolate the rail line from the foundations of adjacent or connected buildings.
- Floating (isolated using vibration absorbing material) slab trackbeds where track is fixed to a solid concrete trackbed.
- "Soft" track fasteners with solid concrete trackbeds.

- Low impact switch frogs.
- Ballast mat for at-grade track.
- Resilient bridge bearing pads between structure girders and support columns for aerial track

**Applicable Design Criteria, Drawings, and Specifications**

Noise and vibration is addressed in Chapter 11 of the Dallas Area Rapid Transit Rail Design Criteria. Aerial noise barriers are shown in DART Structural Standard Drawings.

Noise barriers reduce transit noise levels in a Calgary neighborhood



## WATER RESOURCES

### Issue

Will floodplains be altered, reducing their ability to store flood waters? Will the capacity of channels or floodways to transport flood waters be reduced? Will the flow patterns of storm waters be altered? Will surface or ground water quality be degraded? Will proposed water transportation opportunities be altered?

### Policy

**Environmental Quality Assurance Objectives**

- Avoid alterations to storm water flow patterns that would result in quantities that exceed municipal storm sewer and drainage channel capacity.
- Preserve floodplain capacity and the hydrological capacity of channels and floodways to transport flood waters.
- Prevent degradation of surface and ground water quality.
- Avoid the obstruction of existing or future options for water transportation.

**Impact Measures**

- The change in storm water drainage patterns and quantity; the change in 100-year flood levels; and the change in the hydraulic capacity of existing channels and floodways in terms of cubic feet per second.
- Use of grease, oils, chemicals, and wash water at maintenance facilities that cannot be placed in municipal sewers and the change in sanitary waste disposal requirements.
- Encroachment on navigational channels or clearances.

**Impact Assessment Method**

1. Drainage and Flooding

    a. Existing storm water drainage patterns will be determined from site maps, aerial photographs, and site inspections. Storm sewer capacity will be

identified. Changes in drainage patterns and the quantity of runoff will be identified. The ability of municipal storm sewers and open drainage channels to handle project runoff will be determined. Mitigation alternatives will be developed and compared in conjunction with municipal and drainage district representatives.

b. The location of the 100-year floodplain will be determined from Federal Emergency Management Agency Flood Insurance Maps. If the project is in the floodplain, reasons for the project's location in the floodplain, the alternatives considered, and the reasons why these alternatives are not considered practical will be documented. It will be determined if the project conforms to municipal floodplain protection standards, i.e. rail project facilities are raised out of the floodplain and floodplain levels are not significantly affected. This will be done in conjunction with municipal representatives.

c. The hydraulic capacity of existing channels and floodways will be determined. The change in capacity with the rail project will be calculated. Design alternatives to restore any lost capacity will be identified and compared.

2. Water Quality

a. Surface bodies of water on or adjacent to the rail project site will be identified and their present quality will be described. The applicable requirements of the 208 Areawide Water Management Plan will be identified. Provisions for containing rail project pollutants at maintenance sites will be defined. Future water quality both with and without the proposed project will estimated and compared to federal, state, and/or local water quality standards. Additional measures required to contain project pollutants will be defined and compared in conjunction with municipal and 208 representatives.

b. Sanitary sewer capacity will be identified and its ability to accommodate projected sanitary wastes will be calculated. Treatment requirements for rail maintenance site wastes prior to their introduction to the sanitary sewer system will be determined. Means for disposing of wastes that cannot go into the municipal sewer system will be proposed. They will comply with state and federal law.

3. Navigation. Navigation requirements on the Trinity River will be determined in consultation with the U.S. Coast Guard, U.S. Army Corps of Engineers, and the Texas State Department of Highways and Public Transportation, Highway Design Division, Environmental Section. The Trinity River is the only river or creek in the DART service area for which navigation requirements defined by the U.S. Coast Guard apply. For rail project Trinity River crossings, the relative merits of meeting clearance requirements for future navigation improvements now versus raising the rail project bridge at a later date will be examined. Bridge costs, now and later, and the likelihood of implementation of a Trinity River navigation project will be taken into account.

**Mitigation Warrants**

- The capacity of storm sewers is exceeded; the 100-year floodplain is encroached and the flood level is increased beyond municipal limits; the capacity of channels or floodways is reduced.

- Contamination of nearby bodies of water is likely; violations of federal, state, or municipal water quality standards are likely to occur.

- The U.S. Coast Guard indicates that the proposed project would affect navigation improvement plans.

**Background**

**Regulating Law and Industry Practice**

Several federal, state, and local water resource related laws and orders apply to both federally and locally funded rail projects.

Executive Order 11988, Floodplain Management (3 CFR 117) requires a federal funding or licensing agency to prepare written justification for a project proposed for placement in a floodplain; a statement indicating whether the action conforms to applicable state or local floodplain protection standards; and a list of alternatives considered. Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C 403) requires that a permit be issued for all filling or excavation in U.S. waterways. The removal of sand, shell, gravel, and mudshell from streams is regulated by Texas Parks and Wildlife Code, Chapter 86. Municipal governments control development within flood hazard areas via requirements contained in their zoning ordinances or development codes. These controls are based on those of the federal Flood Insurance Act of 1968 (42 U.S.C. 4001 et seq.). They prohibit building or filling in the "regulatory

floodway" (the way floodwaters travel as they recede). Residences must be elevated and nonresidential buildings must be flood proofed in designated flood hazard areas outside the floodway (the 100-year floodplain). Utilities must be located and constructed to minimize or eliminate flood damage.

Section 404 of the Clean Water Act (33 U.S.C 1344) requires that a federal permit be obtained from the U.S. Army Corps of Engineers in order to discharge fill material into U.S. waterways and wetlands. State water quality agencies must certify that a dredge or fill project will not cause any long term violations of water quality standards under the requirements of Section 401 of the Clean Water Act (33 U.S.C 1341). Under the requirements of the Clean Water Act, the U.S. Environmental Protection Agency regulates oil pollution prevention (33 CFR 153) and the National Pollutant Discharge Elimination System (40 CFR 6, 115, 121-125, 402, and 403). Chapter 26 of the Texas Water Code regulates water quality, including the discharge of wastes into waterways, disposal of industrial solid waste, and oil and hazardous substance cleanup.

Section 9 of the Rivers and Harbors Act of 1899 (33 U.S.C 401) requires that a permit be issued for any bridge built over U.S. navigable waterways. This law applies in the DART service area only to crossings of the Trinity River.

**Regulating Agencies**

U.S. Army Corps of Engineers (Section 401, Section 404, Section 10, and Executive Order 11988), U.S. Coast Guard (Section 9), U.S. Environmental Protection Agency (Section 404 and pollution regulations), Federal Emergency Management Agency and municipal government (flood hazard regulations), Texas Water Commission and Department of Water Resources (Texas Water Code Chapter 26), and Texas Parks and Wildlife Department and the City of Dallas (Texas Parks and Wildlife Code Chapter 86).

**Common Mitigation Techniques**

Water resource mitigation techniques include:

- Make stream channel improvements.
  - Install current deflectors.
  - Install gabions (wire mesh enclosed stones) to create cascades.
  - Use stockpiles of riparian (stream bank) soils as a top dressing.

- Provide for storm water storage.
  - Provide detention basins for storm water renovation.
  - Provide infiltration basins for storm water retention where possible.
- Provide sediment catch basins or traps for waste water.
- Transport and dispose of wastes off site when they cannot be placed in municipal sewers.
- Meet bridge clearance and span requirements or agree to alter bridge clearance and/or increase spans should proposed navigation improvement plans ever be implemented.

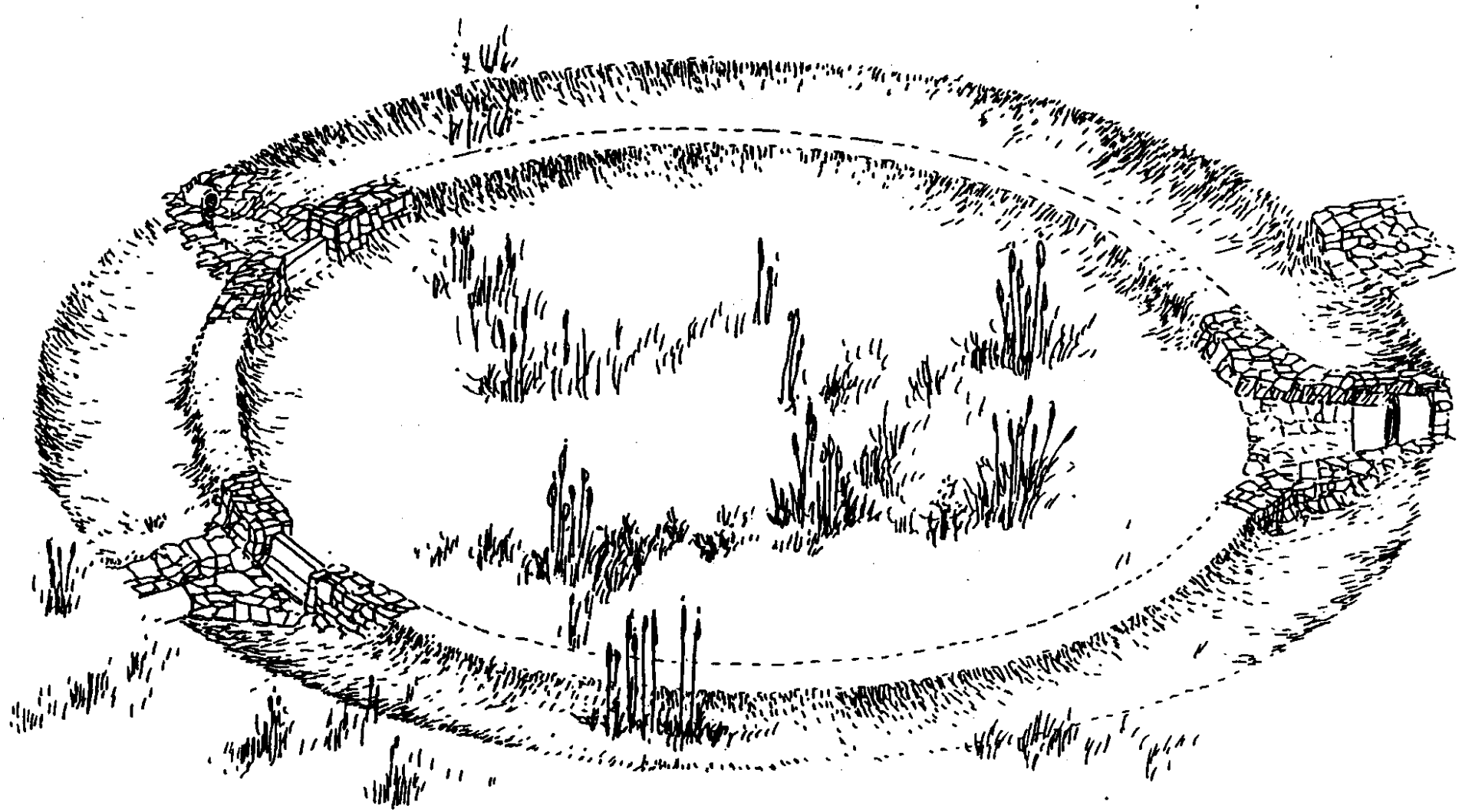
Guidance for developing water resource mitigation programs can be found in:

- Restoration & Management Notes. University of Wisconsin Press.
- Springer Series on Environmental Management. New York.
- Restoration of Fish Habitat in Relocated Streams. Federal Highway Administration Report No. 1P-79-3.
- Water Resources Protection Measures in Land Development. University of Delaware.
- An Analysis of Design Features in Mitigating Highway Construction Impacts in Streams. Pennsylvania Department of Transportation.

**Applicable Design Criteria, Drawings, and Specifications**

Drainage and water quality are addressed in Chapter 7, "Drainage," and Chapter 30, "Plumbing and Drainage Systems," of the Dallas Area Rapid Transit Rail Design Criteria.

A storm water detention basin.



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## WETLANDS AND ECOSYSTEMS

### Issue

Will wetlands, other sensitive natural features, wildlife habitat or movement, threatened or endangered species, or prime and unique farmlands be affected by the rail project?

### Policy

**Environmental Quality Assurance Objectives**

- Avoid the disturbance of U.S. Army Corps of Engineers jurisdictional wetlands.
- Avoid loss or disturbance of other ecologically sensitive areas, including woodlands, marshes, other high quality wildlife habitat, wildlife movement corridors, lakes, streams, unique landforms and geological formations, and pristine natural areas.
- Avoid adversely affecting the existence or habitat of threatened or endangered flora and fauna.
- For federally funded or licensed projects, avoid the use of prime or unique farmlands, as defined by the U.S. Soil Conservation Service.

**Impact Measures**

- Extent of direct (e.g. displacement) and the nature of indirect (e.g. changes in drainage patterns, water pollution) impacts on Corps of Engineers jurisdictional wetlands. The size of the area of effect and the ecological value of the wetland (e.g. flood control, erosion control, water pollution abatement, wildlife habitat) will be taken into account when judging impact significance.
- As appropriate, the affect on the water quality, wildlife, soils, hydrology, flora, fauna, land use, recreational use, and aesthetics of other ecologically sensitive areas, as determined using measures contained in applicable policy statements.
- Extent of fish and wildlife habitat disturbed and its quality and value, contrasted against its prevalence in the region; and wildlife movement corridors crossed and the affect on that movement.

- The presence of threatened or endangered plant species within disturbed natural areas or the likelihood of use of these natural areas by threatened or endangered wildlife.

- Acres of prime and unique farmlands used for a federally funded or licensed rail project site or right-of-way.

**Impact Assessment Method**

1. A field reconnaissance will be conducted to identify the limits of likely Corps of Engineers jurisdictional wetlands and other ecologically sensitive areas in the study area, including threatened and endangered species habitat. The characteristics of fish and wildlife habitat in the rail project area and the species they serve will be determined. Wildlife movement corridors will be identified. Unique geologic features also will be identified. A list of area threatened and endangered species and known threatened and endangered species locations in the project area will be requested from the U.S. Fish and Wildlife Service and the Texas Parks and Wildlife Department. For federally funded or licensed projects, the location of prime and unique farmlands in the project area will be requested from the U.S. Soil Conservation Service.

2. Inventory results will be sent to the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and Texas Parks and Wildlife Department for concurrence.

3. Based on existing conditions data, impacts will be defined using the impact measures. This will be done in consultation with the regulatory agency or agencies with jurisdiction over the resources potentially affected.

4. Alternative means for mitigating impacts will be defined and compared. These alternatives will be developed in consultation with the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and Texas Parks and Wildlife Department.

**Mitigation Warrants**

Loss, alteration, or other adverse effects to wetlands, ecologically sensitive areas, threatened or endangered species, or, for federally funded or licensed projects, prime or unique farmlands.

## Background

### Regulating Law and Industry Practice

Section 404 of the Clean Water Act (33 U.S.C 1344) requires that a federal permit be obtained from the U.S. Army Corps of Engineers in order to discharge fill material into U.S. waterways and wetlands. This law applies to both federally and locally funded DART rail projects. Executive Order 11990, Protection of Wetlands (3 CFR 121) directs that federal funding or licensing agencies take action "to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands." It further directs that each agency will "to the extent permitted by law avoid undertaking or providing assistance for new construction located in wetlands" unless "there is no practicable alternative to such construction" and "the proposed action includes all practicable measures to minimize harm to wetlands."

Federally funded or licensed projects must also meet the requirements of the Endangered Species Act of 1973 (16 U.S.C. 1531), the Farmland Protection Policy Act of 1981 (7 U.S.C. 4201 et seq.), the Fish and Wildlife Coordination Act of 1958 (16 U.S.C. 662). The Endangered Species Act of 1973 requires that all federal agencies, in consultation with the Departments of Interior and Commerce, carry out programs for the conservation of endangered and threatened species listed by the Department of Interior. The Farmland Protection Policy Act of 1981 requires federal agencies to identify and take into account the adverse effects of their programs on the preservation of farmland, to consider alternative actions, as appropriate, that could reduce such adverse effects, and to ensure that their programs are compatible with state and local government and private programs and policies to protect farmland. The Fish and Wildlife Coordination Act of 1958 requires that federal agencies coordinate with the U.S. Fish and Wildlife Service when assessing fish and wildlife impacts.

### Regulating Agencies

U.S. Army Corps of Engineers (Section 404, Executive Order 11990), U.S. Fish and Wildlife Service (endangered species and coordination requirements), and U.S. Soil Conservation Service (farmland protection).

### Common Mitigation Techniques

. Create new wildlife habitat and wetlands.

  - Create upland or wetland habitat using native seed.

- Determine the mean groundwater elevation and create wetland conditions by excavation to ground water or if possible, create perched wetland (on surface through which water will not percolate) soils.

- Use a combination of vegetative and mechanical means to interconnect habitats, e.g. willow mats and rip rap (stones) in waterways.

. Provide underdrains to maintain water flow between sections of a divided wetland.

. Provide wildlife corridor passage ways for small and large animals.

  - Base passageway clearances on species expected in the habitat.

  - Design to avoid barriers to passage, such as waterfalls, steps, and unnatural substrate (surfaces).

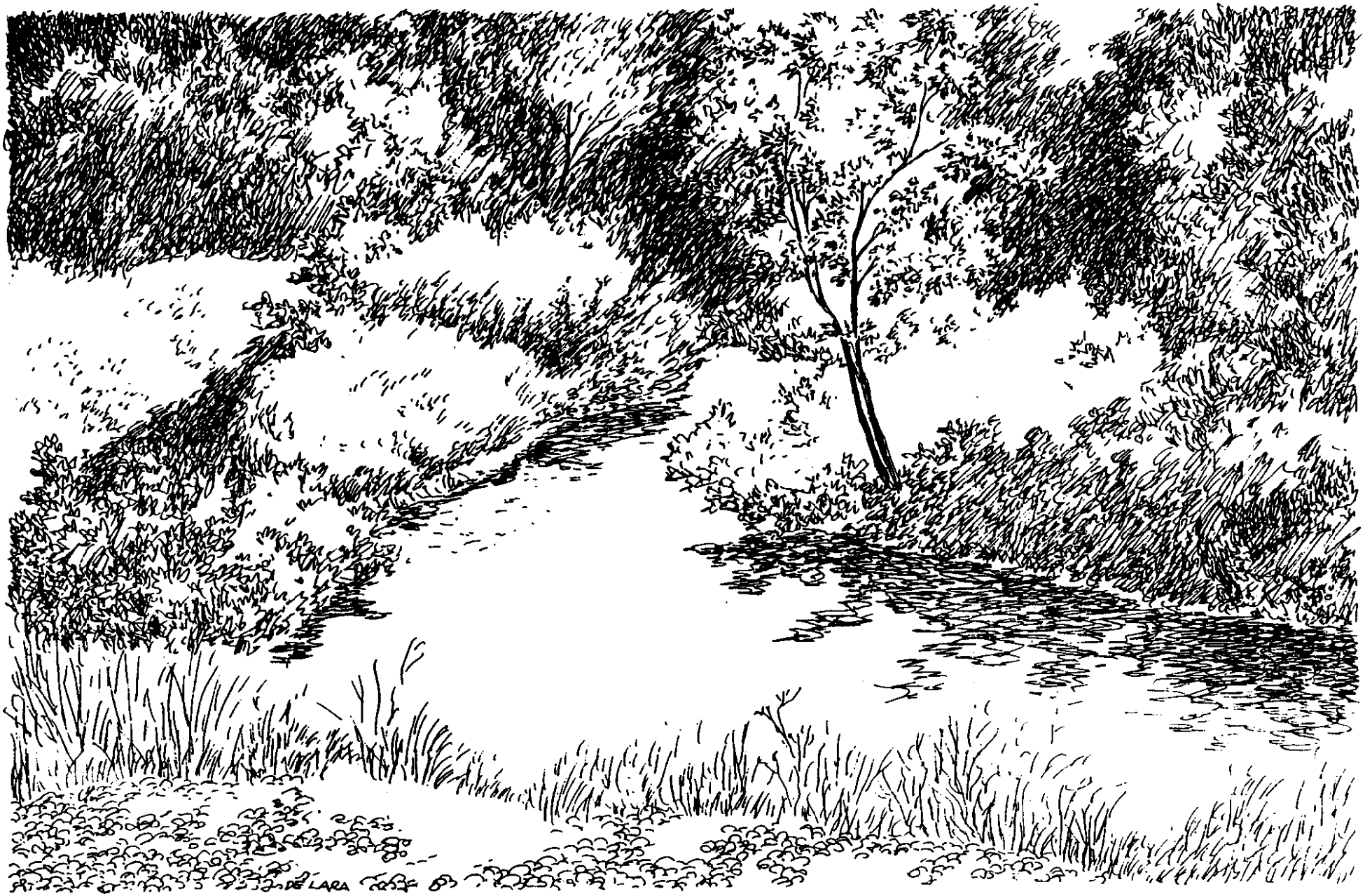
. Use barriers, such as fencing, boulders, trenches, moats, to isolate sensitive habitats from human trespassing.

. Protect sensitive resources that are to be retained within the rail project site or right-of-way from damage during construction. See policy statement 4.7, "Natural Resources Protection."

**Applicable Design Criteria, Drawings, and Specifications**

The situation of each wetland, other sensitive natural feature, wildlife habitat or movement corridor, threatened or endangered species, and prime and unique farmland will be addressed individually.

A wetland.



## CIRCULATION MAINTENANCE

### Issue

How will traffic and pedestrian circulation patterns and access be maintained during construction?

### Policy

**Environmental Quality Assurance Objectives**

- Maintain access to all adjacent properties.
- Minimize the time during which circulation patterns and access points are temporarily changed.
- Maintain at least traffic level of service "D" on affected streets and thoroughfares or, if the level of service would "E" or "F" without the construction project, take steps to avoid worsening congestion.
- Avoid the use of local residential streets for detouring thoroughfare traffic.
- Establish the approach to access and circulation maintenance for each project prior to the start of construction.
- Involve municipal authorities in access and circulation maintenance planning and obtain their approval.
- Mark temporary changes in access and circulation patterns so they can be clearly understood by the public.

**Impact Measures**

The need for a temporary partial or full closure to public access of streets, walkways, and other passageways, or a temporary change in traffic circulation patterns, because of construction, demolition, or related activities.

**Impact Assessment Method**

1. A general construction staging scenario will be prepared.
2. Existing traffic volumes and the level of service on surrounding streets will be identified. Property and building access points for occupants, visitors and

customers, deliveries, refuse collection, repair services, and emergency services will be identified.

3. Based on items 1 and 2, the need for a temporary partial or full closure to public access of streets, walkways, and other passageways, or a temporary change in traffic circulation patterns will be identified in general.

4. Alternative approaches to temporary access and circulation patterns -- including alternative construction staging plans, and general maintenance and protection of traffic plans -- will be compared from the perspective of congestion potential, degree of inconvenience, effect on provision of emergency services, and length of time required.

**Mitigation Warrants**

Any temporary partial or full closure to public access of streets, walkways, and other passageways, or a temporary change in traffic circulation patterns.

**Background**

**Regulating Law and Industry Practice**

Municipal codes are followed. A maintenance and protection of traffic plan is developed and written approval is obtained from the appropriate municipal government. Guidelines for maintenance of access to adjacent properties are incorporated into master construction specifications and must be followed by all contractors.

**Regulating Agencies**

Municipal government for traffic maintenance.

**Common Mitigation Techniques**

- Incorporate general access and circulation maintenance requirements into project master specifications. These requirements can specify that construction contractors:
  - Prepare a detailed maintenance and protection of traffic plan for approval by transit authority and municipal representatives, and obtain required permits.
  - Divert traffic to collector streets and thoroughfares and avoid diverting traffic to local residential streets.

- Use traffic control signs, striping, and/or barricades to redirect motor vehicle and pedestrian traffic, as per municipal requirements.

- Carefully schedule construction activities and vigorously pursue project completion as required to permit the reopening of streets and access points as soon as possible and without unnecessary delays.

- Use steel plates and/or timber decking over excavations within street rights-of-way as appropriate to maintain needed circulation and access.

- Provide temporary walkways where sidewalks must be removed in order to maintain access to adjacent homes, businesses, and services.

- Maintain access to all property from roads and highways (unless loss of access is agreed to with the property owner) and, if the existing access point is temporarily cut, provide temporary access for occupants, visitors and customers, deliveries, refuse collection, repair services, and emergency services.

- Keep persons responsible for emergency services informed of the location, nature, and duration of construction operations.

- Address complaints. Notify transit authority representatives of the complaint and the action taken.

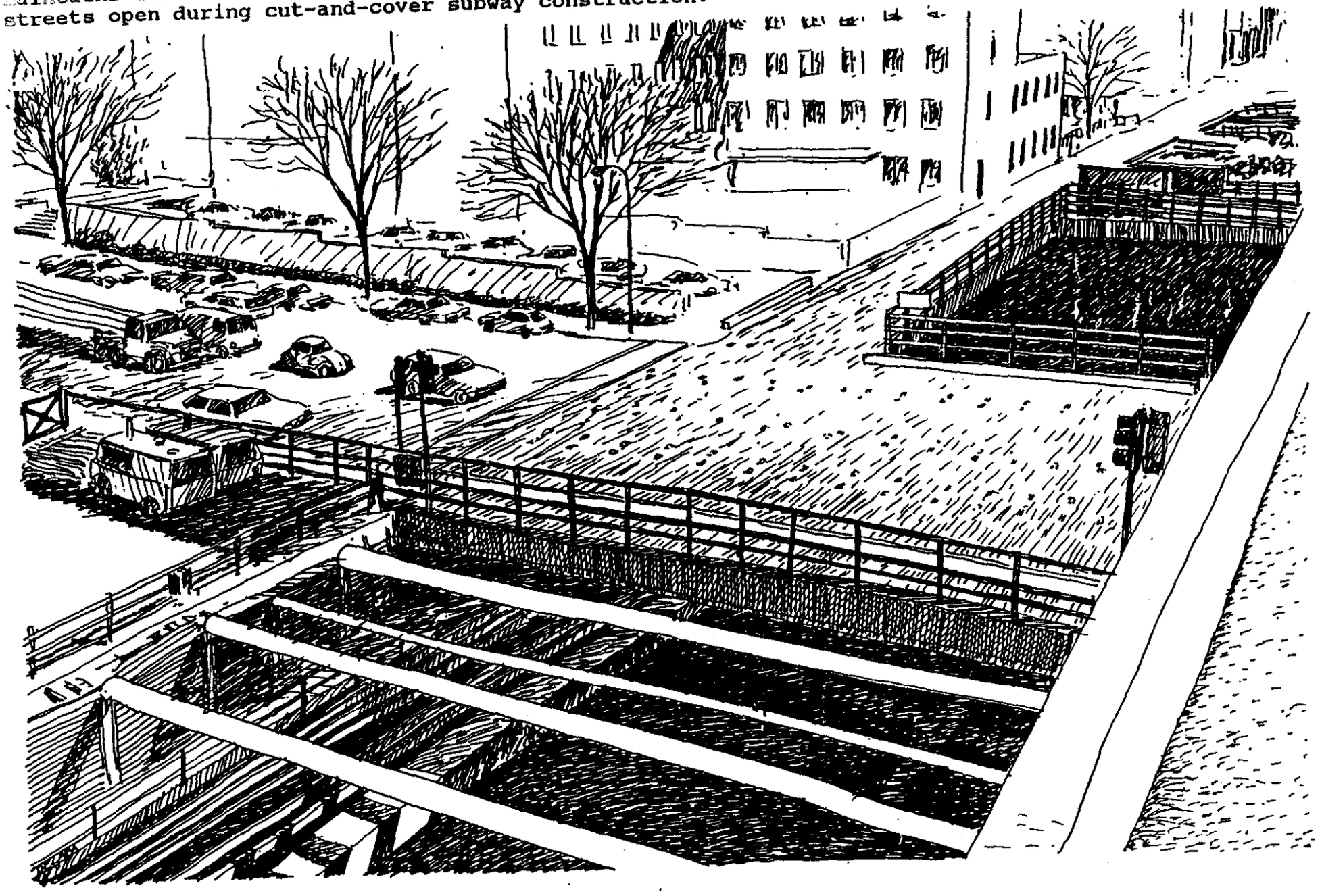
- During preliminary design, develop a specific construction staging plan and approach to circulation and access maintenance in areas where circulation and access maintenance is particularly critical. The Dallas Central Business District, where high density development generates high traffic volumes, is one example. Such plans would be approved by municipal authorities.

- Monitor contractors as a part of construction management to ensure that access and circulation specifications and plans are being carried out.

**Applicable Design Criteria, Drawings, and Specifications**

These issues are addressed in sections 01500, "Temporary Construction Facilities," and 01560, "Environmental Protection," of the Dallas Area Rapid Transit Master Construction Specifications.

Partial decking in Washington, D.C. (a heavy rail system) maintains access to adjacent buildings and keeps critical streets open during cut-and-cover subway construction.



## CONSTRUCTION SITE OPERATION

### Issue

How will the sensitivity to disturbance of surrounding land uses be taken into account when establishing construction storage and staging areas, scheduling construction operations, and operating all construction sites?

### Policy

**Environmental Quality Assurance Objectives**

- Ensure that the sensitivity of surrounding land uses to disturbance is taken into account when selecting construction storage and staging sites, planning the placement of equipment and materials on those sites, and scheduling construction operations.
- Provide opportunites for the public to keep informed about the project.
- Ensure that storage, staging, and construction sites are orderly, provide necessary utilities, and are free of accumulations of waste materials and rubbish.
- Avoid storing unnecessary materials or equipment at construction sites.
- Prevent entry into storage, staging, and construction areas by children, animals, and unauthorized adults and vehicles.
- Restore storage and staging areas to their original condition at the end of construction.
- Provide adequate parking for workers on the construction site.

**Impact Measures**

The location of construction areas in relation to sensitive land uses, populations, and natural resources.

**Impact Assessment Method**

1. A general construction scenario will be prepared, including identification of potential construction stages, the timing and duration of construction,

storage and staging site alternatives, equipment required by stage, and the number of workers.

2. Existing land use, population, and natural resource characteristics will be identified.

3. Based on items 1 and 2, planned construction operations, including schedules, at all areas where construction activities will occur will be examined in terms of their relationship to adjoining land uses that are sensitive to disturbance, their relationship to places where people congregate, their accessibility to thoroughfares, the character and value of on-site natural resources, and their relationship to sensitive natural resources on adjoining lands. Planned construction operations, including schedules, at alternative potential storage and staging sites will be compared from the same perspectives plus the adequacy of site size and shape for an efficient operation.

**Mitigation Warrants**

Positive steps to ensure that the quality assurance objectives are attained are warranted for all construction sites, but particularly at sites adjacent to sensitive land uses, places where people congregate, or sensitive natural resources, or with sensitive on-site natural resources.

**Background**

**Regulating Law and Industry Practice**

Storage, staging, and construction site operations are defined by the requirements of specifications and/or construction contracts, and must be followed by all contractors. Municipal building codes also apply.

**Regulating Agencies**

Municipal government.

**Common Mitigation Techniques**

- Incorporate general construction site operation requirements into master construction specifications. These requirements can specify that construction contractors:

  - Meet all municipal building requirements.

  - Confine construction activities to locations specified by the transit authority within drawings, specifications, and/or contracts.

- When adjacent to land uses or natural resources identified by the transit authority as sensitive to disturbance, submit staging and storage area sites and layouts, as well as construction schedules, for approval by transit authority representatives. The layouts should show the locations of all offices, shops, storage areas, security fencing, stationary equipment, mobile equipment, employee parking, and other facilities.

- Provide and maintain all necessary utilities with a capacity adequate for all workers and construction equipment.

- Erect and maintain signs, fences, barricades, pedestrian ways, security lighting, and/or security guards as necessary to prevent entry onto construction sites by children, animals, and unauthorized adults and vehicles.

- Post construction information signs identifying what is being built, who is building it, and where one may call for additional information.

- Hold preconstruction public information meetings.

- Store only necessary materials or equipment at the construction site.

- Pick up trash, place it in containers that are emptied on a regular schedule, and dispose of it off site.

- Restore storage and staging areas to as close as possible to their original condition immediately upon project completion. Repair or replace public improvements damaged during construction to equal or better condition than that prior to the start of construction.

. During preliminary design, develop specific construction site operation plans where the characteristics of construction sites or adjoining lands warrant efforts beyond what would be normally included in master construction specifications.

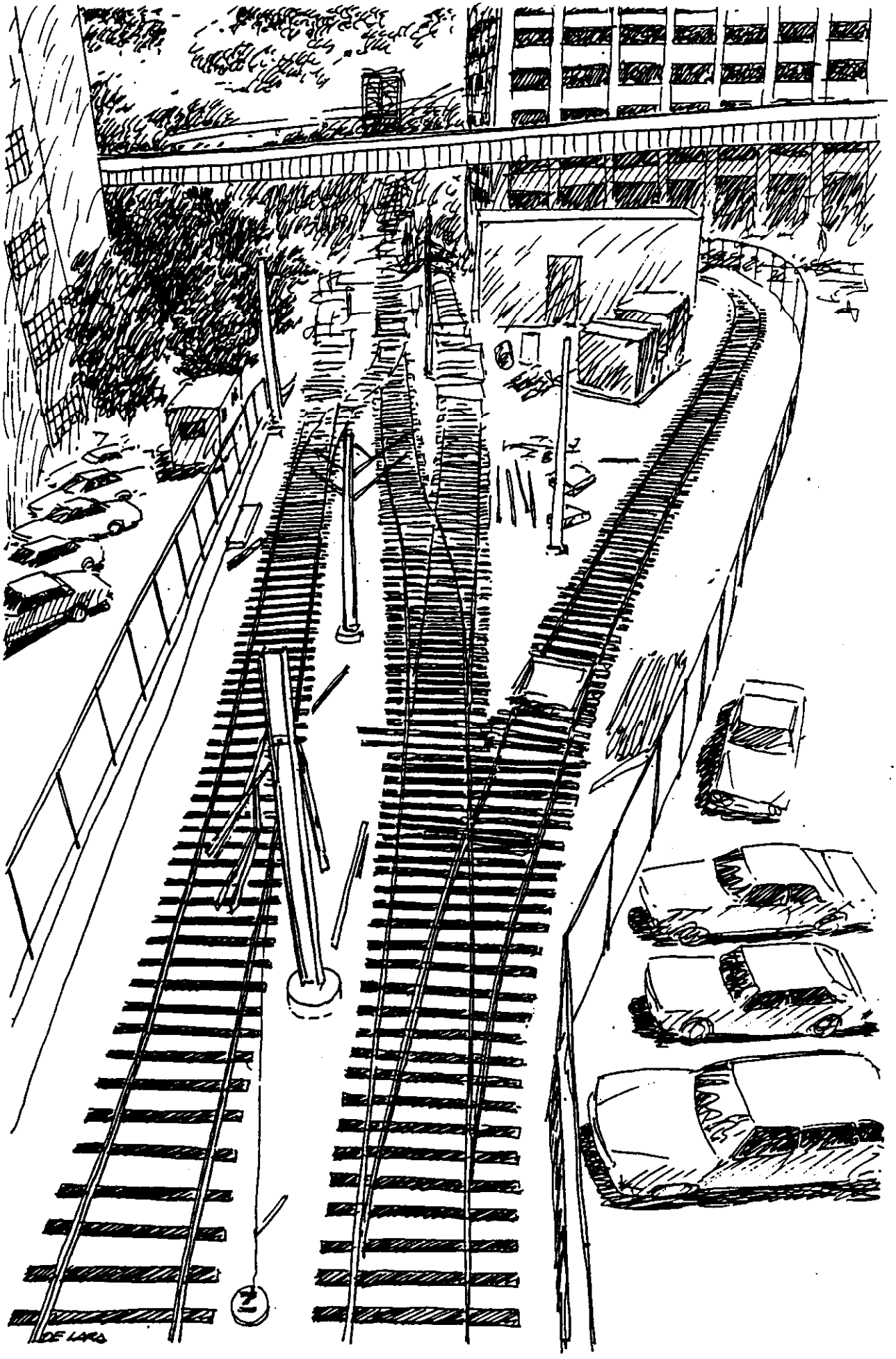
. During construction, offer safety awareness classes for school children.

. Monitor contractors as a part of construction management to ensure that construction site operation specifications and plans are being carried out.

**Applicable Design Criteria, Drawings, and Specifications**

These issues are addressed in sections 01500, "Temporary Construction Facilities," and 01560, "Environmental Protection," of the Dallas Area Rapid Transit Master Construction Specifications.

Trackwork construction in Pittsburgh.



## MATERIALS TRANSPORT

### Issue

How will materials and equipment be brought to construction sites?

### Policy

**Environmental Quality Assurance Objectives**

- Avoid the use of local residential streets for transport of equipment and materials.
- Ensure that equipment and materials are transported to the job site in conformance with applicable municipal, state, and federal law and regulations.
- Minimize material spillage during transport and clean up any spillage that does occur.

**Impact Measures**

The location of construction areas in relation to thoroughfares and in relation to sensitive land uses, populations, and natural resources.

**Impact Assessment Method**

1. A construction scenario will be prepared that includes a general description of the materials that will be required and the manner in which they will be transported to storage and staging areas, and construction sites for use or installation.
2. Existing thoroughfares and collector streets, and the land use along local streets in the vicinity of project construction will be identified.
3. Based on items 1 and 2, the points where local residential streets will be used for the transport of materials will be identified. Options for avoiding this need will be examined.

**Mitigation Warrants**

Positive steps to ensure that the quality assurance objectives are attained are warranted for all transport of materials, but particularly at locations where materials must be transported over local residential streets.

## Background

### Regulating Law and Industry Practice

Materials transport procedures are defined by the requirements of construction specifications and/or contracts. Municipal codes related to truck routes also apply.

### Regulating Agencies

Municipal government.

### Common Mitigation Techniques

- Incorporate general materials transport requirements into project master specifications. These requirements can specify that construction contractors:
  - Prepare a detailed plan for materials transport for approval by municipal authorities. It would designate truck routes to the nearest major thoroughfare; truck ingress, egress, and on-street loading and unloading locations; truck parking and staging locations; and any special restrictions necessary to protect public property.
  - Contain materials transported in open trucks, in order to avoid spillage, and clean up materials spilled.
- During preliminary design, develop a specific materials transport plan for locations where local residential streets must be used.
- Monitor contractors as a part of construction management to ensure that materials transport specifications and plans are being carried out.

### Applicable Design Criteria, Drawings, and Specifications

This issue is addressed in section 01560, "Environmental Protection," of the Dallas Area Rapid Transit Master Construction Specifications.

## UTILITIES MAINTENANCE

### Issue

Will utility services be disrupted during construction?

### Policy

**Environmental Quality Assurance Objectives**

Avoid or minimize inconvenience to utility users.

**Impact Measures**

The location of excavation and construction equipment movement in relation to subsurface and surface utility lines.

**Impact Assessment Method**

1. The approximate location of subsurface and surface utility lines will be identified as a part of engineering design. Utilities include facilities belonging to government agencies, public utility corporations, railroads, and privately owned companies for the provision of sewer, water, gas, electrical, telephone, telegraph, cable television, and other communications services; street lighting; pipelines; alarm systems; and parking meters.

2. The relationship between the rail project and utility lines will be identified.

3. Discussions will be held with affected utility operators in order to identify in general how best to relocate affected utilities or maintain them in place during construction. Relocation methods and timing will take into account the need to minimize disruption in utility service.

**Mitigation Warrants**

Positive steps to ensure that the quality assurance objective is attained are warranted whenever utilities are affected by project construction.

## Background

### Regulating Law and Industry Practice

Generally, design and construction of public utilities rearrangements are accomplished entirely by the utility owner in accordance with their own standard criteria and specifications. The cost paid by the transit authority is subject to negotiation.

### Regulating Agencies

Dallas area utility companies and agencies that own facilities that could be affected by DART construction include but are not limited to:

- Municipal public works departments
- American Telephone and Telegraph (AT&T)
- Dallas Water Utilities (DWU)
- Exxon Pipeline Company
- GTE-Sprint Communications
- LDX Net, Inc.
- Lone Star Gas (LSG)
- MCI Communications (MCI)
- North Texas Municipal Water District
- Southwestern Bell
- Texas Municipal Power Agency
- Texas State Department of Highways & Public Transportation
- Texas Utilities Electric Company (TUE)
- United Gas Pipeline Company
- Western Union Telegraph Company (WU)

### Common Mitigation Techniques

- Maintain and protect existing utilities in-place during construction.
- Provide temporary connections for services that must be discontinued for extended periods of time.

- Maintain existing services as long as reasonably possible.

- Notify users well in advance of any anticipated service disruptions and attempt to coordinate convenient times for necessary service outages.

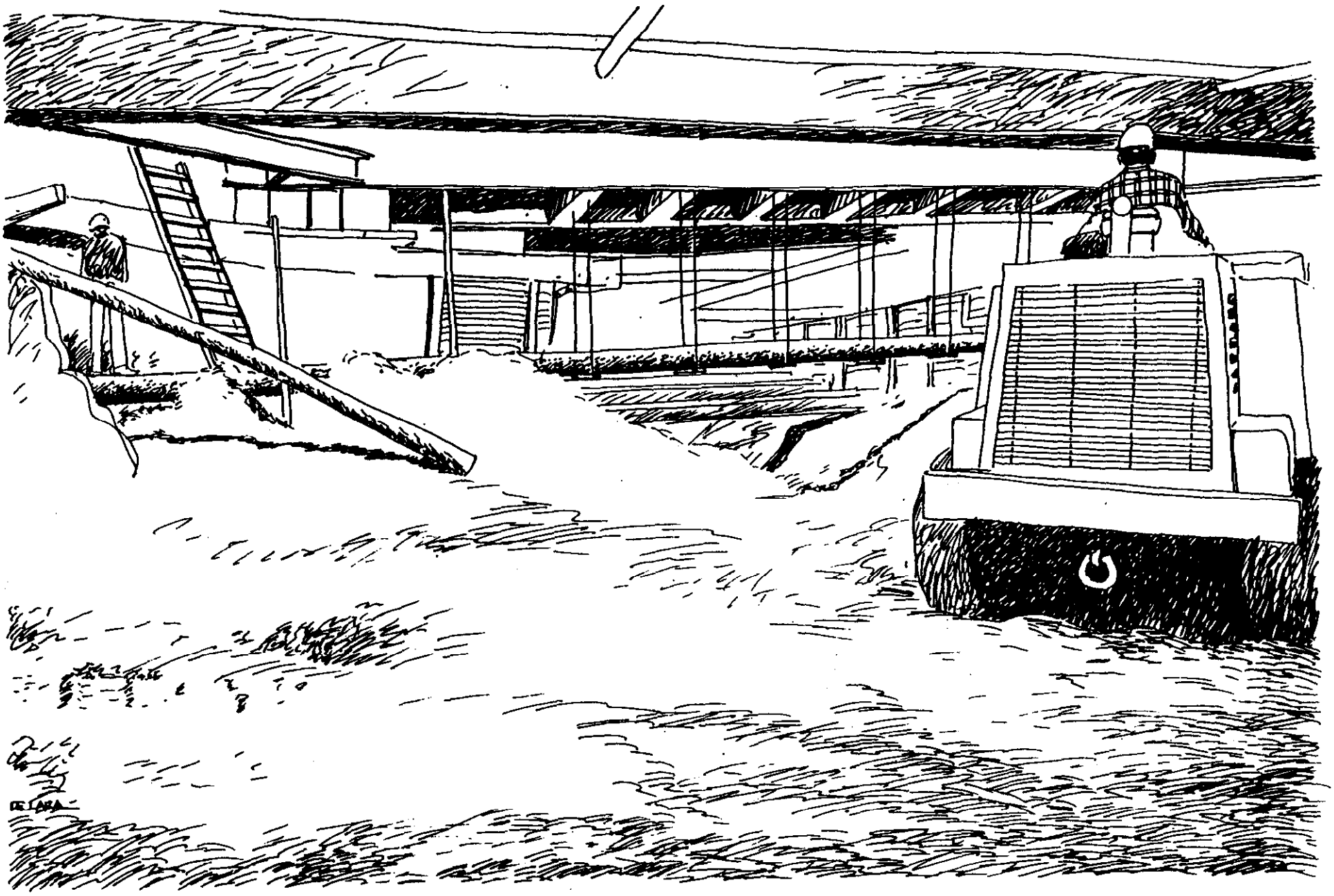
- Monitor contractors as a part of construction management and include financial incentives in construction contracts that encourage contractors to actively seek to avoid accidental disruption of services.

- Coordinate the schedules of multiple utility rearrangements in order to minimize negative impacts on users.

**Applicable Design Criteria, Drawings, and Specifications**

This issue is addressed in section 02156, "Maintenance, Support, and Restoration of Utility Facilities" of the Dallas Area Rapid Transit Master Construction Specifications and in chapter 6, "Utilities" of the Dallas Area Rapid Transit Rail Design Criteria.

A utility line being supported in place during Pittsburgh subway construction.



## WASTE DISPOSAL

### Issue

How will waste materials be disposed?

### Policy

**Environmental Quality Assurance Objectives**

- Ensure that excess excavated material not approved as clean fill, rubbish, and demolition debris is transported off the construction site in a timely manner and is disposed in a manner that complies with municipal and state requirements.

- Ensure that when sewage is disposed via a connection to municipal sewer systems that the connection and the wastes meet municipal requirements, and ensure that chemical toilets are properly emptied.

- Ensure that chemical waste is transported off the construction site and disposed in a manner conforming to applicable municipal, state, and federal laws and regulations.

- Ensure that the Texas Water Commission is immediately notified if oil or hazardous substance spills occur that may be large enough to violate municipal, state, or federal regulations. Notify municipal government if substances spilled reach storm drains.

- Ensure that toxic substances encountered during construction are transported off the site and disposed in accordance with state and federal law.

**Impact Measures**

The characteristics and quantity of wastes to be removed from construction sites.

**Impact Assessment Method**

1. A general description will be prepared of the wastes that will be removed from construction sites, including: type, estimated quantities, anticipated method of removal, special treatments or permits required for disposal, and the availability of disposal sites.

2. An environmental audit designed to identify preexisting oil or hazardous waste spills in the proposed rail right-of-way, and station and other facility sites, will be conducted.

3. The findings of items 1 and 2 will be discussed with appropriate regulatory agencies.

4. Additional testing required to confirm the character of excavation and demolition wastes and the need for special treatments or permits prior to disposal will be identified. Any other general disposal problems will be identified. Steps that will be taken to prevent accidental waste spills and general spill contingency plans will be defined.

**Mitigation Warrants**

Positive steps to ensure that the quality assurance objectives are attained are warranted for all disposal of wastes, but particularly in the disposal of any oil or hazardous wastes that may be encountered during excavation and demolition.

**Background**

**Regulating Law and Industry Practice**

State of Texas solid waste disposal, oil and hazardous substance, and water quality requirements, as well as municipal liquid and solid waste disposal ordinances.

**Regulating Agencies**

U.S. Environmental Protection Agency, Texas Water Commission, Texas Air Control Board, and municipal government, local emergency planning committee.

**Common Mitigation Techniques**

- Incorporate general waste disposal requirements into project master specifications. These requirements can specify that construction contractors:

  - Meet the requirements of municipal, state, and federal waste disposal laws, including the obtaining of appropriate permits.

  - Obtain approval from transit authority representatives of all disposal sites.

  - Obtain approval from transit authority representatives of the contractor's designation of excavated material as clean fill suitable for use

elsewhere on the transit right-of-way where fill is required.

- Notify a transit authority representative if unanticipated hazardous materials are encountered during building demolition or soils excavation.

- Notify a transit authority representative and water quality regulators if oil or hazardous substance spills occur.

. During preliminary design, conduct all testing programs recommended by the environmental impact analysis in order to determine where special disposal requirements must be met, what those requirements are, and how much they will cost. If this is done prior to property purchase, the need to clean up preexisting oil and hazardous waste spills can be taken into account when negotiating a purchase price.

. Monitor contractors as a part of construction management to ensure that wastes are being properly disposed.

**Applicable Design Criteria, Drawings, and Specifications**

These issues are addressed in sections 02050, "Demolition," and 01560, "Environmental Protection," of the Dallas Area Rapid Transit Master Construction Specifications.

## NOISE, VIBRATION, AND AIR POLLUTANT CONTROL

### Issue

How will noise, vibration, and air pollutant emissions be controlled at construction sites?

### Policy

**Environmental Quality Assurance Objectives**

- Minimize noise and vibration from construction operations.
- Keep dust down at all times, including nonworking hours.
- Control exhaust emissions from construction equipment.

**Impact Measures**

Maximum allowable daytime and nighttime decibel levels at 50 feet from the construction site or at the nearest sensitive receptor will be used to measure construction noise impact. The maximum allowable levels will be more strict near noise sensitive land uses, for nighttime construction, and for construction operations that involve equipment that emits sound continuously during its operation. Noise from individual pieces of construction equipment will be measured in terms of maximum noise limits. Vibration from construction operations will be measured in terms of a maximum permitted vibration level at 200 feet from the construction site or at the nearest sensitive receptor.

Municipal, state, and federal air pollution control standards applicable to dust control and air pollutant emission control will be used.

**Impact Assessment Method**

1. A general construction scenario will be prepared, including identification of potential construction stages, storage and staging site alternatives, and equipment required by stage.
2. Existing land use, population, and natural resource characteristics will be identified.
3. Based on items 1 and 2, all areas where construction activities will occur will be examined in terms of

their relationship to adjoining land uses that are sensitive to disturbance from dust, air pollutant emissions, noise, or vibration.

4. A general noise and vibration level range at sensitive receptors will be calculated based on average noise levels for the construction equipment being used and the extent of equipment usage by stage. Locations where special operating procedures would likely be needed to ensure that maximum allowable noise and vibration limits are not exceeded will be identified.

**Mitigation Warrants**

Noise or vibration mitigation is warranted if maximum noise or vibration levels are exceeded. The specific limits that will not be exceeded are contained in section 01560, "Environmental Protection," of the Dallas Area Rapid Transit Master Construction Specifications.

Positive steps to ensure that the quality assurance objectives for dust control and air pollutant emissions are attained are warranted for all project construction activities.

**Background**

**Regulating Law and Industry Practice**

Construction noise limits (maximum allowable levels) are included in master construction specifications. Dallas area municipal law prescribes procedures for dust control during structure demolition and, in order to control noise, restricts the hours of construction operation in residential areas.

**Regulating Agencies**

Municipal government for demolition dust control and hours of operation in residential areas.

**Common Mitigation Techniques**

- Incorporate noise and vibration requirements into project master specifications. These requirements can specify that construction contractors:
  - Meet specified construction noise limits.
  - Provide working machinery and equipment with efficient noise suppression devices, including mufflers and sound retardant housings.

- Restrict working hours and schedule operations in a manner that will minimize the disturbance of adjoining land uses.

- Select quieter alternative operating procedures when they are available.

- Use shields, impervious fences, or other physical sound barriers to inhibit transmission of noise.

- Line or cover hoppers, storage bins, and chutes with sound deadening material.

- Route construction equipment along streets which will cause the least disturbance to residents when bringing construction materials to a construction site or carrying waste materials away from a construction site .

- Place stationary equipment away from sensitive land uses.

- Use vibratory pile drivers or augering for setting piles in lieu of impact pile drivers.

- Monitor construction noise and vibration levels and maintain records for inspection by transit authority representatives, as well as notify the transit authority of any complaints, the action taken in response, and the results of the action taken.

Incorporate dust control requirements into project master specifications. These requirements can specify that construction contractors:

- Treat soil at the construction site, on haul roads, and other areas disturbed by construction operations, as well as materials stockpiled for the project, with dust suppressors or cover.

- Not use dry power brooming; not perform any sand blasting unless it is specifically specified; and only use wet cutting as a method for cutting concrete block, concrete, and asphalt.

- Inspect all vehicles for dirt prior to their leaving the construction site and remove dirt, soil, and rubble likely to be dislodged from tires during transit.

- Secure and cover transport equipment and loose materials to ensure that materials do not become airborne during transit.

- Incorporate air pollutant control requirements into project master specifications. These requirements can specify that construction contractors:

  - Use and maintain emission control devices on gasoline and diesel construction equipment.

  - Avoid idling and unnecessary operation of equipment.

- During preliminary design, develop specific noise and vibration control plans for locations where noise and vibration control is particularly critical.

- Monitor contractors as a part of construction management to ensure that noise and vibration, dust control, and air pollutant emission specifications and plans are being carried out. This would include a review of noise and vibration monitoring records and the contractor's handling of complaints.

**Applicable Design Criteria, Drawings, and Specifications**

These issues are addressed in section 01560, "Environmental Protection," of the Dallas Area Rapid Transit Master Construction Specifications.

## NATURAL RESOURCES PROTECTION

### Issue

How will natural resources be protected during construction?

### Policy

**Environmental Quality Assurance Objectives**

- Preserve natural resources outside the limits of permanent structures and facilities in their existing condition or restore to an equivalent condition upon completion of construction.
- Confine on-site construction activities to areas defined be drawings and specifications, including temporary use areas.
- Control soil erosion and sediment discharge into waterways during construction.
- Protect existing wetlands and watercourses outside areas where changes to wetlands and watercourses are allowed by municipal and/or federal permits.
- Avoid disturbance of water flows and wildlife habitat near or adjacent to project construction areas in order to protect fish and wildlife resources.
- Protect from damage trees, shrubs, and other vegetation not in areas designated to be cleared.
- Avoid unnecessary soil compaction by vehicles or stockpiles of materials.

**Impact Measures**

The characteristics, function, and value of natural resources adjacent to construction areas.

**Impact Assessment Method**

1. A general construction scenario will be prepared, including identification of potential construction stages; storage and staging site alternatives; location of clearing, cuts, and fills; and equipment and materials required by stage.

2. The characteristics, function, and value of natural resources adjacent to construction areas, including storage and staging area site alternatives, will be identified. The erodibility of soils to be exposed will be identified.

3. Based on items 1 and 2, the potential effect of construction on adjacent natural resources of high value, including vegetation, habitat, wildlife, wetlands, and watercourses, will be identified. The significance of the impact will take into account the size of the area effected and its ecological value. The potential for significant soil erosion on construction sites and sediment discharge into waterways will be determined.

4. Strategies for protecting or restoring effected resources will be identified and evaluated in consultation with natural resource regulatory and permitting agencies.

**Mitigation Warrants**

Positive steps to ensure that the quality assurance objectives are attained are warranted for all construction sites, but particularly at sites that are adjacent to valuable natural resources. The need for mitigation at specific locations will be dependent in part on the policies of natural resource regulatory agencies.

**Background**

**Regulating Law and Industry Practice**

The following laws and orders apply to both federally and locally funded DART rail projects:

- Section 404 of the Clean Water Act (33 U.S.C. 1344) requires that a federal permit be obtained to discharge fill material into U.S. waterways and wetlands.

- Section 401 of the Clean Water Act (33 U.S.C. 1341) requires that state water quality agencies certify that a dredge or fill project will not cause any long term violations of water quality standards.

- Section 9 of the Rivers and Harbors Act of 1899 (33 U.S.C. 401) requires that a permit be issued for any bridge built over U.S. navigable waterways. This law applies in the DART service area only to crossings of the Trinity River.

- Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) requires that a permit be issued for all filling or excavation in U.S. waterways.

- Executive Order 11988, Floodplain Management (3 CFR 117) requires a federal funding or licensing agency to prepare written justification for a project proposed for placement in a floodplain.

- Executive Order 11990, Protection of Wetlands (3 CFR 121) directs that federal funding or licensing agencies take action "to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands."

- Texas Parks and Wildlife Code Chapter 86 regulates the removal of sand, shell, gravel, and mudshell from Texas streams.

- DART service area municipal floodplain ordinances regulate use of area floodplains.

The following laws apply only to federally funded rail projects, unless they must be addressed as a part of the U.S. Army Corps of Engineers permitting process that enforces Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act or the U.S. Coast Guard permitting process that enforces Section 9 of the Rivers and Harbors Act:

- Endangered Species Act of 1973 (16 U.S.C. 1531) requires that all federal agencies, in consultation with the Departments of Interior and Commerce, carry out programs for the conservation of endangered and threatened species listed by the Department of Interior.

- Fish and Wildlife Coordination Act of 1958 requires that federal agencies coordinate with the U.S. Fish and Wildlife Service when assessing fish and wildlife impacts.

**Regulating Agencies**

U.S. Army Corps of Engineers (Section 401, Section 404, Section 10, and Executive Orders 11988 and 11990), U.S. Coast Guard (Section 9), U.S. Fish and Wildlife Service (Endangered Species Act and Fish and Wildlife Coordination Act), U.S. Environmental Protection Agency (Section 404), the City of Dallas and Texas Parks and Wildlife Department (Texas Parks and Wildlife Code Chapter 86), and municipal government (floodplain regulations).

**Common Mitigation Techniques**

- Incorporate general natural resource protection requirements into project master specifications. These requirements can specify that construction contractors:

  - Operate within construction limits identified in construction contracts and requires approval of a transit authority representative to alter those limits.

  - Store only necessary materials or equipment at the construction site.

  - Not permit construction debris, excess materials, or rubbish of any kind to purposely be allowed to fall into a river, onto adjacent banks, or onto highways, including paint splatters and spillage. They must provide devices to prevent such an occurrence. They must remove any fallen material promptly and notify a transit authority representative.

  - Control soil erosion and sediment discharge on filled and cleared lands.

  - Not remove, cut, deface, injure, or destroy trees, shrubs, and other vegetation, except in areas indicated for clearing in design plans, without permission of a transit authority representative. They may not attach ropes, cables, or guy wires to trees for anchorage. They must install fencing around the drip lines of trees to be saved within the construction limits to prevent damage. They cannot stockpile soil, tools, materials, or equipment within the drip line of trees that are within construction limits and are to be saved.

  - Not use herbicides unless specified for a specific situation.

  - Repair or restore all trees and landscape features scarred or damaged by equipment or operations to their original condition based on a repair and restoration plan approved by a transit authority representative.

  - Not cross streams by fording of equipment.

  - Remove temporary culverts or bridge structures, if used, and restore the area in which they were located to its original condition.

- Take measures, at all times, to prevent oil or other hazardous substances from entering the ground, drainage areas (including the use of storm drain lines), and local bodies of water. Notify the transit authority and appropriate government officials if spills occur. (See policy statement 4.5, "Waste Disposal.")

- Perform work around wetlands and water bodies in a manner that will ensure their protection and preservation

- Not alter water flows or disturb wildlife habitat near or adjacent to the project construction area.

- During preliminary design, develop specific mitigation plans for protection and restoration of adjacent natural resources that warrant efforts beyond what would be normally included in master construction specifications. This is done in conjunction with the applicable government regulatory and permitting agencies.

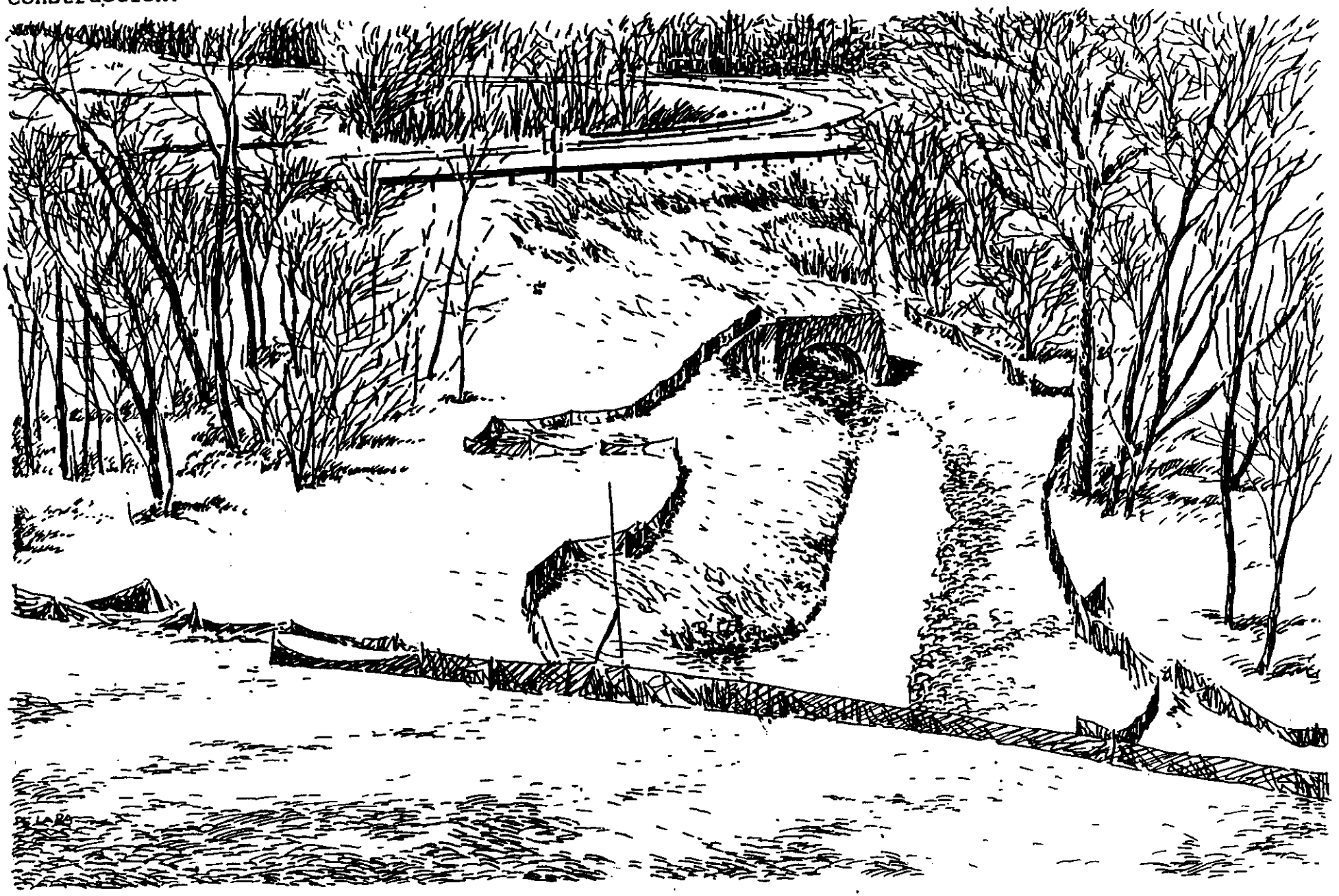
- Prepare an environmental sensitivity handbook that guides contractors and construction managers in the implementation of environmentally sensitive construction practices.

- Monitor contractors as a part of construction management to ensure that natural resource protection specifications and plans, including the requirements of regulatory agency permits, are being carried out.

**Applicable Design Criteria, Drawings, and Specifications**

These issues are addressed in section 01560, "Environmental Protection," and section 02115 "Soil Erosion and Sediment Control" of the Dallas Area Rapid Transit Master Construction Specifications, as well as DART Civil Standard Drawings.

A temporary barrier can be used to control erosion during construction.



Fencing along the drip line protects trees to be preserved on the project site.