

CHAPTER 6 - UTILITIES

6.1 INTRODUCTION

This chapter establishes criteria for the design of all relocations to achieve maintenance, support, continued service or modification of existing utilities that will be affected by the construction of the system. The criteria also govern the design of utilities that may be installed on DART right-of-way to provide utility services to DART's facilities.

"Utilities" are defined as the lines, connections and appurtenances forming a transmission, distribution, collection or communication system belonging to governmental agencies, public utility corporations, railroads and privately owned companies for the provision of sewer, water, gas, electrical, telephone, telegraph, and cable television service. Other systems to be included as utilities are street lighting; petroleum pipelines; fire and security alarm systems; vaults; parking meters; postal service facilities; railroad lines and equipment and other communications systems. Included are service connections to adjacent properties and DART-owned utility facilities or communication systems. For purposes of providing requirements provided in this chapter to existing systems, storm sewers and drainage appurtenances will be considered a utility, in as much as these requirements are not provided in Chapter 7 - Drainage.

Terms used in this chapter are intended to have the following meaning:

- o "Facilities" - Includes "utilities" as described above. May also include other structures or systems, depending on usage.
- o "Owner" - The owner of the utility system or systems in question. The term "utility owner" may also be used for clarity. DART will be considered the owner if the utility in question belongs, or will belong to DART.
- o "Railroad, railroad company", or the like" - Used to define railroad companies ownership instead of the term "owner".
- o "City" - Used to define a municipality's ownership of items that are traffic and transportation related, as opposed to utility type items, such as streets and bridges, street lighting, and traffic signalization.

The required design and construction of utility relocations due to the impact of DART construction will be performed either under contracts directly with DART or entirely by the

affected facility owner. The designer will be required to prepare designs of utility relocations only as specifically directed by DART.

These criteria for utilities relocations shall be used by the designer only to the extent of designing those facilities specifically directed by DART in the 'Scope of Work' of the contract. The criteria provided herein are intended to comply with and supplement, relative to DART systems construction, the applicable City codes, ordinances, regulations, standards and specifications for utility relocations and construction. Such City standards shall include the Standard Specifications for Public Works Construction published by the North Central Texas Council of Governments, local amendments thereto, standard details, construction methods, and design policy and procedures of the City. Utility owner standards and criteria that equal or exceed these criteria shall govern. Specific criteria provided herein shall be in addition to utility owner criteria and standards, and shall govern in the absence of applicable criteria issued by the utility owner.

In the performance of utilities relocations, consideration shall be given to the needs of the utility system, the requirements and obligations of the utility owners, traffic requirements, the service needs of adjoining properties, and policies established, or to be established, by DART.

Such consideration shall also include making the following determinations according to criteria provided in Systems Design Criteria Chapter 8 - Corrosion Control and Chapter 9 - System Grounding:

- Utilities which do not generate electromagnetic interference (EMI) or any other interference that would compromise either operations or safety of any element of the system.
- Metallic pipes and casings are protected against corrosion by the use of corrosion-resistant materials, protective coatings, and/or cathodic protection, and are made electrically continuous in accordance with the requirements of Systems Design Criteria Chapter 8 - Corrosion Control and Chapter 9 - System Grounding and the corrosion control standard and directive drawings.
- Utility system design covered by these criteria shall be coordinated with Systems Design Criteria Chapter 8 - Corrosion Control. DART-owned utility structures may require atmospheric, soil and water, and/or stray current corrosion-prevention measures. Utility company structures shall be designed and constructed in accordance with each company's standard corrosion control practices and the provisions of any agreements between DART and the utility owners.

6.1.1 Relocation Alternatives

The necessary relocation of utilities shall be performed by using one of the following alternative procedures:

- o Support and maintain impacted utility in place during construction of DART's facility, and continue in service following completion of the DART system facilities.
- o Temporary relocation and maintenance, then, upon completion of the DART system facilities, restoration of the existing facility.
- o Temporary relocation and maintenance, then, upon completion of the DART system facilities, replacement with a new utility facility.
- o Permanent utility relocation beyond the DART construction limits, preferably clear of the DART right-of-way.
- o Replacement with a new utility facility to be supported and maintained-in-place during DART's construction, then continued in service following completion of the DART system facilities.

No relocation of utilities shall be done within DART subways with the exception of DART-owned facilities such as fire mains and chilled water mains.

Utilities service to adjoining properties shall not be interrupted without permission of the facility owner, and, if temporarily relocated, shall be restored upon completion of construction.

6.1.2 Replacements and Relocations Design

Design of replacement or relocation of utility facilities shall be performed generally on a replacement-in-kind basis. However, the minimum replacement or relocation standards and design procedures agreed to by DART and each owner, as listed in Section 6.4, shall govern. If betterments are to be included, they shall be approved by DART in accordance with cooperative and detailed agreements with the applicable agency, utility, or railroad.

All design involving utility relocations and replacements will include maintenance of service, support in place, replacement due to damage and coordination of other utilities work and all designs shall follow the utility owner's design criteria and specifications. The designer shall coordinate their work and submit utilities replacement and relocation designs and plans for review and approval by DART in accordance with their contract and the terms and conditions of the cooperative agreements between DART and the utility owner. Detailed procedures for coordinating with the utility owner will be as established by DART. The designer shall

coordinate their work with the other designers of adjacent sections, agencies, utility owners, and private developers to ensure compatibility of the respective replacements or relocations.

Specifications and design standards provided by the utility owners known to be affected shall be obtained directly from them by the designer. The designer shall coordinate the location of existing utilities and the new proposed utilities with the DART facility or related construction.

It is common practice, in the preparation of contract drawings, to specify control elevations for only those utilities that are dependent on proper slopes for their operation, such as gravity sewers.

Such practices in the design of the system may result in underground facilities conflicts not resolvable by field engineering. Possible sources of conflict include two or more of the following facilities: footings; sanitary and storm sewers; water, gas, and oil lines; conduits for train control, communications, and auxiliary power systems; conduits for the traction power system; DART electric service ducts; underdrains; retaining wall stems and counterforts; manholes and pull boxes; and structure walls.

Elevations of all utilities shall be corrected to the datum of the U.S. Coast and Geodetic Survey. Where critical to the design, utilities shall be exposed to verify elevations. In particular, the elevations of the inverts of all new manholes and ductbanks shall be clearly shown on the plans and profiles at the center of the manhole and at the break points along the ductbank or at the manhole or junction box, respectively. Other critical elevations and dimensions shall also be highlighted on the plans or profiles to notify the Contractor of any special conditions.

Wherever there is a potential underground facilities conflict in the system, and where required by utility owners, the designer shall design to eliminate the conflict and shall indicate sufficient elevations and horizontal dimensions so that the design is effectively implemented in the construction.

Wherever inclusion of the above data or the number of utilities involved results in the plans becoming congested or difficult to interpret, separate drawings shall be prepared for each utility owner's facilities. Separate utility drawings will be prepared for City-owned utilities in accordance with the City's policies, design criteria, standards and procedures.

Plans prepared for City-owned utilities and drainage facilities will be prepared in accordance with the City's requirements, as published in design manuals, development guidelines, standard construction details, standard specifications, and related documents.

6.1.3 DART Service Connections

Utilities service connections to DART facilities shall be shown on the utilities plans; their design shall be coordinated with other items of the work. The designer shall ensure that service

connections from the utility mains are indicated on either their plans or those for the adjacent construction contracts to preclude the cutting of new pavement.

6.2 DART UTILITY DESIGN CRITERIA

The following section is general criteria to be used by the designer in the preparation of construction plans for new utilities and the relocating or replacing of existing utilities parallel to, contiguous with, or across and either on, below or above the surface of DART's right-of-way. The first part of this section discusses requirements for all utilities related to DART's right-of-way. The second part of this section discusses in detail the underground utilities, the overhead utilities and surface utilities.

6.2.1 General Categories

Utilities relocations or replacements are classified into three categories: 1) utilities crossing DART trackways; 2) utilities on DART right-of-way clear of tracks; and 3) utilities clear of DART right-of-way.

Utilities Crossing DART Trackways. Utility crossings of DART system trackways, roadways, and parking lots shall be kept to a minimum. Crossings under special trackwork should be avoided, if possible. Utilities service connections, other than those serving DART's system facilities, shall not cross beneath system at-grade tracks. However, properly constituted and franchised utility agencies and licensees have the right to cross system rights-of-way with transmission and distribution/collection facilities to fulfill their existing service obligations.

Utilities crossings shall be perpendicular to the DART's system trackway or roadway alignment, or as nearly perpendicular as possible. Utilities shall not be placed within drainage culverts, or in any manner or position that might cause damage to, or impair the safety of the facility or the system.

Existing utilities within the system right-of-way shall be relocated to the extent necessary to conform to the criteria prescribed herein, unless specifically excluded from this requirement by DART and the utility owner.

New utilities crossings under operating DART's system trackways shall be made by boring, jacking, or tunneling, and shall be subject to DART approval in each case. Open-trench methods may generally be used under streets, parking lots, and aerial structures.

To facilitate maintenance operations, utility markers shall be provided to indicate the location of underground utility lines, drainage lines, and appurtenances beneath at-grade tracks. Section 6.3, Utility Markers, of this chapter outlines design details and requirements for utility markers.

Flammable or hazardous liquid or gas lines crossing the trackways shall have a valve at each end of the line at the right-of-way for shutoff in emergencies.

Utilities may exist on, or be relocated to cross the right-of-way for subway, at-grade, or aerial trackways. Such utilities may pass above or beneath the DART facilities.

Underground utilities relocations above subways shall be designed according to Section 6.3, Design Criteria for Underground Utilities. Those beneath subways shall be encased as provided in the utility owner's standards or criteria, or as provided in the DART standard drawings.

The designer shall perform their designs so that utilities service will be maintained when required by the facility owner. When practicable, the existing facilities shall be maintained complete-in-place.

Utilities on DART Right-of-Way Clear of Tracks. Utilities extending longitudinally along the trackway shall be limited to those serving DART's facilities. Facility relocations clear of tracks but within the DART right-of-way may be allowed in some instances. When utilities exist within the DART right-of-way and the most feasible and economical solution would be to support or relocate the facility within the right-of-way, the designer shall submit conceptual schematic designs to DART for approval prior to beginning of detailed facility design. Such designs should preclude future disruption to DART operations.

These general criteria govern the design of relocations of utilities that are affected by the DART system and that will be relocated in public or private property clear of the DART right-of-way or beneath DART parking lots.

The design of facility relocations shall be on a replacement-in-kind basis. It is with the understanding that any upgrading in a replacement facility resulting solely from the replacement of devices or materials no longer regularly manufactured, processed, or installed shall be considered as a replacement-in-kind. This is based on provisions that such replacement shall be only to that standard used on other projects financed solely by the utility owner. Minimum replacement standards and methods of design shall be in accordance with the criteria of the utility owner, and as agreed by DART and each facility owner or, for a facility that is to be supported in place during system construction, the standards must be sufficient to provide required structural strength.

Should a utility owner require the upgrading of a facility beyond the standard described above, such upgrading shall constitute a betterment and shall not be included in the work prior to an agreement being reached between DART and the utility owner.

Facilities clear of DART right-of-way shall be supported or relocated to facilitate system construction and meet the requirements of facility owners. The designer shall coordinate their work with all affected utility owners so that the most economic overall solution is obtained according to these requirements. These facilities also include those crossing railroad trackways.

6.3 DART DESIGN CRITERIA FOR UNDERGROUND UTILITIES

The design criteria for underground utilities will include utilities that will cross, parallel or clear of the DART right-of-way. These utilities will consist of storm sewers, sanitary sewers, water mains, gas lines, and petroleum lines. There are several general requirements related to the underground utilities, which need to be addressed as follows:

- Utilities wires or cables installed in conduits crossing under at-grade or subway structures shall be placed in plastic or other approved nonmetallic conduits such as Poly Vinyl Chloride (PVC). The conduits shall be encased in concrete in accordance with the utilities standards. The utility owner may perform the design and installation of encased utility relocations. In this instance, the designer shall provide the owner with plans of the DART facilities and shall coordinate their work with that of the utility owner to ensure that the design conforms to these criteria. The designer shall coordinate the design of the encased utility with other affected facility owners where necessary and shall include the relocation in the utilities plans and construction sequence plans.
- Pipelines crossing under aerial structures need not be placed in casings unless there is danger of damage to the DART facilities. Even if such a danger exists, casings may be omitted if the design of the carrier pipe is specifically approved by DART in each case.
- Pipelines crossing under at-grade sections of the system or beneath subways shall be placed in casings as shown on the utility owner's standards or minimum standards established by DART. Excluded from this requirement are storm sewers that normally operate under intermittent or continuous pressure of less than 10 psi. Construction of casing will be in accordance with the utility owner's standards. The space between casings and carrier pipes shall be plugged so as to prevent the formation of a waterway under the trackway, and casings shall be installed with an even bearing throughout their length.
- Installation of pipeline crossings by open-trench methods shall comply with the requirements for conduit bedding and backfilling as contained in the utility owners standards, or minimum standards established by DART.

- If no casing is required, bored or jacked installations shall have a bored-hole diameter essentially the same as the outside diameter of the approved carrier pipe. If voids should develop or if the bored-hole diameter is greater than the outside diameter of the casing or approved carrier pipe, all voids shall be grouted. Boring operations shall not be stopped if such stoppage would be detrimental to the system.
- Tunneling operations shall be conducted as approved by DART. If voids are caused by the tunneling operations, they shall be filled by pressure grouting or by other approved methods that will provide proper support. Boring, jacking, and tunneling shall be performed according to the utility owners standards or minimum standards established by DART.
- Shut-off valves shall be used as mutually agreed to by DART and the utility owner. Other than drainage or sewer lines, accessible emergency shutoff valves shall be installed in pipelines on each side of DART's system trackway. Wherever possible, such shutoff valves shall be located outside the DART right-of-way. Where pipelines are provided with valved automatic control stations at locations and within distances approved by DART, no additional valves shall be required.
- Utilities may exist in public right-of-way and on private property that will become part of the right-of-way for a DART parking lot. When such utilities are encountered, they will be allowed to remain in place beneath the DART parking lots provided that:
 - 1) The facility can withstand the construction loading and permanent parking lot loading;
 - 2) The depth of cover over the facility upon completion of construction will not be less than the minimum cover allowed by the facility owner, greater than the maximum depth used by the facility owner in its own construction, and greater than an existing utility conduit may withstand;
 - 3) The facility is not located beneath major access roads, or bus stalls;
 - 4) The facility does not compromise reliability, maintainability, or safety;
 - 5) The cables are installed in conduit; and
 - 6) The construction of the parking lot does not violate an existing utility easement, interfere with owners maintenance of utility, or is otherwise unacceptable to the utility owner.

When a utility facility must be relocated because of parking lot construction, the relocation may be placed beneath the parking lot, provided the section designer shows it is more economical than relocation in the public right-of-way or in right-of-way acquired specifically for the purpose (and approved by the owner). Such facility relocations shall be located clear of the parking lot, major access roads, and bus stalls to minimize possible future disruption to

the parking lot by utilities maintenance operations. The criteria used to design utilities relocations beneath DART parking lots shall be those used for the design of each utility.

For underground utilities specific criteria is required by DART and by the individual utility owner. The stricter of the two criteria shall be used which is either DART or the utility owner's criteria for each utility. The DART design criteria is as follows:

Excavation Support. Refer to Chapter 16 - Excavation Support for design of trench excavation and shoring related to all utility facilities.

6.3.1 Storm and Sanitary Sewers

The designer is responsible for the preparation of contract documents for the relocation of all conflicting storm and sanitary sewers. Unless DART and the facility owner agree otherwise, the design and relocation of sanitary and storm sewer facilities that conflict with the system shall be performed without the use of permanent ejectors or pumping stations. Sewer facility relocations shall be designed to conform to the design criteria, standards, and ordinances of the utility owner and applicable regulatory agency requirements. Adequate closed flumes shall be provided to handle the flow of sanitary sewers temporarily removed from service. No sewage shall be discharged into open trench.

Design storm sewers and capacity requirements for storm sewers, and the design of storm sewer facilities, including the relocation of existing facilities, shall be performed according to the requirements of Chapter 7 - Drainage.

Municipal requirements will be incorporated into the design as necessary. Where existing municipal storm sewer facilities cross beneath the DART alignment and must be relocated, the relocated facilities shall be designed to current standards and criteria of the municipality. The pipe size shall be determined by calculating the discharge from the upstream contributory area and considering the future development trends of the area, as set forth in Chapter 7 - Drainage. The resulting flows shall be used to size the complete sewer relocation. Where relocation is an extension of an existing storm sewer, and replacement is not otherwise required, the extension shall be of similar size and shape and of a hydraulic capacity equal to or greater than the existing pipe.

When no additional flow is added to the storm sewer, conditions downstream of the relocation need not be studied. Where increase in flow takes place as a result of construction, conditions downstream shall be evaluated. The extent of this evaluation shall be determined on an individual basis. Should retention/detention be considered a solution to an increased rate of storm water discharge or downstream sewer inadequacy, the retention/detention facility must be in accordance with Chapter 7 - Drainage.

The Designer shall have the following responsibilities to:

- 1) Provide the sewer utility owner with plans showing the DART facilities and coordinate with the owner to determine the extent of the system impact upon the sewer facilities. The utility owner shall determine which facilities may be abandoned or taken out of service during the utility construction. The utility owner and the designer shall determine which facilities may be supported-in-place during utility construction. The utility owner and the designer, through DART, shall decide upon locations for the relocation of conflicting sewer facilities that are acceptable to DART, the utility owner, and the owners of other affected facilities.
- 2) Prepare the design so that service in sanitary and storm sewer facilities is maintained at all times, except in those facilities previously determined to be abandoned as a result of construction.
- 3) Prepare contract documents for the sewer facility relocations including those betterments requested by the owner and agreed to by DART.
- 4) Coordinate sewer facility relocations with other utilities owners and local government agencies.
- 5) Include the sewer facility relocations in the construction sequence plans.
- 6) Include provisions in the design to maintain service to all properties, which are to remain connected to sanitary or storm sewers affected by the construction.

The Designer shall also consider in his design the following factors related to storm and sanitary sewers:

Location and Cover. The location of sanitary sewers with respect to water supply wells and potable water lines shall follow the regulations of the Texas Department of Health and the criteria and standards of the utility owner. Sanitary sewers shall be located with a minimum of 3 feet of cover in areas not subject to vehicular traffic. No part of a proposed storm sewer shall be designed within the improved subgrade of a proposed pavement. The minimum cover for storm sewers in areas not subject to vehicular traffic is 2 feet, although greater cover is desirable. Where exceptions to these provisions are made necessary due to connection to existing lines or for other causes, special material or bedding may be required. Design of sanitary and storm sewers outside of DART right-of-way shall conform to the design criteria and standards of the respective local public agency involved.

Cross Connections. Physical connections between a public or private potable water supply system and any sewer, drain, facility, or equipment shall not be made, except in strict accordance with applicable plumbing codes and all local or state regulations pertaining to cross connections.

Materials. Materials shall be selected to give best service under local conditions and the requirements of the design. Special consideration shall be given to the character of industrial

wastes, possibilities of septicity, exceptionally heavy external loads, abrasion, infiltration and exfiltration, soil conditions, pipe bedding, and similar problems. Unless otherwise approved by DART, reinforced concrete pipes shall be used for storm sewers. Vitrified clay, reinforced concrete or PVC sewer pipe(s) will be used for sanitary sewers. Materials shall comply with utility owners criteria and standards.

Size. The minimum allowable diameter for sanitary sewers shall be 8 inches, 4 inches for residential services, and 6 inches for other than residential services. Sanitary sewer laterals within easements or dedicated right-of-way shall be at least 6 inches in diameter.

Slopes. All sewers shall be designed with slopes sufficient to give mean velocities, when flowing full or half full, of not less than 2.0 feet per second to a maximum of 10 feet per second based on Manning's formula. Sanitary sewer velocities shall be determined using a Manning's "n" of 0.013. Optimum flow velocity is considered to be 3.0 feet per second, and slopes producing less than 3.0 feet per second shall be used only with the approval of the utility owner.

Pipe Size Increases. At manholes where a sanitary sewer is increased in size and any points where a smaller sewer connects into a larger sewer, the invert of the larger sewer shall be at a lower elevation so that the energy gradient is maintained. To achieve this, pipes shall be installed with the crowns at the same elevation.

Alignment. Sanitary sewer mains shall be designed with straight alignment wherever possible. Where curved alignments are required, design shall not exceed the minimum curve radius for pipe material specified, and shall be in accordance with the utility owner's standards.

Manholes. Manholes shall be installed at the end of each sewer line; at all changes in grade, pipe size, junctions, and intersections; at changes in alignment, except where an approved curved alignment is involved, and at other locations as may be required by the utility owner. Manhole spacing shall be in accordance with the utility owner's standards and criteria. Manholes and covers shall be constructed according to the utility owner's criteria, specifications and standard details. The invert elevation of the manhole shall be clearly shown on the plans and profiles at the center of the manhole. Other critical elevations and dimensions shall also be highlighted on the plans or profiles to notify the Contractor of any special conditions. The designer shall have the option to permit precast manholes to be used. The requirements, criteria and details shall be noted on the respective plans and defined in the general notes for the precast manhole.

Inverted Siphons. If no other option exists, and if approved by the utility owner, design of inverted siphons shall follow the utility owners standards and the requirements of the Texas Department of Health.

Force Mains. Force mains shall be constructed of ductile iron or PVC pipe with mechanical or other approved joints, or, if approved by the facility owner, other materials such as prestressed concrete cylinder pipe.

Sanitary Sewer Flows. Where the design of new sanitary sewers is included in the work, such sewers shall be designed according to the utility owner's criteria.

Connections. Connections to existing sanitary sewers shall be by manholes or other construction approved by the utility owner.

Drainage Report. A drainage report for the design of the storm sewer shall be prepared for submittal to the local government agency having jurisdiction. The report shall describe the effect of construction of a section of the DART system upon the existing drainage facilities and shall show that the design conforms to the applicable DART and utility owner's policies, criteria and standards. For further details of drainage report requirements refer to Chapter 7 - Drainage.

Low Pressurized Pipe. Pipelines included in this section are those installed to carry water, or any other nonflammable substance, which, from its nature of pressure, might cause damage escaping on, or in the vicinity of, system property. The following casing requirements apply to storm and sanitary sewer lines and waterlines. Water lines relocations and replacements are discussed in more detail later in this section.

Relocations of storm and sanitary sewer facilities that cross under at-grade system trackways and that normally operate under pressures of less than 10 psi shall be designed according to procedures specified herein and by the utility owner. However, the design shall be checked to provide a safeguard for the system should such facilities become surcharged during a 100-year-frequency storm (Chapter 7 - Drainage). Non-encased facilities shall have watertight joints and the capability of serving for a period of at least 50 years with minimal maintenance. Reinforced concrete pipe meeting ASTM C76 and having "O"-ring rubber gasket joints conforming to ASTM C443 will satisfy these requirements.

Nonflammable Substance Pipelines. Pipelines containing nonflammable substances under low pressure shall be designed as follows:

- 1) Carrier pipe and joints for lines under system trackways shall be of comparable type, strength, and material to that required by the utility owner for direct burial application or by AREMA Manual, whichever is more stringent. Joints for carrier pipe operating under pressure shall be push-on, mechanical joints, or welded. Carrier pipes shall be in accordance with the utility owner's criteria and standards, except where these requirements are more stringent or have additional requirements.

- 2) Casing materials shall consist of corrugated metal, steel, or reinforced concrete pipe, all in accordance with the requirements prescribed below. For larger or high-pressure mains that require periodic inspection, and where otherwise appropriate, reinforced concrete utilities tunnels may be used. The standards of the utility owners shall be complied with when more restrictive or stringent.
- 3) Corrugated metal casing pipe requirements shall be designed according to the latest edition of Corrugated Metal Pipe Culverts - Structural Design Criteria and Recommended Installation Practices, published by the Federal Highway Administration. For water mains and sanitary sewer casings, the standards of the utility owner for corrugated metal pipe and circular liner plate shall be used.
- 4) Steel casing pipe requirements shall have a minimum yield strength of 35,000 psi. Wall thickness for steel casing pipe with a protective coating installed in a trench shall conform to Table 6.1. The wall thicknesses shown in Table 6.1 shall be increased by at least 0.063 inch for uncoated casing and by at least 0.063 inch for coated or uncoated casings to be installed by jacking or boring. For water mains and sanitary sewer, the standards of the utility owner will be used, subject to approval by DART, in lieu of the foregoing.
- 5) Reinforced concrete pipe and fittings requirements shall conform to the requirements of ASTM C76, Class IV, minimum, in accordance with the owner's standards. "O"-ring gaskets shall conform to the requirements of ASTM C443.
- 6) Casing pipe and joints shall be designed to withstand the imposed loading. Casings shall be sloped to drain. They shall be protected against corrosion in accordance with the requirements of Systems Design Criteria Chapter 8 - Corrosion Control and Chapter 9 - System Grounding and corrosion control standards and directive drawings. Care shall be taken to select materials that will not be damaged through dissimilar metals contact. Where both carrier pipe and casing are metallic, they shall be separated electrically by using insulated spacers. The inside diameter of the casing shall be at least 2 inches greater than the largest outside diameter of the joint or coupling of the carrier pipe and shall also meet the requirements of the utility owner. In any case, the casing shall be large enough to allow pressurized carrier pipe to be removed subsequently without disturbing the casing pipe or trackbed. For water main and sanitary sewer casing pipes, the standards of the utility owner will be used. For sanitary sewer lines, voids between the encasement and carrier pipes shall be grouted.
- 7) The ends of the casing shall be suitably sealed to protect against the entrance of foreign materials. Utility owner's standard details for seals and drainage shall be used.
- 8) The limits of the casing pipe unless otherwise approved by DART and the utility owner, casing pipe shall extend to the greater of the following horizontal distances, measured perpendicular to the centerline of track: a minimum distance of 2 feet outside the fenced portion of the system right-of-way or minimum distance of 25 feet from the centerline of the outside track.

- 9) If additional tracks are constructed in the future, the casing shall be extended correspondingly. Where future additional tracks are planned, utilities shall be installed on a straight line and grade for the appropriate distance to facilitate future casing extension.
- 10) Minimum cover over uncased pipe or over casings shall be 3 feet at areas subject to vehicular traffic, unlined ditches, and other unpaved surfaces, and 2 feet at lined ditches. Additional cover shall be provided where necessary to comply with the utility owner's policy or local government ordinances. On at-grade DART trackways, the minimum clearance between the top of uncased pipe or top of casing pipe and the base of the system rails shall be 4 feet 6 inches. The standards of the utility owners will be used if more stringent than the above.
- 11) Sewer services shall be in accordance with the codes and standards of the utility owner.

TABLE 6-1

**MINIMUM WALL THICKNESS FOR STEEL CASING
PIPE UNDER DART TRACKWAYS**

NOTE:	For	Coated	Casings	Installed	in	a	Trench
Height of Cover in Feet	10 or less		Diameter in inches 11 to 20		21 to 30		
12 or less	0.250"	0.250"	0.250"	0.250"	0.250"		
14	0.250"	0.250"	0.250"	0.250"	0.250"		
16	0.250"	0.250"	0.250"	0.250"	0.250"		
18	0.250"	0.250"	0.250"	0.250"	0.281"		
20	0.250"	0.250"	0.250"	0.250"	0.312"		
22	0.250"	0.250"	0.250"	0.250"	0.344"		
24	0.250"	0.250"	0.250"	0.281"	0.344"		
26	0.250"	0.250"	0.250"	0.312"	0.375"		
28	0.250"	0.250"	0.250"	0.312"	0.406"		
30	0.250"	0.250"	0.250"	0.344"	0.438"		
32	0.250"	0.250"	0.250"	0.344"	0.469"		
34	0.250"	0.250"	0.250"	0.344"	0.469"		
36	0.250"	0.250"	0.250"	0.375"	0.500"		
38	0.250"	0.250"	0.250"	0.375"	0.500"		
40	0.250"	0.250"	0.250"	0.406"	0.562"		
42	0.250"	0.250"	0.250"	0.438"	0.562"		

NOTE: For water mains and sanitary sewers, the standards of the utility owner will be used, subject to approval by DART, in lieu of the above table.

NOTE: The above thicknesses pertain to coated pipe casings installed in a trench. A maximum allowable trench width shall be indicated to assure that trench condition loading actually occurs. If casing is to be installed in an embankment and positive projecting installation is anticipated, maximum allowable deflection shall be equal to 0.05 of nominal pipe diameter, and wall thickness shall be determined from Spangler's formula.

6.3.2 Water Mains

Water mains belonging to local government agencies will be affected by construction of the system. The section designer is responsible for the preparation of contract documents for relocation of all conflicting water facilities not performed by the utility owner. Unless DART and the facility owner agree otherwise, the design and relocation of water facilities that conflict with the system shall be performed on a replacement-in-kind basis.

Designer Requirements. It shall be the designer's responsibility to implement the following general requirements for the relocation or replacement of water mains and service lines:

- 1) Provide the water utility owner with plans showing the DART facilities and coordinate with the owner to determine the extent of the system impact upon the water facilities. The utility owner and the designer shall determine which facilities may be abandoned or taken out of service during DART system construction and which facilities may be supported-in-place during system construction. All water mains with lead joints shall be replaced with ductile iron or PVC pipe having mechanical or push-on joints prior to supporting-in-place. The utility owner and the designer shall decide upon the locations for the relocation of conflicting water facilities which are acceptable to DART, the facility owner, and the owners of other affected facilities.
- 2) Prepare the designs so that water service is maintained at all times, except in those facilities previously determined to be abandoned as a result of the reconstruction. No water main or fire hydrant shall be out of service without prior approval of the utility owner.
- 3) Prepare contract documents for the water facility relocations, including those betterments requested by the owner and agreed to by DART.
- 4) Coordinate water facility relocations with other utilities owners and local government agencies.
- 5) Include the water facility relocations in the DART construction sequence plans.

The designer shall incorporate into the plans the following design requirements for the following specific items and elements related to the relocation or replacement of water mains and service lines.

- 1) Water mains, materials and fittings shall be as required by the owner. Relocation alignments must meet the current standards of the utility owner.
- 2) Depth of cover shall be 4 feet minimum on DART right-of-way or property, and in accordance with the utility owner's criteria in all public right-of-way, DART right-of-way, or utility easement.
- 3) Fire hydrant installation shall comply with the utility owner's standards. The section designer shall consider both temporary and permanent requirements when designing hydrant relocations. The following pertains to fire hydrant installation:
 - a) Spacing:
 - o Residential and commercial/central business district areas: Hydrant spacing shall follow utility owner and local fire department requirements.
 - o DART stations and other DART facilities: Hydrant spacing shall follow the requirements specified in Chapter 29 - Fire Protection Systems.
 - o DART yard facilities: Hydrant spacing shall be a maximum of 300 feet.
 - b) Valving for hydrants: Hydrants shall be installed on a 6-inch lateral and shall have a 6-inch gate valve located between the hydrant and the main.
 - c) Bracing: Hydrants shall be anchored in accordance with the utilities standards.
- 4) Valve type and spacing shall be in accordance with the utility owner's criteria and standards.
- 5) Thrust blocks or approved joint restraint systems shall be provided at bends (horizontal and vertical), tees, and plugs according to the utility owner's criteria and standard details.
- 6) Casings are required for all water mains crossing under DART tracks. Crossings under DART trackways shall conform to casing requirements detailed under **Storm and Sanitary Sewers**.
- 7) Crossings under other facilities shall comply with the standards and criteria of the specific facility owner. Where the facility must remain in operation, the use of tunneling or jacking shall be considered for the installation of relocating facilities crossing below.
- 8) Services taps on new, relocated and replaced water mains shall be installed according to the requirements of the utility owner.
- 9) All cleaning, pressure and leakage tests, and chlorination for disinfection requirements shall be in conformance with the criteria of the utility owner.
- 10) Water mains on bridge crossings or structure shall comply with the following requirements:

- a) All pipe joints that are to be aerially supported over or under a bridge or similar structure shall be thoroughly restrained against both longitudinal and lateral movement with a minimum of one restraining device per joint.
 - b) Pipe material shall be ductile iron or steel and in accordance with utility owner's requirements.
 - c) Each crossing shall have a valve on each side of the bridge and beyond the abutment located in proximity to the crossing. Valves shall not be on the bridge structure.
- 11) Blow-off valves, air vents or air/vacuum release valves shall be provided when directed by the utility owner, and shall be in accordance with the utility owner's criteria and standards.
 - 12) Pipe insulation, if required for aerially supported or other above grade lines, shall meet or exceed insulation equivalent to the following, and approved by the owner:
 - a) Insulating material: 3-inch-thick polyurethane pipe covering, formed to fit the particular pipe diameter.
 - b) Outer covering material: 0.016-inch aluminum chiller jacket with moisture shield secured with stainless steel straps.
 - 13) Right-of-way for publicly owned water facilities shall never be placed on private property. Should the area within the public right-of-way be insufficient for facility installation, sufficient right-of-way or an easement shall be provided.
 - 14) Connections to water main shall be shown on the plans. The designer shall prepare plans showing details for the connection of new, relocated or replaced water mains to the existing mains. Such details shall include valves, temporary hydrants, fittings, and temporary and permanent plugs. The connection plan shall delineate the following responsibility for performance of the work: unless specified otherwise, all water main connections shall be constructed by the contractor after necessary valve operation by the utility owner.
 - 15) Service Connections shall be shown on the plans. Commercial and industrial service connections 4 inches and larger shall be detailed on the plans. Residential service connections shall be included by reference on the drawings. Responsibilities for relocation of service connections shall be in accordance with the utility owner's standard procedure and criteria.
 - 16) Water services and meters shall be installed according to the codes and standards of the utility owner.
 - 17) DART fire and domestic water service connections shall be designed by the designer. The size of the domestic connection and meter shall be based upon peak-demand/pressure loss calculations in conjunction with local codes and ordinances. Fire flow and pressure data in the existing water main shall be obtained from the water utility owner.
 - 18) The fire and domestic services in public right-of-way and up to the DART right-of-way shall be installed by DART's contractor. The domestic service meter must be in public

right-of-way or in a utility easement granted by DART to the water utility. The utility will install all domestic meters, and either the utility or DART's contractor may install fire service meters.

6.3.3 Gas Facilities

The designer shall comply with the following general requirements as they relate to gas lines and facilities. These requirements will also apply to petroleum lines and lines which carry flammable and highly volatile substances. The designer shall pay close attention to the facilities owner's requirements in the design of the relocation or replacement of these lines.

Pipelines for Flammable Substances. Pipelines included in this section are those installed to carry natural gas, oil, petroleum products, or other flammable or highly volatile substances. They shall be encased under DART tracks and right-of-way in accordance with the following criteria:

- 1) Carrier pipe:
 - a) The following requirements for carrier pipe apply to pipelines crossing under both at-grade and aerial sections of the system. These requirements apply for a minimum horizontal distance of 50 feet from the centerline of the outside track or 25 feet beyond the end of casing when casing is required whichever is greater.
 - b) Pipelines carrying oil and other flammable products shall conform to the requirements of the current edition of ANSI B31.4, Liquid Petroleum Transportation Piping Systems, and other applicable ANSI codes.
 - c) Wall thickness for carrier pipe shall be based on the design criteria, standards, and specifications used by the facility owner for encased crossings beneath highways or railroads. In no case shall the encased facility be of lesser strength than the adjacent, direct-burial sections.
- 2) Casing materials: Casing pipe and joints shall be of corrugated metal, steel, ductile iron, or reinforced concrete pipe according to the requirements prescribed for nonflammable carrier pipe, excluding plastic pipe. For large or high-pressure mains that require periodic inspection, reinforced concrete utilities tunnels may be used.
- 3) Casing design: Casing pipe and joints shall be watertight and shall be capable of withstanding the imposed loading. Casings shall be sloped to drain. They shall be protected against corrosion in accordance with the requirements of Systems Design Criteria Chapter 8 - Corrosion Control and Chapter 9 - System Grounding chapter and the corrosion control standard and directive drawings. Care shall be taken to select materials that will not be damaged through dissimilar metals contact. Where both carrier pipe and casing are metallic, they shall be separated by using insulated spacers. The inside diameter of the casing shall be at least 2 inches greater than the largest outside diameter of the joint or coupling of the carrier pipe. The casing diameter shall always be large enough to allow the carrier pipe to be removed subsequently without disturbing the casing

pipe or trackbed. All joints or couplings, supports, insulators, or centering devices for the carrier pipe within a casing shall be taken into account. In addition, casing shall be designed so that its maximum vertical deflection is 5 percent of its diameter and so that no loads from the trackbed, track, traffic, or casing pipe itself are transmitted to the carrier pipe.

- 4) Ends of casings and vents:
 - a) The ends of casings shall not project above ground level. They shall be closed with a liquid-tight seal bushing or bulkhead.
 - b) Casing pipe shall extend to the greater of the following horizontal distances, measured perpendicular to the centerline of track, unless otherwise approved by DART and the utility owner:
 - o A minimum distance of 2 feet outside the fenced portion of the DART right-of-way.
 - o A minimum distance of 25 feet from the centerline of the outside track, when the casing is sealed at both ends.
 - c) If additional tracks are constructed in the future, the casing shall be extended correspondingly.
 - d) Casings shall be vented at each end by vent pipes attached near the ends of the casing and having a minimum diameter of 2 inches. Vents shall project through the ground surface outside the DART right-of-way at a distance of not less than 6 inches from the right-of-way line or not less than 25 feet measured at right angles from the centerline of the nearest track, unless otherwise approved by DART and the utility owner.
 - e) Vent pipes on DART right-of-way shall extend not less than 4 feet above the ground surface. The top of the vent pipe shall be fitted with a down-turned elbow that shall be screened or fitted with a relief valve. Vents in locations subject to high water shall be extended above the maximum elevation of high water and shall be adequately supported and protected.
 - f) Vent pipes on DART right-of-way shall terminate at least 8 feet below aerial electric wires carrying 750 volts or less and 12 feet below aerial electric wires carrying over 750 volts.
- 5) Cover: Minimum cover over uncased pipe or over casings shall be 4 feet in areas subject to vehicular traffic, unlined ditches, and other unpaved surfaces, and 2 feet at lined ditches. Additional cover shall be provided where necessary to comply with the facility owner's policy or local design conditions. On at-grade trackways, the minimum clearance between the top of encased pipe or top of casing pipe and the base of the system rails shall be 5'-6".

Natural gas transmission and distribution facilities belonging to the gas companies will be affected by construction of the system. The gas companies, coordinating through DART and

other facility owners, shall decide upon locations for the relocation of affected gas facilities that are acceptable to DART, the companies, and other affected facility owners.

Unless DART and the gas company agree otherwise, the design and relocation of gas facilities that conflict with the system shall be performed on a replacement-in-kind basis by the gas company according to their criteria and standards, and all local, State and federal standards and codes.

Abandoned gas pipe lines within DART right-of-way shall be excavated and disposed of after they have been purged by the gas company.

Designer Requirements. It shall be the designer's responsibility to:

- 1) Provide the gas company with plans showing the DART facilities.
- 2) Include the company's requirements for maintenance of gas facilities complete-in-place in the preparation of the DART design.
- 3) Include the gas facility relocations to be performed by the company in the DART construction sequence plans.

Gas Company Responsibilities. The gas company shall coordinate with the designer through DART to determine the extent of the system impact on the gas facilities, and the company shall:

- 1) Determine facilities where service may be terminated on a temporary or permanent basis.
- 2) Delineate those facilities that are to be maintained complete-in-place.
 - o Facilities that are to be maintained-in-place above DART subways shall be constructed of steel; facilities of other materials shall be replaced with steel by the gas company prior to system construction.
 - o Facilities to be maintained-in-place beneath at-grade DART tracks shall be enclosed in a casing in accordance with the requirements for Pipelines for Flammable Substances.
- 3) Design and construct new facilities necessary to maintain continuity of service to the company's customers.

6.3.4 Petroleum Products Pipelines

High-pressure fuel and oil transmission pipeline facilities belonging to different privately owned pipeline companies will be affected by construction of the DART system. The design and relocation of pipelines that conflict with the system shall be performed by the facility owner according to company standards and all applicable local, state, and federal standards and codes. The general requirements for pipelines carrying flammable substances shall be implemented on petroleum lines.

Designer Requirements. It shall be the designer's responsibility to:

- 1) Provide the company with plans showing the DART facilities and proposals for the relocation of other utility facilities so that the company may complete its design.
- 2) Prepare utility plans showing the work to be performed by the affected company, consider such work in the design, and, where necessary, consider such work in the preparation of the construction sequence plans.
- 3) Coordinate with the affected company during the design, where appropriate.

Petroleum Company Responsibilities. The petroleum company shall coordinate with the designer through DART to determine the extent of the system impact on the petroleum facilities, and the company shall:

- 1) Determine facilities where service may be terminated on a temporary or permanent basis.
- 2) Delineate those facilities that are to be maintained complete-in-place.
 - a) Facilities that are to be maintained-in-place above DART subways shall be constructed of steel.
 - b) Facilities of other materials shall be replaced with steel by the petroleum company prior to DART construction.
 - c) Facilities to be maintained-in-place beneath at-grade DART tracks shall be enclosed in a casing in accordance with the requirements for Pipelines for Flammable Substances above.
- 3) Design and construct new facilities necessary to maintain continuity of service to the company's customers.

6.4 DART DESIGN CRITERIA FOR UTILITIES BOTH AERIAL AND UNDERGROUND

Aerial utilities, other than DART owned, preferably shall have the supporting poles, towers, and guys located outside the DART right-of-way. Where such location is impractical, a minimum horizontal clearance of 25 feet from the centerline of the outside track shall be provided to any pole, tower, guy, or wire. This clearance may be reduced where approved by DART and the affected utility owner.

Minimum vertical clearances to wires or cables above existing streets, top-of-rail, or other structures shall comply with the requirements of the latest editions of the National Electrical Safety Code and the OSHA regulations for construction clearances. See Figures 6.1, 6.2, and 6.3.

Design of aerial wire and cable arrangements shall be performed by the utility owners. The designer shall coordinate their work with the respective owners through DART to ensure that adequate clearances are provided.

If DART believes it is uneconomical to provide an aerial relocation of an existing aerial wire or cable above the trackway, the facility shall be relocated beneath the trackway in approved conduit encased in concrete.

The designer shall coordinate their work with the utility owner to determine the need for any temporary bypass during any bridge construction. The design of utilities supported on bridges or aerial structures shall be performed by the designer and shall comply with the structural criteria contained in the structural criteria and the criteria and specifications of the facility owner, whichever is the most stringent.

Where it is not practical to accommodate utilities on a bridge that crosses over the tracks, a separate utilities bridge may be considered. However, the designer shall submit comparative cost estimates for aerial and underground relocations and shall obtain DART's approval of the proposed utilities bridge before proceeding with its design.

For aerial utilities such as electricity, telephone, telegraph and cable television lines, these utilities can be located underground. When underground facilities for these utilities are encountered by the designer the following general criteria shall be incorporated in the design in conjunction with the utility's requirements and standards.

Conduit Facilities. Utilities wires or cables placed beneath DART trackways shall be installed in conduits. In the absence of DART criteria and specifications to the contrary or more stringent, conduit facilities shall be designed according to the utility owner's standard details and specifications.

Where jacking or boring must be employed, conduits may be steel, ductile iron, or reinforced concrete.

Where open-trench methods are employed, plastic or approved type of nonmetallic conduits shall be encased in concrete in accordance with the utilities or railroad standards, whichever is more stringent.

- 1) Sizes:
 - a) Conduits shall be a minimum of 4 inches in diameter and shall be on a reasonably straight line and grade beneath the tracks.
 - b) Where bends are required, they shall be situated clear of the tracks and shall be of sufficiently large radius to allow the installation of cable without damage.
- 2) Cover: The clearance between top of conduit encasement and top of rail shall normally be not less than 5 feet. Where savings may be realized by reduction of this clearance, the section designer shall obtain the approval of DART before completing the detailed design.

- 3) 3) Horizontal clearance:
 - a) Manholes shall not be located closer than 25 feet from the centerline of the outside track and shall be located outside any ditch section required at that location. Exceptions may be approved by DART.
 - b) Where the distance between DART and railroad near tracks is less than 25 feet, or where there would be no means of access to a manhole located between the DART tracks and the railroad tracks, the conduits shall be continuous across both the DART and the railroad trackways.

6.4.1 Electrical Power Facilities

Electrical power transmission and distribution facilities belonging to the power company will be affected by construction of the DART system.

The following types of facilities may be encountered:

- o Aerial wires and cables, which may be mounted on wood or metal poles belonging to power company or telephone and telegraph companies.
- o Underground conduit and manhole systems containing electrical power transmission and distribution cables.

Coordinating through DART and other facility owners, the designer shall determine locations for the relocation of affected power facilities that are acceptable to DART, the power company, and other affected facility owners.

Unless DART and the facility owner agree otherwise, the design and relocation of the electrical power facilities that conflict with the system shall be performed on a replacement-in-kind basis by the power company and coordinated with the system construction and the relocation of other facilities.

Electrical power facility relocations shall be designed by the power company according to its in-house criteria and standards.

Designer Requirements. It shall be the designer's responsibility to:

- 1) Provide the power company with plans showing the DART facilities, and coordinate with the power company to determine the extent of the system impact on the company facilities.
- 2) Determine, through further coordination, which facilities may be maintained-in-service during system construction. Underground electrical facilities may be maintained-in-

service by retaining the facility complete-in-place or by removing the existing conduit structure, placing cables in a new temporary structure, and, ultimately, reinstalling the facility with a concrete encasement on compacted backfill.

- 3) Prepare the design so that power service shall be maintained at all times, except in those facilities previously determined to be abandoned as a result of DART construction.

Power Company Responsibilities. It will be up to the power company to:

- 1) Determine those facilities where service may be terminated as a result of DART construction.
- 2) Design and construct all aerial facility relocations.
- 3) Design and install all surface, aerial and underground facilities relocations.

6.4.2 Telephone Facilities

Telephone transmission and distribution facilities belonging to telephone and telegraph companies will be affected by the construction of the system.

The following types of facilities may be encountered:

- o Aerial wires and cables that may be mounted on wood or metal poles belonging to a telephone company, power company, or a local government agency.
- o Underground conduit and manhole systems containing telephone and telegraph company cables, and cables belonging to local private and government agencies (such as private security alarm lines and fire alarm lines).

The telephone companies, by coordinating through DART and other facility owners, shall decide upon locations for the relocation of affected telephone facilities that are acceptable to DART, the telephone company, and other affected facility owners.

Unless DART and the facility owner agree otherwise, the design and relocation of telephone facilities that conflict with the system shall be performed on a replacement-in-kind basis by the telephone company and coordinated with the system construction and the relocations of other facilities.

Telephone relocations shall be designed in accordance with the standards and practices of the respective telephone and telegraph company.

The DART contractor shall install conduits for public telephones in DART stations and parking lots from the telephones to the DART property line. The location and elevation of the conduit

stub at the property line shall be coordinated with the telephone company by the designers and indicated on the plans.

Designer Requirements. It shall be the designer's responsibility to:

- 1) Provide the respective telephone company with plans showing the DART facilities, and coordinate with that telephone company to determine the extent of the system impact on telephone facilities.
- 2) Determine through further coordination, which facilities may be maintained-in-place during DART construction.
- 3) Consider retaining underground communications facility service by maintaining the facility complete-in-place or by removing the existing conduit structure, placing existing cables in a temporary structure, and, ultimately, encasing the facility with concrete on a compacted backfill based on the requirements previously discussed in underground utilities.

Telephone Company Responsibilities. The telephone facility owner shall be responsible for any necessary coordination and shall:

- 1) Determine the facilities in which service may be terminated as a result of DART construction.
- 2) Design and construct all aerial, surface, and underground facility relocations.

6.4.3 Telegraph Facilities

Telegraph facilities belonging to the Western Union Telegraph Company will be affected by construction of the system.

The following types of facilities may be encountered:

- o Aerial wires and cables mounted on poles belonging to a telephone company and/or power company.
- o Underground conduit and manhole systems containing cables.

Unless DART and Western Union agree otherwise, the design and relocation of telegraph facilities that conflict with the system shall be performed on a replacement-in-kind basis in accordance with the Western Union Telegraph Company Specifications.

Designer Requirements. It shall be the designer's responsibility to:

- 1) Provide Western Union with plans showing the DART facilities, coordinate with Western Union through DART to determine which telegraph facilities may be abandoned and which must be maintained-in-place on a temporary or permanent basis. Western Union and the designer shall decide upon locations for the relocation of conflicting facilities that are acceptable to DART, Western Union and other affected facility owners.
- 2) Consider retaining underground communications facilities service mains by maintaining the facility complete-in-place or by removing the existing conduit structure, placing existing cables in a temporary structure, and, ultimately, encasing the facility with concrete on a compacted backfill.

Western Union Telegraph Company Responsibilities. Western Union shall:

- 1) Perform all design and construction involving cables.
- 2) Coordinate with DART and other facility relocations.

6.4.4 Cable Television

Cable television facilities belonging to various cable television companies will be affected by construction of the system. With very few exceptions, cable television facilities are aerial and are mounted on utility poles belonging to a power company or a telephone and telegraph company.

Each cable television company shall be responsible for the design and relocation of its facilities which conflict with the system.

Designer Requirements. It shall be the designer's responsibility to:

- 1) Provide the company with plans showing the DART facilities and proposals for the relocations of other utility facilities so that the affected cable television company may complete its design.
- 2) Show the location of the existing and relocated cable television facilities on the utility plans and, where necessary, consider such work in the preparation of construction sequence plans.
- 3) Coordinate through DART with the affected cable television company during the design, when appropriate.

6.5 DESIGN CRITERIA FOR SURFACE FACILITIES

Surface facilities are utilities that are impacted by the DART construction and are facilities that incorporate other utilities. These facilities include traffic signal and appurtenances; street lighting; alarm systems; intelligent transportation systems (ITS); security systems.

6.5.1 Traffic Signalization, ITS and Street Lighting

Street lighting, ITS and traffic control facilities will be affected by construction of the system. Unless DART and the facility owner agree otherwise, the design and relocation of street lighting, ITS and traffic control facilities that conflict with the system shall be performed on a replacement-in-kind basis. Refer to Chapter 5 - Traffic Control for traffic signalization requirements for additional details.

DART-owned street lighting facilities are to be mounted on metal poles and are connected in circuits. Power supply cables may be aerial, attached to the poles, or in metal conduit buried in the sidewalks adjacent to the street curbs. Individual lights can be taken out of service provided doing so does not disrupt service in the circuit. Refer to Chapter 26 - Lighting for requirements within the DART right-of-way.

Design and construction responsibilities will be defined in DART's agreement with the local government having jurisdiction.

Designer Requirements. It shall be the designer's responsibility to:

- 1) Provide affected facility owners with plans showing the DART facilities, and coordinate with the City to determine the extent of the system impact upon lighting facilities and the City's requirements for facility relocation.
- 2) Prepare street lighting contract documents for the relocation of City-owned street lighting facilities and connecting conduits, including temporary facilities, where necessary. In the performance of this work, care shall be taken to ensure compatibility among street lighting, DART parking lot lighting, and DART station site lighting.
- 3) Prepare contract documents for the relocation of the affected signals, ITS elements and traffic control facilities such as control boxes, loop detectors, conduits, electrical boxes, etc.
- 4) Coordinate with the power company regarding disconnection and restoration of power supplies to lighting facilities, ITS systems and traffic signalization systems.
- 5) Include temporary lighting, ITS and signal facilities in the construction sequence and traffic control plans.
- 6) Base the design of lighting, ITS and signalization facilities on the standard drawings, criteria, and specifications of the City.

6.5.2 Fire Alarms and Other Security Systems

Fire alarm facilities belonging to the local fire services and security system facilities owned by private security system companies will be affected by DART construction of the system.

The facilities consist of fire alarm boxes connected in circuits to various fire stations and the fire department central headquarters, and security system circuits to various customers and the security system control room. The fire alarm and security system circuit cables may be aerial, installed on telephone company or power company utility poles, or underground, installed in telephone company duct banks. Fire alarm and security system circuits must be maintained-in-service at all times, unless otherwise approved by the respective authorities or utility owners. The Fire Department and fire alarm and security system owners shall be notified when relocations are being constructed or service is to be interrupted.

Designer Requirements. It shall be the designer's responsibility to:

- 1) Provide the City and security system owners with plans showing the DART facilities, and coordinate with them through DART to determine the extent of the system impact upon their facilities and whether affected facilities may be abandoned or taken out of service during DART construction. The city, security system owners, and the designer shall decide upon locations for the relocation of conflicting facilities that are acceptable both to DART and the owners of the affected facilities.
- 2) Prepare the design so that service in fire alarm systems facilities is maintained at all times, except where the facility owner has agreed otherwise.
- 3) Prepare contract documents for the relocation of affected facilities, as directed by DART.
- 4) Coordinate plans to relocate or maintain these facilities in-place with the power company or telephone and telegraph companies as necessary to ensure continuity of service.
- 5) Include above facilities relocations in the DART construction sequence plans.
- 6) Coordinate with the facility owners, and include in the design provisions to allow adequate and continuous facilities operations during DART construction of the system. Such provisions may include:
 - a) All work related to fire alarm systems shall be in accordance with the requirements of the respective facility owner's criteria and standards.
 - b) All work related to security and systems owned by private security companies will be performed by themselves or by telephone or other companies providing the service to the security company.

Security Company Responsibilities. The security company shall:

- 1) Perform all design and construction involving security and alarm facilities.
- 2) Coordinate with DART and other facility relocations.

6.5.3 U. S. Postal Service

The postal service shall relocate affected facilities prior to DART construction.

Designer Requirements. It shall be the designer's responsibility to:

- 1) Provide the postal service with plans showing DART facilities and the location of affected collection and distribution boxes.
- 2) Coordinate through DART with the U.S. Postal Service during design.

U.S. Postal Service Responsibilities. The Postal Service shall:

- 1) Coordinate with DART for any facility relocations.

6.5.4 Parking Meters

All work related to removal, relocation, restoration, and installation of parking meters shall be in conformance with the requirements of the City. All work shall be coordinated through DART with the City. The City shall remove, store, and install meter heads and DART's contractor shall remove, store, and install meter posts.

Designer Requirements. Where DART facilities will impact parking meters the designer shall:

- 1) Coordinate impacted parking meters through DART so that adequate data may be furnished to the City for completion of its work.
- 2) Show the necessary relocations of impacted parking meters on the DART utilities plan.
- 3) Provide details for the installation of meter posts on the utility plans.

City Responsibilities. The City shall:

- 1) Perform all removal and store meter heads. The City will reinstall meter head once new posts have been relocated.
- 2) Coordinate with DART and other facility relocations.

6.6 DESIGN CRITERIA FOR MISCELLANEOUS UTILITIES

6.6.1 Vaults

All remodeling, abandonment, or other work involving private vaults extending from adjoining buildings into public space shall be in accordance with current codes, standards, and practices of the concerned jurisdiction. All work related to private vaults shall be coordinated through DART with the vault owners.

Designer Requirements. The designer shall determine which vaults will be affected by DART construction. Plans shall show, as a minimum, portions of each vault to be removed and the area available for permanent use upon completion of DART construction. This information shall be

forwarded to DART at the earliest practical date so prompt action can be taken to avoid delay in construction.

Vault Owner's Responsibilities. The owner of the vault shall:

- 1) Perform all design and construction involving cables.
- 2) Coordinate with DART and other facility relocations.

6.7 DESIGN CRITERIA FOR UNDERGROUND FLAMMABLE AND COMBUSTIBLE LIQUID STORAGE TANKS

The following criteria provide the design requirements for dealing with flammable and/or combustible liquid storage tanks and related appurtenances adjacent to DART trackway running through a subsurface structure or on the surface. Designs shall conform to NFPA 130, Section 3-2.8.1-6. The classification of liquids according to the National Fire Protection Association (NFPA) is given in the following table:

Classification of Liquids

<u>Agency Classification</u>	<u>NFPA Classification</u>	<u>Flash Point</u>
Flammable	Class I	Below 100°F (37.8°C)
Combustible	Class II	100°F to 140°F (37.8°C to 60°C)
	Class III	Above 140°F (60°C)

Underground tanks for Class I flammable and Class II and Class III Combustible liquids and related piping shall not be permitted directly over a subsurface DART structure or within 25 feet (measured horizontally) from its outside wall.

6.7.1 New Underground Storage Tank Installation

Where the tops of underground storage tanks and related piping for Class I flammable liquids and Class II and III combustible liquids are more than 2 feet above the lowest point of excavation for a DART substructure, and where they are within 25 to 100 linear feet from the outside wall of the DART substructure, they shall be installed in accordance with NFPA 130.

6.7.2 Service Stations

Where service stations dispensing Class I flammable liquids, and Class II and III combustible liquids are located in the area within 100 feet (measured horizontally) from the outside wall of subsurface structure, NFPA 130 requirements shall be complied. If service stations are outside the DART right-of-way, the designer shall notify DART so that arrangements for complying with NFPA 130 can be developed.

6.7.3 Existing Tanks

Existing storage tanks for Class I flammable liquids and Class II and III combustible liquids located on DART right-of-way in or under buildings, directly above a subsurface transit structure, or within 25 linear feet from a subsurface transit structure outside wall shall be removed and relocated to outside the prohibited area.

All existing storage tanks, above ground or underground, shall comply with NFPA 130 when located within the distances specified in that standard. Where existing storage tanks for Class I flammable liquids or Class II and III combustible liquids are governed by that standard and outside the DART right-of-way, the designer shall notify DART so that arrangements for compliance can be developed.

6.8 DESIGN CRITERIA FOR UTILITY RELOCATIONS CROSSING RAILROAD TRACKWAYS

Utilities may presently cross railroad trackways, or, because of DART construction, be relocated to cross railroad trackways. Signal and communications lines belonging to railroad companies will be affected by DART construction. The design and relocation of railroad facilities that conflict with the DART system shall be performed by the railroad according to the railroad's standards.

Designer Requirements. Where DART facilities will impact railroad utility facilities, or where relocation of other utility facilities will impact, or possibly affect the operation of railroad facilities, the designer shall:

- 1) Coordinate work through DART so that adequate data may be furnished to the railroad for completion of its work.
- 2) Show the necessary relocations of railroad utilities in the DART utilities plan.
- 3) Coordinate through DART with the affected utility owners to define the limits of existing facilities that are in conflict, and determine the responsibility for the design and construction of relocated facilities that will eliminate such conflicts.

- 4) Coordinate and furnish data to utility owners who are designing their relocations so that they may complete their design.
- 5) Review the utility owner's proposals to ensure that they are compatible with the DART design and that of other affected owners.
- 6) Show such relocated utility alignments on the plans and provide appropriate copies of those plans for distribution to other affected facility owners.

Railroad Company Responsibilities. The railroad company shall:

- 1) Perform all design and construction involving it utilities.
- 2) Coordinate with DART and other utility relocations.

6.8.1 Underground Facilities Crossing Railroad Trackways

When building underground facilities, the following items will either be enclosed in casings, or conduits.

- o Casings:
 - Pipelines carrying either flammable or nonflammable substances under pressure beneath railroad trackways.
 - All sanitary sewers, whether operating by gravity or under pressure.
- o Conduits:
 - Electrical cables.
 - Communications cables.

When an underground facility relocation is designed by the section designer, such design shall provide for installation of the facility in the following manner:

- o When utilities must be installed beneath active railroad mainline tracks, such installation shall be by jacking, boring, or tunneling. The section designer shall determine the specific requirements of the railroad for each type of installation, including materials, prior to proceeding with the detailed design.
- o When utilities must be installed beneath active railroad secondary tracks, such installation shall be by methods approved by the railroad.

- o When utilities must be installed beneath inactive or proposed railroad tracks, such installation preferably shall be by open-trench methods, provided the installation will be more than 25 feet away, or other distance approved by the railroad, from active mainline tracks and beyond existing fill sections or other ditch sections.

- o When open-trench methods will be used:
 - All installation shall comply with "Installation of Pipe Culverts", Chapter 1, Part 4, of the AREMA Manual for Railway Engineering of the American Railway Engineering and Maintenance-of-way Association (AREMA) and railroad requirements.

 - The design shall include details of sheeting and method of supporting the railroad track for utility facilities installation, if appropriate.

- o Underground facilities shall:
 - Cross railroad trackway at right angles, where practicable. When this cannot be done, the skew shall in no instance be greater than 45 degrees.

 - Be designed for Cooper E-80 loading as specified in Chapter 15, Part 1, Section 1.3.3 of the AREMA Manual for Railway Engineering and railroad requirements.

Encased Facilities

Utility owner's standard details and specifications shall be used for design, except where these requirements or the railroad criteria and specifications are more stringent. Pipeline encasements shall be designed according to the requirements of Chapter 1, Part 5, of the AREMA Manual for Railway Engineering.

- o Casing thickness:

Chapter 1, Part 5, of the AREMA Manual for Railway Engineering provides for steel casings up to 42 inches in diameter. In situations where steel casings larger than 42 inches in diameter are required, the following wall thicknesses shall be used:

Outside Casing Diameter (Inches)	Minimum Wall Thickness (Inches)
44	0.500

46	0.625
48	0.625
50	0.625
52	0.750
54	0.750
60	0.813

An allowance for increased wall thickness shall be made for uncoated pipe having a diameter greater than 42 inches as is required in Chapter 1, Part 5, of the AREMA Manual for Railway Engineering.

o Casing design considerations:

For large-diameter carrier pipe, it may be necessary to perform installation and routine maintenance from within the casing, in which case appropriate internal clearance shall be provided. Where additional clearance is required, the alternatives of arch and elliptical sections might be considered.

Extension of an existing casing shall be of similar style and shape and of compatible materials to the existing casing. The extension of an existing casing shall continue the line and grade of the existing casing.

Where the distance between DART and railroad near tracks is less than 25 feet, or where there would be no means of access to the end of the casing between DART and railroad tracks, the casing shall be continuous across both the DART and railroad trackways. Such casings shall be on a straight grade and alignment, be of uniform strength throughout their length, and conform to either DART or railroad criteria, depending on which is the most stringent.

Nonencased Facilities - Storm Sewers. Casings may be omitted on storm sewers where the facility will normally operate under pressures of less than 10 psi.

Utility owner's standard details and specifications shall be used for design of encased facilities, except where these requirements or the railroad criteria and specifications are more stringent.

o Cover:

The top of non-encased sewers shall normally be not less than 5 feet 6 inches below the bottom of rail because of possible problems during track maintenance. For sewers with diameters in excess of 84 inches, the minimum cover should be 2 feet greater than

one-half the inside diameter. Where substantial savings may be realized by reduction of this clearance, the section designer shall submit studies showing how the relocated facility will withstand railroad loading, and the approval of the railroad shall be obtained before completion of the detailed design.

Strength design of non-encased sewer facilities shall be based on the criteria of Chapter 1, Part 10, of the AREMA Manual for Railway Engineering.

- o Horizontal clearance:

Manholes shall not be located closer than 25 feet from the centerline of the railroad outside track and shall be located outside the ditch section required at that location.

Where the distance between DART and railroad near tracks is less than 25 feet, or where there would be no means of access to a manhole located between DART tracks and the railroad tracks, the sewer shall be continuous across both the DART and the railroad trackways. New sewers shall be on a straight grade and alignment, be of uniform strength and material throughout its length, and conform to either DART or railroad criteria, depending on which is the most stringent. Extensions for existing sewers shall be of similar style and shape, of compatible materials, and equal to or greater in hydraulic capacity than the existing sewer.

- o Minimum size:

Minimum size of sewers beneath railroad tracks shall be 18 inches in diameter.

- o Minimum slope:

Minimum slope for sewers shall be as set forth in Chapter 7 - Drainage.

Conduit Facilities. Utilities wires or cables placed beneath railroad tracks shall be installed in conduits. Utility owner's standard details and specifications shall be used for design of conduit facilities, except where these requirements or the railroad criteria and specifications are more stringent.

Where jacking or boring must be employed, conduits may be steel, or reinforced concrete.

Where open-trench methods are employed, plastic or approved type of nonmetallic conduits shall be encased in concrete according to the utilities or railroad standards, whichever is more stringent.

- o Sizes:

Conduits shall be a minimum of 4 inches in diameter and shall be on a reasonably straight line and grade beneath the railroad tracks.

Where bends are required, they shall be situated clear of the tracks and shall be of sufficiently large radius to allow the installation of cable without damage.

- o Cover:

The clearance between top of conduit encasement and top of rail shall normally be not less than 5 feet. Where savings may be realized by reduction of this clearance, the section designer shall obtain the approval of the railroad before completing the detailed design.

- o Horizontal clearance:

Manholes shall not be located closer than 25 feet from the centerline of the outside track and shall be located outside the ditch section required at that location. Exceptions may be approved by the railroad.

Where the distance between DART and railroad near tracks is less than 25 feet, or where there would be no means of access to a manhole located between the DART and the railroad tracks, the conduits shall be continuous across both the DART and the railroad trackways.

Table 6-2
MINIMUM COVER FOR UNDERGROUND UTILITIES
(in feet)

UTILITY	TRAFFIC AREAS UNLINED DITCH OTHER UNPAVED	LINED DITCH	DART ROW & PROPERTY	DART LRT CROSSING	RAILROAD CROSSING	NON- TRAFFIC
Sanitary Sewer	3	2		4.5*	4.5*	3
Storm Sewer	2	2		5.5*	5.5*	2
Non-flammable Substance Pipelines	3	2		4.5*	4.5*	3
Water	4	4	4	4.5*	4.5*	4
Gas	4	2		5.5*	5.5*	4
Wiring/Cable Conduits	2	2		5**	5**	2

* Top of pipe, casing or encasement to base of rail.

** Top of pipe, casing or encasement to top of rail.

NOTE: Minimum cover outside DART right-of-way shall comply
with standard requirements of the jurisdictional municipality.

6.8.2 Aerial Facilities

Utilities wire or cable facilities may cross aerially above railroad tracks or be relocated to cross aerially above railroad tracks. Such facilities may be owned by a power company, telephone and telegraph companies, cable television companies, or other local agencies.

In the absence of railroad criteria and specifications to the contrary or more stringent, aerial facilities shall be designed according to the following criteria. Design of aerial wire and cable relocations shall be performed by the utility owners. The section designer shall coordinate with the respective utility owners to ensure that adequate horizontal and vertical clearance will be provided.

Horizontal Clearance. Where railroad tracks are paralleled or crossed by overhead lines, the poles shall, if practicable, be located outside railroad right-of-way. If location on railroad right-of-way is necessary, the poles shall be not less than 25 feet from the centerline of the nearest track and outside any ditch section required at that location. The exceptions cited below

may be necessary in some instances; they shall not be used, however, unless approved by the railroad before completion of the detailed design.

- o Exception 1:

At sidings, a 15-foot clearance is preferred. The absolute minimum clearance shall be 10 feet from the track centerline provided sufficient space for a driveway is left where railroad cars are loaded or unloaded.

- o Exception 2:

Where necessary to provide safe operating conditions that require an uninterrupted view of signals and signs along tracks, the parties concerned shall cooperate in locating poles to provide the necessary clearance.

Vertical Clearance. The minimum vertical clearance of wire or cable above the top of rail shall not be less than specified in Table 6-3.

When warranted by conditions of span length, voltage, and method of supporting the conductors, the vertical clearance of wire or cable above top of rail shall be increased in accordance with Article 232B of the National Electrical Safety Code.

Should it be impractical to provide an aerial relocation of an existing aerial wire or cable above a railroad, the facility shall be relocated beneath the railroad trackway in conduit in accordance with the conduit facilities described in Section 6.8.1.

6.9 UTILITY MARKERS

Markers as shown in the utilities standard drawings shall be used to indicate the location of below-grade utilities installations whether belonging to DART, private utilities companies, or local governments.

6.9.1 Location

Markers shall be placed at the centerline of the facility being marked. Lines beginning or ending within the DART right-of-way shall be marked at their ends. Lines crossing DART right-of-way shall be marked at a point near the edge of the subballast shoulder. Track underdrains shall be marked at changes in direction and at outflows. Markers are not required for underdrains extending along bases or tops of retaining walls. Markers, when required, shall be placed on retaining walls in retained sections.

Where a marker location, as prescribed above, results in a conflict with other underground facilities, the marker shall be placed away from the trackbed at a point near the right-of-way line.

Utility markers are not required, however, for storm drains crossing under the DART trackway when the storm drains can be readily located by trackside catch basins, manholes, or headwalls, or when the storm drains are so deep that they will not be affected by trackway work. The section designer shall indicate the location of utility markers on project plan drawings and shall prepare a schedule of utility markers for facilities in their project, defining the legend for each marker. The schedule shall be on a project drawing.

6.9.2 Description

Utilities markers shall consist of a metal target plate mounted vertically on a formed metal post and shall be furnished and installed by the contractor. The front face of the target plate shall be marked as indicated on utilities standard drawings, with the station number, a symbol identifying the type of facility, and the utilities owner. Markers located near the edge of the subballast shoulder shall be oriented so that the front face faces away from the tracks. Markers located away from the trackbed shall be oriented so that the front face faces the tracks.

TABLE 6-3

**MINIMUM VERTICAL CLEARANCE OF WIRES AND CABLES
ABOVE RAILROAD TOP-OF-RAIL**

Line Wires, RAILROADS Service Drops	Guys; Messengers; Communication, Span, and Lightning Protection Wires; Communication Cable Supply Cable having Effectively Grounded	Open	Supply	
	Continuous Metal Sheath, or Insulated Conductors Supported on and Cabled together with an Effectively Grounded Messenger	Arc	Wires, and Less than 750V 750V	21,99 750V
(Names of the Railroads)				
All Other Railroads in Accordance with National Electrical Safety Code	27 ft.	27 ft.	28 ft.	

(1) Over 50,000 volts, add 0.5 inch for each 1,000 volts over 50,000 vol