



**Pima County  
Department of Transportation**

**STREET LIGHTING AND ITS CONDUIT  
DESIGN MANUAL**



**August 2006**



# MEMORANDUM

Department of Transportation

**Date:** 8/7/06  
**To:** Ben Goff  
**From:** Albert Letzkus   
**Subject:** Re-submittal of TED Street Lighting and ITS Conduit Design Manual

Enclosed with this memo is the above manual that we submitted approximately 3 years ago for approval. The approval was never finalized. I am re-submitting it in the original form, to include the chapter on street lighting and ITS conduit. The previous director wanted to delete the chapter on ITS conduit, but I feel it is necessary to include, and this manual is the best manual in which to include it. The ITS conduit chapter was developed in partnership with the COT and sets the design standards for ITS conduit installation on City and on County CIP projects. Minor changes were made to the manual to reflect the change in DOT leadership and to update other changes since the manual's initial development.

Just as a reminder - this manual sets forth the street lighting design for continuous and for spot street lighting after the decision has been made to install street lights on a project or at a location. It does not set forth any warranting criteria for the decision to install the street lights themselves.

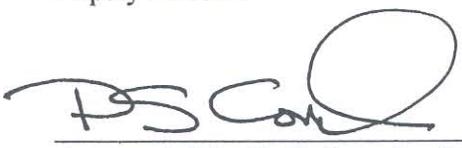
This manual is referenced in the County's 2003 Roadway Design Manual and we have had at least one recent request from a local consultant for the street lighting manual, so I would like to get your and Priscilla's approval as quickly as possible. If you will again approve this manual, then please send it on to Priscilla for approval and signature below AND on the manual's signature page, and return this manual original to me for reproduction and listing on the TED website.

Thank you.

Enclosure

  
Approved, Ben Goff, P.E.  
Deputy Director

8/9/06  
Date:

  
Approved, Priscilla S. Cornelio, P.E.  
Director

8/9/06  
Date:

file: Traffic I:\Signals\Street Light Manual\memo Ben Goff agl re-submittal of street lighting and ITS conduit design manual for approval 080706.doc

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# **INTRODUCTION**

## **Purpose**

The first edition of the Pima County Street Lighting and ITS (Intelligent Transportation Systems) Conduit Design Manual expands upon existing guidelines to more completely identify guidelines and layouts for street lighting on County roads, and design standards for ITS facilities.

In the past, roadway lighting requirements were generally limited to intersections with traffic signals. When continuous roadway lighting was required on a road project, the design team was required to study and develop the construction plans for the lighting system for each given project. The primary purpose of this manual is to provide a consistent set of guidelines and layouts for use by engineers, contractors, and Pima County Department of Transportation Traffic Engineering Division (PCDOT/TED) staff for street lighting when required at signalized intersections, at unsignalized intersections, at mid-block pedestrian crosswalks, and as continuous lighting along roadways.

Another purpose of this manual is to provide the standards and specifications for the installation of ITS conduit and related facilities on roadway projects for the immediate or future installation of ITS communication systems.

This manual will be used in conjunction with the latest edition of the Pima County/City of Tucson Standard Specifications for Public Improvements, the Pima County/City of Tucson Standard Details for Public Improvements, and the October 2001 PCDOT/TED Supplementary Specifications. This document supersedes the 1998 Pima County Roadway Design Manual, its March 2000 and October 2002 updates, and the January 2002 Pima County Traffic Signal Design Manual.

## **Application of Manual**

This manual is to be used for the layout of street lighting after the decision is made to install street lighting on a project. Street lighting at the intersection is always included with all traffic signal projects using traffic signal combination poles (signal faces and street lights). Street lighting is sometimes installed at non-signalized intersections and along roadway segments. This manual does not establish any criteria nor requirements for the use of street lighting at non-signalized intersections nor along roadway segments (as continuous lighting). The decision to install street lighting at these locations is made on a project by project basis based on other considerations, such as type of development activity, available funding levels, community acceptance, etc.

The ability of street lights to provide illumination of the intersection or roadway area is a function of many variables. Some of the variables, such as pole/luminaire spacing and set backs, have to be adjusted at specific pole locations due to conflicting roadway elements. Many of the variables change over time for a given application, such as the light output of the luminaire, the level of reflectance of the roadway surface, the impact of vegetation, etc. Other factors, such as the eye's ability to absorb light and to adapt to changing light conditions, literally vary from

person to person. Therefore, the lighting industry typically uses “average” values of these factors in determining lighting systems. While typical lighting levels recommended by lighting industry sources for various roadway environments were incorporated into the development of the lighting layouts contained within this manual, this manual does not establish specific lighting levels for use on County roads or intersections. The layouts represent configurations of street lighting poles and luminaires that will provide desirable lighting, in general, for various roadway and intersection environments.

This manual assembles and documents guidance developed by PCDOT/TED regarding typical street lighting pole and luminaire layouts for a variety of typical roadway and intersection types. The goals of the manual are to (1) reduce the amount of time and resources project engineers spend on developing street lighting construction plans, and (2) reduce the amount of time PCDOT/TED staff spend on reviewing these plans. However, users of this manual are expected to use engineering judgment when applying the street lighting layouts within this manual to project specific locations and/or conditions.

### **Revision Process**

All users of this manual are encouraged to suggest changes to this manual. Suggestions should be submitted in written and/or diagram form to PCDOT/TED. Suggestions will be reviewed as time and resources permit. Adopted modifications will be incorporated into future revisions of the manual.

Questions regarding the use of this manual should be referred to the Pima County TED project manager (on specific projects) or to the Pima County Traffic Engineer.

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Priscilla S. Cornelio, P.E.  
Director

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Albert G. Letzkus, P.E., PTOE  
County Traffic Engineer

## ABBREVIATIONS

<b>AASHTO</b>	American Association of State Highway and Transportation Officials
<b>ADA</b>	Americans with Disabilities Act
<b>ADOT</b>	Arizona Department of Transportation
<b>ANSI</b>	American National Standards Institute
<b>AWG</b>	American Wire Gauge
<b>COT</b>	City of Tucson
<b>Fc</b>	Foot-candle
<b>HID</b>	High Intensity Discharge
<b>IESNA</b>	Illuminating Engineering Society of North America
<b>ITS</b>	Intelligent Transportation Systems
<b>HPS</b>	High Pressure Sodium
<b>LPS</b>	Low Pressure Sodium
<b>MSL</b>	Micro-Site-Lite Computer Program
<b>NEC</b>	National Electrical Code
<b>NEMA</b>	National Electrical Manufacturers Association
<b>PCDOT/TED</b>	Pima County Department of Transportation Traffic Engineering Division
<b>PPG</b>	Process/Procedure Guideline
<b>RP-8-00</b>	IESNA Recommended Practice-8-2000
<b>TWLTL</b>	Two-Way Left Turn Lane
<b>V</b>	Volt
<b>W</b>	Watt

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**Street Lighting & ITS Conduit Design Manual**

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**General Information**  
**Typical Abbreviations**

SHEET NO.

**1-01**

## DEFINITIONS

<b>Clear Zone</b>	Term used to designate the unobstructed, relatively flat area provided beyond the edge of the traveled way for the recovery of errant vehicles. The clear zone includes any shoulder or auxiliary lanes.
<b>Conduit Run</b>	An underground conduit from pull box to pull box or from pull box to pole foundation. Conduits in the same trench are often given one conduit run number.
<b>Full Cutoff</b>	Term used to indicate that a luminaire directs almost no light above the horizontal plane through the luminaire.
<b>Luminaire</b>	A complete lighting fixture consisting of a lamp or lamps together with the ballast, reflector, refractor, photocell when required, and the housing.
<b>Mounting Height</b>	The vertical height of the luminaire as mounted on the street light pole or mast arm. The height is typically the perpendicular measured distance from the ground or pavement to the center of the luminaire light source.
<b>Pedestrian Night Time Activity Levels:</b> <ol style="list-style-type: none"> <li>1. High</li> <li>2. Medium</li> <li>3. Low</li> </ol>	<ol style="list-style-type: none"> <li>1. Areas with significant number of pedestrians expected to be on the sidewalks or crossing the streets during darkness. Examples are downtown retail areas, near theatres, concert halls, stadiums and transit terminals.</li> <li>2. Areas where lesser numbers of pedestrians utilize the streets at night. Typical locations are downtown office areas, blocks with libraries, apartments, neighborhood shopping areas, industrial, older city areas, and streets with transit lines.</li> <li>3. Areas with very low volumes of night pedestrian usage. These can occur in any of the cited roadway classifications but may be typified by suburban single family streets, very low density residential developments, and rural or semi-rural areas.</li> </ol>
<b>Pole Offset (relating to crosswalks)</b>	The distance between the center of a pedestrian crosswalk and the center of a street lighting pole.
<b>Pole Setback</b>	The perpendicular measured distance from the traveled roadway edgeline or face of curb to the center of the street light pole.

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		<b>General Information</b> <b>Typical Definitions</b>	

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## DEFINITIONS

### Continued

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#### Type III Distribution

An asymmetrical (non-circular) light distribution pattern that indicates how far a luminaire directs light across the width of a street. Distribution patterns vary from Type I to Type V. The higher the number, the further the light is directed across the street. A Type V is a circular pattern.

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#### Roadway Classification:

1. Major
2. Collector
3. Local

1. That part of the roadway system that serves as the principal network for through traffic flow. Major routes connect areas of principal traffic generation and important rural roadways leaving the city.
  2. Roadways servicing traffic between major and local streets. These are streets used mainly within residential, commercial and industrial areas.
  3. Local streets are used primarily for direct access to residential, commercial and industrial, or other abutting property.
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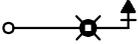
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**PCDOT Traffic Engineering Division**  
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**General Information**  
**Typical Definitions**

**SHEET NO.**  
**1-02**  
2 of 2

# COMMON SYMBOLS

SYMBOL	DESCRIPTION
	Metered Service Pedestal
	Traffic Signal/Street Lighting Controller
	No. 7 Pull Box
	No. 7 Pull Box with Extension
	No. 3 1/2 Pull Box
	Conduit Run
	Traffic Signal Pole with Luminaire Mast Arm
	Street Lighting Pole
	Pedestrian Crosswalk
	Street Lighting Pole Number
	Street Lighting Circuit Number

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General Information  
Common Symbols

**1-03**

# LIGHTING DESIGN GUIDELINES

## Background

The generally excepted authority in the area of roadway related lighting is the Illuminating Engineering Society of North America (IESNA). In 2000, under the rules of procedure of the American National Standards Institute (ANSI), the IESNA sponsored the development of the American National Standard Practice for Roadway Lighting. The practice was issued as the ANSI/IESNA Recommended Practice-8-00 (RP-8-00). It is from the RP-8-00 that the basis for various lighting criteria for the Pima County Street Lighting and ITS Conduit Design Manual has been derived.

## Purpose of Roadway Lighting

The principal purpose of roadway lighting is to produce quick, accurate, and comfortable visibility at night. RP-8-00 goes on to state “the proper use of roadway lighting as an operative tool provides economic and social benefits to the public including:

- (a) Reduction in night time accidents, attendant human misery, and economic loss
- (b) Aid to police protection and enhanced sense of personal security
- (c) Facilitation of traffic flow
- (d) Promotion of business and the use of public facilities during the night time hours”

## Signalized & Unsignalized Intersection Lighting Design Guidelines

**Intersecting roadways with continuous lighting:** The lighting requirements for these locations were determined using the RP-8-00 Table 9. Each intersecting roadway was evaluated between major, collector and local functional classifications and the pedestrian classification was determined. The table was then referenced to determine the recommended average lighting level and uniformity.

**Intersecting roadways with no lighting:** The lighting recommendations for these locations were determined using the roadway recommended lighting values shown in RP-8-00 Table 2, for the pavement classification column R2/3. The recommended lighting levels and uniformity were determined by referencing the table using the roadway with the highest functional class and the determined pedestrian classification. This lighting level recommendation was increased by 50% to determine the recommended intersection lighting level.

**Signalized & Unsignalized Intersection Lighting Layouts:** The selected lighting layouts for signalized intersections are provided in Chapter 3, sheets 3-01 through 3-08. The selected lighting layouts for unsignalized intersections are provided in Chapter 4, sheets 4-01 through 4-06. These recommended layouts meet the above recommendations for the widest range of configurations of 2 lane through 6 lane divided intersections.

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## **Pedestrian Crossing Lighting Design Guidelines**

**Mid-Block Pedestrian Crossings:** Each roadway was evaluated between major, collector and local functional classifications. The pedestrian classification was also determined to be high, medium or low. The lighting level recommendations for mid-block pedestrian crossings on non-continuously lighted roadways were determined using the recommended lighting levels for roadways in the RP-8-00, Table 2, for pavement classification R2/3. The lighting level recommendations for mid-block pedestrian crossings on continuously lighted roadways are 1.5 times the recommended lighting levels used for the non-continuously lighted roadways.

**Pedestrian Crossings at Intersections:** The lighting level recommendations for pedestrian crossings at intersections default to the recommended lighting levels and layouts for the respective intersections discussed above.

**Mid-Block Pedestrian Crossing Lighting Layouts:** The selected lighting layouts for pedestrian crossings are provided in Chapter 5, sheets 5-01 through 5-05. These recommended layouts meet the pedestrian crossing recommendations for the widest range of configurations of 2 lane through 6 lane divided roadways.

## **Roadway Lighting Design Guidelines**

**Roadway Segments:** The lighting level recommendations for roadway segments were determined using the RP-8-00, Table 2, for pavement classification R2/3 and the Pima County/City of Tucson Standard Detail T.S. 3-24. Each roadway was evaluated between major, collector and local functional classifications. The pedestrian classification was also determined to be high, medium or low. The tables were then referenced to determine the recommended average lighting level and uniformity.

**Roadway Lighting Layouts:** The selected lighting layouts for roadway segments are provided in Chapter 6, sheets 6-01 through 6-03. These recommended layouts meet the above recommendations for the widest range of configurations (2 lane through 6 lane divided roadway) where a staggered pole configuration can be used. In locations where a staggered pole configuration is not appropriate, a lighting analysis study will need to be performed to determine the appropriate single-sided or median lighting layout.

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REVISED		Lighting Design Guidelines	

## DESIGN CRITERIA REFERENCES FOR STREET LIGHTING

1. Street lighting design should meet or exceed the average illuminance per the AASHTO publication, *An Informational Guide for Roadway Lighting*, 1984.
2. Pole locations should be positioned beyond the AASHTO clear zone requirements specified in the AASHTO *Roadside Design Guide*, 2002 (convert to English measurements).
3. Light Distribution shall satisfy the most recent edition of the Pima County Outdoor Lighting Code.
4. All installations shall meet the *National Electric Code* requirements.
5. Installations shall be in conformance with the Roadway Lighting – Illuminating Engineering Society of North America, ANSI/IESNA RP-8, 2000.

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REVISED		Standard References for Street Lighting	<b>2-02</b>

# General Guidelines for Signalized Intersection Lighting Layouts

## General

1. All installations shall meet the National Electric Code requirements and conform to the most recent edition of the Pima County Outdoor Lighting Code.
2. Signalized intersection street lighting layout may be modified with approval from the Pima County DOT/TED Project Manager.

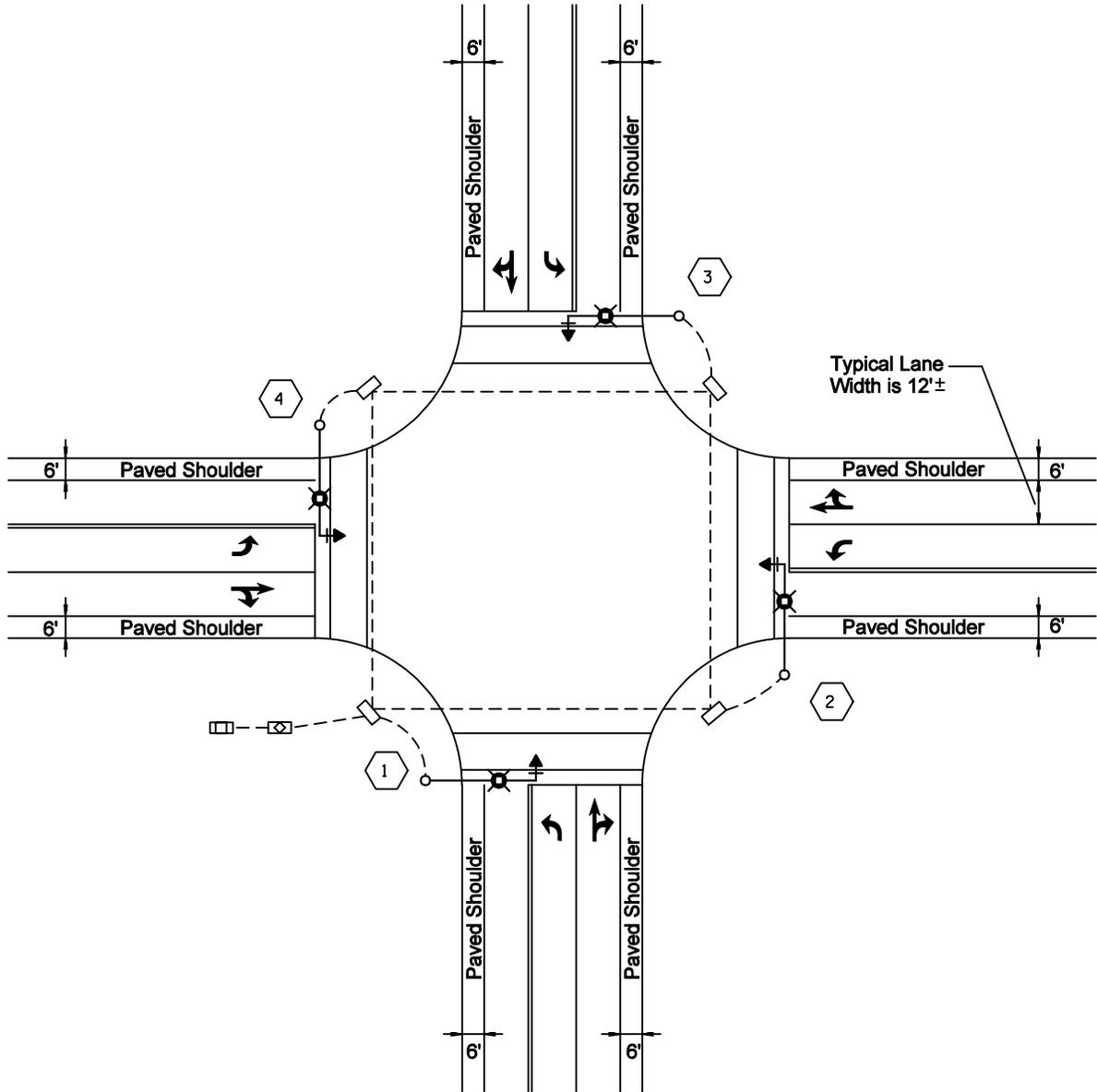
## Equipment

3. All street lighting equipment at signalized intersections shall be placed according to the PCDOT Traffic Signal Design Manual. Street lighting equipment is to include, but not be limited to the following items.
  - Poles, mast arms and foundations
  - Conduit, pull boxes and control cabinets
4. The street lighting pole setback shall meet the clear zone requirements as discussed in the Pima County Roadway Design Guidelines.
5. Signalized intersection street lighting will utilize 20' mast arms at a 35' mounting height.
6. The number and orientation of street lights at signalized intersections shall correspond to the layouts on sheets 3-01 through 3-08 of the PCDOT Street Lighting Manual.
7. Luminaires placed at signalized intersections shall be 120 volt, 400 watt High Pressure Sodium fixtures with Type III distribution and Full Cutoff lenses.

## Power

8. Luminaire conductors and circuiting shall be completed as shown in the PCDOT Traffic Signal Design Manual and in PC/COT Standard Detail T.S. 1-7. Power shall be provided through the traffic signal controller cabinet from a metered service pedestal.
9. The street lighting photo electric cell shall be mounted on the luminaire of the pole closest to the traffic signal controller.

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<b>REVISED</b>		<b>Signalized Intersection Lighting</b> <b>General Guidelines</b>	<b>3-00</b>



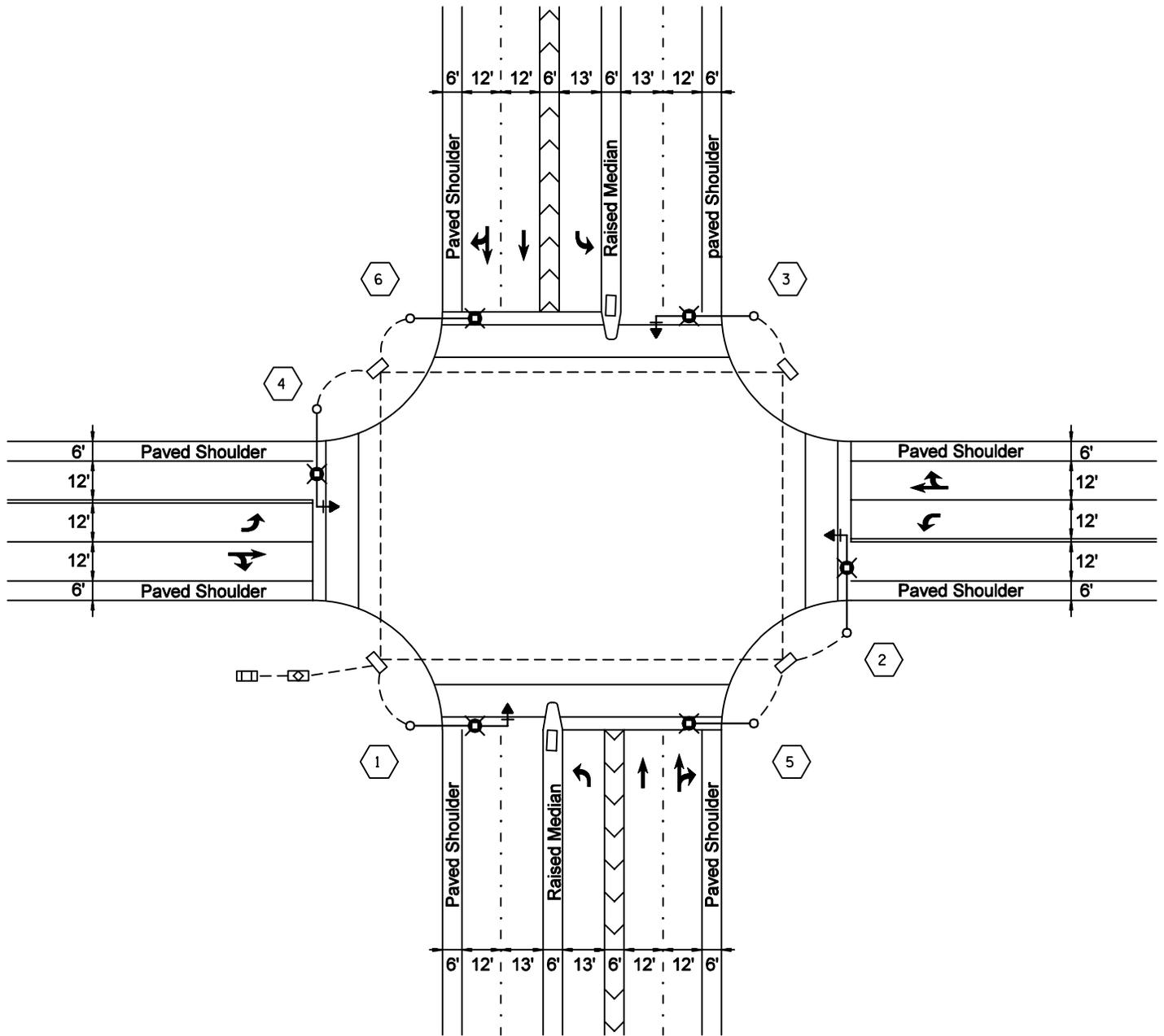
**LAYOUTS**

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1 & 3	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1
2 & 4	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2

**NOTES:**

1. Signal pole types to be determined using the PCDOT Traffic Signal Design Manual.
2. Poles, conduit and pull boxes are to be placed and circuited according to PCDOT Traffic Signal Design Manual.
3. Street lighting power to be provided through the traffic signal controller from a metered service pedestal.

<p><b>ISSUED</b> August 2003</p>		<p align="center"><b>PCDOT Traffic Engineering Division</b> <b>Street Lighting &amp; ITS Conduit Design Manual</b></p>	<p><b>SHEET NO.</b></p>
<p><b>REVISED</b></p>			<p align="center"><b>Signalized Intersection 1</b> <b>3 Lane Intersecting 3 Lane</b> <b>All Approaches with a TWLTL</b></p>



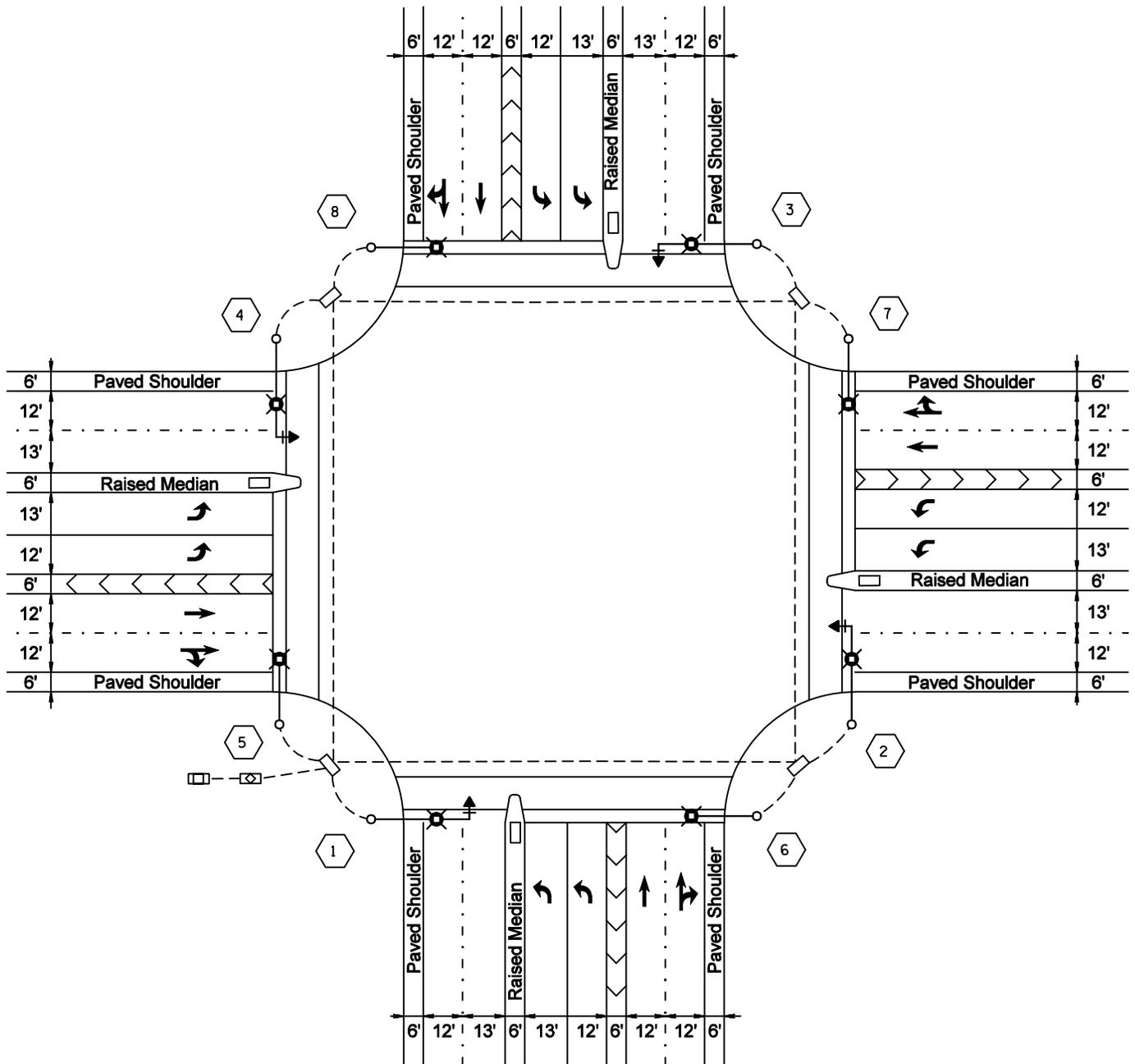
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1 & 3	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1
2 & 4	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2
5 & 6	Type G or Type 2	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2

**NOTES:**

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4. Pole locations for street light (only) poles to follow typical layout for traffic signal poles.
5. Type 2 street lighting poles to be used only when lighting on the arterial is present.

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<b>REVISED</b>			<b>Signalized Intersection 2</b> <b>4 Lane Divided Intersecting 3 Lane with a TWLTL</b>



**LAYOUTS**

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1 & 3	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1
2 & 4	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2
5 & 7	Type G or Type 2	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1
6 & 8	Type G or Type 2	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2

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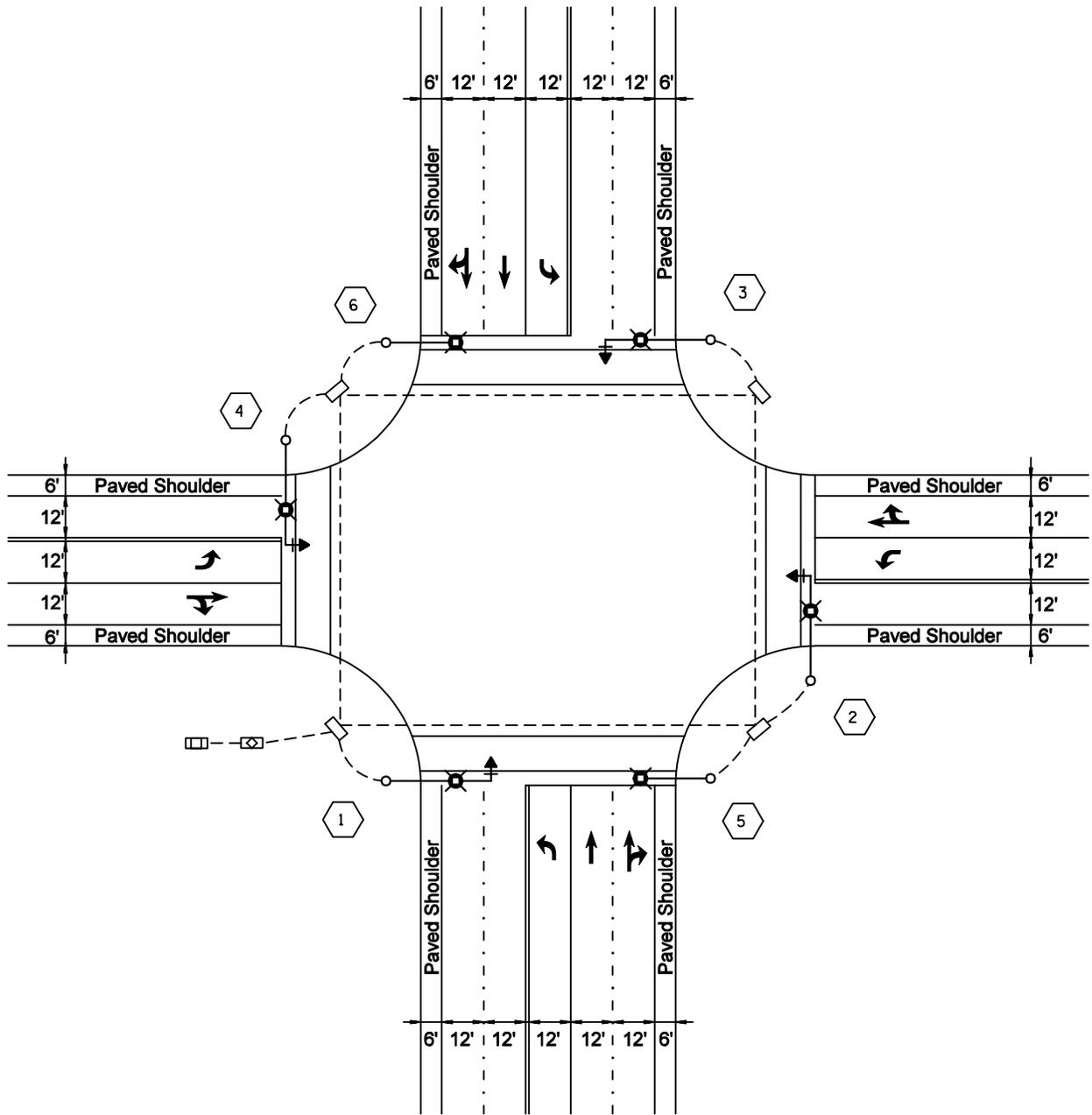
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**Signalized Intersection 3**  
**4 Lane Divided Intersecting 4 Lane Divided**  
**All Approaches with Dual Left Turn Lanes**

**SHEET NO.**  
  
**3-03**



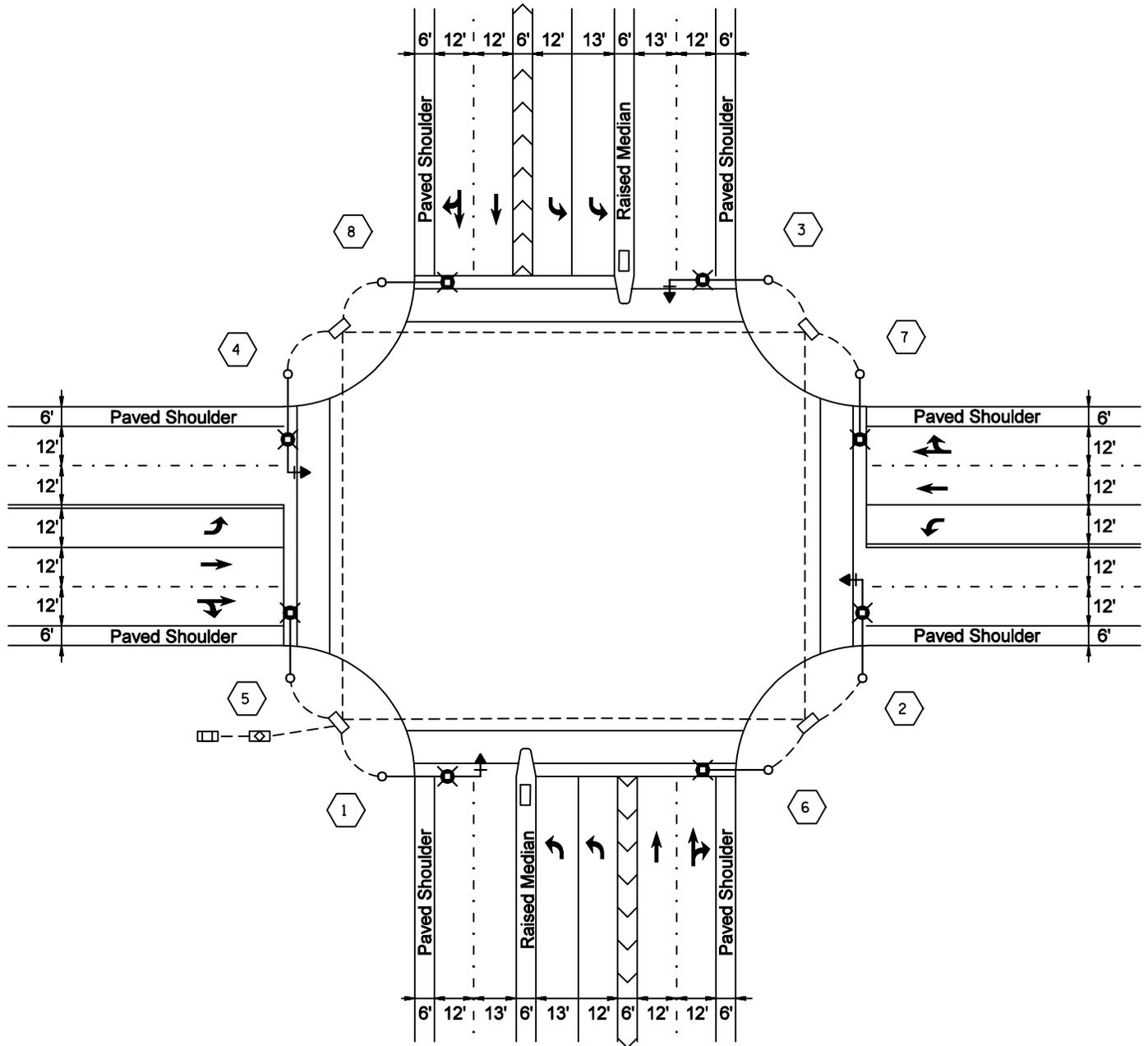
**LAYOUTS**

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1 & 3	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1
2 & 4	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2
5 & 6	Type G or Type 2	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2

**NOTES:**

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<b>REVISED</b>			<b>Signalized Intersection 4</b> <b>5 Lane Intersecting 3 Lane</b> <b>All Approaches with a TWLTL</b>



**LAYOUTS**

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1 & 3	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1
2 & 4	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2
5 & 7	Type G or Type 2	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1
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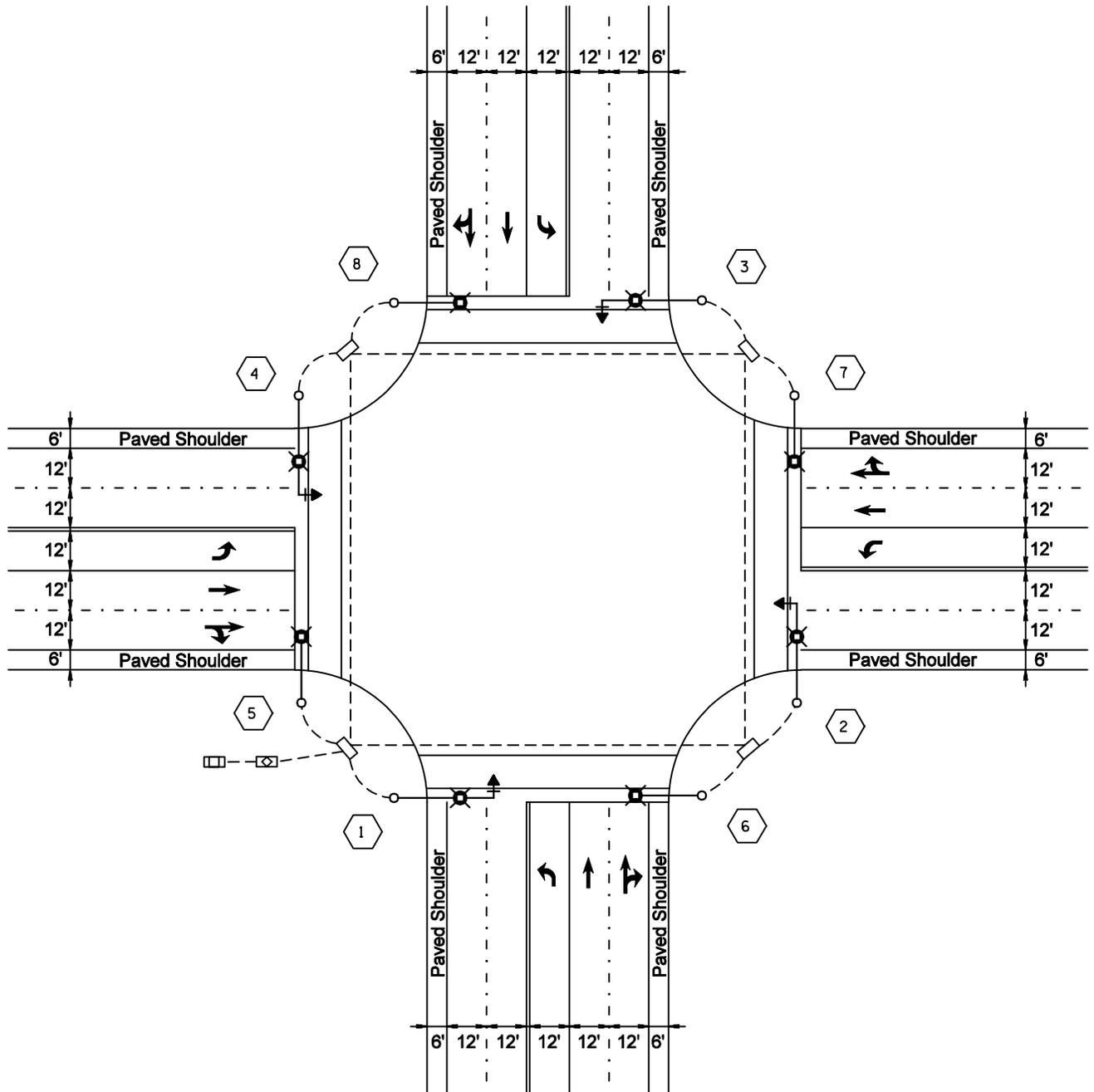
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**Street Lighting & ITS Conduit Design Manual**  
 Signalized Intersection 5  
 5 Lane with a TWLTL Intersecting  
 4 Lane Divided with Dual Left Turn Lanes

**SHEET NO.**

**3-05**



**LAYOUTS**

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1 & 3	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1
2 & 4	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2
5 & 7	Type G or Type 2	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1
6 & 8	Type G or Type 2	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2

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4. Pole locations for street light (only) poles to follow typical layout for traffic signal poles.
5. Type 2 street lighting poles to be used only when lighting on the arterial is present.

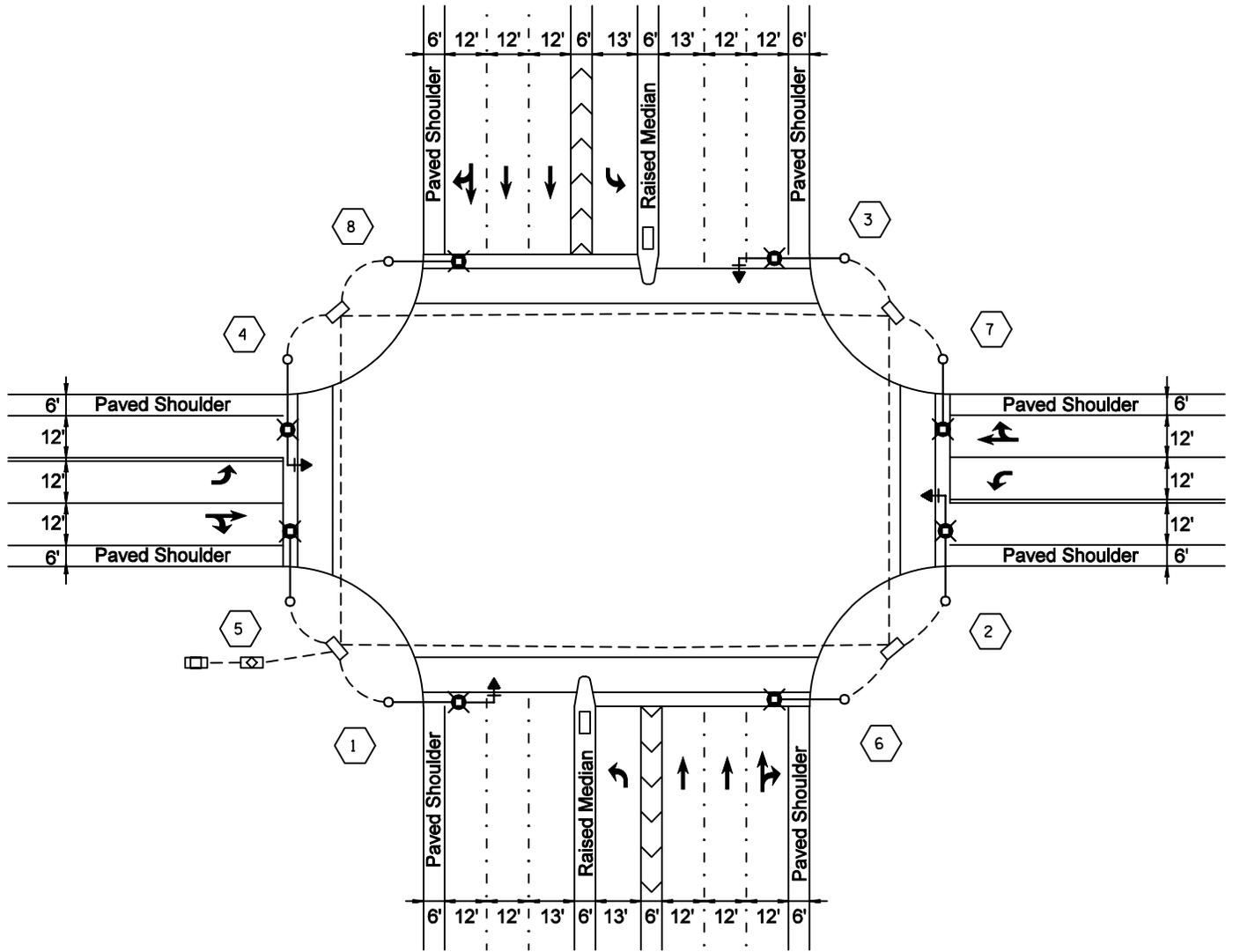
**ISSUED**  
August 2003

**REVISED**



**PCDOT Traffic Engineering Division**  
**Street Lighting & ITS Conduit Design Manual**  
 Signalized Intersection 6  
 5 Lane Intersecting 5 Lane  
 All Approaches with a TWLTL

**SHEET NO.**  
  
**3-06**



**LAYOUTS (When 3 Lane Roadway Has A Major Roadway Classification)**

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1 & 3	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1
2 & 4	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2
5 & 7	Type G or Type 2	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1
6 & 8	Type G or Type 2	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2

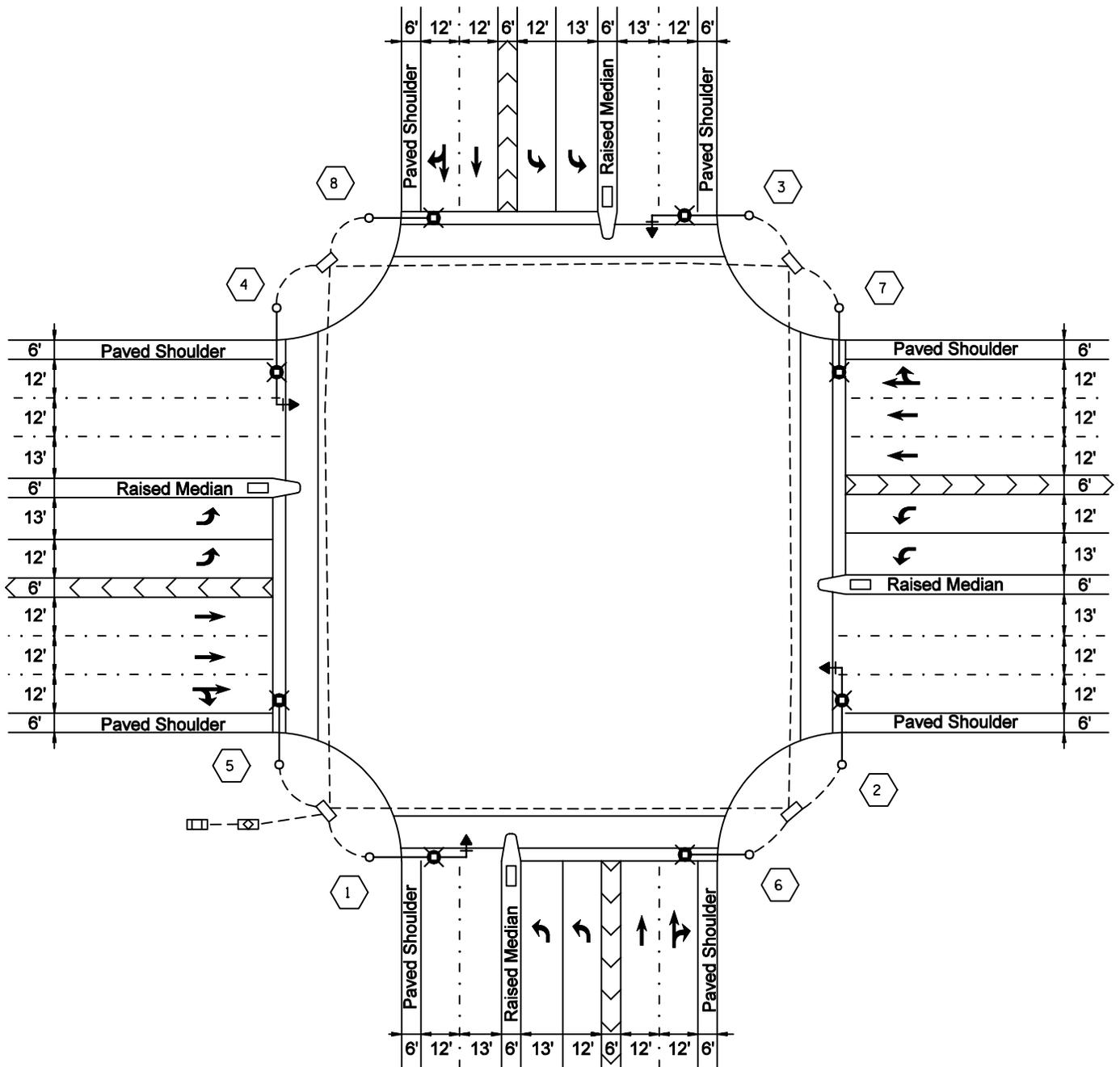
**LAYOUTS (When 3 Lane Roadway Has A Collector Roadway Classification)**

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1 & 3	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1
2 & 4	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2
5 & 7	Not Used				
6 & 8	Type G or Type 2	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2

**NOTES:**

1. Signal pole types to be determined using the PCDOT Traffic Signal Design Manual.
2. Poles, conduit and pull boxes are to be placed and circuited according to PCDOT Traffic Signal Design Manual.
3. Street lighting power to be provided through the traffic signal controller from a metered service pedestal.
4. Pole locations for street light (only) poles to follow typical layout for traffic signal poles.
5. Type 2 street lighting poles to be used only when lighting on the arterial is present.

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<b>REVISED</b>			<b>Signalized Intersection 7</b> <b>6 Lane Divided with Single Left Turn Lane</b> <b>Intersecting 3 Lane with a TWLTL</b>



**LAYOUTS**

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1 & 3	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1
2 & 4	Signal Pole	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2
5 & 7	Type G or Type 2	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1
6 & 8	Type G or Type 2	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2

**NOTES:**

1. Signal pole types to be determined using the PCDOT Traffic Signal Design Manual.
2. Poles, conduit and pull boxes are to be placed and circuited according to PCDOT Traffic Signal Design Manual.
3. Street lighting power to be provided through the traffic signal controller from a metered service pedestal.
4. Pole locations for street light (only) poles to follow typical layout for traffic signal poles.
5. Type 2 street lighting poles to be used only when lighting on the arterial is present.

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August 2003



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**Signalized Intersection 8**  
**6 Lane Divided Intersecting 4 Lane Divided**  
**All Approaches with Dual Left Turn Lanes**

**SHEET NO.**

**3-08**

# General Guidelines for Unsignalized Intersection Lighting Layouts

## General

1. All installations shall meet the National Electric Code requirements and conform to the most recent edition of the Pima County Outdoor Lighting Code.
2. Unsignalized intersection lighting layouts may be modified with approval from the Pima County DOT/TED Project Manager.

## Equipment

3. Street lighting poles at unsignalized intersections shall correspond to the layouts on sheets 4-01 through 4-06 of the PCDOT Street Lighting Manual. Pole setback locations can be adjusted  $\pm 2$  feet from the roadedge dimension to avoid any of the following conflicts. Adjustments greater than 2 feet require written approval by the Pima County DOT/TED Project Manager.
  - Right-of-Way restrictions
  - Utilities (underground or overhead)
  - Drainage structures
  - Buildings
  - Roadway alignments
  - Other miscellaneous structures and obstructions
4. The street lighting pole setback shall meet the clear zone requirements as discussed in the Pima County Roadway Design Guidelines.
5. Street lighting equipment, including but not limited to pole type, power source, conduit, conductors, pull boxes and control device, are to be determined and designed for each individual unsignalized intersection project.
6. Unsignalized intersection street lighting will utilize 20' mast arms at a 35' mounting height.
7. Luminaires placed at unsignalized intersections shall be 120 volt, with 250 or 400 watt High Pressure Sodium fixtures with Type III distribution and Full Cutoff lenses.

## Power

8. Luminaire conductors and circuiting shall be completed as shown in the PC/COT Standard Detail T.S. 1-7.
9. The street lighting photo electric cell shall be mounted on the luminaire of the pole closest to the metered service pedestal.

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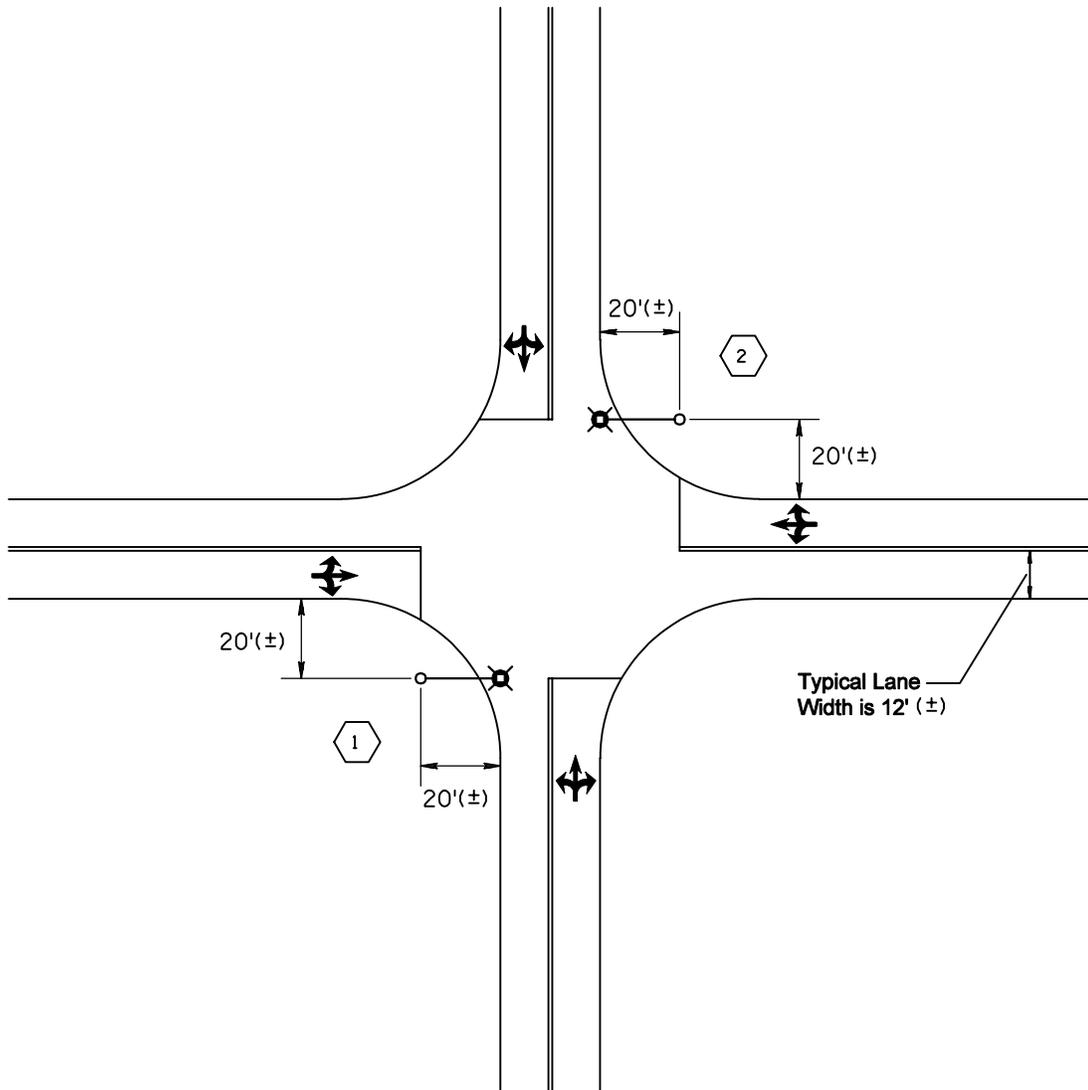


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**Street Lighting & ITS Conduit Design Manual**

**Unsignalized Intersection Lighting**  
**General Guidelines**

**SHEET NO.**

**4-00**



**LAYOUTS (When 2 Lane Roadway Has A Collector Roadway Classification)**

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1	To Be Determined	20'	35'	120 V, 250 W HPS, Type III Full Cutoff	1
2	To Be Determined	20'	35'	120 V, 250 W HPS, Type III Full Cutoff	2

**LAYOUTS (When 2 Lane Roadway Has A Local Roadway Classification)**

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1	To Be Determined	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1

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August 2003

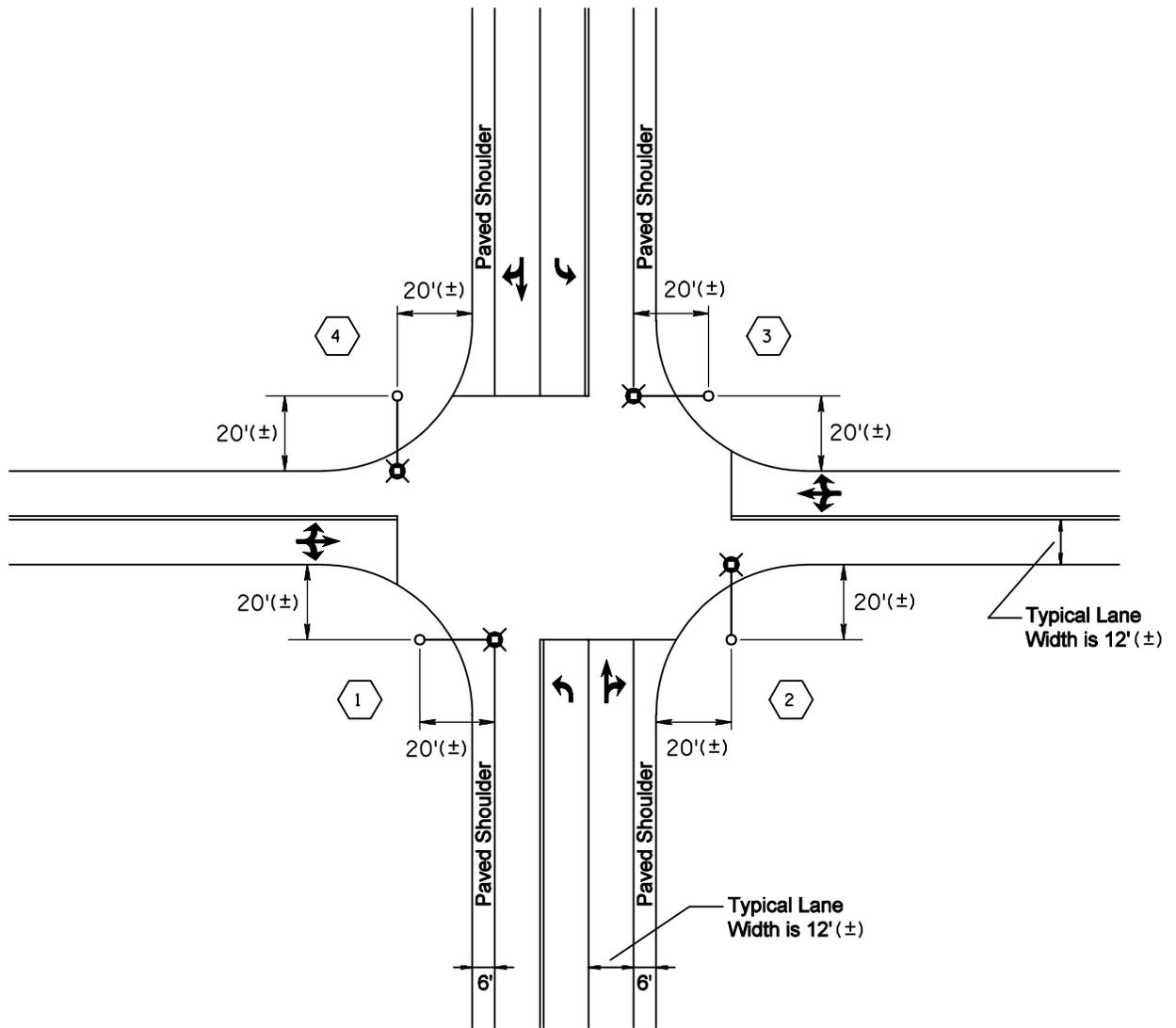


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**Street Lighting & ITS Conduit Design Manual**

**Unsignalized Intersection 1**  
**2 Lane Intersecting 2 Lane**

**SHEET NO.**

**4-01**



**LAYOUTS (When 3 Lane Roadway Has A Major Roadway Classification)**

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1 & 3	To Be Determined	20'	35'	120 V, 250 W HPS, Type III Full Cutoff	1
2 & 4	To Be Determined	20'	35'	120 V, 250 W HPS, Type III Full Cutoff	2

**LAYOUTS (When 3 Lane Roadway Has A Collector Roadway Classification)**

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1	To Be Determined	20'	35'	120 V, 250 W HPS, Type III Full Cutoff	1
3	To Be Determined	20'	35'	120 V, 250 W HPS, Type III Full Cutoff	2
2 & 4	Not Used				

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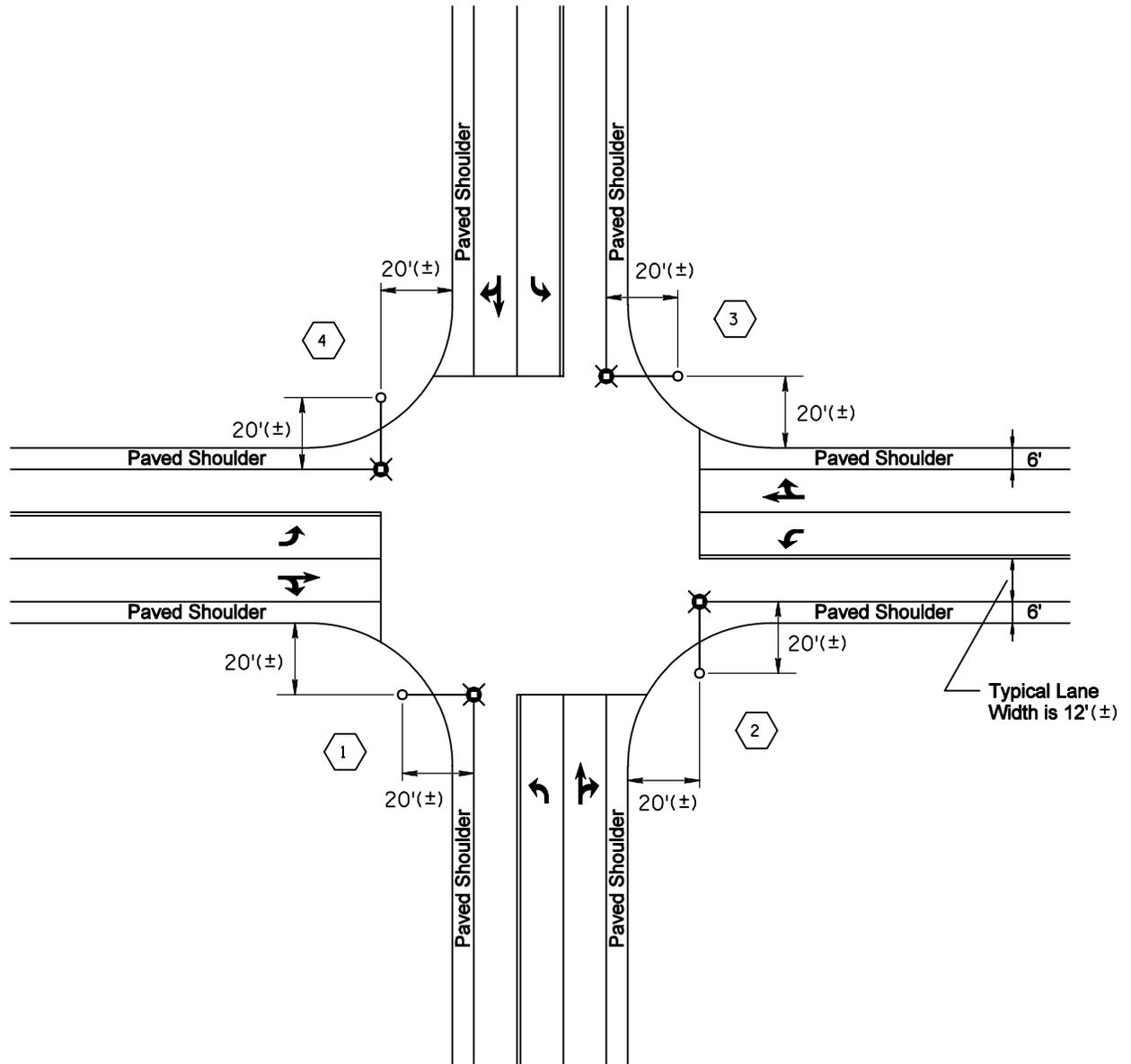
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**Unsignalized Intersection 2  
3 Lane with a TWLTL Intersecting 2 Lane**

**SHEET NO.**

**4-02**

REVISED



LAYOUTS

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1 & 3	To Be Determined	20'	35'	120 V, 250 W HPS, Type III Full Cutoff	1
2 & 4	To Be Determined	20'	35'	120 V, 250 W HPS, Type III Full Cutoff	2

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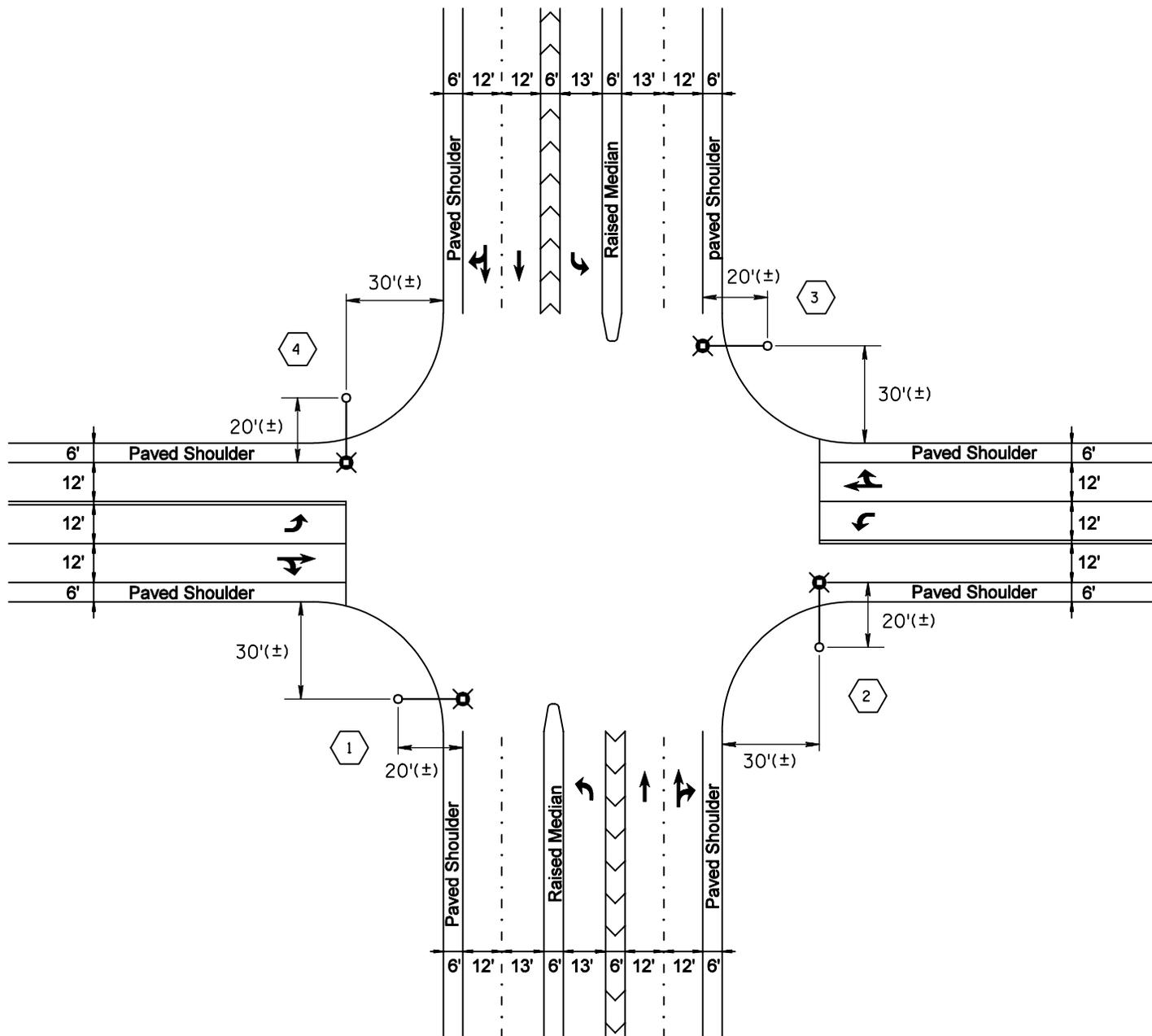
**PCDOT Traffic Engineering Division**  
**Street Lighting & ITS Conduit Design Manual**

**Unsignalized Intersection 3**  
**3 Lane Intersecting 3 Lane**  
**All Approaches with TWLTL**

SHEET NO.

**4-03**

REVISED



**LAYOUTS**

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1 & 3	To Be Determined	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1
2 & 4	To Be Determined	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2

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August 2003

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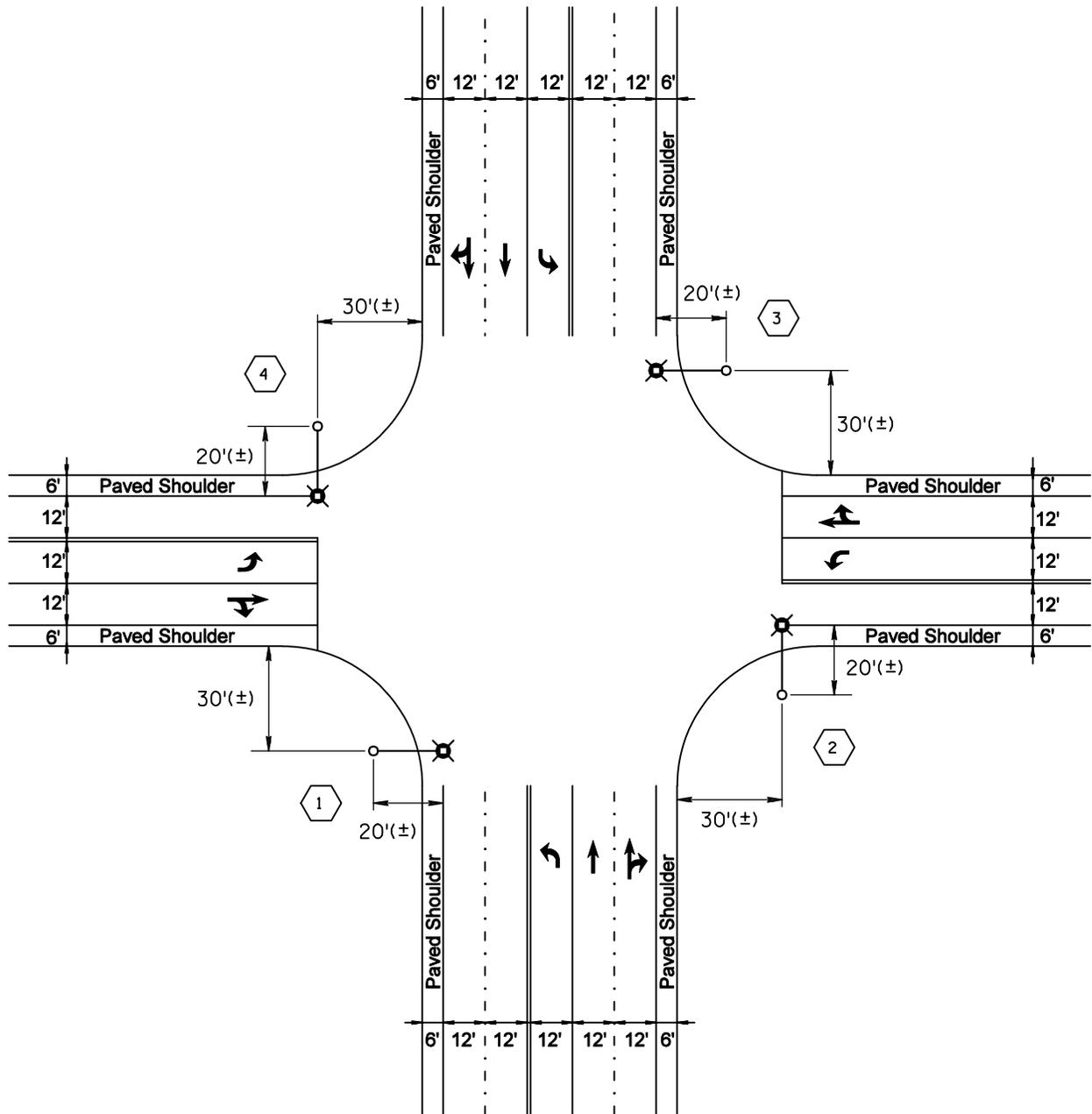


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**Unsignalized Intersection 4**  
**4 Lane Divided with Single Left Turn Lane**  
**Intersecting 3 Lane with a TWLTL**

**SHEET NO.**

**4-04**



LAYOUTS

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1 & 3	To Be Determined	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1
2 & 4	To Be Determined	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2

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August 2003



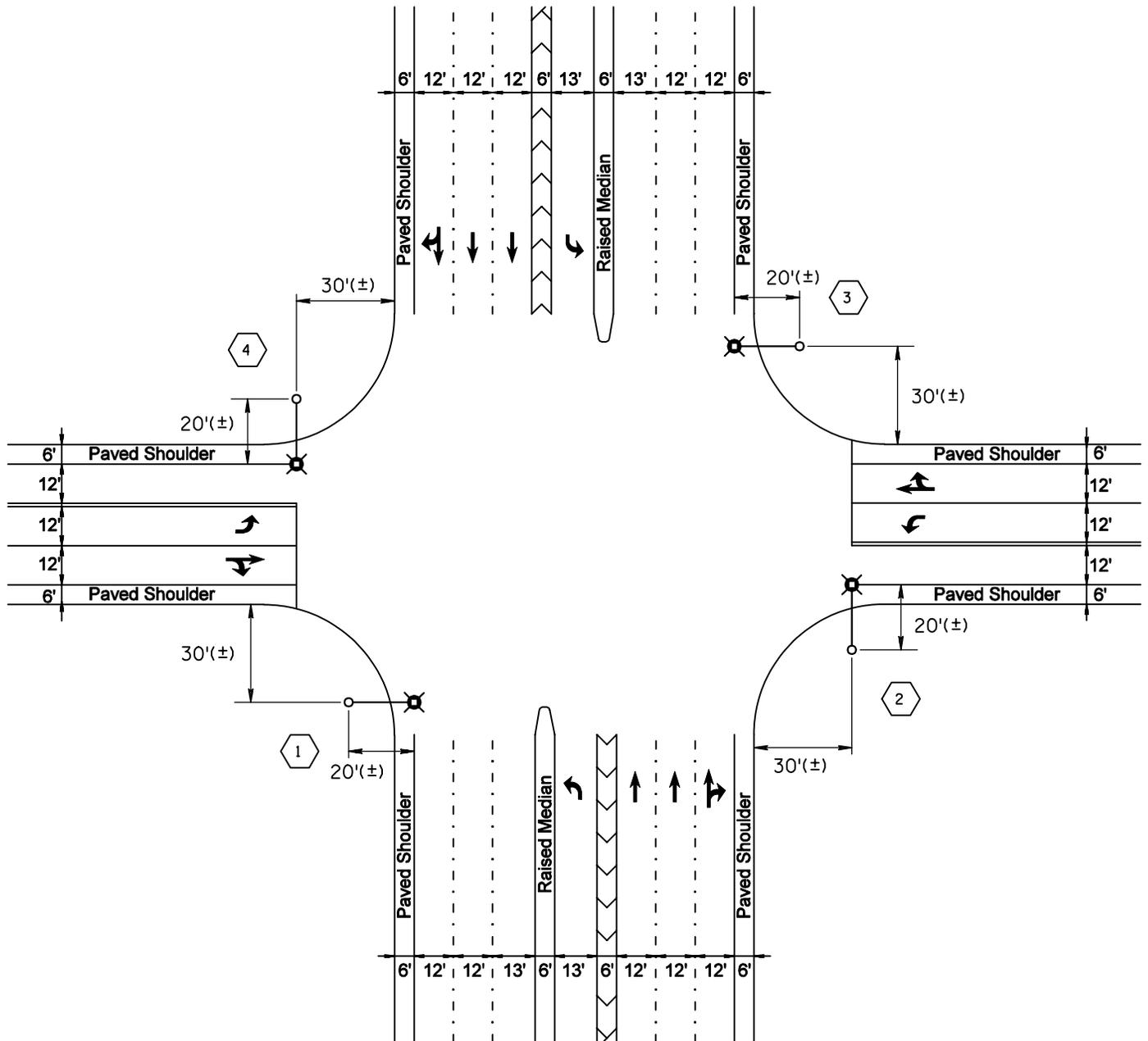
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**Unsignalized Intersection 5**  
**5 Lane Intersecting 3 Lane**  
**All Approaches with a TWLTL**

SHEET NO.

**4-05**



LAYOUTS

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1 & 3	To Be Determined	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	1
2 & 4	To Be Determined	20'	35'	120 V, 400 W HPS, Type III Full Cutoff	2

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**Unsignalized Intersection 6**  
**6 Lane Divided with Single Left Turn Lane**  
**Intersecting 3 Lane with a TWLTL**

SHEET NO.

**4-06**

# General Guidelines for Mid-Block Pedestrian Crossing Lighting Layouts

## General

1. All installations shall meet the National Electric Code requirements and conform to the most recent edition of the Pima County Outdoor Lighting Code.
2. Mid-block pedestrian crossing street lighting layouts may be modified with approval from the Pima County DOT/TED Project Manager.

## Equipment

3. Street lighting poles at mid-block pedestrian crossings shall correspond to the layouts on sheets 5-01 through 5-06 of the PCDOT Street Lighting Manual. Pole setback locations can be adjusted  $\pm 2$  feet from the setback dimension to avoid any of the following conflicts. Adjustments greater than 2 feet require written approval by the Pima County DOT/TED Project Manager.
  - Right-of-Way restrictions
  - Utilities (underground or overhead)
  - Drainage structures
  - Buildings
  - Roadway alignments
  - Landscaping features
  - Other miscellaneous structures and obstructions
4. The street lighting pole setback shall meet the clear zone requirements as discussed in the Pima County Roadway Design Guidelines.
5. Street lighting equipment, including but not limited to pole type, power source, conduit, conductors, pull boxes and control device, are to be determined and designed for each individual mid-block pedestrian crossing project.
6. Mid-block pedestrian crossing lighting will utilize 20' mast arms at a 35' or 40' mounting height.
7. Luminaires placed at mid-block pedestrian crossings shall be 120 volt, with 250 or 400 watt High Pressure Sodium fixtures with Type III distribution and Full Cutoff lenses.

## Power

8. Luminaire conductors and circuiting shall be completed as shown in the PC/COT Standard Detail T.S. 1-7.
9. The street lighting photo electric cell shall be mounted on the luminaire of the pole closest to the metered service pedestal.

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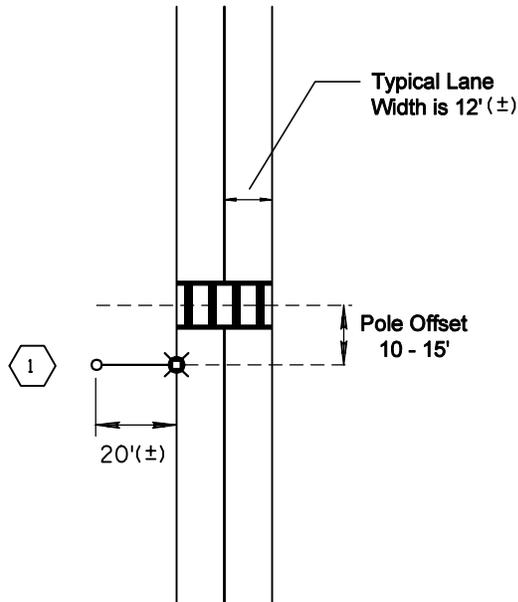


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**Mid-Block Pedestrian Crossing Lighting**  
**General Guidelines**

**SHEET NO.**

**5-00**



**LAYOUTS (For All Non-Continuously Lighted Roadways & Continuously Lighted Collector Roadways)**

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1	To Be Determined	20'	35'	120 V, 250 W HPS, Type III Full Cutoff	1

NOTE 1: Use a 400 W HPS luminaire for Continuously Lighted Major Roadways.

NOTE 2: This configuration can be used for a roadway width less than 37 feet.  
Two lane roadways with a width of 37 feet or greater should use  
Mid-Block Pedestrian Crossing 2 on Sheet No. 5-02.

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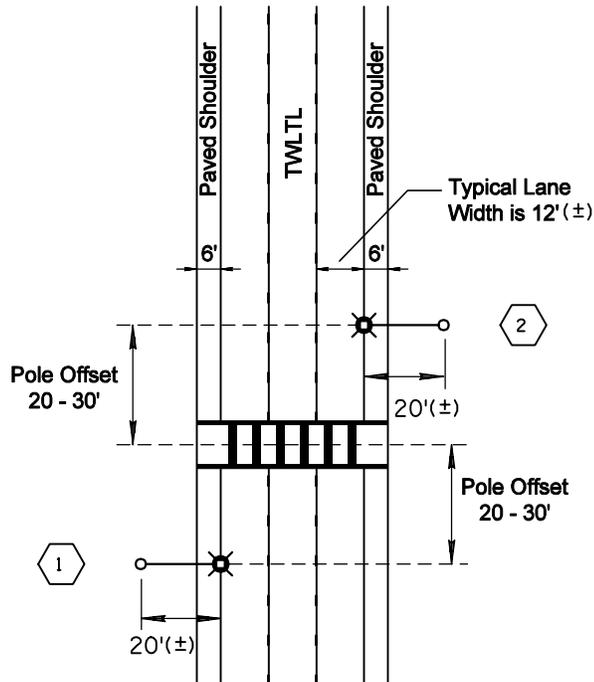
**PCDOT Traffic Engineering Division**  
**Street Lighting & ITS Conduit Design Manual**

**Mid-block Pedestrian Crossing 1**  
**2 Lane Road**

**SHEET NO.**

**5-01**

REVISED



**LAYOUTS (For All Non-Continuously Lighted Roadways & Continuously Lighted Collector Roadways)**

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1	To Be Determined	20'	35'	120 V, 250 W HPS, Type III Full Cutoff	1
2	To Be Determined	20'	35'	120 V, 250 W HPS, Type III Full Cutoff	2

**NOTE 1:** Use 400 W HPS luminaires for Continuously Lighted Major Roadways.

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August 2003



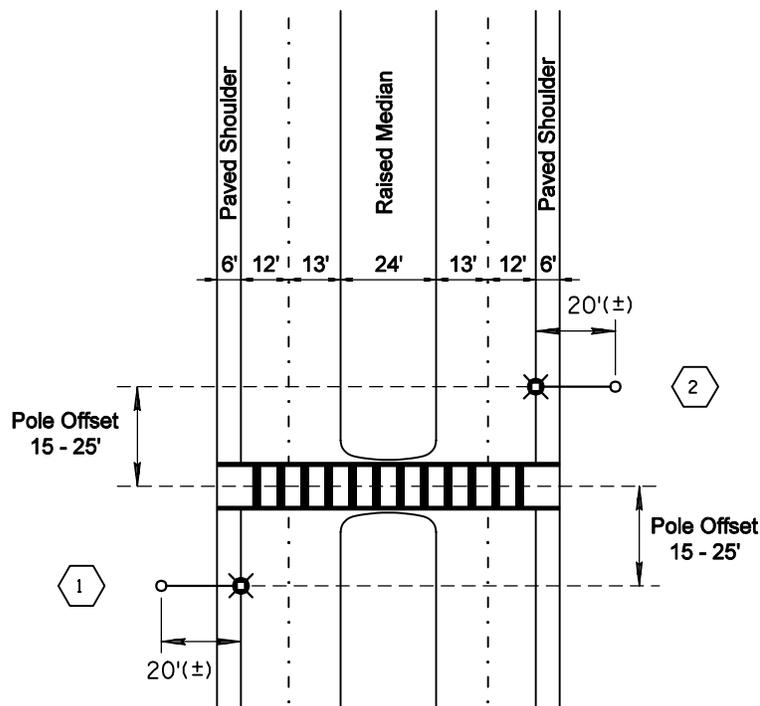
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**Street Lighting & ITS Conduit Design Manual**

**Mid-block Pedestrian Crossing 2**  
**3 Lane Road with a TWLTL**

**SHEET NO.**

**5-02**



LAYOUTS (For Non-Continuously Lighted Roadways)

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1	To Be Determined	20'	40'	120 V, 250 W HPS, Type III Full Cutoff	1
2	To Be Determined	20'	40'	120 V, 250 W HPS, Type III Full Cutoff	2

NOTE 1: Use 400 W HPS luminaires for Continuously Lighted Roadways.

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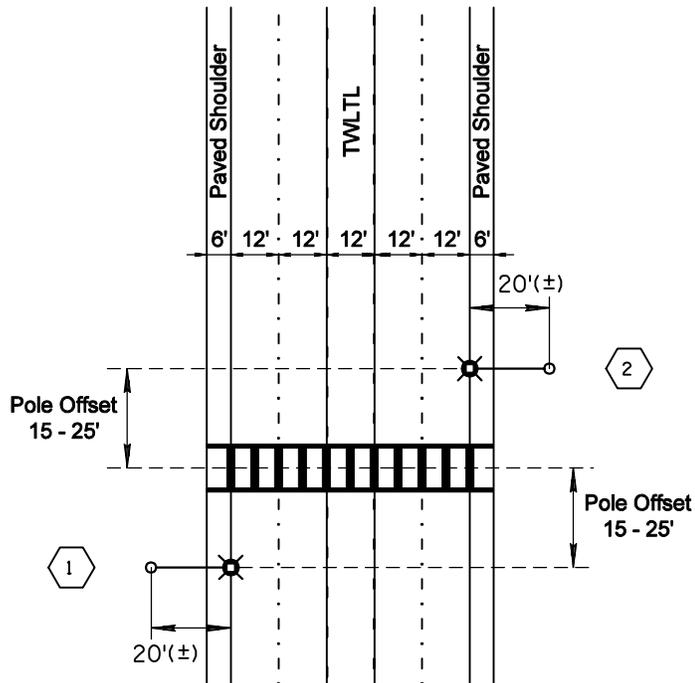
PCDOT Traffic Engineering Division  
Street Lighting & ITS Conduit Design Manual

Mid-block Pedestrian Crossing 3  
4 Lane Road Divided with Median

SHEET NO.

5-03

REVISED



LAYOUTS (For Non-Continuously Lighted Roadways)

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1	To Be Determined	20'	40'	120 V, 250 W HPS, Type III Full Cutoff	1
2	To Be Determined	20'	40'	120 V, 250 W HPS, Type III Full Cutoff	2

NOTE 1: Use 400 W HPS luminaires for Continuously Lighted Roadways.

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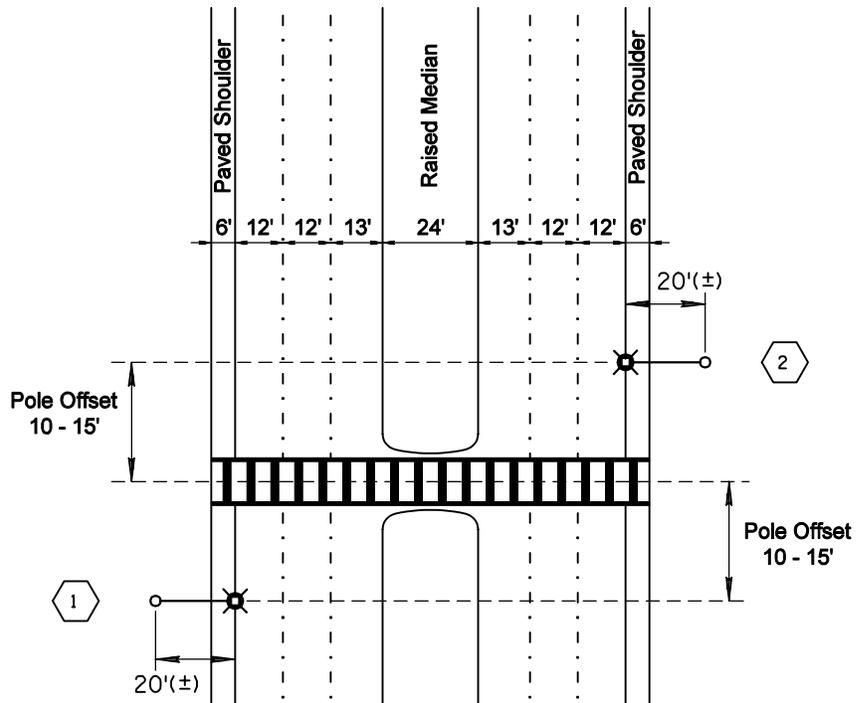
PCDOT Traffic Engineering Division  
Street Lighting & ITS Conduit Design Manual

Mid-block Pedestrian Crossing 4  
5 Lane Road with a TWLTL

SHEET NO.

5-04

REVISED



LAYOUTS (For Non-Continuously Lighted Roadways)

POLE #	POLE TYPE	MAST ARM	MOUNTING HEIGHT	LUMINAIRE	CIRCUIT
1	To Be Determined	20'	40'	120 V, 250 W HPS, Type III Full Cutoff	1
2	To Be Determined	20'	40'	120 V, 250 W HPS, Type III Full Cutoff	2

NOTE 1: Use 400 W HPS luminaires for Continuously Lighted Roadways.

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Street Lighting & ITS Conduit Design Manual

Mid-block Pedestrian Crossing 5  
6 Lane Road Divided with Median

SHEET NO.

5-05

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# General Guidelines for Roadway Lighting Layouts

## General

1. All installations shall meet the National Electric Code requirements and conform to the most recent edition of the Pima County Outdoor Lighting Code.
2. Roadway street lighting layouts may be modified with approval from the Pima County DOT/TED Project Manager.

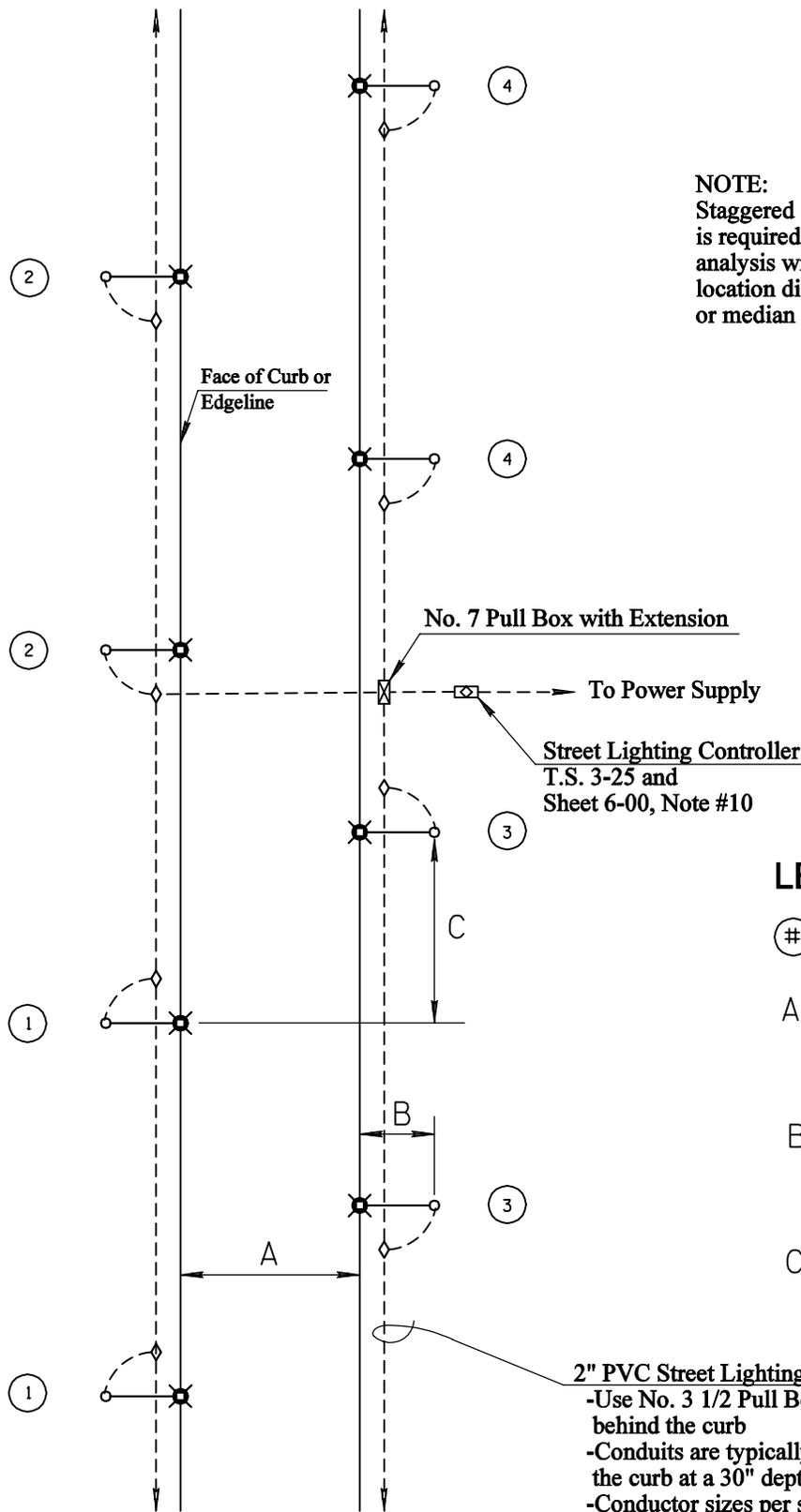
## Equipment

3. Street lighting equipment placement and pole spacing shall correspond to the typical layout shown on sheet 6-01 of the PCDOT Street Lighting Manual. Pole setback locations can be adjusted  $\pm 2$  feet from the setback dimension to avoid any of the following conflicts. Adjustments greater than 2 feet require written approval by the Pima County DOT/TED Project Manager.
  - Right-of-Way restrictions
  - Utilities (underground or overhead)
  - Drainage structures
  - Buildings
  - Roadway alignments
  - Landscaping features
  - Other miscellaneous structures and obstructions
4. The street lighting pole setback shall meet the clear zone requirements as discussed in the Pima County Roadway Design Guidelines.
5. Roadway street lighting will utilize 20' mast arms at a 35' or 40' mounting height.
6. Luminaires with roadway lighting shall be 480 volt, with 250 or 400 watt High Pressure Sodium fixtures with Type III distribution and Full Cutoff lenses.
7. The street lighting controller shall be placed in the vicinity of the power supply source from Tucson Electric Power.

## Power

8. Luminaire conductors and circuiting shall be completed as shown in the PC/COT Standard Details T.S. 1-7 and T.S. 3-25. The use of a 120, 240 or 480 volt system will be determined by the most convenient available source from Tucson Electric Power. The use of a step up transformer is required should 480 volt power not be available.
9. The street lighting photo electric cell shall be mounted on the luminaire of the pole closest to the street lighting controller.
10. The preferred location of the street lighting controller is in the middle of the street lighting system as shown on sheet 6-01. If this is not possible, the poles shall be circuited so that as close to an equal load as possible is placed on each of the four street lighting circuits so that no more than 2/3 of the number of poles on one side of the street are placed on one circuit. This may require additional conductors in a single conduit. Conductor size shall follow the requirements on sheet 6-03.

ISSUED August 2003		<b>PCDOT Traffic Engineering Division</b> <b>Street Lighting &amp; ITS Conduit Design Manual</b>	<b>SHEET NO.</b>
REVISED		<b>Roadway Street Lighting</b> <b>General Guidelines</b>	<b>6-00</b>



**NOTE:**  
 Staggered street lighting configuration is required. A project specific lighting analysis will need to be performed if the location dictates the need for a single-sided or median lighting configuration.

**LEGEND**

- ① Street Lighting Circuit Number Per PC/COT Std. Dtl. T.S. 3-25
- A Roadway Width:  
 -Varies from 2 lane roadway to a 6 lane divided roadway with a median
- B Pole Setback:  
 - 20' Typical With Out Curb  
 10' Typical With Curb  
 See Notes on Sheet 6-00
- C Pole Spacing:  
 -Varies Per Table on Sheet 6-02

**2" PVC Street Lighting Conduit**  
 -Use No. 3 1/2 Pull Boxes typically placed behind the curb  
 -Conduits are typically placed behind the curb at a 30" depth  
 -Conductor sizes per sheet 6-03

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 Street Lighting & ITS Conduit Design Manual**

**SHEET NO.**

REVISED

**Roadway Lighting with Typical Staggered Pole Arrangement**

**6-01**

**USE OF TABLES**

1. Determine the roadway classification as either major or collector for the roadway to be lighted.
2. Determine the type (width) of the roadway to be lighted.
3. Use the tables below to determine the street lighting system wattage, mounting height and pole spacing based on roadway type and classification.
4. Refer to Sheet 6-03 for conductor size requirements.

**STAGGERED ROADWAY LIGHTING LAYOUTS FOR COLLECTOR ROADWAYS**

DESCRIPTION	ROADWAY WIDTH (TYP.)	LAMP	MOUNTING HEIGHT	TYP POLE SETBACK (1)	POLE SPACING (2)
2 Lane Roadway	24'	250 W	35'	20' w/o Curb/ 10' w/ Curb	110' - 120'
3 Lane Roadway with a TWLTL	48'	250 W	35'	20' w/o Curb/ 10' w/ Curb	95' - 104'
4 Lane Roadway	60'	400 W	35'	20' w/o Curb/ 10' w/ Curb	150' - 161'
4 Lane Divided Roadway	86'	400 W	40'	20' w/o Curb/ 10' w/ Curb	100' - 110'
5 Lane Roadway with a TWLTL	72'	400 W	40'	20' w/o Curb/ 10' w/ Curb	130' - 139'
6 Lane Divided Roadway	110'	400 W	40'	20' w/o Curb/ 10' w/ Curb	90' - 100'

**STAGGERED ROADWAY LIGHTING LAYOUTS FOR MAJOR ROADWAYS**

DESCRIPTION	ROADWAY WIDTH (TYP.)	LAMP	MOUNTING HEIGHT	TYP POLE SETBACK (1)	POLE SPACING (2)
2 Lane Roadway	24'	400 W	35'	20' w/o Curb/ 10' w/ Curb	145' - 155'
3 Lane Roadway with a TWLTL	48'	400 W	35'	20' w/o Curb/ 10' w/ Curb	120' - 132'
4 Lane Roadway	60'	400 W	35'	20' w/o Curb/ 10' w/ Curb	110' - 121'
4 Lane Divided Roadway	86'	400 W	40'	20' w/o Curb/ 10' w/ Curb	75' - 85'
5 Lane Roadway with a TWLTL	72'	400 W	40'	20' w/o Curb/ 10' w/ Curb	85' - 96'
6 Lane Divided Roadway	110'	400 W	40'	20' w/o Curb/ 10' w/ Curb	60' - 70'

**NOTES:**

- (1) Preferred pole setback distance may be adjusted  $\pm 2$  feet to conform to project or individual pole site conditions. Adjustments greater than 2 feet require written approval of the Pima County DOT/TED Project Manager.
- (2) Lighting layouts are expected to have a consistent, uniform pole spacing per project within these spacing ranges. Pole spacing outside these ranges require written approval of the Pima County DOT/TED Project Manager.

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August 2003



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**Street Lighting & ITS Conduit Design Manual**

**SHEET NO.**

**REVISED**

**Staggered Roadway Lighting Layouts**

**6-02**

**USE OF TABLES**

1. Layout the street lighting system per tables on sheet 6-02.
2. Calculate the average pole spacing on the designed street lighting system.
3. Use the tables below to determine the conductor size required based on the number of poles per circuit and the average pole spacing.

**MINIMUM CONDUCTOR SIZES FOR 250 W LUMINAIRE  
AVERAGE POLE SPACING (STAGGERED)**

<b>NUMBER OF POLES PER CIRCUIT</b>		<b>91' - 100'</b>	<b>101' - 110'</b>	<b>111' - 120'</b>	<b>121' - 130'</b>	<b>131' - 140'</b>
	<b>19**</b>	<b>#6</b>	*	*	*	*
	<b>18</b>	<b>#6</b>	*	*	*	*
	<b>17</b>	<b>#6</b>	<b>#6</b>	*	*	*
	<b>16</b>	<b>#6</b>	<b>#6</b>	*	*	*
	<b>15</b>	<b>#8</b>	<b>#6</b>	<b>#6</b>	*	*
	<b>14</b>	<b>#8</b>	<b>#8</b>	<b>#6</b>	<b>#6</b>	*
	<b>13</b>	<b>#8</b>	<b>#8</b>	<b>#8</b>	<b>#6</b>	<b>#6</b>
	<b>12</b>	<b>#10</b>	<b>#8</b>	<b>#8</b>	<b>#8</b>	<b>#6</b>
	<b>11</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#8</b>	<b>#8</b>
	<b>10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>
	<b>9</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>
	<b>8</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>
	<b>7</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>
<b>6</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	

\* See Roadway General Notes Sheet 6-00, Note #10.

\*\* A project specific design will need to be completed for lighting systems with more than 19 poles per circuit.

**MINIMUM CONDUCTOR SIZES FOR 400 W LUMINAIRE  
AVERAGE POLE SPACING (STAGGERED)**

<b>NUMBER OF POLES PER CIRCUIT</b>		<b>61'-70'</b>	<b>71'-80'</b>	<b>81'-90'</b>	<b>91'-100'</b>	<b>101'-110'</b>	<b>111'-120'</b>	<b>121'-130'</b>	<b>131'-140'</b>	<b>141'-150'</b>	<b>151'-160'</b>
	<b>19**</b>	<b>#6</b>	<b>#4</b>	<b>#4</b>	<b>#4</b>	*	*	*	*	*	*
	<b>18</b>	<b>#6</b>	<b>#4</b>	<b>#4</b>	<b>#4</b>	*	*	*	*	*	*
	<b>17</b>	<b>#6</b>	<b>#4</b>	<b>#4</b>	<b>#4</b>	<b>#4</b>	*	*	*	*	*
	<b>16</b>	<b>#6</b>	<b>#6</b>	<b>#4</b>	<b>#4</b>	<b>#4</b>	*	*	*	*	*
	<b>15</b>	<b>#8</b>	<b>#6</b>	<b>#6</b>	<b>#4</b>	<b>#4</b>	<b>#4</b>	*	*	*	*
	<b>14</b>	<b>#8</b>	<b>#6</b>	<b>#6</b>	<b>#6</b>	<b>#6</b>	<b>#4</b>	<b>#4</b>	*	*	*
	<b>13</b>	<b>#8</b>	<b>#8</b>	<b>#6</b>	<b>#6</b>	<b>#6</b>	<b>#6</b>	<b>#4</b>	<b>#4</b>	*	*
	<b>12</b>	<b>#10</b>	<b>#8</b>	<b>#8</b>	<b>#6</b>	<b>#6</b>	<b>#6</b>	<b>#6</b>	<b>#6</b>	<b>#4</b>	<b>#4</b>
	<b>11</b>	<b>#10</b>	<b>#8</b>	<b>#8</b>	<b>#8</b>	<b>#8</b>	<b>#6</b>	<b>#6</b>	<b>#6</b>	<b>#6</b>	<b>#6</b>
	<b>10</b>	<b>#10</b>	<b>#10</b>	<b>#8</b>	<b>#8</b>	<b>#8</b>	<b>#8</b>	<b>#8</b>	<b>#6</b>	<b>#6</b>	<b>#6</b>
	<b>9</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#8</b>	<b>#8</b>	<b>#8</b>	<b>#8</b>	<b>#8</b>	<b>#6</b>
	<b>8</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#8</b>	<b>#8</b>	<b>#8</b>
	<b>7</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>
<b>6</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	<b>#10</b>	

\* See Roadway General Notes Sheet 6-00, Note #10.

\*\* A project specific design will need to be completed for lighting systems with more than 19 poles per circuit.

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## ITS CONDUIT DESIGN GUIDELINES

1. The Pima County ITS Conduit Design Guidelines and associated Special Provisions are based upon the City of Tucson Department of Operations Technical Planning and Resources Division Section 975 - Telecommunications Infrastructure recommendations.
2. The intent of the ITS conduit design is for future fiber optic use throughout Pima County.
3. A set of special provisions (Section 975 – Telecommunications Infrastructure) is provided on sheet 7-01 and includes all of the requirements for equipment and construction of the ITS conduit system. Additional standard details are included on sheets 7-02 through 7-04.
4. The provided special provisions include design requirements for a 4” PVC ITS conduit system that is innerduct ready as well as a 4” PVC with 4-1” innerduct ITS conduit system that is cable ready. The decision as to which system is used will be made on a per project basis.
5. The ITS conduit system can contain PVC field bends with minimum radii of 50 feet or greater and 30 degrees or less. Factory bends can be used for smaller radii when necessary. Factory bends must be manufactured out of PVC or rigid steel conduit per the special provisions provided.
6. The general ITS conduit system layout requires pull boxes or vaults to be placed a maximum of 600’ apart. The completed 4” conduit system will be required to run a 3 ¾” mandrel.

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**ITS Conduit Design**  
**Design Guidelines**

## Section 975 - Telecommunications Infrastructure

### 975-1 DESCRIPTION

The work covered under this section shall consist of a Complete-in-Place installation, furnishing all material, labor and equipment, and installing conduit, pull boxes, vaults, and tracer wires for an underground fiber optic conduit system, including excavation, backfilling, compacting, jacking, and boring in accordance with the details.

### 975-2 MATERIALS

**975-2.01 Polyvinyl Chloride (PVC) Conduit.** All conduit shall be listed by Underwriters Laboratory (UL) and conform to NEC standards. Unless otherwise specified, all conduits to be installed underground or installed in concrete structures shall be 4-inch diameter, rigid Polyvinyl Chloride (PVC) Non-Metallic Conduit. The PVC conduit shall be schedule 40, heavy wall, sunlight resistant, manufactured from high impact material and shall be rated for use at 90 degrees centigrade. The conduit shall meet the specifications of UL 651 and NEMA TC-2, and furnished with interface fit bell ends. Fittings shall be schedule 40 PVC, meeting the specifications of NEMA TC-3 and UL 514. PVC bends of 30 degrees or greater may be used when necessary. Field bends should not have a radius of less than 50 feet. Factory bends shall have a radius of not less than 12 times the nominal diameter of the conduit.

**975-2.02 Conduit with Integral Innerduct.** Conduit with Integral Innerduct shall be of schedule 40 PVC in modular, slip fit lengths. Shall have pre-lubricated innerducts with internal spacers and which expand and contract at the same rate as the outerduct. Conduits shall have anti-reversing gaskets and an o-ring gasket at bell base. Shall have inward tapering holes on coupling body for easy assignment, printed indication such as "Install Print Side Up" to keep system straight during installation, and marked innerduct and marked hole on coupling body to insure proper innerduct alignment and allow crews to work from opposite directions. Bends shall be flexible and engineered to be cut-through resistant. Innerducts shall be Carlon Telecom Systems Multi-Gard brand or equivalent. All integral innerducts shall have a continuous non-spliced, unknotted detectable 1250 pound test mule tape installed.

**975-2.03 Solvent Cement for Polyvinyl Chloride (PVC) Conduit and Couplings.** All solvent cement shall meet the requirements of ASTM D 2564. The cement shall be of medium or heavy bodied cement capable of making watertight joints. The cement and primer shall be of a type recommended by the manufacturer of the conduit.

**975-2.04 Rigid Steel Conduit Bends.** Conduit bends shall be listed by UL and conform to NEC standards. The bends shall be steel, hot dipped zinc coated, meeting the requirements of UL 6 and ANSI C80.1, and shall carry the UL label. Non-thread couplings shall not be used. Bends shall have a minimum radius of 12 times the nominal

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diameter of the conduit. Steel conduit bends shall have a factory applied 40 mil PVC coating or be doubled (half overlap) wrapped with a 10 mil PVC plastic tape specifically manufactured for corrosion protection of metallic conduits installed below grade. For PVC conduit bends see section 975-2.01.

**975-2.05 Flexible Conduit.** When specifically indicated on the plans and where approved by the engineer, flexible solid wall direct bury conduit may be used. The conduit shall be manufactured of Polyvinyl Chloride (PVC), or Polyethylene (PE) plastic. The conduit shall be specifically manufactured for direct buried fiber optic raceway systems and shall be Carlon “Optic-Gard PE” conduit, or approved equal. Flexible conduit shall not be utilized for making bends in conduit system. Connection between the flexible conduit and conduits of other materials shall be made with a watertight transition coupling manufactured for the specific type of material.

**975-2.06 Plastic Conduit Spacers.** Spacers shall be constructed of Polyvinyl Chloride (PVC) or other non-metallic material. The spacers shall be vertical and horizontal interlocking and provide a minimum of 3-inch clearance between conduits. Base spacers shall be provided with a wide base plate to provide solid support on the bottom of the trench. The base spacers shall provide for a minimum clearance of 3 inches between the bottom of the trench and the conduit.

**975-2.07 Aggregate Bedding Material.** Aggregate material for bedding material shall meet the gradation indicated in the specifications and on the drawings for the subject project. The plasticity index shall also conform to the specifications under which the subject project is designed and constructed.

**975-2.08 Not Used**

**975-2.09 Detectable Warning Tape.** On open trenching an electronically detectable 6” Fiber Warning tape shall be installed 18” above the conduit. Tape shall be acid and alkali-resistant polyethylene film, with a minimum thickness of 0.004 inch. The tape shall have a minimum strength of 7500 PSI lengthwise and 1,500 PSI crosswise. The tape shall be manufactured with integral wires, foil backing, or other means to enable its detection by a metal detector when the tape is buried up to a depth of 3 feet deep. The tape shall be orange in color and have the following continuous inscription, “CAUTION - FIBER OPTIC CABLE BURIED BELOW”. The inscription shall be 2 inch black letters.

**975-2.10 Backfill Material.** The backfill material shall be designed and constructed using the plans and specifications of the subject project.

**975-2.11 Tracer Conductor.** The cable and conductor shall be listed by UL and conform to NEC standards. The conductor shall be a continuous unspliced stranded CU 6AWG, rated for 600 volts, and shall have THW or XHHW insulation. The color of the

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insulation shall be green. The conductors shall be of the required length to eliminate all splices within the conduit.

**975-2.12 Pull Boxes.** Communications pull boxes shall be UL listed. All pull boxes shall have an etched polyethylene face, anchored in concrete, with an ultraviolet inhibitor and be of a neutral color. Unless specified otherwise, pull box lids shall be of ‘fiberlight’ material, polyester pre-mix with Calcium Carbonate, and shall be equipped with a bolt-down cover secured by a minimum of two (2) recessed penta-head bolts. The pull box cover shall have the word “COMMUNICATIONS” in permanent raised or stamped letters. Pull boxes shall be open base. The pull box cover shall have two (2) ½” x 4” pull slots. The pull box base shall have two (2) 4 ½” x 4 ½” mouse holes, one at each end. Pull boxes may be extended by means of an “extension”. The extension shall have eight (8) 4 1/2” x 4 1/2” knockouts, two on each side. Contractor shall provide all necessary collars, extensions, hardware, sealant, and conduit caps. All conduit entrances shall be sealed. The assigned pull box number shall be painted on the box at the time of installation. Chipped, cracked, or otherwise damaged boxes and covers will not be accepted.

**975-2.13 Vaults.** (Also known as ADOT No. 9 Pull Box) Communications vaults shall be UL listed. Vault base shall be pre-cast concrete with a minimum thickness of 6”. Vault cover shall be fabricated steel, 36” diameter, secured by a minimum of one (1) recessed penta-head bolt. The cover lid shall have “COMMUNICATIONS” written on it in permanent raised, stamped or welded lettering. The vault base and vault cover shall be gasketed and weather proof. Vaults shall have a minimum outside dimension of 48” long by 48” wide by 50” high with a minimum thickness of 4”. The base shall have one (1) 8” diameter by 4” deep sump hole knockout in the floor. The base interior shall have a minimum of one (1) 2 ½” diameter ground rod knockout in the floor, at a corner; the base interior shall have four (4) 7/8” diameter pulling irons, one centered on each side. The base exterior walls shall have four (4) 36” “C” channels precast in the sides, one on each side; the base exterior shall have four (4) 18” x 18” knockouts, one on each side; and, the base exterior shall have sixteen (16) 4 1/2” diameter knockouts for 4” conduit entrances, four on each side. The contractor shall provide all necessary collars, extensions, hardware, sealant, and conduit caps. All conduit entrances shall be sealed. The assigned box number shall be painted on the box at the time of installation. Chipped, cracked, or otherwise damaged boxes and covers will not be accepted.

**975-2.14 Portland Cement Concrete.** Concrete shall be Class B meeting the requirements of Section 1006 of the Pima County/City of Tucson Standard Specifications for Public Improvements.

**975-2.15 Innerduct.** Innerduct shall be 1" PVC constructed of a smooth walled exterior and a longitudinally ribbed interior with a continuous unknotted 1250 lbs test mule tape installed. No corrugated innerduct will be accepted. Each innerduct within a single conduit shall be of a different color (orange, brown, blue and black).

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**975-2.16 Watertight Alibi.** Watertight Alibi shall consist of a Quadraplex Duct Plug designed to seal around, organize, and support innerduct where it emerges at the top of the riser. Fasteners shall be stainless steel. Plug shall support a minimum of 400 lbs of cable, and shall be removable. Jackmoon or equivalent. No chemical seals will be accepted.

**975-2.17 Blank Duct Plugs.** Blank Duct Plugs shall be installed in each individual innerduct where it emerges at the top of the riser. Duct plugs shall be all plastic construction, corrosion proof, water and air tight to 30 psi. Jackmoon or equivalent.

**975-3 CONSTRUCTION DETAILS**

**975-3.01 Conduit.**

**(A) Handling and Storage.** All conduit shall be transported in modules or bundled in a straight and level position. The straps securing the conduit to the vehicle shall be a minimum of 4 inches in width and shall not deform or damage the conduit in any manner. Conduits shall be unloaded in accordance with the manufacturer’s recommendations and shall not be dropped to the ground.

Conduits shall be stored in a straight and level position in stacks not exceeding 8 feet in height. Materials shall be stored in an approved manner and covered to prevent ultraviolet deterioration due to the exposure to sunlight. When stored, conduit ends shall not be capped nor shall conduit be subject to temperatures in excess of 140° F.

**(B) Cleaning.** The interior of the conduit shall be kept clean and free of debris. Prior to installation, all foreign materials shall be removed from the interior of the conduit with compressed air and a swab.

**(C) Size.** Unless otherwise indicated on the plans or special provisions, all conduit shall be 4-inch diameter.

**(D) Cuts and Connections.** The conduit shall be cut square, de-burred, and trimmed to remove all rough edges.

PVC conduit connections shall be of the solvent weld type. Wipe conduit dry and clean before joining. Apply a full coat of primer to the pipe and coupling per the manufacturer’s recommendations. Apply a full and even coat of solvent cement to the entire area inserted into the fitting. Prevent excess cement from accumulating in the interior of the conduit. Allow joint to cure a minimum of 20 minutes. The complete joint shall be water tight. Where a connection is made to a steel bend, the coupling used shall be a PVC female adapter.

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Expansion fittings shall not be installed in PVC conduit runs unless otherwise specified. Expansion fittings shall be installed in conduit runs where both ends are fixed in-place, such as between two foundations, and within concrete structures. Expansion fittings shall allow for a minimum linear expansion of 6 inches.

**(E) Bends.** Bends shall be installed only when absolutely necessary. All bends shall be manufactured out of PVC or rigid steel conduit. Bend shall be factory bent or field bent. Field bends should not have a radius of less than 50 feet. Factory bends shall have a radius of not less than 12 times the nominal diameter of the conduit. Conduit shall be bent without crimping or flattening, using the longest radius practicable. The sum of the deflection angles of all bends in any conduit run shall not exceed 270 degrees between termination and/or junction points. For the purpose of calculating the sum of the deflection angles, bends with a radius of 500 feet or greater may be excluded from these criteria.

**(F) End Treatment.** Conduit ends shall be capped with conduit end caps at all times when work is not in progress. Rigid steel bends terminating in pull boxes shall terminate with an approved plastic bushing.

**(G) Placement.** Conduit runs shown on the plans shall be changed only to avoid underground obstructions and only as directed by the Pima County DOT/TED Project Manager.

Unless otherwise specified, conduits shall be placed with a minimum cover of 36 inches to the top of the conduit below the finished grade; the minimum requirement for transportation projects is 30" due to the depth of electrical conduit placement. When conduit runs, or any part thereof, cannot be installed at the minimum depth, the run, or part thereof, shall be encased in concrete.

Conduits shall be installed along the straightest horizontal and vertical alignment practicable, and with a uniform depth of cover. Variations in the alignment shall be accomplished with smooth transitions maximizing the radius of the bends. In cases where it is impossible to maintain the alignment of the conduit, the grade of the conduit shall be transitioned using the minimum number and the longest radius bends. Should discovered field conditions necessitate additional bends in the conduit run, the location and number of pull boxes shall be adjusted as directed by the Pima County DOT/TED Project Manager.

Conduits to be encased within concrete shall be installed on plastic conduit spacers. The spacers shall be placed at suitable locations to prevent sagging of the conduit between spacers or at 10 foot maximum centers. Prior to the placement of the concrete, the conduits shall be tied down to prevent them from floating.

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Conduit penetrations into pull boxes shall be made using the knockouts or shall be cored in the structure. Conduits entering through the side wall of pull boxes shall be located 3 inches above the floor and 3 inches away from the end wall of the box. Conduit entering the bottom of pull boxes shall be located in the near side corner of the box, approximately 3 inches away from the side and end walls. The conduit shall be sloped towards the top center of the box to facilitate pulling of the cables and innerduct. Conduits terminating in pull boxes shall terminate a minimum of 3 inches inside the box wall. The void between the conduit and the box shall be completely filled with mastic to form a watertight seal.

Conduits entering vaults shall enter through single duct knockouts. The location of the knockout shall be as indicated on the plans, or directed by the engineer. The joint between the knockout and the conduit shall be filled to form a watertight seal.

At all locations where the conduits cross under a new curb, the letters “FO” shall be cut into the top of the curb directly over the conduit run. The letters shall be 3 inches tall and shall be clearly defined.

**975-3.02 Trenching.** Unless otherwise specified, all conduit runs shall be installed by trenching methods. Trenching shall include the removal of all material to the design grade no matter what type of material is encountered. The alignment of the conduit shall be staked in the field per the Pima County standard procedures.

When trenching in excess of 5 feet is required, the contractor shall submit, in writing to the Pima County DOT/TED Project Manager, a detailed description of their proposed trenching operations, including shoring methods, prior to the commencement of construction.

All conduit shall be covered with bedding material or concrete at the completion of each day’s work to prevent shrinkage and thermal expansion that could influence the alignment of the conduit.

Concrete encasement shall be a minimum of Class B (2,500 PSI) in accordance with Pima County/City of Tucson Standard Specifications and provide a minimum cover of 3 inches on all sides of the conduit. Otherwise, bedding and shading of the conduit shall be in accordance with the plans and specifications of the subject project. When installed adjacent to water mains, the conduit shall be encased in concrete.

**(A) Bedding and Shading.** Bedding and shading of the conduit shall be in accordance with the following:

Conduits installed in conjunction with Tucson Water projects shall be designed and installed using the plans and specifications of the subject project.

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Conduits installed with traffic signal or street lighting conduits shall be designed and installed using the plans and specifications of the subject project.

Conduits with a depth of cover less than cited above, and where indicated on the plans, shall be encased in concrete. The concrete shall be placed to provide a minimum of 3 inches of encasement on all sides of the conduit.

**(B) Backfill.** Upon completion of the conduit and bedding installation, the trench shall be backfilled and compacted. The backfill shall be designed and constructed using the plans and specifications of the subject project. Place the detectable warning tape in the backfill, 18 inches below finished grade and directly above the conduit.

**975-3.03 Boring and Jacking.** Conduit runs shall be installed by boring and jacking methods when required by the plans or directed by the Pima County DOT/TED Project Manager. The boring and jacking method shall be approved by the Pima County DOT/TED Project Manager prior to the commencement of work. Where a conduit run is required by the plans to be installed by boring or jacking, the trenching method shall not be utilized except with prior written approval of the Pima County DOT/TED Project Manager.

When casing is used, the casing shall be schedule 40 “standard wall” steel pipe. The casing shall not deviate more than 0.20 feet from the design grade. The joints in the casing shall be fully welded in accordance with A.S.M.E. Section 9. Concrete end seals shall be provided at each end. The intervening annular space shall be filled with sand material approved by the Pima County DOT/TED Project Manager.

Conduits installed within the casing used for water mains shall consist of either four each one (1) inch, four each one and one-half (1 1/2) inch, or two, or more, two (2) inch diameter flexible conduits. The largest practical size shall be used. The conduits shall be strapped to the glass reinforced skids installed on the water line, pulled into the casing after the water main is installed, or installed on a hanger welded to the casing. The alignment of the conduits shall be maintained as straight as possible. The placement of sand within the annular space of the casing shall be controlled to a rate that does not displace the conduit.

Boring and jacking pits shall be located a minimum of 2 feet outside the pavement edge. The diameter of the bore shall be as close to the outside diameter of the conduit such that it will enable the conduit to be installed. At all locations where the diameter of the bore is 2 inches, or greater, than the outside diameter of the conduit, the interstitial space between the conduit and the bore shall be filled with slurry. All boring and jacking methods used shall neither damage nor deform the conduit. The installed conduit shall conform to the alignment and grade shown on the plans.

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**975-3.04 Concrete Structures.** Conduit embedded in concrete structures shall be securely attached to the reinforcing steel at locations and intervals detailed on the plans. Expansion fittings shall be installed at all locations where the conduit crosses expansion joints in the structure. Expansion joints shall also be installed at the point where the conduit enters and exits the concrete structure. Where it is not possible to install expansion joints, the conduit shall be installed in a conduit sleeve of sufficient size to provide a minimum of 1/2-inch clearance between the outside diameter of the conduit and the inside wall of the sleeve. Sleeves shall be discontinuous across the expansion joints in the structure.

**975-3.05 Pull Boxes and Vaults.** Prior to setting the pull box or vault, verify that the excavation is to the design elevation and alignment. Pull boxes and vaults shall be placed such that the crushed stone does not wash away or into the conduit. Vaults and pull boxes shall NOT be placed in a location of water drainage or standing water. Set boxes and vaults true and plumb. The top plane of the cover shall be a minimum of 1 inch above finished grade and 6 inches above possible standing water level for the location. Backfill and compact around the structure avoiding damage to the structure. The backfill shall be compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Pull boxes are to be placed on a minimum of 5 cubic feet of clean 1 inch (size 57) rock and vaults are to be placed on a minimum of 16 cubic feet of clean 1 inch (size 57) rock.

Pull boxes shall be encased in a concrete ring a minimum 10 inches wide and a minimum of 12 inches deep on compacted soil. Each pull box/vault shall be provided with a 5/8 inch by 8 foot ground rod and acorn, driven vertically in the corner with 6 inches of rod exposed above the top of the drainage rock.

Install the precast sections in accordance with ASTM C891. Joints between the precast sections shall be sealed with a flexible butyl sealant meeting the requirements of AASHTO M-198. Install precast adjustment rings and the frame and cover to finished grade. Pull boxes shall be encased in a concrete ring a minimum 10 inches wide and a minimum of 12 inches deep on compacted soil.

Cables passing through pull boxes require a minimum 50 feet service loop where attainable without exceeding manufacturer's minimum bend radius. Cables pulled through vaults require not less than 150 feet before exiting.

**975-3.06 Innerducts.** All 4 inch conduits shall have a minimum of four 1 inch smooth wall exterior, longitudinally ribbed interior innerducts with 1250 lbs test rated pull strength mule tape installed. Each innerduct within a single conduit shall be of a different color (orange, brown, blue and black).

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**975-3.07 Tracer Wire, Electronic Marker, Mule Tape.** A continuous, separate #6 AWG THW/XHHW CU insulated tracer wire shall be installed in each conduit run, external to the innerducts. All lubricants used in the pulling of the tracer wire shall be water soluble. No splicing of the tracer wire shall be permitted in the conduit runs. The ends of the wire shall extend into each pull box, or vault, a minimum of 5 feet, coiled and secured. Connect the ends of all tracer wires within a pull box, or vault, together to a common lug. An electronic marker, 3M model 1255 mini-marker shall be placed by the Contractor at the location of any capped conduit not in a building or pull box/vault. All unoccupied or capped conduits shall have a continuous unspliced unknotted detectable 2500 lbs test rated pull strength mule tape installed, secured at each end and shall be labeled with location of opposite end.

**975-3.08 Testing and Cleaning.** The completed conduit runs shall be cleaned and tested prior to final acceptance. Cleaning shall consist of pulling a swab through the conduit and removing all foreign material from within the conduit. If water is allowed to enter the conduit during construction, it shall be blown out or removed by other satisfactory means prior to the acceptance of the system. Vaults and pull boxes shall be cleaned of all debris. Upon completion of the cleaning operations, the ends of the conduit shall be capped. RGS sweeps terminating in pull boxes shall be plugged.

All conduit runs shall be clearance tested after the completion of all backfilling and subgrade preparation operations. This test shall consist of pulling a mandrel through the conduit run. The mandrel shall be segmented with an outer diameter of 1/4 inch less than the inside diameter of the conduit, and shall be 10 inches in length. The test shall be considered acceptable when the mandrel can be passed through the entire conduit run with a pulling force of 300 lbs or less. Each conduit run shall be verified for continuity along its entire length, as noted on the plans, and by means of an underground line locator. The installed conduit system shall be marked on the ground using standard bluestake color code and markings procedures.

All testing of the system shall be scheduled with, and conducted in the presence of the Pima County DOT/TED Project Manager. All portions of the system that do not pass the specified testing shall be repaired by the contractor, and retested, at no additional cost.

**975-4 METHOD OF MEASUREMENT**

**975-4.01 Conduits.** Conduits shall be measured by the linear foot for each diameter size of conduit. The measurement shall be from center to center of pull box or vault. No measurement or direct payment will be made for the trenching, bedding, encasement, tracer wire, marking tape, mule tape, backfill and testing, the cost being considered as included in the contract price for the conduit.

**975-4.02 Pull Boxes.** Pull boxes will be measured as a unit for each pull box installed complete with cover and accessories.

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<p>REVISED</p>		<p><b>Special Provisions</b> <b>Section 975 – Telecommunications Infrastructure</b></p>	

**975-4.03 Vaults.** Vaults will be measured as a unit for each vault complete with frame and cover and accessories.

**975-5 BASIS OF PAYMENT**

**975-5.01 Conduit.** Acceptable quantities of conduit, measured as provided above, will be paid for at the contract unit price per linear foot, which price shall be full compensation for the work, complete in place, including any excavation, removals of obstruction, bedding, encasement, backfill, and any incidentals necessary to complete the work.

**975-5.02 Pull Boxes.** Acceptable quantities of pull boxes, measured as provided above, will be paid for at the contract unit price each, which price shall be full compensation for the work, complete in place, including any excavation, removals of obstruction, bedding, coring, knockouts, backfill, and any incidentals necessary to complete the work.

**975-5.03 Vaults.** Acceptable quantities of vaults, measured as provided above, will be paid for at the contract unit price each, which price shall be full compensation for the work, complete in place, including any excavation, removals of obstruction, coring, knockouts, support channels, bedding, backfill, risers, frames and covers, accessories, and any incidentals necessary to complete the work.

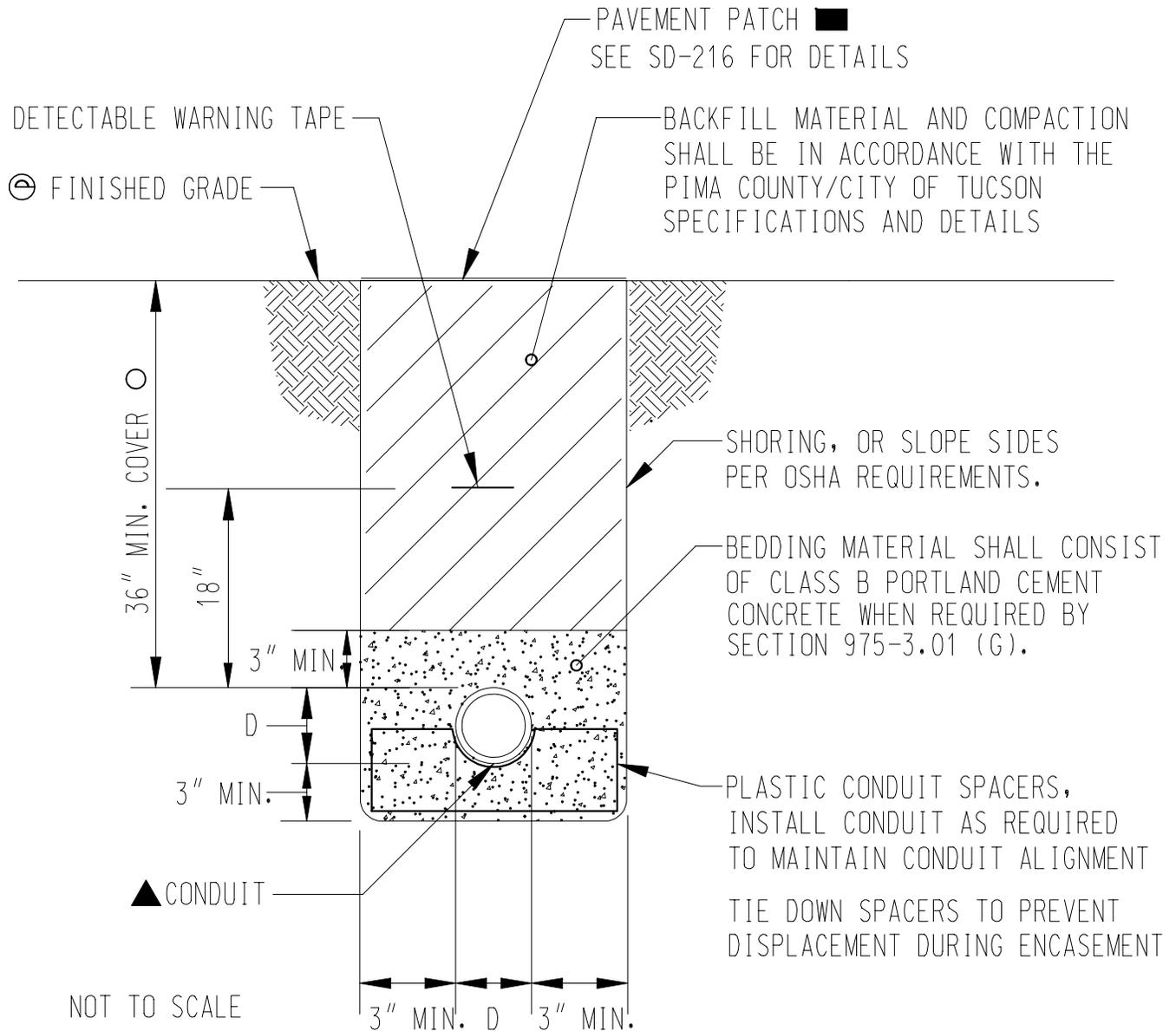
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TYPE 1: SINGLE FO CONDUIT

REFER TO SHEET 6 OF 6 FOR GENERAL NOTES AND SYMBOLS.

NOTE: CONCRETE ENCASEMENT REQUIREMENT  
FOUND IN SECTION 975-3.01(G)

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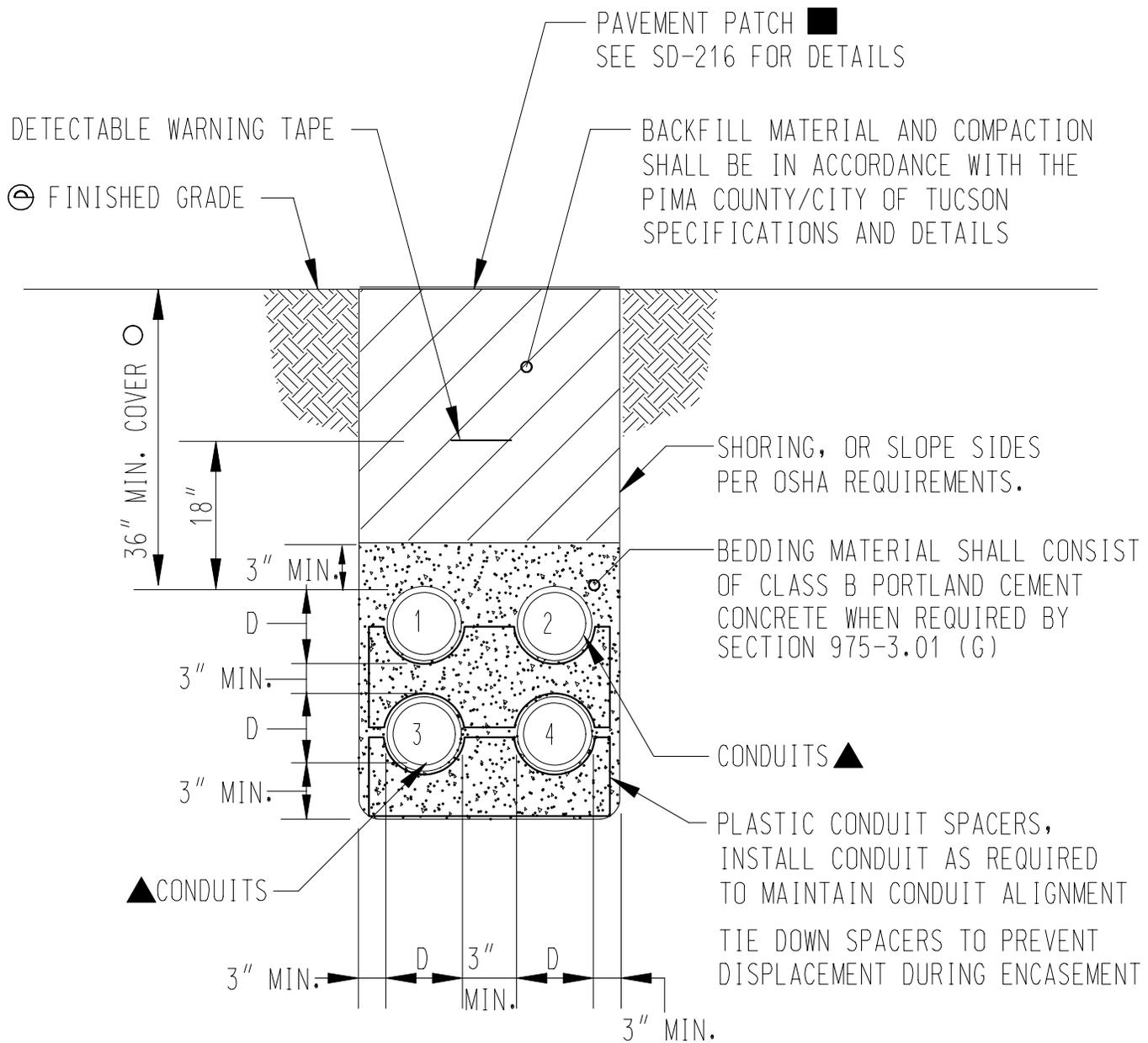
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NOT TO SCALE

TYPE 2 : MULTIPLE FO CONDUITS

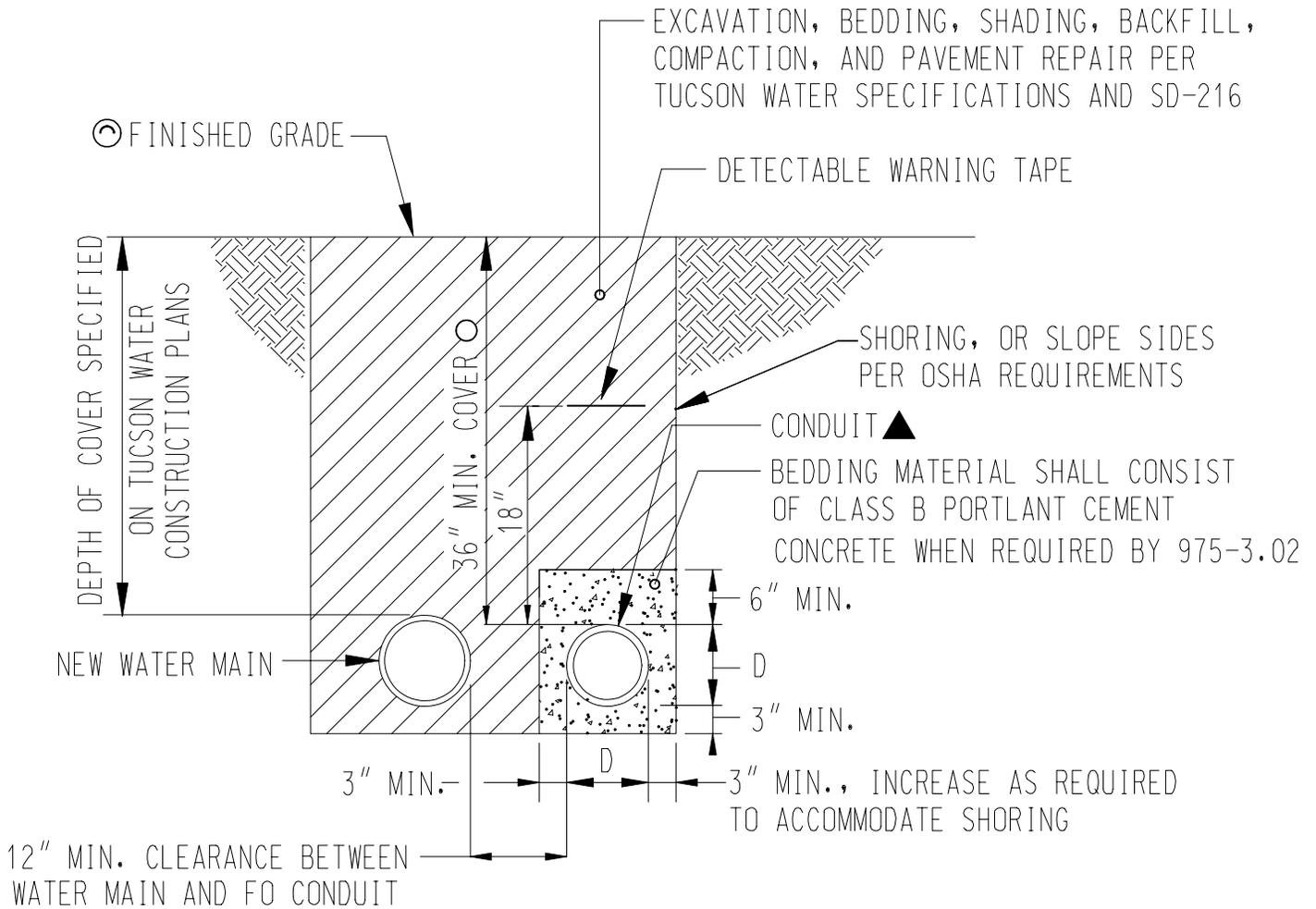
REFER TO SHEET 6 OF 6 FOR GENERAL NOTES AND SYMBOLS.  
 NOTE: CONCRETE ENCASEMENT REQUIREMENT  
 FOUND IN SECTION 975-3.01(G)

ISSUED  
 August 2003  
 REVISED



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NOT TO SCALE

**TYPE 3: FO CONDUIT INSTALLED  
ADJACENT TO TUCSON WATER MAIN**

REFER TO SHEET 6 OF 6 FOR GENERAL NOTES AND SYMBOLS.

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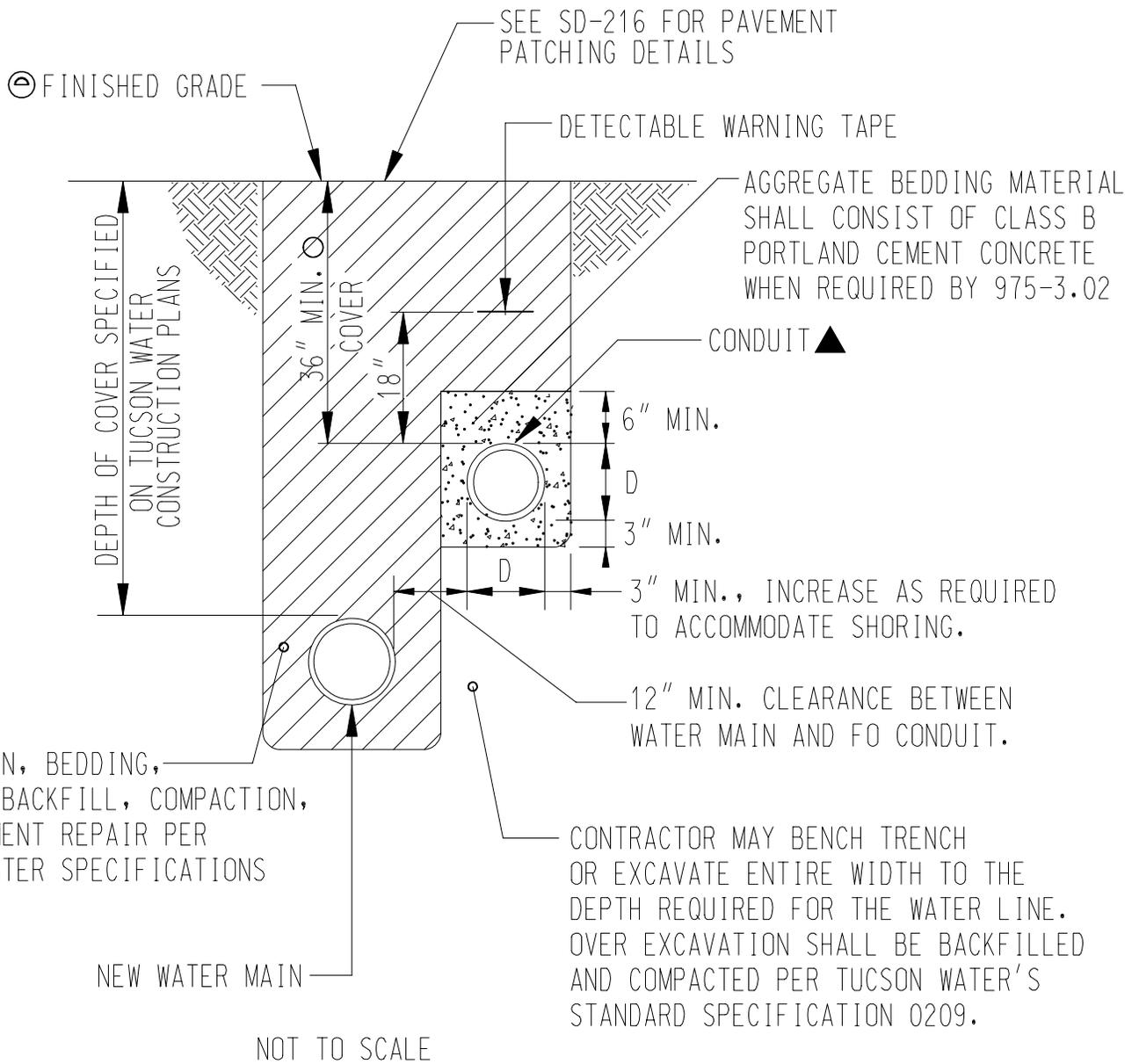
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TYPE 4: FO CONDUIT INSTALLED ABOVE TUCSON WATER MAIN

REFER TO SHEET 6 OF 6 FOR GENERAL NOTES AND SYMBOLS.

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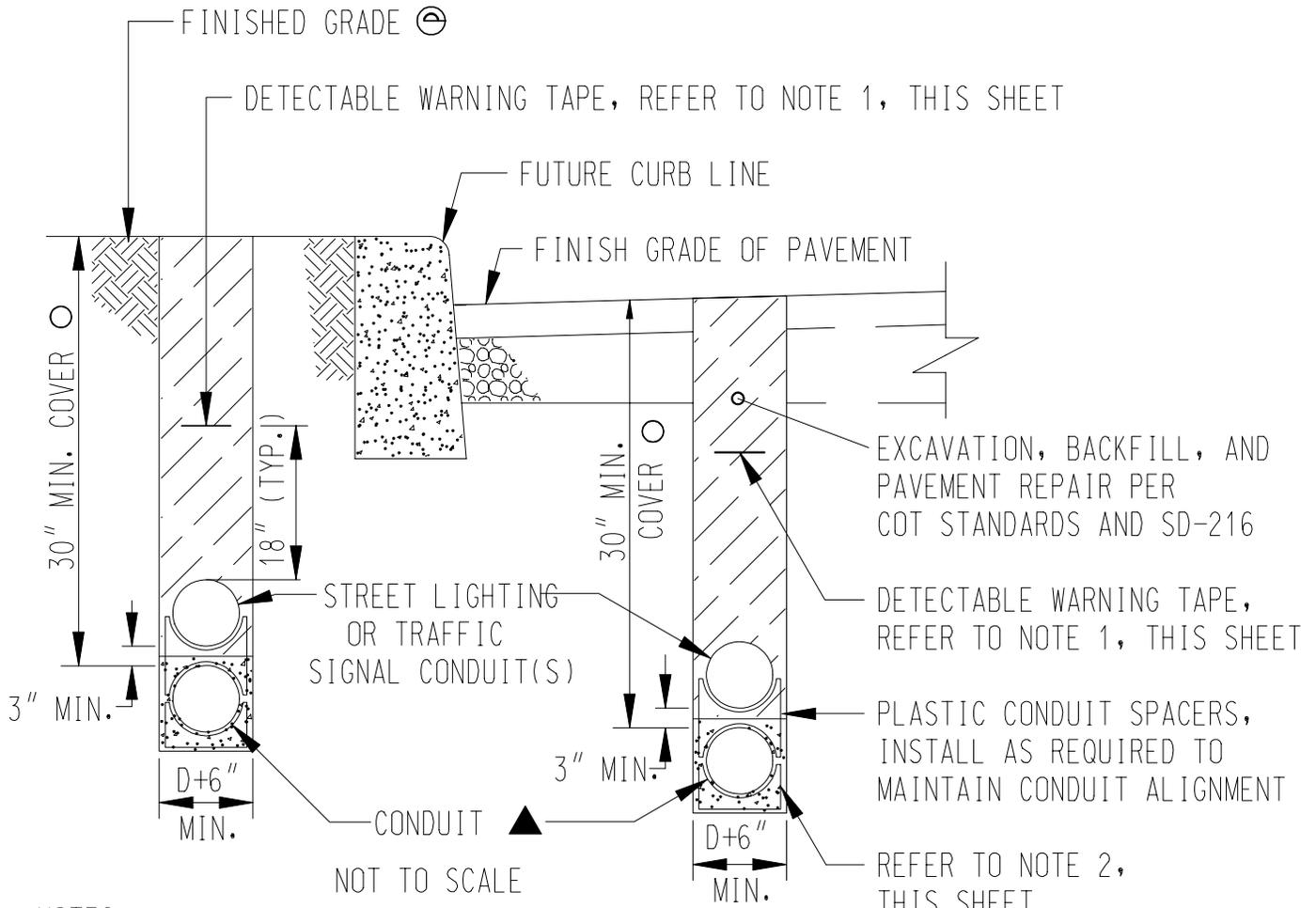
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NOTES:

1. INSTALL WARNING TAPE FOR THE FIBER OPTIC SYSTEM AND THE STREET LIGHTING / TRAFFIC SIGNAL CONDUITS, SIDE BY SIDE AT THE SPECIFIED DEPTH.
2. AT STREET CROSSINGS, WHERE THE STREET LIGHTING / TRAFFIC SIGNAL CONDUIT IS ENCASED IN CONCRETE, ENCASE FO CONDUIT IN CLASS B CONCRETE.
3. EXCAVATION, BEDDING, SHADING, BACKFILL, AND COMPACTION OF THE STREET LIGHTING AND TRAFFIC SIGNAL CONDUITS SHALL BE IN ACCORDANCE WITH THE PIMA COUNTY/CITY OF TUCSON STANDARD SPECIFICATIONS AND DETAILS FOR PUBLIC IMPROVEMENT.

TYPE 5: FO CONDUIT INSTALLED WITH STREET LIGHTING OR TRAFFIC SIGNAL CONDUIT

REFER TO SHEET 6 OF 6 FOR GENERAL NOTES AND SYMBOLS.

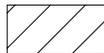
NOTE: CONCRETE ENCASEMENT REQUIREMENT FOUND IN SECTION 975-3.01(G)

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GENERAL NOTES:

1. FOR CONDUIT IN THE ROADWAY RIGHT-OF-WAY WHERE REQUIRED BY THE CITY OF TUCSON/PIMA COUNTY SPECIFICATIONS AND DETAILS, AND WHERE SPECIFICALLY CALLED OUT ON THE DRAWINGS, CONDUIT SHALL BE ENCASED IN CLASS B PORTLAND CEMENT CONCRETE.
2. CONSTRUCTION STAKING SHALL BE IN ACCORDANCE WITH PROJECT REQUIREMENTS.
3. SHORING AND / OR BRACING SHALL CONFORM TO OSHA REQUIREMENTS.
4. REFER TO SPECIFICATIONS FOR THE REQUIREMENTS FOR THE DETECTABLE WARNING TAPE.

LEGEND:

- D            OUTSIDE DIAMETER OF CONDUIT.
- ▲            CONDUIT SHALL BE 4" IN DIAMETER UNLESS OTHERWISE NOTED ON THE PLANS.
- ⊕            THE LOWER OF EXISTING OR FUTURE FINISHED GRADE.
- PAVEMENT PATCHING SHALL CONFORM WITH THE REQUIREMENTS OF PIMA COUNTY / CITY OF TUCSON STANDARD DETAIL FOR PUBLIC IMPROVEMENTS, STANDARD DETAIL No. 216, AND THE CONSTRUCTION DOCUMENTS.
- 36" MINIMUM COVER, AND A MINIMUM OF 24" BELOW THE LIMITS OF SUBGRADE SCARIFICATION.
-             NATIVE UNDISTURBED SOIL.
-             BACKFILL MATERIAL AND COMPACTION SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE AUTHORITY THAT HAS JURISDICTION OVER THE RIGHT-OF-WAY, AND PROJECT SPECIFICATIONS.
-             AGGREGATE BEDDING MATERIAL OR CLASS B PORTLAND CONCRETE CEMENT AS REQUIRED IN SECTIONS 975-3.01 AND 975-3.02.
-             BACKFILL, BEDDING AND SHADING MATERIAL OF A JOINT TRENCH TO BE CONTROLLED BY THE SPECIFICATIONS AND DETAILS OF THE AGENCY RESPONSIBLE FOR THE UTILITY.

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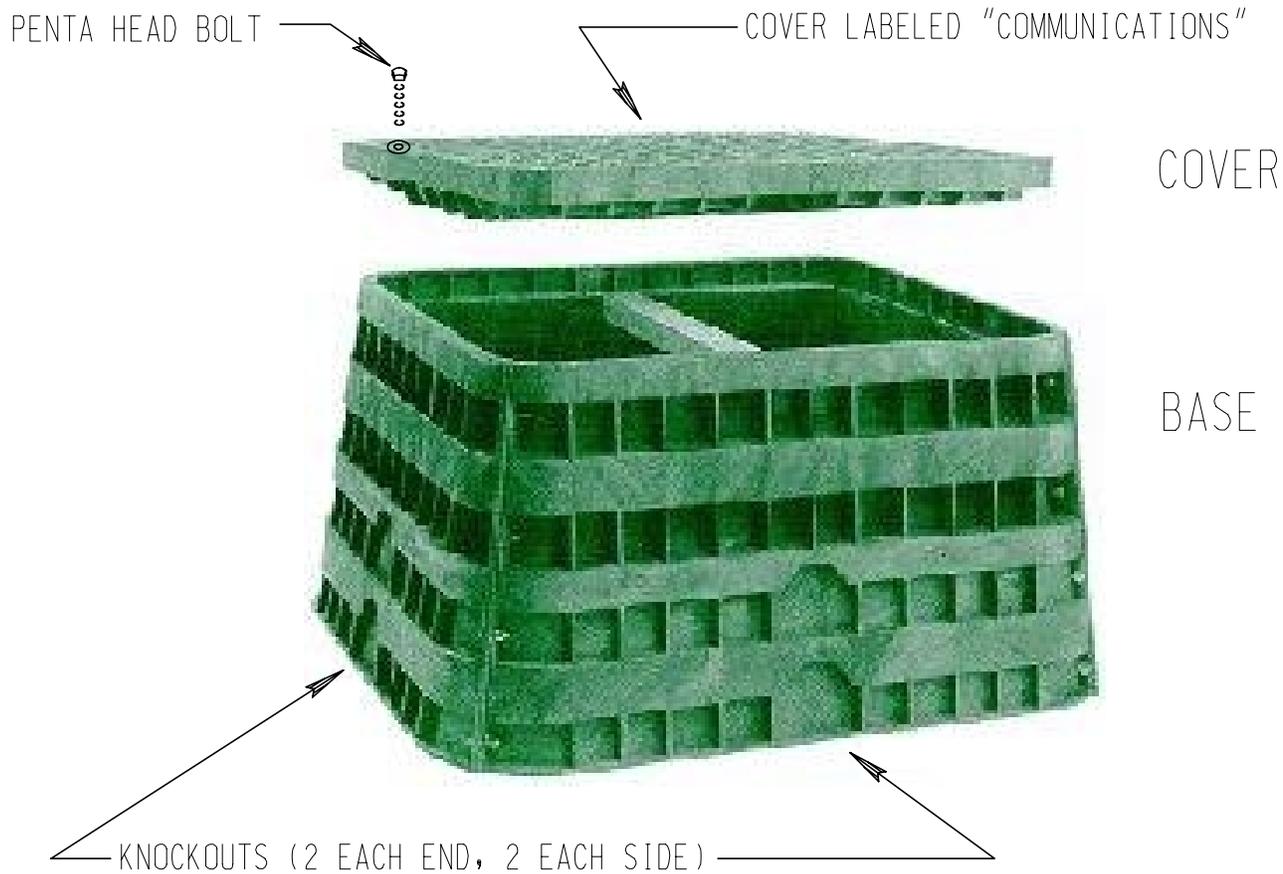
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**Conduit Installation**

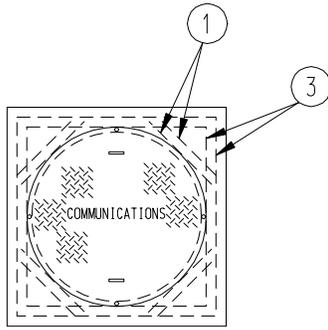
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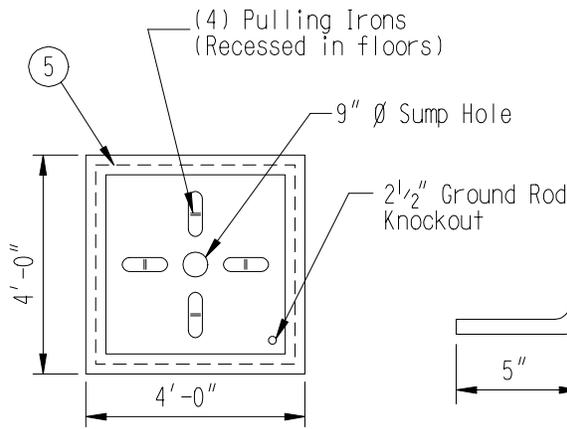
GENERAL NOTES:

1. BASE AND COVER SHALL BE IN A NEUTRAL COLOR.
2. BASE SHALL BE MOLDED HIGH DENSITY POLYETHYLENE.
3. PULL BOX SHALL BE OF THE DIMENSIONS 30" WIDTH BY 48" LENGTH BY 24" DEPTH.
4. COVER SHALL BE A POLYESTER PRE-MIX WITH CALCIUM CARBONATE.
5. COVER SHALL BE FACTORY EMBOSSED WITH "COMMUNICATIONS".
6. COVER SHALL BE SECURED BY 3/8-16 PENTA HEAD BOLTS.
7. PULLBOX MAY BE EXTENDED BY MEANS OF EXTENSION.

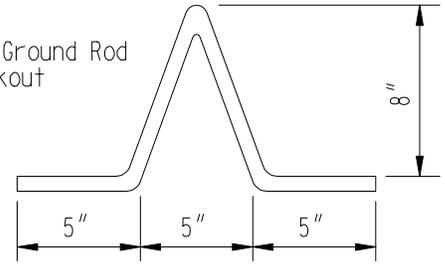
<p>ISSUED August 2003</p>		<p><b>PCDOT Traffic Engineering Division</b>  <b>Street Lighting &amp; ITS Conduit Design Manual</b></p>	<p><b>SHEET NO.</b>  <b>7-03</b>  1 of 1</p>
<p>REVISED</p>			



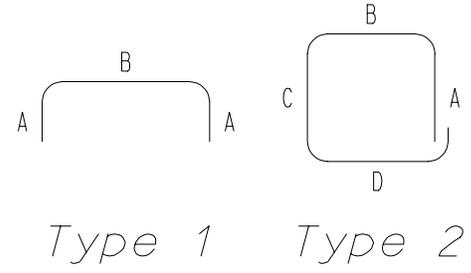
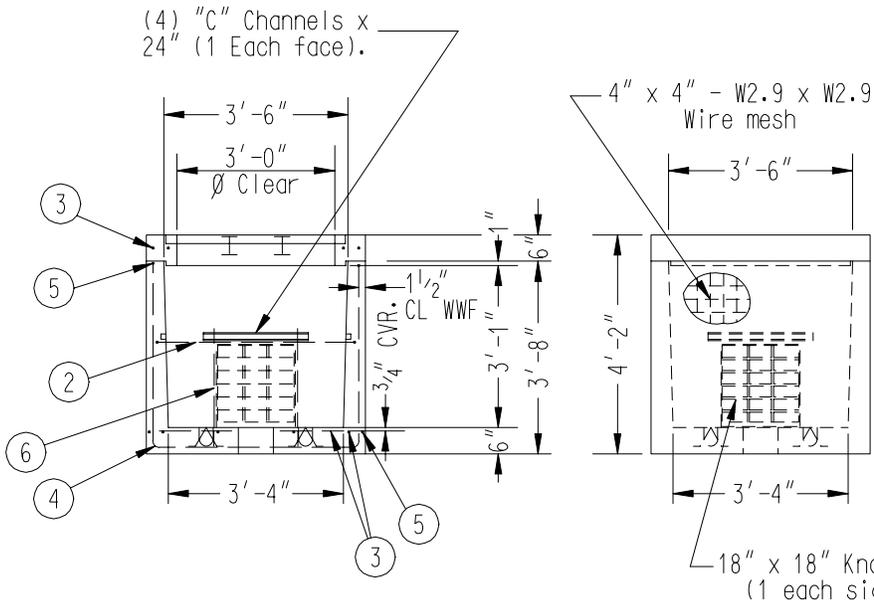
PLAN VIEW WITH COVER



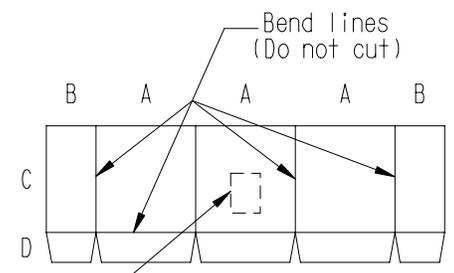
PLAN VIEW



PULLING IRON DETAIL



Type 1 Type 2



Type 2 REINFORCING

GENERAL NOTES

1. Pull irons are  $3/4$ "  $\varnothing$  cold rolled galvanized steel.
2. Weight Concrete: Cover = 663#, Vault = 2858#, Total = 3689#.
  - Rebar: Cover = 91#, Vault = 79#, Total = 170#.
  - Door: 175#.

STRUCTURAL NOTES

1. Concrete: 28 Day compressive strength  $f'c = 4500$  PSI.
2. Rebar: ASTM A-615 Grade 60.
3. Mesh: ASTM A-185 Grade 65.
4. Design ACI-318-89 Building Code.
5. Loads: HS-20 truck wheel with 30% impact per AASHTO ASTM C-857 "Minimum structural design loading for underground precast concrete utility structures.

MARK	SIZE	BEND TYPE	NO. REQ'D	LENGTH (mm)	A	B	C	D	E
1.	#5	STR.	8	1'-7"					
2.	#4	1	4	8'-9"	2'-6"	3'-9"			
3.	#4	STR.	16	3'-9"					
4.	4x4-W2.9	3	1	15'-11" x 4'-9"	3'-9"	2'-4"	3'-3"	1'-6"	
5.	#4	2	2	16'-0"	3'-9"	3'-9"	3'-9"	3'-9"	1'-0"
6.	#4	STR.	8	2'-6"					

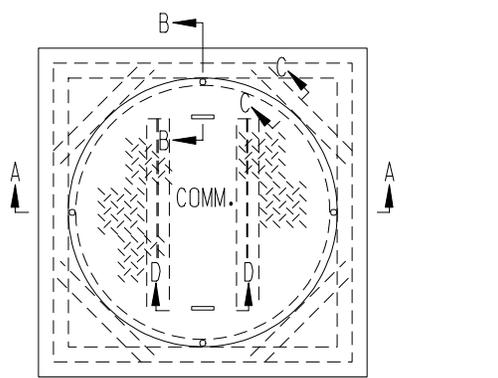
Cut-outs typ. at knockouts

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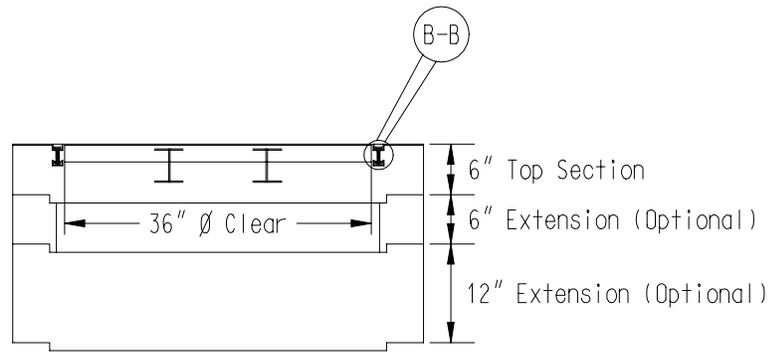


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 Detail No.: FO-301  
**Typical Fiber Optic Vault**

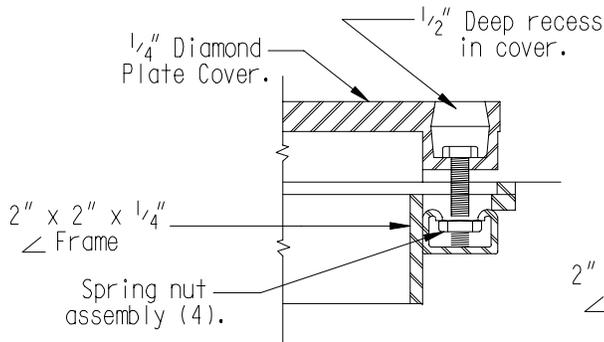
**SHEET NO.**  
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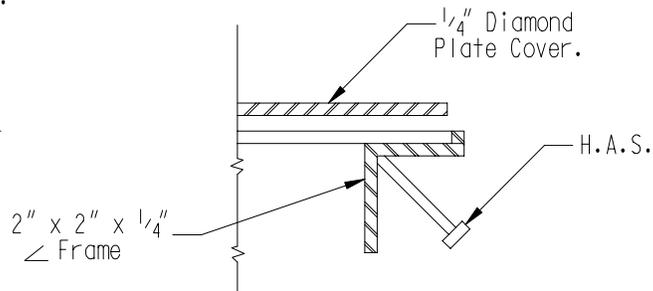
PLAN VIEW WITH COVER



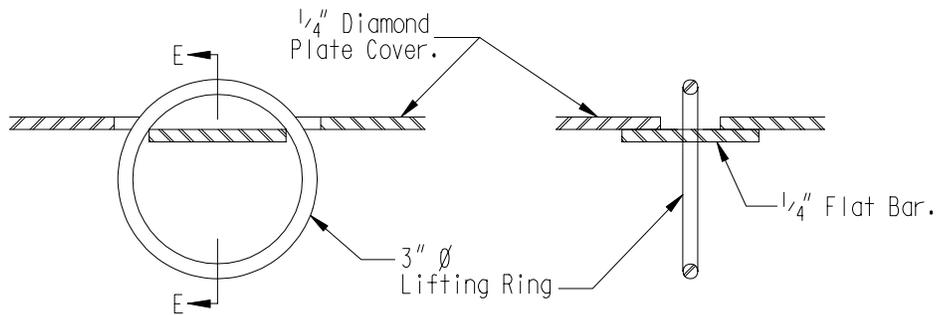
SECTION A-A



SECTION B-B  
(Bolt Down)

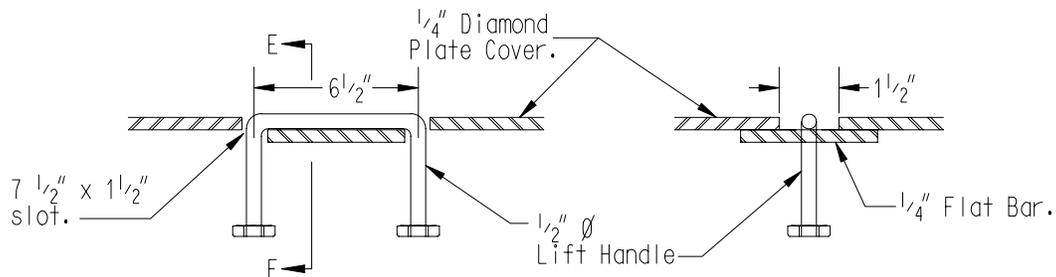


SECTION C-C  
(Typical)



SECTION D-D  
(Lifting Ring)

SECTION E-E  
(Lift Ring)



SECTION D-D  
(Lift Handle)

SECTION E-E  
(Lift Handle)

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Detail No.: FO-301  
Typical Fiber Optic Vault Cover & Lift Handles

SHEET NO.

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