
TRANSPORTATION

This chapter provides minimum design criteria for planning, designing, and preparing final plans for modifying and constructing transportation facilities within the city. It addresses traffic impact analysis, rights-of-way considerations, street geometrics, traffic signal design, signs and markings, transit amenities, bikeways, pedestrian facilities, neighborhood traffic management, and flexible pavement design.

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5-3 GEOMETRICS

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DEPARTMENT RESOURCE INFORMATION

Aviation/Airport	15000 N. Airport Dr.	480-312-2321
Advance Planning Services	7506 E. Indian School Rd.	480-312-7990
Capital Project Management	7447 E. Indian School Rd., Suite 205	480-312-7250
Current Planning	7447 E. Indian School Rd., Suite 105	480-312-7000
Customer Service	7447 E. Indian School Rd., Suite 100	480-312-7800
Downtown Group	4248 N. Craftsman Ct.	480-312-7750
Facilities Management	9191 E. San Salvador Dr.	480-312-5999
Fire & Life Safety/ Inspections	8401 E. Indian School Rd.	480-312-1855
Fire Plan Review	7447 E. Indian School Rd., Suite 125	480-312-7080
Inspections & Land Survey	9191 N. San Salvador Dr.	480-312-5750
Parks Department	7340 Scottsdale Mall	480-312-2915
One Stop Shop/Permit Services	7447 E. Indian School Rd., Suite 100	480-312-2500
Plan Review	7447 E. Indian School Rd., Suite 125	480-312-7080
Records Division	7447 E. Indian School Rd., Suite 100	480-312-2356
Solid Wastewater Management	9191 N. San Salvador Dr.	480-312-5600
Stormwater Management	7447 E. Indian School Rd., Suite 205	480-312-7250
Street Operations	9191 N. San Salvador Dr.	480-312-5626
Transportation	7447 E. Indian School Rd., Suite 205	480-312-7696
Water Resources	9388 E. San Salvador Dr.	480-312-5685
City of Scottsdale	www.scottsdaleaz.gov	

TRANSPORTATION IMPACT STUDIES

A Transportation Impact & Mitigation Analysis (TIMA) may be required for General Plan Amendments, rezoning, and use permit applications. This section presents the analysis process and requirements for completing a traffic impact and mitigation analysis to determine needed modifications to the existing and planned transportation system as a result of proposed development.



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GENERAL INFORMATION

5-1.000

A. Major Issues Addressed in Transportation Analysis

The Transportation Impact and Mitigation Analysis (TIMA) document will address such issues as:

1. The current transportation system and operational characteristics in the site vicinity,
2. The interface between the on-site circulation system and the adjacent circulation system,
3. The intensity and character of the development,
4. Trip generation,
5. Distribution and assignment estimates, and
6. Impacts of the development on the existing and planned transportation systems.

B. Study Timing

A TIMA may be required for general plan amendment, rezoning, and use permit applications. The need for, and extent of, the study shall be based on the criteria described in this guide and any analysis provided in previous applications. All studies shall be submitted in final form prior to scheduling a development proposal for public hearing.

C. Study Preparation Process

The study preparation process should include open discussions between the applicant, study consultant, and City of Scottsdale staff. Therefore, project discussion should begin when the application for the development is initiated, not after a development plan is finalized and a traffic study completed. This will ensure that the objectives of both the land owner/developer and the city can be met.

After a pre-application meeting, issues and process will be determined and discussed at a joint meeting with staff members from the city's Planning and Transportation Departments. Members from these departments, representing a "Development Review Team" will determine if any at-large issues are affected by the proposal. The Transportation Department staff and the Project Coordination Manager will establish a timetable and oversee the TIMA document preparation process. A meeting will be arranged to review the scope of the work and the proposed timetable for completion.

After the TIMA document is completed, it will be submitted to the city for review. The document will be reviewed for completeness and compliance with TIMA Guidelines within 5 working days. This completeness review will only determine if all required information and analysis has been provided. It will not assess the quality of the submitted report or its findings. If the document is determined to be complete, a meeting will be scheduled to review the report and findings with the applicant. Transportation staff will conduct a thorough review of the document and prepare a summary report of the findings. This summary and a copy of the TIMA document will be included in the staff report for the case. Minor revisions may be required before the project will be scheduled for the requested hearing.

5-1.100**INITIATING IMPACT & MITIGATION ANALYSIS****A. Pre-application Meeting**

The procedures outlined herein present the minimum information required to determine what level of traffic analysis is required. The purpose of the pre-application conference is to provide guidance and direction to the applicant concerning the nature and extent of the analysis. Failure by the applicant to provide these items may result in delay in initiating the TIMA process. At a minimum, the following items must be provided for review:

1. Vicinity map
2. Current aerial map
3. Summary of existing building or development on the site – examples: existing building area and land use, current zoning, approved site plan, previous zoning history, etc.
4. Preliminary summary of proposed development by land use – examples: building area, number of employees, leasable tenant space, acreage, etc.
5. Proposed site plan
6. Market analysis, if available.

B. Warrants for Studies

Proposed projects will fall into one of three categories for purposes of transportation impact and mitigation analysis. The first category is proposed projects that are deemed to have insignificant traffic impacts. The second category is projects that have localized impacts to the city's transportation system. The third category is proposed developments that have significant impacts to the transportation system that may extend beyond the vicinity of the site. For those situations where it is questionable as to which category is appropriate, the Traffic Engineering Director will make the final determination. The Traffic Engineering Director also has the authority to waive the requirement for a traffic impact analysis for unusual situations that fall outside of the following guidelines or where the analysis is deemed to be unnecessary based on previous studies or current traffic conditions.

"Existing, allowed land use" will be interpreted as development that is allowed under the city's current zoning and General Plan designation. Development may be restricted to previously approved site plans and development programs where prescribed by zoning stipulations. For those situations where it is questionable as to what level of development is allowed on the site, the Zoning Administrator will make the final determination.

5-1.101**CATEGORY 1**

If a proposed development is anticipated to generate less daily trips than it would under the existing allowed land use, and generates less than 100 vehicle trips per hour in the "peak period on the adjacent street system", a transportation impact and mitigation analysis is not necessary. The following sizes of different land use classifications are deemed to generate less than 100 trips in the peak hour and therefore do not require any analysis.:

- < 100 residential dwelling units,
- < 6,000 gross square feet retail,
- < 25,000 gross square feet office,
- < 100,000 gross square feet industrial/employment
- < 160 hotel / motel / resort rooms,
- < 30,000 gross square feet medical office

For a development application that falls under this category, the applicant will be required to submit the following:

1. Site plan
2. Adjacent street volumes
3. Accident history
4. Trip generation comparison to the existing land use

CATEGORY 2

If a proposed development is anticipated to generate more daily trips than it would under the existing, allowed land use, and generates less than 100 vehicle trips per hour in the “peak period on the adjacent street system,” then a Category 2 study is required to determine the extent of the transportation impacts of the proposed development.

For a development application that falls under this category, the traffic analysis will include the following:

1. Site plan
2. Adjacent street volumes
3. Accident history
4. Trip generation comparison to the existing land use
5. Level of service analysis of roadway segments and intersections adjacent to the site

The following considerations are some of the development and transportation system characteristics that will be evaluated in determining the extent of the study area and the need for additional or expanded analysis such as a traffic signal warrant analysis.

- Current traffic volumes and level of service on the adjacent streets
- Driveway location and volume
- Collision data on adjacent street segments and at nearby intersections
- Special conditions and circumstances particular to the development or the transportation system

CATEGORY 3

If a proposed development is anticipated to generate more daily trips than it would under the existing, allowed land use, and generates more than 100 vehicle trips per hour in the “peak period on the adjacent street system, then a Category 3 study is required to determine the extent of the transportation impacts of the proposed development.

For a development application that falls under this category, the traffic analysis will include the following:

1. Site plan
2. Adjacent street volumes
3. Accident history
4. Trip generation comparison to the existing land use
5. Level of service analysis of roadway segments and intersections adjacent to the site
6. Level of service analysis of major roadway segments and intersections in the vicinity of the site

The following considerations are some of the development and transportation system characteristics that will be evaluated in determining the extent of the study area and the need for additional analysis, such as neighborhood traffic mitigation.

1. Current traffic volumes and level of service on the adjacent streets
2. Driveway location and volume

5-1.102**5-1.103**

3. Proximity to and potential impact upon nearby residential areas
4. Collision data on adjacent street segments and at nearby intersections
5. Special conditions and circumstances particular to the development or the transportation system

5-1.200

EXTENT OF STUDIES

5-1.201

CATEGORY 2 STUDY

This study will include the following:

1. A site plan with proposed access points;
2. An area map showing the surrounding transportation system, including the locations of the signalized intersections within 2 miles of the nearest signalized intersection on adjacent streets in all directions;
3. Most recent accident rates and rankings on adjacent roadway segments and intersections within the study area;
4. Current traffic volumes on the street system within the study area;
5. Trip generation;
6. Trip distribution;
7. Traffic assignment;
8. Existing levels of service on adjacent roadways, including signalized intersections within the study area; and
9. Horizon-year levels of service with and without the proposed development.

The Category 2 study need not be a detailed analysis of the present and future conditions. No elaborate data collection effort or extensive computer modeling is usually necessary for such a study. Its purpose is to provide an analysis of existing and anticipated traffic conditions on the adjacent transportation system and identify potential concerns that may need additional analysis.

5-1.202

CATEGORY 3 STUDY

A complete TIMA analysis will be required for any proposed development that is anticipated to generate more than 100 trips in the peak hour of the adjacent street. The type and extent of analysis required for a complete TIMA analysis will depend on the development under consideration and its potential impact on the study area transportation network. Large developments with regional impacts will require extensive analysis and sophisticated computer modeling applications; smaller developments might only require manual trip distribution and assignment techniques. The city will determine the extent of the Category 3 study.

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STUDY AREA

The study area for a Category 2 study will be the roadway segments and intersections located adjacent to the site. Major intersections within 1 mile of the site may be included in the study area based upon the guidelines noted above.

The study area for a Category 3 study will be the intersections, and connecting roadway segments, within 2 miles of the site or the nearest signalized intersection that satisfy either of the following traffic conditions:

- Intersections with entering volumes that currently exceed 40,000 vehicles per day, or
- Intersections with approach volumes in the design year that are increased by 5% or more, as a result of the traffic generated from the proposed development.

CONTEXT & FRAMEWORK

5-1.400

EXISTING CONDITIONS

5-1.401

The reports for either a Category 2 or Category 3 study will provide current approach volumes for 24 hours of a typical weekday, and turning movement volumes in 15 minute intervals for the time periods of 7:00 to 9:00 a.m. and 4:00 to 6:00 p.m., for all intersections of streets that are classified as major collector (rural, suburban, or urban), minor arterial (rural, suburban, or urban), major arterial (rural, suburban, or urban), or freeway in the study area. 24 hour typical weekday volumes should also be provided for adjacent roadway segments. The results of a level-of-service analysis, for the peak, fifteen-minute periods in the morning and in the evening for the existing conditions, will be included in the report. The report will also list the accident rate, frequency, and severity for all intersections and roadway segments in the study area for the most recent available year.

HORIZON YEAR(S)

5-1.402

For a Category 2 study, the traffic analysis will be based on traffic conditions for the build-out or completion year of the development. In some cases, staff may require an additional horizon year if there are significant changes anticipated to the surrounding infrastructure or traffic volumes.

For a Category 3 study, the traffic analysis will be based on traffic conditions for the build-out or completion year of the development, and a minimum 5-year projection from the anticipated build-out date, which may be rounded up to the closest 5-year increment (2015, 2020, and 2025, etc.) If the project is a large, multi-phased development, the initial horizon year will be the date that corresponds to the opening of the first major phase of development. In some cases staff may require an additional horizon year for multi-phase projects or projects with significant changes anticipated to the surrounding infrastructure or traffic volumes.

The study will provide morning and evening peak hour approach and turning movement volumes for each intersection in the study area for the required horizon years. Level-of-service analyses for these peak hour conditions, without the site traffic and with the site traffic, will be included in the report.

PEAK TRAFFIC HOURS(S)

5-1.403

The report will analyze the peak traffic periods on the adjacent street system during the morning and evening, peak, 15-minute periods. The report will also analyze the peak traffic periods for the development, should these periods occur at different times or on different days from the peak periods of the adjacent street system.

BACKGROUND STUDY AREA DATA

5-1.404

The City of Scottsdale Traffic Engineering Division prepares a traffic volume and accident data report for every even-numbered year. This information will be available to the traffic-engineering consultant. The consultant will use the most recently available data, at a minimum. If data from earlier years is deemed pertinent, the consultant may utilize it to supplement the most recent data.

The City of Scottsdale Traffic Engineering Division periodically obtains traffic volume information at various locations. This information will be available to the consultant. The consultant may not use traffic volume data older than 15 months as current information. However, it may be utilized for supplemental purposes. If traffic volume data more recent than 15 months is not available, then the developer is responsible for obtaining the information directly.

The City of Scottsdale Transportation Planning Division prepares traffic volume projections for 5-year increments. This information will be available to the consultant. However, the information will need to be reviewed by the consultant for applicability to the TIMA. Adjustment and recalculation may be necessary. In the event that the proposed development is very large

in terms of anticipated traffic generation or in terms of deviation from the Scottsdale General Plan, comprehensive traffic projection modeling may be necessary.

5-1.405**REVIEW OF ANTICIPATED OFF-SITE CHANGES**

The Transportation Department will provide copies of TIMAs prepared for previous proposed developments that may be pertinent to a current analysis. The city will also provide other transportation related reports that may be of assistance. The consultant will be responsible for reviewing these reports and incorporating their data, conclusions, and recommendations where appropriate.

The consultant will be responsible for obtaining copies of the current Circulation Element of the General Plan for the City of Scottsdale, and adhering to the policies and guidelines it contains.

5-1.406**FIELD RECONNAISSANCE AND DATA COLLECTION**

If current traffic volume data is not available, the consultant will be responsible for obtaining traffic volume data in accordance with the requirements of the study, as stated previously. The consultant must also obtain speed limit information and analyze sight distance availability and requirements. The Transportation Planning Division will provide information regarding bicycle and transit facilities in the vicinity of the site of the proposed development. The consultant will be responsible for incorporating the needs of these facilities into the analysis and report.

5-1.500**NON-SITE TRAFFIC FORECASTS****A. Components of Non-Site Traffic**

Estimates of non-site traffic are required for a complete analysis of horizon-year conditions. These estimates represent the “base” conditions, that is, without the site development.

B. Methodology

There are two principle methods of projecting off-site traffic that are acceptable: use of area-wide modeled data and trends or growth rates. Each method has its appropriate use depending on the availability of data and the size of the proposed development.

In most cases, modeled data will be available from the Transportation Department. In those cases where this data is not available, the city will determine if the data needs to be produced for an adequate analysis, or if a trends analysis will suffice.

C. Analysis of Future Conditions

Future traffic demand estimates are developed by adding the estimated site generated traffic, all approved (or potential) development in the area, and current traffic volumes adjusted for general growth in the area. The consultant will determine the levels of service in the study area based on the non-site traffic for the horizon year.

5-1.600**SITE TRAFFIC GENERATION****5-1.601****GENERAL PROCEDURE**

The potential traffic impacts of a planned development are forecast for the projected conditions in the horizon year(s) of the project. The first step in the process is trip generation.

The trip generation process provides an estimate of the number of trips that will be generated due to the new development. Generally, the trip generation process consists of applying trip rates or equations for different types and sizes of land use development to the proposed land

uses in the development to determine the total number of new trips added to the system. Trip generation will be calculated for the a.m. and p.m. peak hours and the daily period.

SOURCES

The sources from which trip generation rates are taken are extremely important in assuring an accurate estimate of the impacts of a proposed development. In general, whatever the source, it is important to establish that the trip rate for a given land use is representative of the proposed development land use. Such items as size, location, services, and number of studies should be considered before using any data source.

A. State and Local Data Sources

In most cases, assuming a similar number of studies, local trip generation rates will be more accurate for predicting the trip generation of the development proposal. If such data is available, it should be reviewed with city staff to determine its applicability to the site.

B. National Data Sources

Several national data sources are available. The most widely used is Trip Generation, published by the Institute of Transportation Engineers (ITE). Other sources include: NCHRP Report 187, Transportation Research Board, 1978 and Development and Application of Trip Generation Rates, Federal Highway Administration, 1985.

National sources can be used as starting points in estimating the amount of traffic that may be generated by a specific building or land use. Whenever possible, or when the number of studies on which the rate is based is limited, these national rates should be adjusted to reflect local conditions. National sources should not be used without the application of sound judgment.

C. Collection of Additional Data

If it is determined that a local rate is most appropriate, but existing local data samples are limited, the consultant will be required to collect additional local data to provide a credible sample size on which to base the trip generation estimate. Local trip generation data should be collected at sites that exhibit similar characteristics to the development being studied and that are self-contained, with adequate parking not shared by other activities. The consultant should follow the guidelines contained in Trip Generation Handbook: An ITE Recommended Practice, ITE, 2000.

SELECTION OF TRIP GENERATION RATES OR EQUATIONS

As described in Trip Generation Handbook, the following step-by-step procedure must be used for determining whether the equation or the rate should be used:

1. Calculate and compare the forecasted trips using both the regression equation and the trip rate. Generally, if the forecasted trips calculated from the two methods are within 5% of each other, use the method that most closely represents the data points in the range of the independent variable being used. If the difference is greater than 5%, go to step 2.
2. Use the equation when there are at least 20 data points that are distributed over the range of values typically found for the independent variable, when there are few erratic data points, and when the y-intercept for the equation is 0 or near. If these conditions are not met, go to step 3.
3. Compare the lines representing the equation and the rate to determine which best fits the data points at the size of the independent variable in question. Use the equation or the rate whose line best fits the data points at the size of the independent variable in question. If neither line fits the data points, or if both fit equally well, go to step 4.
4. Review the standard deviation of the rate and the R² value of the equation. These measures provide information about how well the lines, in general, fit the data points. A

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low standard deviation (less than 110% of the average rate) is good. A high R² value (more than 0.75 for the equation) is good. Use the equation or the rate, depending on how well its measure satisfies these standards. If a decision still cannot be made, go to step 5.

5. Since at this point, there is no logical and valid basis for choosing between the rate and the equation, the user must choose the method to use based only on their best judgment, or collect an acceptable set of local data from which a local rate or equation can be derived.

A. Use of Average, Minimum, and Maximum Rates

Most trip generation data sources report the average rate based on a group of studies for land use. Sometimes maximum and minimum observed rates and some statistical measure of the spread of data between the extremes are also provided. When comparing average rates from different data sources, be sure to check the consistencies and differences in how the averages were computed.

When using average trip rates, all applicable adjustments must be made for variations in the independent variable. In addition, trips should be estimated for the average rate plus 1 standard deviation, to determine how the results of the analysis would be affected.

B. Use of Equations

As described above, careful consideration must be given to the use of rates versus equations. In most instances, equations provide a better correlation with actual data than do average rates. In any event, the selection and reasons for using either equations or rates should be documented in the report.

C. Choosing the Independent Variable

The choice of the independent variable can be one of the most important decisions in estimating trip generation. The selected variable should be easily projected with reasonable accuracy. When information is available for more than one independent variable, the predictive accuracy of both the independent variable and the trip generation rate or equation must be considered. However, it is also important to check the sample size for each given independent variable. In the case of two variables with a similar correlation, the variable with the larger sample should be used. Trip rates or equations based on small sample sizes should be used with caution.

In the planning stage, some variables, such as employment and parking, are estimated on the basis of other variables, such as gross square feet of building space. When little is known about the size of the generator except the proposed use of the land to be developed, common development densities can be used to obtain a preliminary estimate of the independent variable. The City of Scottsdale Zoning Ordinance should be checked to determine the appropriate density parameters, see www.ScottsdaleAZ.gov/codes.

Floor area is one of the most commonly used independent variables. There are, however, different ways to compute floor area, and there are different definitions. These must be consistent when determining a trip generation rate and they should correspond to accepted floor area definitions. For office buildings, these include gross floor area, gross leasable area, and net leasable area. Care should be taken to exclude areas such as large atriums, which do not by themselves generate trips. Gross leasable area is commonly used for shopping centers.

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CHOOSING THE APPROPRIATE TIME PERIODS

The range of average rates for different time periods will be examined to determine when the generator peaks in traffic flow and to define the relationship between the peak generation and the peaking characteristics of the adjacent street system.

When the peak hour of the generator does not correspond to either the a.m. or p.m. peak hours of the adjacent street system, that additional time period must be analyzed to determine site-specific design requirements (such as auxiliary lane storage lengths).

DAILY AND SEASONAL VARIATIONS

5-1.605

Trip generation estimates for the average weekday are appropriate analyses for most, but not all, land uses. For some land uses, more trips are generated on Friday or Saturday than on the average weekday. Those days, rather than the average weekday, may be the most appropriate design or analysis period for those uses.

Seasonal variations are also important for some land uses. As a prime example, shopping centers should be analyzed for the period between Thanksgiving and Christmas, which is traditionally the busiest shopping season. For recreational and hotel land uses the consultant must provide an analysis that adjusts the background traffic to replicate the appropriate peak season of the generator. Seasonal adjustment factors are available from the Transportation Department.

DRIVEWAY TRAFFIC VS. TRAFFIC ADDED TO ADJACENT STREETS

5-1.606

It is usually assumed that all trips entering and exiting a new development are new trips that were not made to or through the area prior to the development being completed. However, for some non-residential developments, a portion of these trips may be “captured” from trips already being made to other existing developments on the adjacent street system, or they may be merely passing by on the way from one place to another. The driveway volume for a new development may, therefore, be significantly different from the amount of traffic added to the adjacent street system. For example, retail establishments, restaurants, banks, service stations, and convenience markets attract people from the passing stream of traffic; these are known as pass-by trips.

ITE's Trip Generation Handbook contains discussions and references on the issue of pass-by trips. Because of the limited data available, adjustments for pass-by trips should be applied carefully. If pass-by trips are a major consideration, studies and interviews at similar land uses must be conducted or referenced.

MULTI-USE PROJECTS

5-1.607

Most trip generation rates and equations have been gathered at and apply to isolated single-use developments. When multiple uses are combined into one development, simply adding the single-use estimates together can result in a total trip generation estimate that is too high.

While trip rates and equations are available for shopping centers, little data exists for other multi-use projects such as downtowns, suburban mixed-use centers, or planned unit developments. Some national publications, such as NCHRP Reports, may provide data that can be useful in some cases.

Multi-use projects are another case in which any adjustments should be applied carefully because of the limited amount of data available. If this is a major consideration for the proposed development, an analysis should be performed to determine the amount of trips that would be external for single uses, but which would be internal in a proposed mixed-use development. Trip Generation Handbook provides some information on this subject.

SPECIAL OR UNUSUAL GENERATORS

5-1.608

Occasionally, a development proposal will consist of special or unusual land uses for which typical trip generation rates or equations are not available, or simply do not apply. Judgment must be applied to identify a land use or combination of land uses that best represent the trip-making characteristics of the site. The reasoning and data used by the consultant in developing a trip generation estimate for a special or unusual generator must be justified and explained in the report.

5-1.700**SITE TRAFFIC DISTRIBUTION & ASSIGNMENT****5-1.701****DISTRIBUTION METHODS**

The directions from which traffic will access the site can vary depending on many factors, including:

1. The type of proposed development and the area from which it will attract traffic,
2. The presence or absence of competing developments within the same market area,
3. The size of the proposed development, and
4. The conditions on the surrounding street system.

The influence area of the development needs to be identified for the site. Ideally, the influence area should contain approximately 80% of the trip ends that will be attracted to the site. If a market study is available, it should be used in establishing the influence area. Otherwise, an influence area should be established based on a reasonable documented estimate.

The three most common methods for estimating trip distribution are by analogy, model, and surrogate data. In most cases, a surrogate data method can be utilized for developing the trip distribution. Utilizing this procedure involves using socioeconomic and demographic data to establish population or employment land use distributions around the site. In most cases, population can be used as the basis for estimating distribution of office, retail, and entertainment trips; employment is a reasonable surrogate for residential trips, and other trips can be similarly distributed using logical surrogates. For horizon years, land use estimates based on the city's General Plan should be utilized.

For some very large-scale developments, a trip distribution model should be utilized to estimate site trip distribution. The gravity model portion of the city's traffic forecasting model is available for this purpose.

5-1.702**TRIP ASSIGNMENT AND PASS-BY TRIPS**

After trip distribution is completed, trip assignment is used to determine the amount of traffic that will use certain roadway links within the influence area. The product of the trip assignment process is the total project-generated trips, by direction and turning movement.

Trip assignment should be made considering logical routings, available roadway capacities, left turns at critical intersections, and travel times. The assignment should also reflect the horizon year(s), roadway, and land use conditions at that time.

As discussed in [Section 5-1.600](#), many land uses do not generate only vehicle trips that are entirely new to the roadway network. A portion of their trips may simply be diverted from trips already on adjacent or nearby streets. Because of limited data and research in the area of pass-by trips, a thorough analysis is required if pass-by trips are to be accounted for in the study. The following procedure will be used:

1. For the peak hour being analyzed, determine the percentage of pass-by trips as part of the total trip generation. The basis for this estimate should be documented. Split the total trip generation number into a new trip amount and a pass-by trip amount.
2. In addition to estimating a normal trip distribution (for new trips), estimate a trip distribution for pass-by trips (giving strong consideration to the commuting work trip).
3. Perform two separate trip assignments, based on the two distributions. One assignment applies to pass-by trips; the other assignment applies to new trips. Care must be taken, as the pass-by trip assignment is more complicated. Pass-by assignment percentages should not automatically be applied to 2-way traffic, since an outbound pass-by trip may use a different route than an inbound pass-by trip. Also, due to the diversion concept, pass-by trip assignment involves subtracting trips from some existing traffic movements and assigning the trips to other movements.

4. Combine the numerical pass-by and new trip assignments. Remember the subtraction required on some vehicle movements because of diversion. Proceed to the analysis process.
5. Check the results for reasonableness. If pass-by trips diverted from a thoroughfare represent more than 15% of the traffic volume on the street, they should be re-evaluated.

REDEVELOPMENT PROJECTS

5-1.703

Since the purpose of the impact study is to evaluate a development proposal's impact on the transportation system, redevelopment projects require some special analysis. In the case of redevelopment projects, existing site-generated trips should be subtracted from existing and horizon year off-site traffic. The traffic generated by the proposed development is then added to the adjusted off-site traffic according to the above procedures to determine the impacts on the transportation system.

The consultant will establish the existing site generated trips through the collection of driveway counts. If the redevelopment area is substantial, or for some other reason does not lend itself to the collection of driveway counts for this purpose, trip generation rates may be applied to establish the existing site generated trips.

ANALYSIS

5-1.800

This section describes the analytical techniques used to derive the study findings, conclusion, and recommendations. As new methodologies are developed and validated, they may be considered by the city or the consultant for applicability to the study requirements.

Capacity analysis must be performed at each of the major street and site access intersection locations (signalized and unsignalized), as well as transportation links, located within the study area. In some cases, there may be a need to analyze additional critical intersections or segments located outside the basic study area.

In addition to capacity analysis, several other transportation service-related factors shall be considered, including:

- Safety
- Circulation patterns
- Traffic control needs
- Transit needs or impacts
- Transportation system management
- Neighborhood impacts
- On-site parking adequacy and off-site parking facilities if any are to be used for site generated parking
- Pedestrian and bicycle circulation
- Service and delivery vehicle access and circulation

TOTAL TRAFFIC ESTIMATE

5-1.801

For each analysis period being studied, a projected total traffic volume must be estimated for each segment of the roadway system being analyzed. These projected total traffic volumes (consisting of site and non-site traffic) will be used in the capacity analyses. The traffic impact report must clearly depict the total traffic estimate and its components. Projected daily traffic volumes must be determined for all major streets within the study area as well.

5-1.802**GUIDELINES**

Once the total traffic volume estimate has been established, capacity analyses will be performed. In some cases, the projected demand may be unrealistically higher than the capacity available on the existing or proposed transportation system components. In those cases where improvements are not feasible, an adjustment may be necessary in the site and/or background traffic to reflect realistic traffic diversion caused by capacity restraint. In such cases, the traffic components on all adjusted segments must be added again to obtain a more realistic total traffic projection. The original traffic estimates and specific reference to trip diversion shall be included in the report.

5-1.803**IDENTIFICATION OF IMPACTS, NEEDS & COMMON DEFICIENCIES**

The analysis is intended to show the relationship between the operations and geometry and to assess deficiencies, as well as to identify alternatives for further consideration. This requires the identification of impacts, needs, and deficiencies.

The analysis of internal circulation, parking, off-site circulation, and capacity analyses will provide the basis for identifying transportation deficiencies and needs related to the proposed development. The analyses shall be conducted for conditions both with and without the proposed project in order to establish the incremental impacts of the project and the incremental needs it generates.

5-1.804**LEVEL OF SERVICE AND CAPACITY ANALYSIS**

The evaluation of traffic operating conditions is referred to as level of service (LOS). The assessment of LOS is based on the quantitative effect of factors, such as speed and volume of traffic, geometric features of the roadway or intersection, traffic interruptions and delay, and freedom to maneuver.

A. Signalized Intersections

Signalized intersection level of service will be determined utilizing the methods contained in the Highway Capacity Manual (HCM), 2000 or most recent edition. Two methods (operational and planning) are provided for the analysis of signalized.

The operational analysis requires detailed information on all prevailing traffic, roadway, and signalization characteristics. It provides for a full analysis of capacity and level of service and can be used to evaluate alternative traffic demands, geometric designs, signal plans, or all three. Because of the detailed data requirements, the operational analysis should be used only for the evaluation of existing conditions or for the analysis of projects with a horizon year of less than 5 years in the future. When critical variables are missing, it may be necessary to conduct a planning analysis. However, default values may be used for some of the variables without seriously compromising computations. Caution should nonetheless be used when applying such values and it must be used. The input data needs, with values that have been determined to be most appropriate for the City of Scottsdale, are listed in [Figure 5.1-1](#).

TYPE OF CONDITION	PARAMETER	SYMBOL	DEFAULT
Geometric Conditions	Area Type	CBD, Other	No default
	Number of Lanes	N	No default
	Average Lane Width, ft.	W	No default
	Grade, %	%G	0%
	Existence of Exclusive LT or RT lanes	None	No default
	Length of Storage Bay, LT or RT Lane	L _s	No default
	Parking Conditions	Yes, No	No parking
Traffic Conditions	Volumes by Movement, vph	V	No default
	Ideal Saturation Flow Rate by Mov't, pcphgpl	S _o	2,000 pcphgpl (through lanes)
			1,800 pcphgpl (turn lanes)
	Peak Hour Factor	PHF	0.92
	Percent Heavy Vehicles	%HV	2%
	Conflicting Pedestrian Flow Rate, peds/hr	PEDS	None: 0 peds/hr
			Low: 50 peds/hr
			Mod: 200 peds/hr
			High: 400 peds/hr
	Local Buses Stopping in Intersection	NB	0/hr
	Parking Activity, pkg maneuvers/hr	N _m	20/hr (pkg exists)
	Arrival Type (1-6)	AT	3 if isolated
			4 if coordinated
	Proportion of Vehicles Arriving on Green	P	
Signalization Conditions	Cycle length, sec	C	60-120 seconds
	Green Time, sec	G	No default
	Yellow Change Interval	Y	3.0 seconds
	All-Red Clearance Interval	AR	1.0 second
	Actuated or Pre-timed Operation	A or P	Actuated
	Pedestrian Push-Button?	Yes, No	Yes
	Minimum Pedestrian Green	G _p	No default
	Phase Plan	None	No default

*For specific signal timing information, contact the Scottsdale Traffic Management Center (THM) at 480-312-4325.

FIGURE 5.1-1 LEVEL OF SERVICE DEFAULT DATA

One of the most critical traffic characteristics that must be quantified to complete an operational analysis is the quality of the progression. The arrival type is best observed in the field, but could be approximated by examining time-space diagrams for the street in question. The arrival type should be determined as accurately as possible because it will have a significant impact on delay estimates and LOS determination.

The planning analysis only addresses capacity because it is not necessary or practical to perform detailed calculations of delay given the accuracy of the data that are generally available for planning purposes. The planning method generates two important products: (a) a projection of the status of the intersection with respect to its capacity, and (b) an approximation of a signal timing plan. Combining this approximation with appropriate values for other

parameters used in the operational analysis, it is possible to extend the planning analysis into the level of the operational analysis.

The data requirements for the planning method are much less rigorous. Still, it is necessary to answer the following three questions in order to perform the analysis:

1. Will parking be allowed?
2. Will the signal be coordinated with the upstream signal on this approach?
3. How will left turns be accommodated?

If the answers are not known to any of these questions, then the analysis should be completed and compared for each alternate condition, and a recommendation made as to the most desirable design conditions.

B. Unsignalized Intersections

Unsignalized intersection level of service will be determined utilizing the methods contained in the Highway Capacity Manual (HCM), 2008 or most recent edition. Procedures have been developed to analyze both 2-way stop controlled intersections and all-way stop controlled intersections. Each of these analysis methods is further divided into analysis of 4-way intersections and T-intersections.

C. Arterials

In most cases, the capacity of an arterial street is dictated by the signalized intersections operating along its length. The analysis procedures described in the HCM rely on the results of the analysis methods above as a part of the input. Planning applications may use the entire arterial methodology, in a straightforward but somewhat simplified way, by computing stopped delay using certain default values as outlined in the signalized intersection analysis section. A reasonable estimation of the intended signal timing and quality of progression is vital to this process.

D. Capacity Analysis Software

Software that accurately replicates the HCM computations may be used in lieu of manual computations. Assumptions should be verified, as well as checking default values. The consultant must verify that the city has access to the software that it intends to use, so that city staff may properly verify inputs and results.

5-1.805

SAFETY

A. Vehicles

The initial review of existing data within the study area shall include the accident experience for the past 3 years. This review should identify locations where roadways serving the site must be analyzed, and measures to alleviate accident hazards must be considered. Accident rates vary, but any intersection with more than one accident per million entering vehicles is worthy of additional analysis. Accident records can be obtained from the Transportation Department.

B. Pedestrians and Bicycles

The site plan should be reviewed to ensure that the internal circulation system and external access points are designed for pedestrian safety and to minimize vehicle/pedestrian conflicts. Locations for transit stops and their associated pedestrian flows to building access points require thorough assessment to ensure safety. Similarly, pedestrian flows to and from parking facilities need careful consideration during site planning, which often requires detailed information on the project's use and layout.

These considerations should also be addressed for projects expected to generate significant bicycle traffic.

FORMULATION OF MITIGATION ALTERNATIVES

5-1.806

When the analyses indicate that a particular location is projected to operate at an acceptable level of service, no improvements are required. If, however, deficiencies are recognized, then improvements in access, geometry, or operations must be investigated. When reasonable improvements cannot sufficiently accommodate projected traffic, more detailed assessments of project size, land use, or development phasing may be required.

Many major projects necessitate improvements to the area's roadway infrastructure, both internally and externally. The nature of these improvements and their timing must be related to the anticipated phasing of the development, as well as the changes within the study area as a whole.

For redevelopment projects, mitigation alternatives will include transportation demand management measures, including, but not limited to transit, bicycle, and pedestrian improvements.

SITE ACCESS & OFF-SITE IMPROVEMENTS

5-1.900

To develop recommendations for site access and off-site roadway improvements requires that judgments be applied to a number of alternative solutions or recommendations.

ESTABLISHMENT OF GOALS

5-1.901

Study recommendations and conclusions are intended to provide safe and efficient movement of traffic to and from, within and past, the proposed development, while minimizing the impact to non-site trips.

The following levels of service are required after the completion of each phase of the development, as well as completion of the entire project:

1. All intersections and arterials must operate at LOS D (or better) during the peak traffic hour of the roadway system. All intersection approaches, and intersection turning movements should operate at LOS D (or better) and must operate at LOS E (or better) during the peak traffic hour of the roadway system. When the planning analysis is performed, the requirement will be that all intersections operate at "near capacity" or "under capacity."
2. In areas where current levels of service, or future levels of service without the development, are E or worse, the delay or v/c ratio may not be significantly increased by the development traffic.

RECOMMENDATIONS

5-1.902

During the final phase of the study, all analyses are reviewed and re-assessed to best respond to the actual transportation needs of the project and the adjacent area. Results must be placed in logical perspective and sequence.

In high-growth areas, particularly when large developments are being analyzed, it is important to determine the impact of individual phases of the development. This procedure becomes necessary in situations requiring assessments to fund improvements. In such cases, the following analyses should be completed:

1. Levels of service under existing conditions.
2. Levels of service for future horizon dates, with anticipated non-site generated traffic growth. Committed improvements should be included for each horizon year in the analyses. Additional improvements necessary to attain LOS D for base conditions should be identified.
3. Levels of service including site generated traffic for horizon years, both with and without proposed additional improvements to local and regional roadways beyond those identified in step 2.

A. Network Improvements

Network improvements recognize that individual developments and increasing traffic volumes are part of the long-term growth of an area. Roadway improvements associated strictly with any given development may not necessarily address the long-term needs of the rest of the region on a systematic basis, and thus not address overall transportation system needs. Therefore, a section of the traffic impact study will address compatibility with the existing and planned infrastructure.

B. Localized Improvements

Localized improvements consist of modification, expansion, and in some cases addition of roadway facilities in the immediate vicinity of the proposed development. The scope of these improvements will be consistent with the LOS criteria established above. They will address specific site and through traffic needs, and will be compatible with the city's long-term improvement plans.

C. Program Improvements

If adequate transportation improvements cannot be reasonably recommended, consideration should be given to reducing trip generation during problem periods by reducing the project magnitude or altering the land use mix.

5-1.903**IMPLEMENTATION SCHEDULE**

It is important to view recommendations for improvements within appropriate time perspectives. Recommendations should be sensitive to the following issues:

1. Timing of short-term and long-term network improvements that are already planned, scheduled, and/or funded.
2. Time schedules of adjacent developments.
3. Size and timing of individual phases of development.
4. Rights-of-way needs and availability of additional rights-of-way within appropriate time frames.
5. City priorities for transportation improvements and funding.
6. Cost-effectiveness of implementing improvements at a given stage of development.
7. Necessary lead-time for additional design and construction.

5-1.1000**ON-SITE CIRCULATION**

An integral part of an overall traffic impact study relates to basic site planning principles. It is extremely important that off-site roadway improvements be fully integrated with on-site recommendations.

5-1.1001**APPROACH TO SITE PLANNING**

Internal design will have a direct affect on the adequacy of site access points. The identification of access points between the site and the external roadway system, and subsequent recommendations concerning the design of those access points, is directly related to both the directional distribution of site traffic and the internal circulation system configuration. It is clear that driveway traffic volumes of varying sizes need to be accommodated on the site in terms of both providing sufficient capacity and queuing space, and of distributing automobiles to and from parking spaces, pick-up/drop-off points, and drive-through lanes. An integrated system should deliver vehicles from the external roadway system in a manner that is easily understood by drivers, maximizes efficiency, accommodates anticipated traffic patterns, and ensures public safety. Pedestrian linkages should conveniently

and safely connect transit stops and parking facilities with building entrances. Similar linkages should be provided between buildings.

It must be understood that simply providing access to a site by means of curb cuts does not necessarily mean that access to the development has been adequately addressed. The quality of access as it relates to the internal site circulation and design will have a direct relationship on the quality of traffic flow in and around the site development, as well as a direct impact on public safety.

ON-SITE PLANNING PRINCIPLES

5-1.1002

A. Access Points

Requirements for access to the public street system are detailed in [Section 2-1.600](#) and [Section 5-3.200](#). The guidelines should be followed as closely as possible. Exceptions will only be granted when there are demonstrable extenuating circumstances.

Joint access (the sharing of a driveway by two or more properties) is desirable; particularly where property frontages are short and driveway volumes will be low. Such driveways should be located on joint property lines or be accessible via cross-access easements on the private property being served by the joint driveway.

B. Vehicular Queuing Storage

Adequate internal and external vehicle queuing storage is essential to providing safe and efficient access and circulation. Queuing analyses must be included to demonstrate the adequacy of the proposed storage lanes.

Drive-in and drive-through establishments should be provided with adequate queue storage capacity to accommodate normal peak queues. Since many of these businesses have major daily or seasonal variations in activity, peaking characteristics should be carefully evaluated.

C. Internal Vehicular Circulation

Internal circulation is the means by which vehicular traffic is delivered between entry points and parking areas, pick-up/drop-off points, and service areas. Internal circulation roadways should permit access between all areas. These roads should be designed to safely and efficiently deliver vehicles and pedestrians to their respective destinations.

D. Service and Delivery Vehicles

Service and delivery vehicles require separate criteria for movement to and from the site. Of particular interest is that adequate turning paths are provided for large service vehicles to allow entry and exit without encroaching upon opposing lanes or curbed areas. In addition, sufficient storage areas must be provided so that service vehicles do not hinder the use of parking and circulation routes for other visitors to the site.

E. Pedestrian, Transit, Bicycles, and Accessible Facilities

The overall site plans should also consider public transportation, pedestrians, bicyclists and those with disabilities. Adequate facilities for parking bicycles should be included. Transit facilities, car pool parking, and shuttle bus staging areas should be provided as appropriate for the development. Where provided, these facilities should be located adjacent to service drive and entrance locations, at key locations along circulation drives, or at major pedestrian focal points along the external roadway system.

Pedestrian connections between these facilities and the site's buildings must be integrated into the overall project design and provide maximum accessibility through the use of sidewalk ramps, etc. These connections must also be provided to the public sidewalk and path or trail systems surrounding the site. See [Section 5-6.000](#) Transit, [Section 5-7.000](#) Bikeways, [Section 5-8.000](#) Pedestrian Facilities, and [Section 5-9.000](#) Neighborhood Traffic Management.

5-1.1100**TIMA REPORT****5-1.1101****PURPOSE AND END USES**

The purpose of the impact and mitigation analysis is to identify and measure the effects of a proposed development on the surrounding transportation system, and determine appropriate measures necessary to mitigate those impacts. The developer will be able to utilize the report to evaluate their development proposal and site plan. The city will also utilize the report in reviewing the attributes of proposed developments in conjunction with requests for annexation, land subdivision, zoning changes, building permits, or other development reviews.

5-1.1102**PRESENTATION**

The study report will include at a minimum:

1. Study purpose and objectives;
2. A description of the site and study area;
3. Existing conditions in the area of the development;
4. Anticipated nearby development;
5. Trip generation;
6. Trip distribution;
7. Modal split;
8. Traffic assignment resulting from the development;
9. Projected future traffic volumes;
10. An assessment of the change in roadway operating conditions resulting from the development traffic; and
11. Recommendations for site access and transportation improvements needed to maintain traffic flow to, from, within, and past the site at an acceptable and safe level of service.

If the assumptions made in the analysis are based on published sources, then those sources should be specifically referenced. If other, less readily available sources are used, a more detailed explanation must be provided and a copy of the relevant information provided in an appendix.

Please follow the sample report outline provided below and the instructions provided by the Transportation Department staff and/or the Project Coordination Manager when completing the analysis and report. Incomplete reports will be returned to the consultant for revisions or completion prior to a full review of the analysis.

5-1.1103**CERTIFICATION**

A professional engineer registered in the State of Arizona must seal the report. If this certification is not provided, the report must be clearly stamped "DRAFT" or "PRELIMINARY."

5-1.1104**SAMPLE REPORT OUTLINE**

The outline structure shown in [Figure 5.1-2](#) provides a framework for the Transportation Impact and Mitigation Analysis report. Some studies will be easily documented using this outline; however, additional sections may be warranted because of specific issues to be addressed and/or the results of the study. Likewise, inapplicable sections listed in the outline may be omitted from the report.

TIMA REPORT OUTLINE	
I. Introduction to Summary A. Purpose of Report and Study Objectives B. Executive Summary 1. Site locations and study area 2. Development description 3. Principal findings 4. Conclusions 5. Recommendations II. Proposed Development A. Off-site development B. Description of on-site development 1. Lane use and intensity 2. Location 3. Site plan 4. Zoning 5. Phasing and timing III. Area Conditions A. Study Area 1. Area of influence 2. Area of significant traffic impact B. Study Area Land Use 1. Existing land uses 2. Existing zoning 3. Anticipated future development C. Site Accessibility 1. Area roadway system a. existing b. future 2. Traffic volumes and conditions 3. Transit service 4. Existing relevant transportation system management IV. Projected Traffic A. Site traffic (each horizon year) 1. Trip generation 2. Trip distribution 3. Modal split 4. Trip assignment B. Through Traffic (each horizon year) 1. Method of projections 2. Non-site traffic for anticipated development in study areas	a. Method of projections b. Trip generation c. Trip distribution d. Modal split e. Trip assignment 3. Through traffic 4. Estimated volumes C. Total Traffic (each horizon year) V. Traffic Analysis A. Site Access B. Capacity and Level of Service C. Traffic Safety D. Traffic Signals E. Site Circulation and Parking VI. Improvement Analysis A. Improvements to accommodate base traffic B. Additional improvements to accommodate site traffic C. Alternative improvements D. Status of improvements already funded, programmed, or planned E. Evaluation VII. Findings A. Site accessibility B. Traffic impacts C. Need for improvements D. Compliance with applicable City of Scottsdale codes VIII. Recommendations A. Site access/circulation plan B. Roadway improvements 1. On-site 2. Off-site 3. Phasing C. Transportation System Management Actions 1. On-site 2. On-site operational 3. Off-site D. Other Conclusions

FIGURE 5.1-2 TIMA REPORT OUTLINE

RIGHTS-OF-WAY MANAGEMENT

This section specifies the requirements for securing an encroachment permit for encroaching in the City of Scottsdale's public rights-of-way (ROW) and public utility easements. It outlines responsibilities and requirements for permits, utility construction plans, construction considerations, and as-builts.



DEPARTMENT RESOURCE INFORMATION

Aviation/Airport	15000 N. Airport Dr.	480-312-2321
Advance Planning Services	7506 E. Indian School Rd.	480-312-7990
Capital Project Management	7447 E. Indian School Rd., Suite 205	480-312-7250
Current Planning	7447 E. Indian School Rd., Suite 105	480-312-7000
Customer Service	7447 E. Indian School Rd., Suite 100	480-312-7800
Downtown Group	4248 N. Craftsman Ct.	480-312-7750
Facilities Management	9191 E. San Salvador Dr.	480-312-5999
Fire & Life Safety/ Inspections	8401 E. Indian School Rd.	480-312-1855
Fire Plan Review	7447 E. Indian School Rd., Suite 125	480-312-7080
Inspections & Land Survey	9191 N. San Salvador Dr.	480-312-5750
Parks Department	7340 Scottsdale Mall	480-312-2915
One Stop Shop/Permit Services	7447 E. Indian School Rd., Suite 100	480-312-2500
Plan Review	7447 E. Indian School Rd., Suite 125	480-312-7080
Records Division	7447 E. Indian School Rd., Suite 100	480-312-2356
Solid Wastewater Management	9191 N. San Salvador Dr.	480-312-5600
Stormwater Management	7447 E. Indian School Rd., Suite 205	480-312-7250
Street Operations	9191 N. San Salvador Dr.	480-312-5626
Transportation	7447 E. Indian School Rd., Suite 205	480-312-7696
Water Resources	9388 E. San Salvador Dr.	480-312-5685
City of Scottsdale	www.scottsdaleaz.gov	

RIGHTS-OF-WAY MANAGEMENT

5-2

GENERAL INFORMATION

5-2.000

PERMIT REQUIREMENTS

5-2.001

Scottsdale requires an encroachment permit according to Chapter 47 of the Scottsdale Revised Code, see www.ScottsdaleAZ.gov/codes.

The city administers all planning, permitting and construction processes in accordance with the following documents:

- **Maricopa Association of Governments (MAG) Uniform Standard Specifications**
www.mag.maricopa.gov/
- **City of Scottsdale Supplement to the MAG Uniform Standard Specifications**
www.ScottsdaleAZ.gov/design/COSMAGSupp
- **Arizona Utility Coordinating Committee (AUCC) Public Improvement Project Guide including the Joint Trench Use Model and Western Underground Trench Formula**
www.ci.phoenix.az.us/AGENCY/PHXEASD/cpage.html
- **City of Phoenix Barricade Manual and the Manual on Uniform Traffic Control Devices** www.mutcd.fhwa.dot.gov/

PURPOSE OF A PERMIT

5-2.002

Permits are necessary to assure that all work done in the rights-of-way (ROW) is:

1. Completed in the proper location with adequate spacing;
2. Built with acceptable materials and in accordance with current specifications;
3. Installed in a safe and expeditious manner.

And that:

4. Final completion is assured and acceptable;
5. All infrastructure is protected;
6. Unnecessary traffic delays or congestion to the traveling public is limited;
7. All landscaping is restored; and
8. Liability issues are properly addressed.

Engineered construction drawings (plans) must be submitted for review. The objective is to make optimal utilization of the space available in the public ROW and public utility easements; assure compliance with all city ordinances, policies and standards; assure coordination with other ROW users, agencies and city project activities; and reduce risk and/or inconvenience to the traveling public. After the application is submitted, the city may add special conditions or stipulations to the permit, which are important for the applicant to review for compliance.

Permits are reviewed in scope by the city and these permits do not relieve a permittee from any of the stated standards in the Permit Requirement section above and/or any federal, state,

city or industry accepted practice. It is the permittee's responsibility to ensure compliance with all of the above stated requirements. Plans that have been reviewed by the city do not relieve a permittee of this requirement unless the deviation from these standards is clearly specified on the plans and permit and the permittee has received; beyond the standard city permit approval, an additional, written approval from the city. This additional approval does not waive any other stated requirements on the plans or stipulations to the plans.

5-2.003

LICENSE AND OTHER REQUIREMENTS**A. Telecommunications Facilities (Pending Telecom Ordinance)**

All telecommunications providers who desire to construct, install, operate or maintain telecommunications facilities in the public highways must first obtain a Telecommunications License from the City of Scottsdale as stated in Chapter 47, Article VI of the Scottsdale Revised Code, except in cases where state law forbids establishment of a license requirement. Licensing information is available by calling the Telecommunications Policy Coordinator at 480-312-4138.

B. Cable TV

All cable television and telecommunications providers who provide cable television services, programs or signals must obtain a Cable TV License from the City of Scottsdale as stated in Chapter 7 of the Scottsdale Revised Code. Licensing information is available by calling the Telecommunications Policy Coordinator at 480-312-4138.

C. Wireless Communications

All providers who provide wireless communications infrastructure must file a pre-application with the Planning & Development Services Department to determine the approval process prior to obtaining a ROW encroachment permit.

For more call 480-312-2500 or go to www.ScottsdaleAZ.gov/bldgresources/devprocess. An application checklist is available at www.ScottsdaleAZ.gov/bldgresources/forms.

D. All Other Aboveground Improvements

Installation of any aboveground improvements requires a pre-application, filed with the Planning & Development Services Department, to determine the approval process prior to obtaining a ROW encroachment permit.

For more call 480-312-2500 or go to www.ScottsdaleAZ.gov/bldgresources/devprocess.

5-2.100

PERMITS

The ROW encroachment permit application is submitted to the One Stop Shop. Encroachment permit applications for public and private utility work will be submitted to the Inspection Services and Land Survey office at 9191 E. San Salvador. Include with the application a minimum of 3 sets of construction drawings, details, notes, Traffic Control Plan, Barricade Plan, project schedule, insurance certificates, plating plan, a communication plan and any other necessary information. In reference to projects proposed on Primary Roads, it is strongly encouraged that a provider submits project plans and the Traffic Control Plan as far in advance of the project as is reasonably possible, prior to application for an encroachment permit. However, the plans, Traffic Control Plan and a permit application may be submitted simultaneously.

Upon receiving the application and appropriate drawings, details and notes, etc., city staff will log the request into the city's automated permit system and route the documents for technical review. This review includes, but is not limited to, checking for compliance with construction standards, approving alignments, verifying that the work is in the public rights-of-way or public

utility easement, determining if other work is occurring at the same time or at the same site, verifying that all joint trench opportunities have been incorporated into the design, checking for conflicts, reviewing traffic impacts, reviewing the Barricade Plan and verifying that all city requirements have been met and incorporated into the plans.

Upon completion of the review, the permit application will be either issued to the applicant or returned for further modifications. Permits are issued for a specified timeframe based on the estimated length of the project construction. If additions or corrections are required to the plans or permit application, the applicant will be notified and asked to make corrections and resubmit to the city.

PERMIT TYPES

5-2.101

A. General ROW Encroachment Permit

A permit is required for all encroachment in, on, above, over, under or through the city's rights-of-way, including all public utility easements. The Rights-of-Way Encroachment Permit application forms are available at the City of Scottsdale's One Stop Shop. The General ROW Permit Application must be submitted to the One Stop Shop.

B. Public and Private Utility Permit

A permit is required for all utility work, public and private, that occurs within the city's ROW or within public utility easements. A Utility Company Right of Way Permit Application is available at the City of Scottsdale's One Stop Shop or the Inspections and Survey Services office, and online at www.ScottsdaleAZ.gov/bldgresources/forms. The Public and Private Utility Permit Application must be submitted to the Inspections and Survey Services office.

C. Emergency Encroachment Permit

For emergency repairs involving loss of service, call Inspection Services at 480-312-5750 to state the type of emergency, the location, the number of lanes closed, a contact name, estimated time to complete the repairs and a cell phone number. In addition, fax the barricade plan to Inspection Services at 480-312-5704 within 24 hours.

NOTE: The installation of new service is not an emergency.

The appropriate construction project signage needs to be posted by the permittee as outlined in [Section 5-2.307](#).

This permit is available online at eservices.ScottsdaleAZ.gov/planreview.

D. Annual Maintenance Encroachment Permit

A permittee who owns an improvement in the city's ROW or a subcontractor may apply for an annual maintenance encroachment permit at the One Stop Shop. The annual maintenance encroachment permit must be renewed every year; permitted activities include entering manholes, cabinets or other above/below ground improvements, but do not include any pavement or concrete cutting. The maintenance encroachment permit number must be shown on the insurance certificate.

PERMIT FEES

5-2.102

Fees for all permits will be charged per city policy. Permittees must demonstrate proof of insurance as required in [Section 5-2.104](#). Permit fees and other construction costs are collected in accordance with the fee schedule in Chapter 47 of the Scottsdale Revised Code (except as superseded by a franchise or license agreement) when each permit is issued. On joint trench projects, the surcharge fee will be apportioned to the participating utilities. See www.ScottsdaleAZ.gov/bldgresources/fees.

5-2.103**PERMIT DURATION**

The permit application needs to identify the anticipated length of construction (start and stop dates) in calendar days. The city may require additional construction scheduling information on a case-by-case basis. The actual construction start date is subject to city approval. The permit is activated by calling Inspection Services at 480-312-5750 a minimum of 72 hours prior to the start of construction and obtaining city approval of a barricade plan (if needed) prior to commencing work.

In the event a permittee has not begun construction within the approved timeframe, then the project may be subject to additional planning and coordination efforts. If the permittee does not expeditiously complete construction in the approved timeframe, then enforcement action may be taken. Failure to expeditiously complete the project within the permitted timeframe may result in denial of future permits until the project is completed to the city's satisfaction.

5-2.104**INSURANCE REQUIREMENTS**

Before the city will issue any permits, the contractor must provide a Certificate of Insurance with agreed to limits of liability and which lists the city as additionally insured.

A. Permittee Liability

The permittee is responsible for all liability imposed by law for damages arising out of or related to work performance or failure by the permittee, permittee's agents, contractors and all tiers of subcontractors under the permit. If any liability claim is made against the city, its officers or employees, the permittee will defend, indemnify, and hold the city harmless from any such claim.

B. Insurance Limits

No applicant is entitled to an encroachment permit unless a current Certificate of Insurance has been filed and maintained with the city, certifying that the permittee carries public liability and property damage insurance issued by an insurance carrier authorized to do business in the state. This insures the applicant and the city and its agents against loss by reason of injuries to or death of persons or damages to property arising out of or related to work performed by the applicant, its agents or employees while performing any work under the permit. Such insurance is primary and provides coverage for liability assumed by the applicant under subsection (a) of this section and needs to be provided by the permittee in the following minimum amounts:

1. General Liability Insurance - \$1,000,000 each occurrence, \$2,000,000 Products and Completed Operations Aggregate and \$2,000,000 General Aggregate.
2. Vehicle Liability Insurance - \$1,000,000 Combined Single Limit
3. Worker's Compensation Insurance - As required by Arizona law
4. The city Risk Management Director may set higher or lower limits of liability insurance depending on risk exposures.

C. Effective Timeframe of Insurance

Failure by the applicant to provide the city with the required insurance certificate and failure by the city to demand the filing by permittee of such a certificate before such a permit is issued, does not waive the permittee's obligation to provide the insurance.

The required insurance certificate must remain in effect and be kept on file with the city until all work to be performed by the permittee (under the permit) has been completed. Where an encroachment involves a permanent obstruction, the required insurance certificate requirements remain in effect until the construction is removed.

The insurance certificate provides that coverage cannot expire or be canceled without providing the city 10 days written notice of such action.

TRAFFIC CONTROL PLANS

5-2.105

The purpose of a Traffic Control Plan is to proactively plan for, coordinate and minimize the impacts of encroachment and construction in the ROW. The Traffic Control Plan is designed to help the City of Scottsdale understand what traffic impacts will occur during a construction project. The Traffic Control Plan is intended to identify the phasing of large projects, including lane restrictions, closures, plating or any restriction that could delay the traveling public.

1. A Traffic Control Plan needs to be submitted prior to (with plans) or accompanied by the permit application for all proposed work in or on Primary Roads, see [Figure 5.2-1](#). The Traffic Control Plan is subject to all city review processes and must be reviewed and approved by the city prior to permit issuance. Additional information and stipulations may be required on a case-by-case basis. The required Traffic Control Plan is in addition to the submission of a Barricade Plan prior to the start of construction, see [Section 5-2.306](#).
2. The Traffic Control Plan will:
 - a. Provide the estimated start date, preferably within 15 days of actual construction.
 - b. Provide the duration of construction.
 - c. Provide hours that traffic restrictions will be in place (24 hour, off-peak mid-day and off-peak night, etc.).
 - d. Identify the length of the project and location details, including lane closures and type of work.
 - e. Describe any construction phasing that will occur during the project, specifically how the barricading configuration will change during the duration of the project and how it will be accomplished in the project schedule.
 - f. Provide a map of the affected area of construction, showing existing lane striping, proposed work zone, existing speed limit and detail all driveway, alleys, transit facilities, median breaks or other locations where traffic may enter/exit or be in conflict with the project work zone.

UTILITY CONSTRUCTION PLAN

5-2.200

All Utility and Telecommunications Construction Plans must comply with [Section 1-2.100](#) and [Section 9-1.000](#). Additional plan details may be required on a case-by-case basis.

CONSTRUCTION REQUIREMENTS

5-2.300

WORK HOURS IN THE RIGHTS-OF-WAYS

5-2.301

Generally, no interference with traffic flow on Primary Roads is permitted during the hours of 7 to 9 a.m. or from 4 to 6 p.m. unless prior authorization is obtained in writing by the Traffic Engineering Director or designee, see [Figure 5.2-1](#). Specific work hours may be stipulated by the city on the project's Barricade Plan. Night work must have prior authorization from the city and may be required by the Traffic Engineering Director or designee. In addition, certain areas of the city may have seasonal or special event restrictions for construction work, as designated by the city on a case-by-case basis. Contact the Traffic Engineering Division at 480-312-7696 for updated seasonal or special event restrictions.

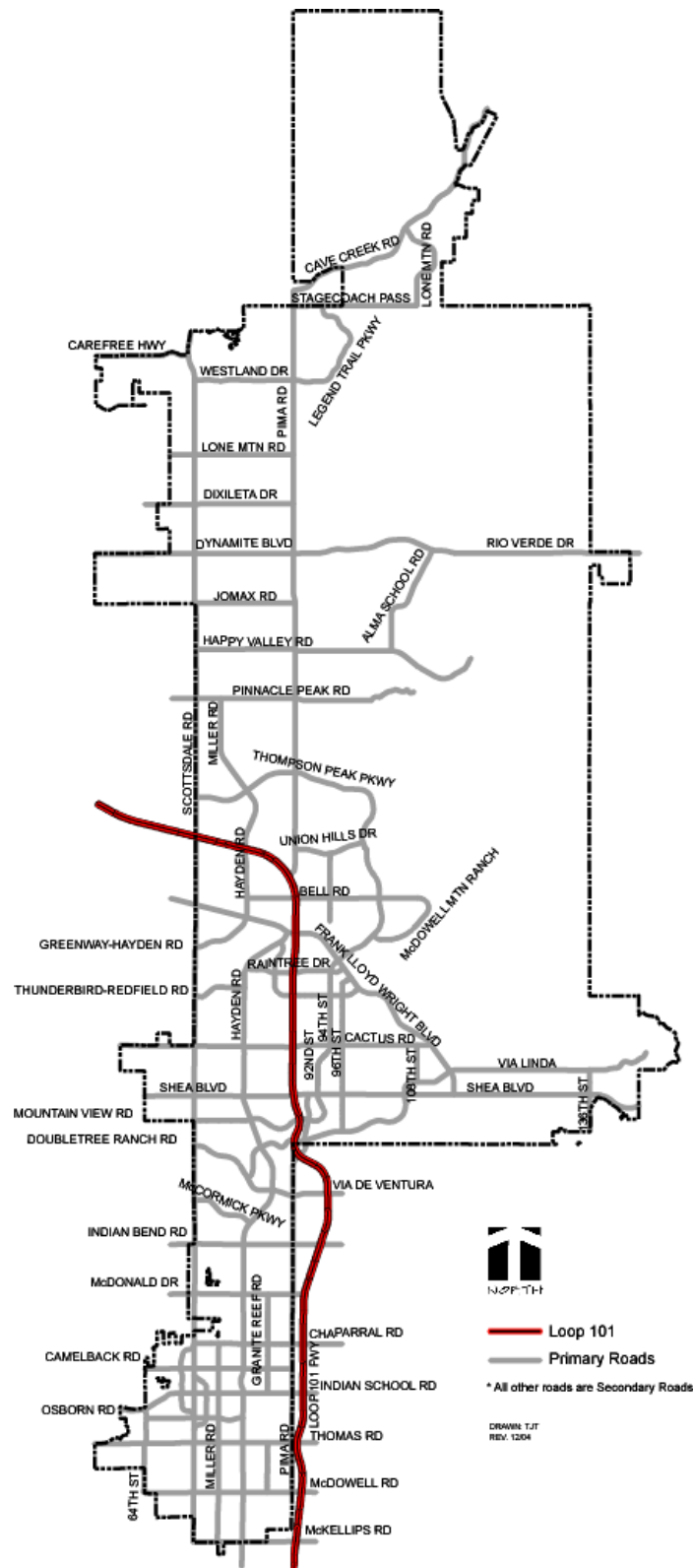


FIGURE 5.2-1 PRIMARY ROADS

5-2.302

JOINT TRENCHING POLICY

Work in the rights-of-way has significantly increased over the past several years causing disruption to the traveling public, continual pavement cuts often in the same location and conflicting with other facilities within the rights-of-way. For these reasons, the city has increased its management of work in the rights-of-way, enacting a joint trench process for projects being done on Primary Roads. This policy is designed to:

1. Minimize the public's inconvenience with minimal lane closures;
2. Decrease multiple pavement cuts that detract from the life of the street;
3. Allow for proper space allocation within a limited rights-of-way area;
4. Aesthetically address multiple users' needs with properly placed facilities, manholes and cabinets, etc.

A. Criteria

The City of Scottsdale requires a permittee to joint trench a project if the project is located on a Primary Road and the trench is 1,000 feet or longer. Joint trenching may also be required by the city on a case-by-case basis when a permittee's trench is 1,000 feet or less or on a Secondary road. The requirement for joint trenching on a Primary or Secondary Road is defined to include the entire ROW, not just curb-to-curb.

All requests for an exception to the joint trench requirement for any project must be submitted in writing to the city and will be reviewed and approved by city staff on a case-by-case basis.

B. Procedure

1. Preliminary planning and design should be done by the permittee in accordance with the Arizona Utility Coordinating Committee's Joint Trench Use Model. See www.ci.phoenix.az.us/AGENCY/PHXEASD/cpage.html for the joint trench use model and notification form.
2. The permittee must contact potential joint trench participants, as listed on file with the City of Scottsdale. Call 480-312-4138 to obtain a current participant list.
3. The permittee as the lead provider, must send a notice to each potential participant, either by fax, email or U.S. mail, of the joint trench opportunity, and provide proof of notice to the city.
4. The permittee must also post a joint trench opportunity notice on the city's web site. See www.ci.phoenix.az.us/AGENCY/PHXEASD/cpage.html for the AUCC Joint Trench Notification Form.
5. If participation is requested by another provider, then the permittee must give a minimum 2 weeks timeframe for interested companies to supply the permittee with their needs so they can be included in the permittee's working drawing.
6. As part of the project plan set, the permittee must provide a trench cross-section and a plan that depicts the details of the proposed work, including the trench, manholes, driveways, utility cabinets/facilities locations and other appurtenances. The plan must show that all location conflicts have been resolved.
7. The permittee then submits 3 copies of the plan set, along with a permit application and a Traffic Control Plan to the city's One Stop Shop for staff review and approval.
8. Upon city approval of the plan, the permittee obtains the permits and schedules an on-site pre-construction meeting with the city's utility inspector to review the proposed work, timing of work and any approved barricade plans prior to commencing any work. This is critical to ensure the positive progress of work being done in ROW.

C. Participants

Participants in the joint trenching include public utility and telecommunication providers (both current and future licensees).

D. Failure to Participate

Permits involving asphalt cuts and joint trench locations will only be issued once during a 2-4 year timeframe in any given location. Providers need to plan accordingly. Under extreme circumstances, the city may, at its sole discretion, waive the stated timeframe requirements. A franchise agreement or license is required to use the rights-of-way. Companies not possessing a license must do so by contacting the city's Telecommunications Policy Coordinator at 480-312-4138.

5-2.303**POTHOLING (VACUUM EXCAVATION)**

A permit is required for all utility location work. All potholing will be done in accordance with COS Standard Details to the MAG Uniform Standard Specifications, Details 2200 and 2201, located on the city's web site at: www.ScottsdaleAZ.gov/design/COSMAGSupp.

5-2.304**STREET BORING REQUIREMENTS**

All utilities or other facilities crossing existing city streets, regardless of the age of the street, must be bored or punched unless permission to open cut has been given in writing by the city Traffic Engineering Director or designee. The burden of proof will lie with the permittee to show that boring is not a feasible requirement. The permittee must specify the boring method on the construction plans, such as "directional boring." This requirement is used to assess appropriate boring methods. Certain types of boring, such as use of water jets are not allowed. The permittee must also indicate on the construction plans the anticipated impact on and restoration of existing facilities. The proposed method is approved by the city on a case-by-case basis during plan review. If field conditions are such that boring has been demonstrated to city Inspections to be infeasible, then the permittee may be permitted to open cut.

5-2.305**UNDERGROUNDING REQUIREMENT**

All new public utility, cable TV, telecommunications fiber optic, cellular, dark fiber or similar facility must be installed underground. If new facilities are proposed in an area that has existing overhead lines, the new facilities will be required to go underground and any permittees with existing overhead facilities may participate in reinstalling these facilities underground when a joint trench opportunity is provided. When major upgrades are planned, utility and telecommunications providers may underground existing facilities currently on existing poles.

Installation of new facilities or major enhancements to existing facilities need to be installed underground unless it can be demonstrated that the public's general health, safety and welfare are affected by the underground installation or that the provider lacks the ability to install the facilities underground. The fact that an underground installation is more costly than an overhead installation is not, in and of itself, a health or safety issue.

All above ground appurtenances need to be designed and installed with attention to minimizing the number of appurtenances, maximizing joint locations, combining with existing boxes and sharing facilities. All locations will meet industry standards for sight distance locations, all industry safety requirements and the aesthetic requirements of the city. The issuance of a permit in violation of any of the requirements will not void the permittee's responsibility, unless the substandard installation is clearly noticed and approved separately from the normal permit requirement.

5-2.306

BARRICADE PLAN

1. Work in/on residential streets typically does not need a Barricade Plan, but, unless otherwise exempted by law, all signs, barricades and other necessary traffic control devices need to be placed in accordance with the city of Phoenix Barricade Manual, <http://phoenix.gov/streets/07barman.pdf>, and the Manual on Uniform Traffic Control Devices (MUTCD), www.mutcd.fhwa.dot.gov/.
2. Where a Barricade Plan is required, it must be submitted with a Barricade Plan application form to Inspection Services a minimum of 3 work days before any proposed partial or complete closure of a street, alley, sidewalk, bus stop, trail, or other public way, by faxing the Barricade Plan to 480-312-5704.
3. Work cannot be initiated on the portion of the project requiring barricading until Barricade Plan approval has been obtained in writing from both Inspection Services and Traffic Engineering divisions.
4. The Barricade Plan must be prepared by a person certified by the American Traffic Safety Services Association (ATSSA).
5. The Barricade Plan must include the following information:
 - a. Streets names, alleys and major driveway intersections to be barricaded
 - b. Sidewalks, trails and multi-use paths to be barricaded.
 - c. Bus bays and any bus stop infrastructure to be barricaded.
 - d. Sign and barricade types to be used by code or graphic depiction
 - e. Sign and barricade location and spacing, including Variable Message Signs, relocated traffic control signs, and project identification signs
 - f. Taper and tangent length
 - g. Graphic depiction of vehicle travel lanes and bike lanes.
 - h. Detour plans
 - i. North arrow
 - j. The hours of operation for the project
 - k. The construction duration and schedule
 - l. Barricade plan preparer, barricade company and contractor contact information.
6. Except during emergencies, pedestrian service/safety needs to be fully preserved at crosswalks (marked/ unmarked) and other facilities used by pedestrians. The Barricade Plan must incorporate these six fundamental principles for successfully accommodating pedestrians through work zones:
 - a. Traffic and pedestrian safety must be an integral and high-priority element in every project, from planning through design and construction.
 - b. Pedestrian and traffic movements should be inhibited as little as practical and planned to reduce exposure to potential hazards.
 - c. Pedestrians and motorists should be guided in a clear and positive manner while approaching, traversing and leaving work sites.
 - d. Routine inspection of traffic control devices must be performed.
 - e. Personnel must be adequately trained in the proper management of pedestrian and traffic control, so they are qualified to make work zone safety decisions in the selection, placement and maintenance of traffic control devices.
 - f. Pedestrian paths through the work zones should replicate as nearly as possible the elements of the existing path and comply with the ADA.
7. The Barricade Plan must be in substantial conformance with the Phoenix Traffic Barricade Manual.
8. Traffic control devices shown in the Barricade Plan must be installed and/or removed by persons certified by Phoenix through successful completion of its temporary traffic control

training program. An employee working for a company certified by Phoenix is deemed certified. Scottsdale accepts the Phoenix temporary traffic control training program certification as set forth in the Phoenix 2007 Traffic Barricade Manual, as amended.

9. Traffic control devices may be placed only when work is about to begin, is underway, or another justifiable reason exists to protect the public health, safety or welfare.
10. A copy of the approved Barricade Plan must be available at the jobsite at all times when work is occurring, including placing and removing barricades. The barricade company is responsible for having the Barricade Plan on site when its workers are placing or removing the traffic control devices.
11. Where a major change to a Barricade Plan is required, it must be submitted on a Barricade Plan change form to Inspection Services a minimum of 3 work days prior to any proposed change, by faxing the Barricade Plan to 480-312-5704.

5-2.307

CONSTRUCTION SIGNS

The permittee is required to post information signs at the work site identifying the name of the utility authorizing the work. The purpose of the sign is to identify the permittee authorizing the work and the contractor performing the work. This signage is still required even when marked company vehicles are present at the work site. Required sign information also includes a phone number where a person can call and receive information about the job and leave a message. The permittee must respond to all phone messages within 24 hours. In addition, all permittees must return regular traffic control signs back to their original place and replace any signs damaged during construction. General signage requirements are listed below. Specific project signage may be required by the city on a case-by-case basis.

A. Primary Roads

Projects on Primary Roads, as identified in [Figure 5.2-1](#) that are either greater than 1 mile in length or have a construction timeframe of 30 calendar days or longer, must utilize the following signage, and as shown in [Figure 5.2-2](#):

1. Variable Message Board (VMB) sign at each end of the project indicating:
 - a. Location of construction, including cross streets names.
 - b. Direction of travel restricted.
 - c. Dates and duration.
 - d. Alternate route suggested.
2. Stationary Signs at each end of the project indicating:
 - a. Names of authorizing company and permittee.
 - b. Phone number for job information and as means to get a response to phone calls/ message.
 - c. Estimated start and completion dates for project.
 - d. Project description.
 - e. Conform to the following format:
 - At least 4 foot x 4 foot size sign, with a minimum of 4 inch to 6 inch letters (black legends/orange background).
 - Type style is to be block, sans serif, medium width stroke, no more than 50 percent condensed, and not extra bold, not italics letters for better readability (For example: Helvetica medium typestyle).
 - Sign should have an inset border with rounded corners.



FIGURE 5.2-2 WORK ZONE PROJECT SIGNAGE

B. Other Primary and All Secondary Roads

All projects not meeting the criteria listed above in [Section 5-2.307](#) paragraph A must post two stationary signs that conform to [Section 5-2.307](#) paragraph A2, or as directed by Traffic Engineering.

COMMUNITY NOTIFICATION

In addition to the above signage requirements, community notification will be required where there will be significant traffic, ingress/egress, construction or noise impacts on a particular area. Community notification may take different forms depending upon the particular permitted project or work. Some possible methods of notification could include: additional signage, door hangers, community newsletters, press releases and should try to include one method of auditory/electronic delivery such as community meetings, phone message lines and web site information. The city reserves the sole right to determine the appropriate community notification requirements for all permitted projects on a case-by-case basis.

5-2.308

INSPECTIONS

All above ground and underground facilities and equipment placed in the ROW, and all construction work done in the ROW is subject to periodic and final inspection for compliance, with all permit requirements, as well as all applicable city, state and federal laws. Permittee must notify Inspection Services at 480-391-5750 at least 72 hours prior to beginning permitted construction work in the ROW. Requests for city inspections must be made 24 hours in advance of required inspections.

5-2.309

PAVEMENT CUTS

As outlined in Chapter 47 of the Scottsdale Revised Code, www.ScottsdaleAZ.gov/codes, no excavation is permitted in newly paved, resurfaced or sealed public streets for the following time frames:

- Construction or reconstruction of a structural section: 4 years.
- Surfacing, resurfacing or sealing of an existing structural section: 2 years.

In the event of emergency, these periods may be waived by the city.

5-2.310

STRIPING/MARKINGS REQUIREMENTS

All striping and markings requirements, placement and removal must comply with:

- The Maricopa Association of Governments (MAG) Uniform Standard Specifications, www.mag.maricopa.gov/, and
- The Manual on Uniform Traffic Control Devices (MUTCD), www.mutcd.fhwa.dot.gov/.

5-2.311

5-2.312**TRANSIT FACILITIES/AMENITIES**

If the project affects a bus stop, the permittee must create a temporary bus stop, with comparable amenities, if feasible, as close to the affected stop as possible and in a safe location. An accessible route of travel must also be provided. Permittee must also return all transit facilities and amenities to their original location and condition or replace them if damaged during construction. Permittees must, as part of their traffic control plan, address how buses (which are generally 108 inches wide, plus mirrors) will maneuver through the site and whether a detour is necessary. In addition, the permittee needs to provide a minimum 2-week notice to the city's transit office so that the city can provide information about detours, access and projected construction timeframe. If the construction is an emergency, the city's transit office needs to be notified immediately 480-312-7696.

5-2.313**ABANDONED FACILITIES OR FACILITIES REMAINING AFTER EXPIRATION OF ENCROACHMENT PERMIT**

If at any time a permittee wishes to cease using and abandon facilities within the ROW, or if the permittee has not applied for and received an extension or renewal of the original permit from the city before an encroachment permit has expired, the permittee must provide for the disposition of its facilities within the ROW as outlined below.

If a permittee desires to abandon its facilities within the ROW, they must submit an abandonment request to Inspection Services Utility Permit Coordinator. The abandonment request may designate one of three alternatives (as defined below). The city then approves the request by issuing an abandonment plan. In issuing an abandonment plan, the city considers and attempts to accommodate the permittee's preference; however, the city retains the sole choice to designate one of the following three options:

1. Require the permittee to remove all structures, cable, equipment or facilities; or
2. Permit the city to accept ownership, in which case, the title to such structures, cable, equipment or other facilities vests in the city; or
3. Require the permittee to leave the facilities in place. If the facilities are abandoned in place, the permittee must record the facilities as "Abandoned in Place" and permanently maintain such records. Facilities that are Abandoned in Place will not need to be removed by the permittee. However, the permittee, by abandoning facilities in place, expressly permits the removal of such facilities by any future party at the sole discretion of the city.

If the abandonment plan requires the removal of facilities from the ROW, and the permittee fails to remove its structures, cable, equipment or other facilities within 180 days of notification by the city, then the city will serve written notice of failure to comply. Furthermore, if the permittee fails to rectify the removal within 10 days from the date the notice was received, the city may rectify the default as outlined below:

Upon removal of the structures, cable or other facilities, the city may submit in writing the cost incurred. Upon the permittee's receipt of notice of such amount, it shall immediately become a lien against the permittee's company, and shall remain a lien in favor of the city until the amount is paid in full, together with interest at the annual rate of 10 percent.

In the event no abandonment request is submitted to the city, the city has complete discretion to determine the disposition of all structures, cable, equipment or other facilities left within the ROW. Any costs and expenses incurred immediately becomes a lien against the permittee's company, and will remain a lien in favor of the city until the amount is paid in full by the permittee, together with interest at the annual rate of 10 percent.

The right and remedy will not be exclusive, and the city has all the rights and remedies available to it in accordance with the laws of the State of Arizona and the City of Scottsdale. The establishment of a lien does not preclude the city from establishing additional liens upon subsequent failure or failures to remove any improvement.

Abandonment of any and all above ground facilities and appurtenances are also subject to all of the requirements stated above.

ALLEYS

5-2.314

If construction or work is planned in an alley, prior to commencing work, the permittee needs to contact Sanitation at 480-312- 5600 to obtain the days of sanitation pickup for that alley. Those days are to be listed on the plan along with a plan note that construction is prohibited on those days; exceptions may be made on a case-by-case basis by the Sanitation Director or designee. A Barricade Plan must be submitted to Inspection Services (where submitted, to whom/what location) at least 72 hours prior to commencing work for any work to be done in an alley.

AS-BUILTS

5-2.400

The city requires submittal of as-built plans for all facilities constructed or installed within public ROW or within easements that are owned by the city. The permittee, who constructs facilities (not owned by the city) in the public ROW or within the easement, is required to maintain the facility as-builts and provide them to the city. The preferred as-built format is digital in either MicroStation or ArcView SHP format. The digital as-builts must conform to the Maricopa Association of Governments Computer Aided Drafting (CAD) standards and must reference the City of Scottsdale encroachment permit number, see [Section 1-2.200](#). It is preferred that digital as-builts utilize the City of Scottsdale's base maps (streets, rights-of-way and parcels) as the foundation for the drawings.

GEOMETRICS

This section identifies the geometric requirements for each street classification within the city.

It includes guidance for sight distance, access, sidewalks, roundabouts, bridges, retaining walls and structural clearances, side slopes, partial street improvements, pavement transitions, frontage roads, subdivision streets and Environmentally Sensitive Lands (ESL) street standards.



DEPARTMENT RESOURCE INFORMATION

Aviation/Airport	15000 N. Airport Dr.	480-312-2321
Advance Planning Services	7506 E. Indian School Rd.	480-312-7990
Capital Project Management	7447 E. Indian School Rd., Suite 205	480-312-7250
Current Planning	7447 E. Indian School Rd., Suite 105	480-312-7000
Customer Service	7447 E. Indian School Rd., Suite 100	480-312-7800
Downtown Group	4248 N. Craftsman Ct.	480-312-7750
Facilities Management	9191 E. San Salvador Dr.	480-312-5999
Fire & Life Safety/ Inspections	8401 E. Indian School Rd.	480-312-1855
Fire Plan Review	7447 E. Indian School Rd., Suite 125	480-312-7080
Inspections & Land Survey	9191 N. San Salvador Dr.	480-312-5750
Parks Department	7340 Scottsdale Mall	480-312-2915
One Stop Shop/Permit Services	7447 E. Indian School Rd., Suite 100	480-312-2500
Plan Review	7447 E. Indian School Rd., Suite 125	480-312-7080
Records Division	7447 E. Indian School Rd., Suite 100	480-312-2356
Solid Wastewater Management	9191 N. San Salvador Dr.	480-312-5600
Stormwater Management	7447 E. Indian School Rd., Suite 205	480-312-7250
Street Operations	9191 N. San Salvador Dr.	480-312-5626
Transportation	7447 E. Indian School Rd., Suite 205	480-312-7696
Water Resources	9388 E. San Salvador Dr.	480-312-5685
City of Scottsdale	www.scottsdaleaz.gov	

GENERAL INFORMATION

5-3.000

USE OF NATIONAL STANDARDS

5-3.001

See the American Association of State Highway and Transportation Officials (AASHTO), A Policy on Geometric Design of Highways and Streets, and AASHTO's Roadside Design Guide for clear zones, roadside obstacles, barriers and curb use.

All traffic control devices must comply with the Manual on Uniform Traffic Control Devices (MUTCD) prepared by the U.S. Department of Transportation as well as [Section 5-4.000](#) and [Section 5-5.000](#) of this manual. See the Transportation Research Board's Access Management Manual, Section 3.103 for access control guidelines.

STREET TYPES

5-3.002

A. Freeways

Freeways will be designed to safely handle very large volumes of through traffic. Direct access will be limited to widely spaced interchanges. Design, construction and operations will be provided by the Arizona Department of Transportation.

B. Arterial Streets

Arterial streets with raised medians provide regional continuity and carry large volumes of traffic between areas of the city and through the city. Full access to abutting commercial and multifamily land uses is limited to the greatest extent possible to facilitate movement of traffic. Pedestrian and bicycle crossings should be grade separated when feasible.

C. Collector Streets

Collector streets provide traffic movement between arterial and local streets, with some direct access to abutting commercial and multifamily land uses. Center left-turn lanes are provided to allow for greater access. Driveway access should be evenly spaced.

D. Local Streets

Local streets provide direct access to abutting land uses, provide access to the collector street system and accommodate low traffic volumes. Local streets should be designed to discourage high travel speeds.

Deciding the location of local collector, residential, commercial and industrial streets are usually done during the development site planning process. Planning for local streets is influenced by the plans for adjacent developments that have recently been approved. The Plan Review staff will review each preliminary proposal for development and will specify any changes needed to conform to previously planned and approved street alignments. Plan Review will also specify the classification for each street involved in the plan.

5-3.003

STREET CLASSIFICATIONS

The six street classifications are based upon the type and level of use for which streets are intended; see the specified figures in [Section 5-3.100](#) for design criteria. Special cross sections and design criteria apply for streets located within the Hillside or Upper Desert/Lower Desert areas of the ESL; [Figure 2.2-1](#) depicts the areas within the city where these criteria apply.

5-3.100

DESIGN STANDARDS

[Appendix 5-3A](#) and [Appendix 5-3B](#) list most of the design standards data necessary for the design of streets within the City of Scottsdale. Subsequent paragraphs in this booklet discuss these standards and provide other criteria that could not be included in the table.

5-3.101

MAJOR ARTERIALS**A. Rural Character**

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 35,000 - 55,000 vpd
- Design Speed: 55 m.p.h. Posted Speed: 45 m.p.h.
- Maximum Grade: 5.0%
- Minimum Grade: 0.4%

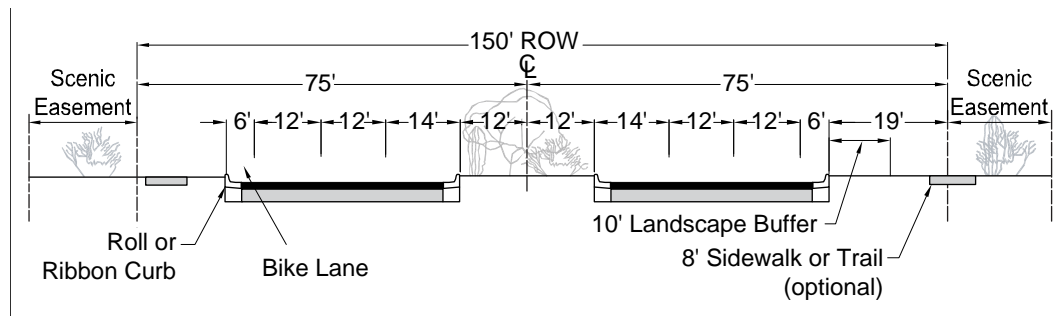


FIGURE 5.3-1 MAJOR ARTERIALS – RURAL CHARACTER

B. Suburban Character

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 35,000 - 55,000 vpd
- Design Speed: 55 m.p.h. Posted Speed: 45 m.p.h.
- Maximum Grade: 5.0%
- Minimum Grade: 0.4%

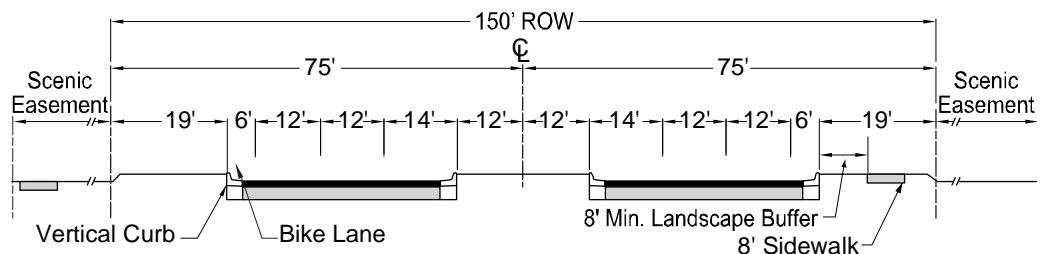


FIGURE 5.3-2 MAJOR ARTERIALS – SUBURBAN CHARACTER

C. Urban Character

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 35,000 - 55,000 vpd
- Design Speed: 55 m.p.h. Posted Speed: 45 m.p.h.
- Maximum Grade: 5.0%
- Minimum Grade: 0.4%

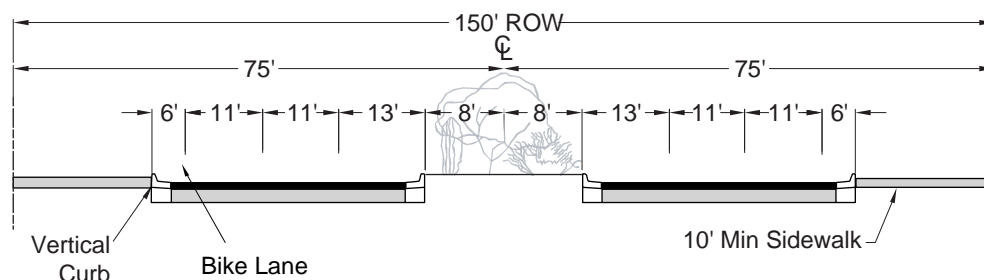


FIGURE 5.3-3 MAJOR ARTERIALS – URBAN CHARACTER

MINOR ARTERIALS

A. Rural/ESL Character

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 25,000 - 35,000 vpd
- Design Speed: 45 m.p.h.
- Maximum Grade: 5.0%
- Minimum Grade: 0.4%

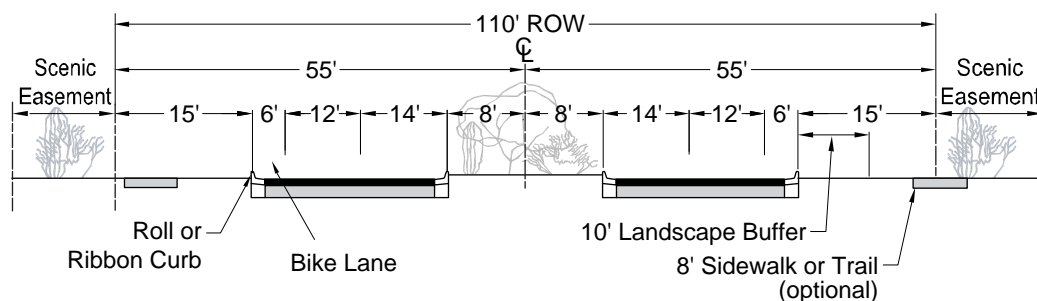


FIGURE 5.3-4 MINOR ARTERIALS – RURAL/ESL CHARACTER

B. Suburban Character

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 25,000 - 35,000 vpd
- Design Speed: 45 m.p.h.
- Maximum Grade: 5.0%
- Minimum Grade: 0.4%

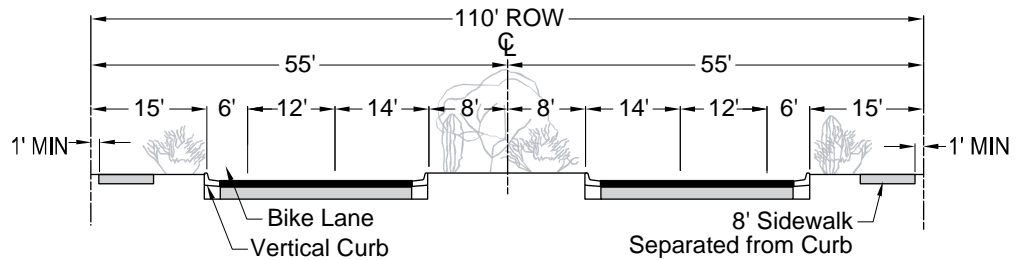


FIGURE 5.3-5 MINOR ARTERIALS – SUBURBAN CHARACTER

C. Urban Character

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 25,000 - 35,000 vpd
- Design Speed: 45 m.p.h.
- Maximum Grade: 5.0%
- Minimum Grade: 0.4%

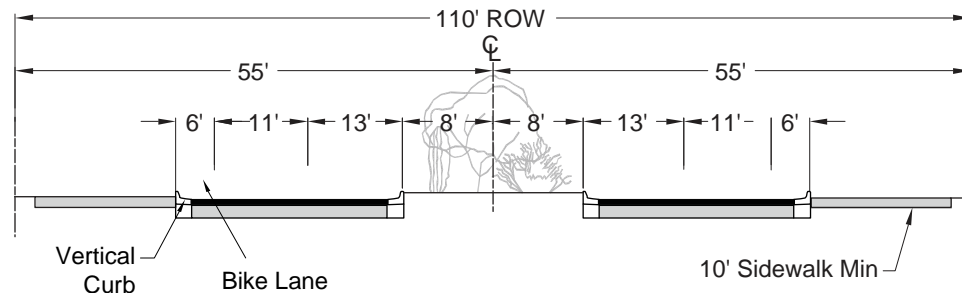


FIGURE 5.3-6 MINOR ARTERIALS – URBAN CHARACTER

5-3.103**COUPLETS**

- Couplet to be constructed in accordance with the Downtown Urban Design Guidelines
- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 25,000 - 35,000 vpd
- Design Speed: 45 m.p.h.
- Maximum Grade: 5.0%
- Minimum Grade: 0.4%

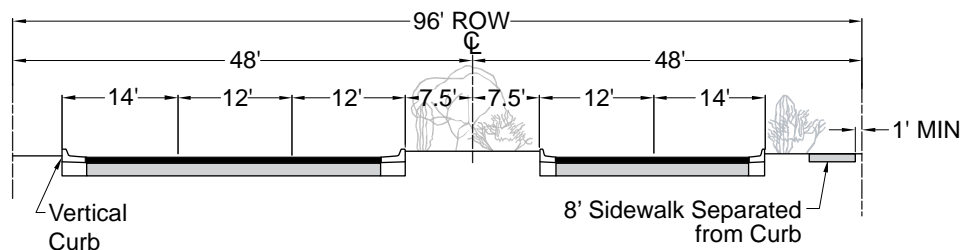


FIGURE 5.3-7 COUPLET STREETS

5-3.104

MAJOR COLLECTORS

A. Rural/ESL Character

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 15,000 - 30,000 vpd
- Design Speed: 45 m.p.h.
- Maximum Grade: 5.0%
- Minimum Grade: 0.4%

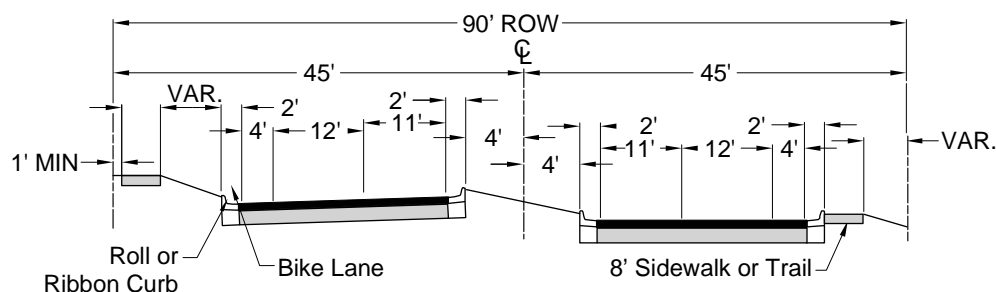


FIGURE 5.3-8 MAJOR COLLECTORS – RURAL/ESL CHARACTER

B. Suburban Character

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 15,000 - 30,000 vpd
- Design Speed: 45 m.p.h.
- Maximum Grade: 5.0%
- Minimum Grade: 0.4%

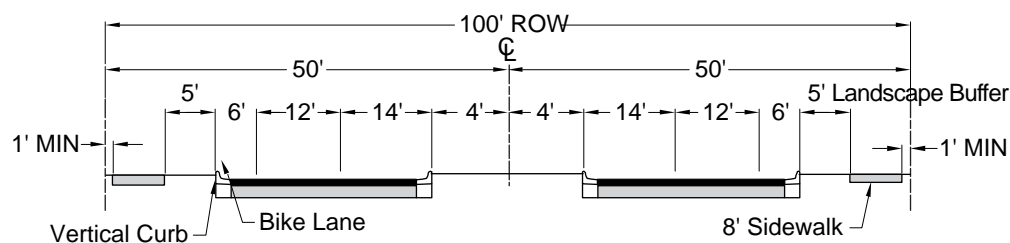


FIGURE 5.3-9 MAJOR COLLECTORS – SUBURBAN CHARACTER

C. Urban Character

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 15,000 - 30,000 vpd
- Design Speed: 45 m.p.h.
- Maximum Grade: 5.0%
- Minimum Grade: 0.4%

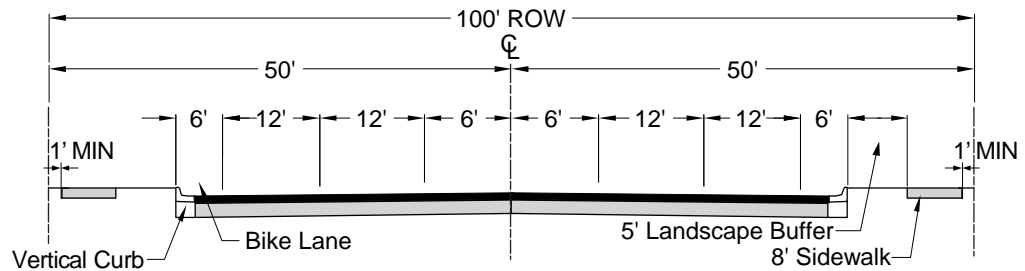


FIGURE 5.3-10 MAJOR COLLECTORS – URBAN CHARACTER

5-3.105

MINOR COLLECTORS**A. Rural/ESL Character with Trails**

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 5,000 - 15,000 vpd
- Design Speed: 35 m.p.h.
- Maximum Grade: 10.0%
- Minimum Grade: 0.4%

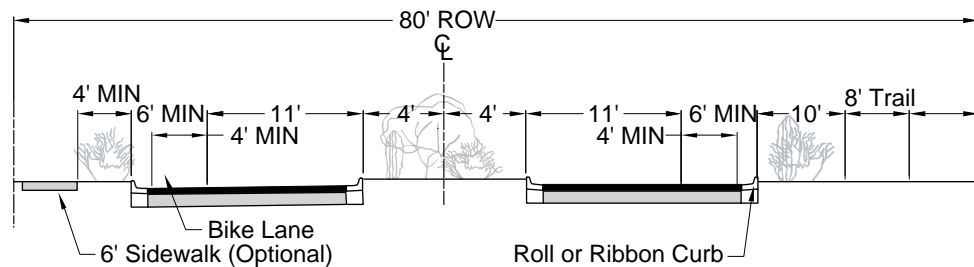


FIGURE 5.3-11 MINOR COLLECTORS – RURAL/ESL WITH TRAILS

B. Rural/ESL Character

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 5,000 - 15,000 vpd
- Design Speed: 35 m.p.h.
- Maximum Grade: 10.0%
- Minimum Grade: 0.4%

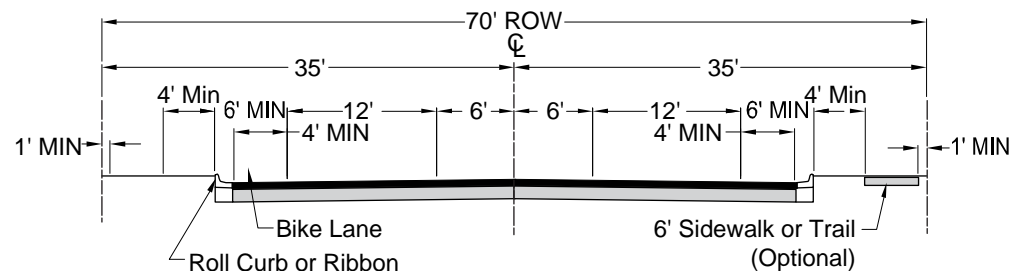


FIGURE 5.3-12 MINOR COLLECTORS – RURAL/ESL CHARACTER

C. Suburban Character

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 5,000 - 15,000 vpd
- Design Speed: 35 m.p.h.
- Maximum Grade: 8.0%
- Minimum Grade: 0.4%

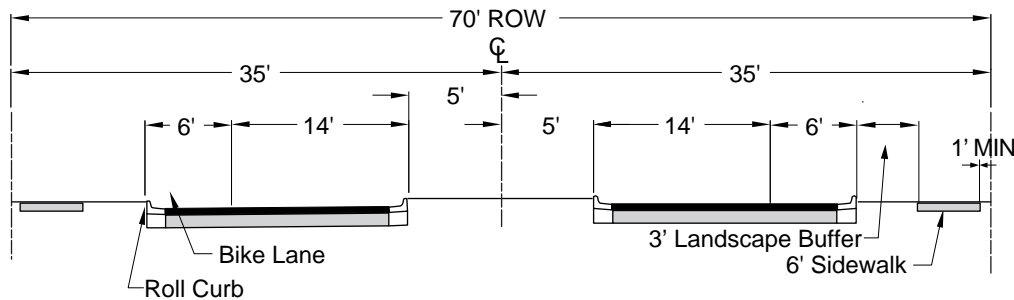


FIGURE 5.3-13 MINOR COLLECTORS – SUBURBAN CHARACTER

D. Urban Character

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 5,000 - 15,000 vpd
- Design Speed: 35 m.p.h.
- Maximum Grade: 7.0%
- Minimum Grade: 0.4%

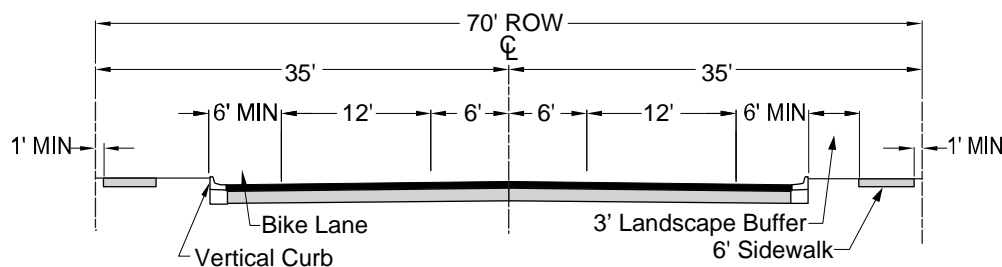


FIGURE 5.3-14 MINOR COLLECTORS – URBAN CHARACTER

LOCAL COLLECTORS

5-3.106

A. Rural/ESL Character with Trails

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 1,500 - 5,000 vpd
- Design Speed: 30 m.p.h.
- Maximum Grade: 11.0%
- Minimum Grade: 0.4%

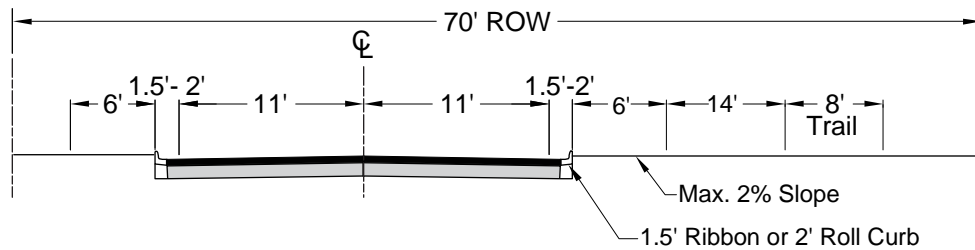


FIGURE 5.3-15 LOCAL COLLECTORS – RURAL/ESL WITH TRAILS

B. Rural/ESL Character

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 1,500 - 5,000 vpd
- Design Speed: 30 m.p.h.
- Maximum Grade: 11.0%
- Minimum Grade: 0.4%

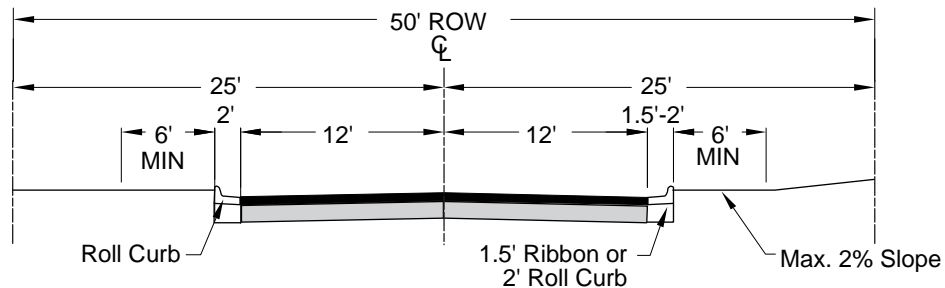


FIGURE 5.3-16 LOCAL COLLECTORS – RURAL/ESL CHARACTER

C. Suburban Character

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 1,500 - 5,000 vpd
- Design Speed: 30 m.p.h.
- Maximum Grade: 9.0%
- Minimum Grade: 0.4%

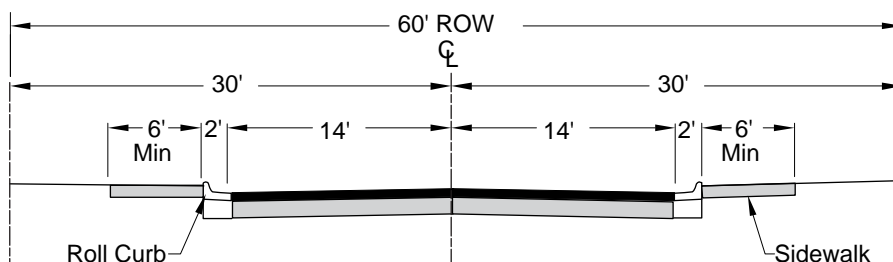
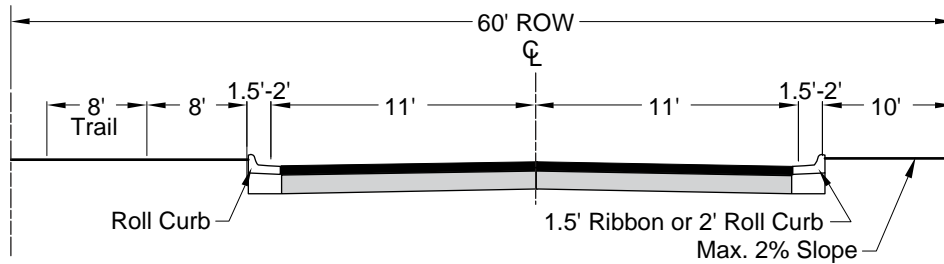


FIGURE 5.3-17 LOCAL COLLECTORS – SUBURBAN CHARACTER

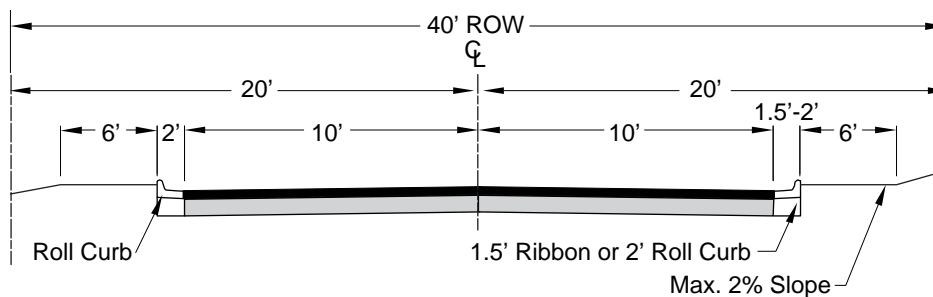
5-3.107

LOCAL RESIDENTIAL**A. Rural/ESL Character with Trails**

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 1,500 vpd Max.
- Design Speed: 20 m.p.h.
- Maximum Grade: 12.0%
- Minimum Grade: 0.4%

**FIGURE 5.3-18 LOCAL RESIDENTIAL – RURAL/ESL WITH TRAILS****B. Rural/ESL Character**

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 1,500 vpd Max.
- Design Speed: 20 m.p.h.
- Maximum Grade: 12.0%
- Minimum Grade: 0.4%

**FIGURE 5.3-19 LOCAL RESIDENTIAL – RURAL/ESL CHARACTER****C. Suburban Character**

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 1,500 vpd Max.
- Design Speed: 20 m.p.h.
- Maximum Grade: 10.0%
- Minimum Grade: 0.4%

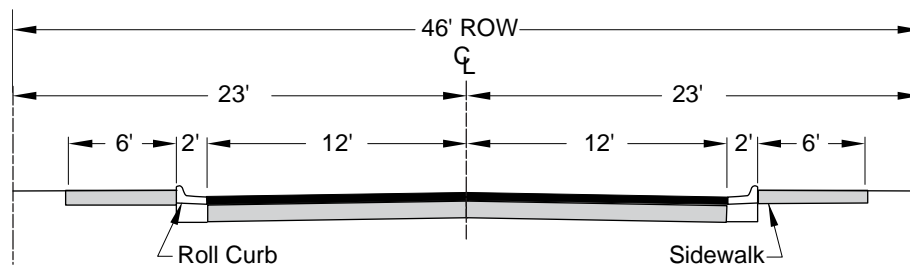


FIGURE 5.3-20 LOCAL RESIDENTIAL – SUBURBAN CHARACTER

5-3.108

LOCAL COMMERCIAL / INDUSTRIAL

- Auxiliary turn lanes may be required at intersections with additional ROW requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 1,500 - 5,000 vpd
- Design Speed: 20 m.p.h.
- Maximum Grade: 8.0%
- Minimum Grade: 0.4%

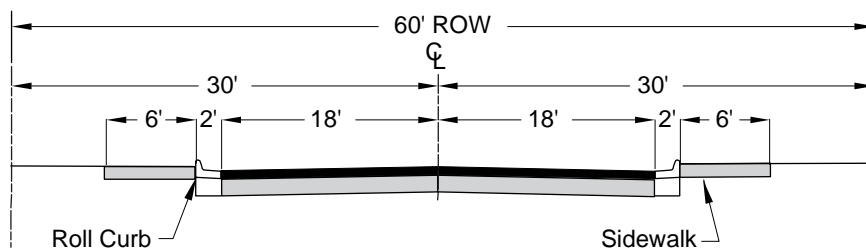


FIGURE 5.3-21 LOCAL COMMERCIAL / INDUSTRIAL

5-3.109

PRIVATE STREET REQUIREMENTS

All private streets shall be constructed to full public street standards, except equivalent construction materials or wider cross-sections may be approved by the Transportation Department. No internal private streets shall be incorporated into the city's public street system at a future date unless they are constructed, inspected, maintained and approved in conformance with the city's public street standards and approved by the City Council. Before issuance of any certificate of occupancy for the site, the developer shall post access points to private streets to identify that vehicles are entering a private street system.

5-3.110

STREET RIGHTS-OF-WAY REQUIREMENTS

Rights-of-way requirements are based on the space needed for the street to meet ultimate development requirements, see [Section 5-2.000](#) and [Section 5-3.100](#). Rights-of-way provides space for utilities, cut or fill slopes, sidewalks, bicycle paths, trails, traffic control devices and information signs, fire hydrants, landscaping, transit facilities and other public facilities that must be located adjacent to street pavements. Additional rights-of-way may be required at major intersections to provide for turn lanes.

Rights-of-way widths in excess of the standard widths may be required in special circumstances such as where:

- Cut or fill slopes cannot be confined within the standard width;
- Minimum sight distance lines on horizontal curves are not within the standards;
- Minimum sight distances at intersections are not within the standards;
- Auxiliary lanes are to be provided.

5-3.111

PAVEMENT CROSS-SECTION SLOPES**A. Typical Street Cross-Sections**

Undivided streets should have a normal crown that is a two-way cross-slope with the cross-section high point on the street centerline. Divided streets should have cross-slope on each pavement section. The high point of each slope on each pavement section must occur on the edge of the pavement nearest to the median. Unusual conditions may cause cross-slope requirements to vary, but normally, the desirable cross-slope is 2%, with a maximum cross-slope of 3%. Any deviation from the desirable cross-slope is subject to review by the Transportation Department.

B. Cross-Sections in Street Dip Sections

While dip sections are discouraged, where storm drainage runoff flows must cross the street, dip sections are needed. The pavements through the dip section should have a 1-way slope (no crown), curbing and medians must not be raised, and cut-off walls must be installed in accordance with City of Scottsdale standard details. Transitions back to normal street cross-slopes will be needed at both ends of the dip section.

MEDIANS

5-3.112

A. Median Widths

Median widths are measured from back-of-median curb to back-of-median curb. Where there is no curb, width is measured from the centers of the continuous, painted median stripes. Median widths are specified in [Appendix 5-3A](#) and [Appendix 5-3B](#). In special circumstances, the Transportation Department may approve other widths.

B. Paved Medians

A median 4 feet wide or less should be paved. The paved surface should be crowned and have the same cross-slope as the street pavement. Typical median paving materials are Portland cement concrete or concrete pavers.

C. Unpaved and Landscaped Medians

Medians that are five feet or more in width are normally not paved. The grading of the unpaved areas should be as shown below in Figure 5.3-22. If a median is to be landscaped, it shall be at least 4 feet wide. In the vicinity of intersections, landscaping and other median features must not restrict sight distance for left turning vehicles on the through street or for vehicles entering from the side street. See [Appendix 5-3A](#), [Appendix 5-3B](#), [Section 5-3.117](#) and [Section 5-3.119](#) for specific sight distance criteria.

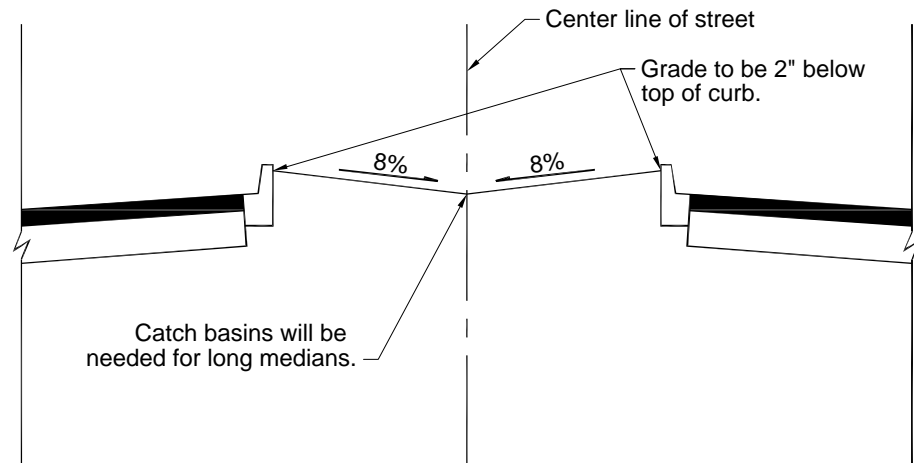


FIGURE 5.3-22 MEDIAN GRADING

5-3.113

CURBS**A. Vertical Curbs**

Vertical curbs are generally required for all streets in urban and suburban areas except local residential streets, see [Appendix 5-3A](#) and [Appendix 5-3B](#). Vertical curbs may be used in place of roll curbs on local streets if desirable for drainage considerations. Vertical curbs may be used on high speed roadways where the posted speed will be 45 m.p.h. or less. Vertical curbs provide positive access control, a refuge for pedestrians in the median and protection of signs.

Vertical curbs with gutter are to be constructed in accordance with City of Scottsdale Supplemental Standard Details for Public Works Construction, matching the adjacent pavement slope to the gutter cross slope direction. The curb height shown on the standard detail is 6 inches, but the following variations may be used where appropriate.

1. Where fire lane or public maintenance vehicle access to abutting property must be provided over the curb, use City of Scottsdale mountable curb and gutter.
2. If special drainage requirements make a higher curb necessary, the curb may be increased to 8 inches maximum and the gutter may be increased to 24-inches wide.

B. Roll Curb

A roll curb is preferred for local residential and local collector streets to provide direct lot access and for drainage considerations, especially on streets with adjacent sidewalk. Roll curbs may be used on major and minor collector streets where an adequate clear zone is provided. They are to be constructed in accordance with MAG Standard Details. Roll curbs are not an acceptable substitute for curb ramps.

C. Ribbon Curb, Maricopa Edge

Ribbon curb may be used in lieu of roll curb for local residential streets in low-density, large lot areas, typically where lot size is greater than 20,000 square feet. Type A Maricopa Edge may also be used for local residential streets in similar rural conditions with approval from the Transportation Department. When ribbon curb or Maricopa Edge is used, drainage runoff from the road should not drain along the road but will be directed to roadside drainage ditches. For design criteria for roadside ditches see [Section 4-1.404](#), and [Figure 4.1-1](#) for a typical cross section.

Ribbon curb or Maricopa Edge should also be used on the outside lanes of arterial streets in rural areas (speed limit 45 m.p.h. or greater, access point average equals 500 feet or greater) with a shoulder and an adequate clear zone provided.

D. Median Curb

In locations where raised medians are constructed, vertical curb should generally be utilized. Roll curb may be used around medians on low speed, low volume streets, typically associated with traffic calming projects, or where needed to maintain adequate width for emergency vehicles.

E. Cut-Off Walls

In locations where dip sections are permitted to allow drainage flows to cross roadways, cut-off walls conforming to City of Scottsdale standard details must be installed on both the upstream and downstream sides of the roadway. Cut-off walls must be at least 3 feet deep and have a top that is flush with the pavement surface. The exposed portion of the cut-off wall will have the appearance of a ribbon curb, with the same width as the street's regular curb and gutter, see [Figure 5.3-23](#). The cut-off walls must extend across the flow path in the dip section to protect the pavement structure during runoff flows from a 100-year storm. Transitions will be needed between the regular curb and the cut-off wall at each end of the dip section.

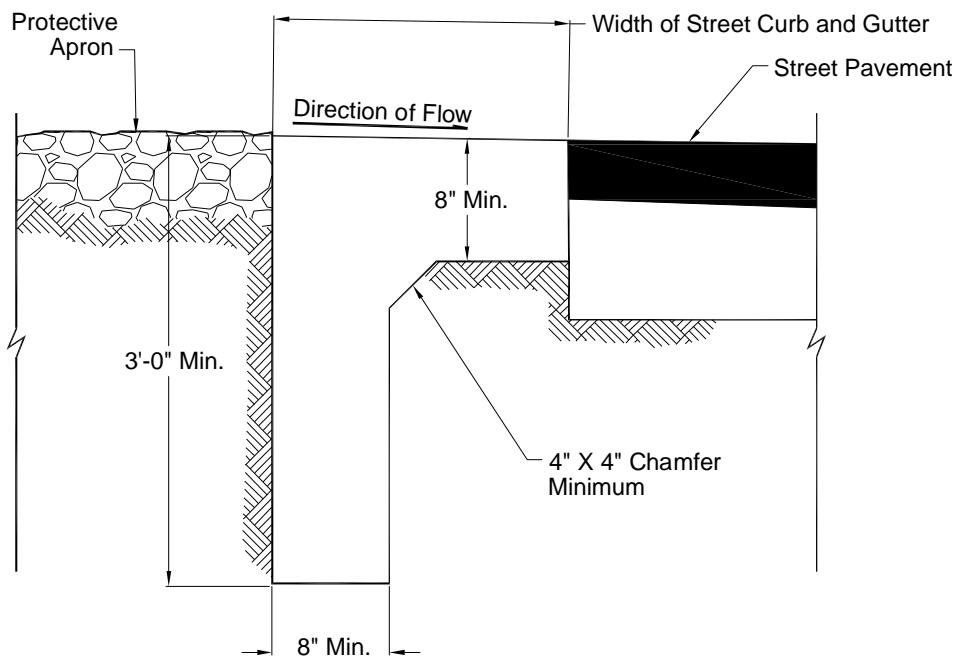


FIGURE 5.3-23 CUT-OFF WALLS

F. Curb Returns

Vertical curb should be used through the curb return from PC to PT regardless of whether the tangent curb sections are vertical or roll curb. All curb returns must be provided with sidewalk from PC to PT of the same width as that provided for the sidewalk behind the tangent curb sections. If no sidewalk is provided behind the tangent curb sections, the curb return sidewalk should be at least 6 feet wide.

1. Curb Return Radii

The radii for curb returns measured to the back of curb will be 25 feet for local street intersections - those that involve either a local collector street or local residential street. The radii for curb returns measured to the back of curb shall be 30 feet for all other major street intersections. Smaller radii may be approved by the Transportation Department in urban areas with higher pedestrian activity.

2. Sidewalk Ramp at Curb Return

Dual sidewalk ramps will be constructed at all curb returns (on all street classifications) in accordance with MAG Standard Details No. 2232* and 2233*. Truncated domes will be installed on all sidewalk ramps per ADA guidelines and COS Standard Detail No. 2231*. If a traffic signal exists or is planned, the ramp and apron must provide access to the pedestrian push button. These standards apply to both public and private streets, see [Section 5-4.104](#) Pedestrian Signals for more information.

*Note: For COS and MAG Standard Details www.ScottsdaleAZ.gov/design/COSMAGSupp.

5-3.114

SELECTION OF A DESIGN SPEED

The design of geometric features such as horizontal and vertical curves will depend upon the design speed selected for the street. The choice of the design speed is primarily determined by the street classification. The design speed is the maximum speed for the safe operation of a vehicle. Design speeds for the various classifications of streets are identified on [Appendix 5-3A](#) and [Appendix 5-3B](#); the use of design speeds other than those shown may be approved through the master plan process. The Transportation Department must approve all other exceptions.

5-3.115

SUPERELEVATION IN CURVES

Superelevation is discouraged on horizontal curves in the portion of the city outside the Environmentally Sensitive Lands area.

A. 0.02 foot/feet Superelevation Rate

A superelevation rate of 0.02 foot/feet may be used when the standard radius cannot be provided due to circumstances beyond the control of the engineer, and the roadway alignment cannot be changed (as determined by city staff).

B. Superelevation Rate Greater than 0.02 ft./ft.

A superelevation rate greater than 0.02 ft./ft. may not be used except when approved by the Transportation Department. In no case shall a superelevation exceed 0.06 ft./ft.

C. Transition for Superelevation

The length of superelevation transition is based on the superelevation rate and the width of rotation. The axis of rotation is generally the pavement centerline. The transition lengths for a superelevation rate of 0.02 ft./ft. are provided in [Appendix 5-3A](#) and [Appendix 5-3B](#). For other superelevation rates, see the AASHTO's Policy on Geometric Design.

In designing the beginning or ending of a horizontal curve, 1/3 of the transition is on the curve and 2/3 of the transition is on the tangent pavement section.

D. Drainage on Superelevated Curves

Whenever superelevation is allowed on a divided street, a storm drainage system must be provided to collect the runoff along the median curb. Nuisance water from the higher traveled area is not allowed to cross the lower traveled area.

5-3.116

HORIZONTAL CURVES

Horizontal alignments need to provide safe and continuous operation of motor vehicles at a uniform design speed for substantial lengths of street. A horizontal curve is required when the angle of change in horizontal alignment is equal to or greater than five degrees. The nature of the surrounding development and topography, and the street classification will establish the factors that determine the radius of a curve.

A. Minimum Radii of Curvature

The minimum radius of curvature is determined by the design speed or by the stopping sight distance.

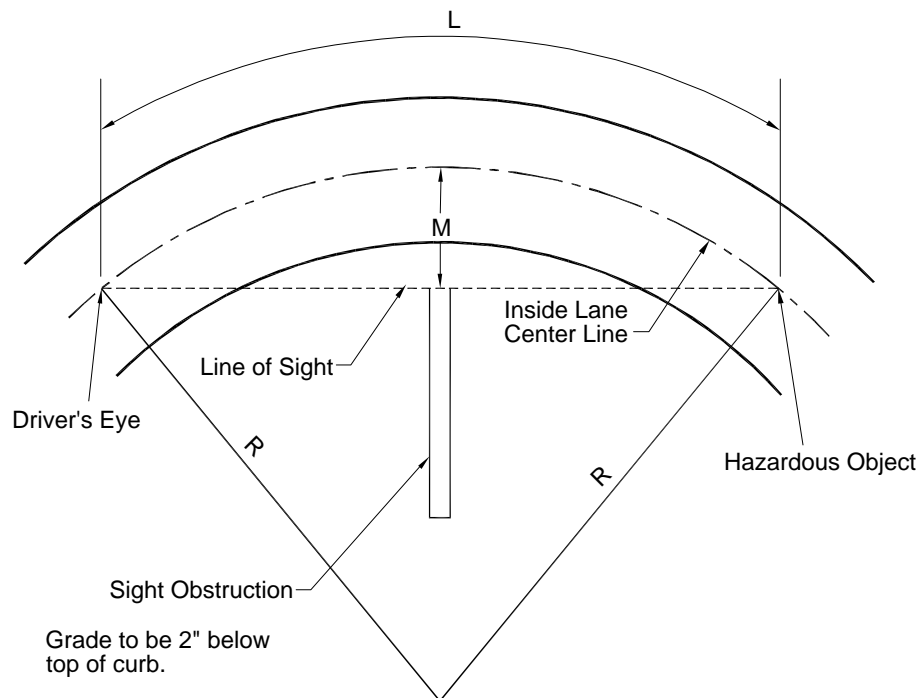
1. Minimum Radii Based on Design Speed

[Appendix 5-3A](#) and [Appendix 5-3B](#) contain the minimum radius of curvature for each street classification with and without a superelevation rate of 0.02 ft./ft. Wherever possible, the radii used in design needs to be larger. If stopping sight distance conditions require a larger radius than that shown in these appendices, then that larger radius becomes the minimum radius for the curve.

2. Consideration of Stopping Sight Distance

When walls, buildings, bridge piers, cut slopes, vegetation, or other obstructions are near the roadway on the inside of a curve, they can block a driver's view of the road ahead. If they are too close, the driver will not have sufficient distance along the curved roadway to stop when a hazardous condition comes into view. For design, the driver's eye is 3.5 feet above the center of the inside lane (the driving lane closest to the inside of the curve) and a hazardous condition is an object 2.0 feet high in the center of the inside lane, or per currently accepted AASHTO standards. The clear distance, "M" is measured from the center of the inside lane to the view obstruction.

Figure 5.3-24 depicts these relationships and provides a table of minimum stopping sight distances for various design speeds.



If the stopping sight distance, S , and the radius to the center of the inside lane, R , are known, the distance, M , is found by the following equation:

$$M = R[1 - \cos(28.65 S/R)]$$

If the radius, R , and the distance, M , are tentatively selected, then the length, L , of the arc in the middle of the inside lane may be found by the following equation:

$$L = (R/28.65) \arccos[(R-M)/R]$$

If the length, L , is less than the stopping sight distance for the desired speed, either the radius, R , or the distance, M , must be increased.

Design Speed MPH	20	25	30	30	30	45	50	50	60	65
Stopping Sight Distance, S , (ft.)	125	150	200	225	300	365	440	500	590	640

FIGURE 5.3-24 VIEW OBSTRUCTIONS AND HORIZONTAL CURVES

B. Reduced Design Speeds on Curves

The reduction of a street design speed on a curve should be avoided; however, where physical restrictions prohibit increasing the radius of the curve or the clear distance, "M" the design speed for the curved section may be reduced. In such circumstances, appropriate signage in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) is required. The difference between the design speed for the roadway approaching the curve and the design speed for the curve cannot be greater than 10 miles per hour. The design speed for a curved roadway section must not be reduced if the reduction occurs at the end of a long tangent or at any location where high approach speeds may be expected.

C. Compound Curves

Compound curves should be avoided; however, if site conditions make the use of compound curves unavoidable, the shorter radius needs to be at least 2/3 the length of the longer radius. Compound curves are not permitted when design speeds require the shorter radius to be greater than 1,000 feet.

D. Tangent Sections Between Curves in the Same Direction

On 2-lane roads, tangent sections are needed between two curves in the same direction. If the pavement cross-sections throughout the curves do not have superelevation then the minimum lengths for tangent sections are listed in [Appendix 5-3A](#) and [Appendix 5-3B](#).

If superelevation is provided in the curved portions of the roadway, then the superelevation transition lengths indicated will determine the tangent lengths.

E. Tangent Sections Between Reverse Curves

Generally a tangent section must be provided between two curves that curve in the opposite direction. Minimum lengths for tangent sections between reverse curves without superelevation are provided in [Appendix 5-3A](#) and [Appendix 5-3B](#). If the curve radii are at least 50% greater than the radii required by the design speed, a tangent section may not be required depending on grades, topography and vegetation. If superelevation is provided for the curves, then the superelevation transition lengths indicated will determine the minimum length of tangent sections between reverse curves.

F. Tangent Sections Approaching Intersections

A tangent section must be provided between a street intersection and a curve unless otherwise approved by the Transportation Department. The minimum tangent length is shown in [Appendix 5-3A](#) and [Appendix 5-3B](#) and shall be measured from the end of the curve to the edge of the intersecting roadway.

VERTICAL ALIGNMENT

A vertical curve is required when grade changes are equal to or greater than 1.5%. All sections of a street's vertical alignment must meet passing and stopping sight distance requirements for the design speed established for the street. For specific details, see the AASHTO's Policy on Geometric Design.

A. Longitudinal Street Grades

For arterial streets, the maximum longitudinal grade is 6%. For collector and local streets, the maximum grade is 9%. The minimum longitudinal street grade for all streets is 0.4%. Wherever possible, longitudinal street grades greater than or equal to the minimum grade are to be provided. Where necessary, grades less than 0.4% may be used with approval from the Municipal Services Department.

B. Vertical Curves

Properly designed vertical curves should provide adequate sight distance, safety and effective drainage.

1. Type of Curve

A parabolic vertical curve is to be used. [Figure 5.3-25](#) provides all necessary mathematical relations for computing a vertical curve, either crests or sags.

The following equations are for parabolic vertical curves. The grades g_1 and g_2 must be used with their algebraic signs (+ or -). If g_1 and g_2 are expressed as percentages, L and X must be expressed in stations. If g_1 and g_2 are expressed as feet per foot, L and X must be expressed in feet. These symbols are defined by the above diagrams.

$$A = g_2 - g_1 \quad D = g_1 - g_2 \quad e = LG/8 \quad y = 4e(X/L)^2 = (A/2L)X^2$$

5-3.117

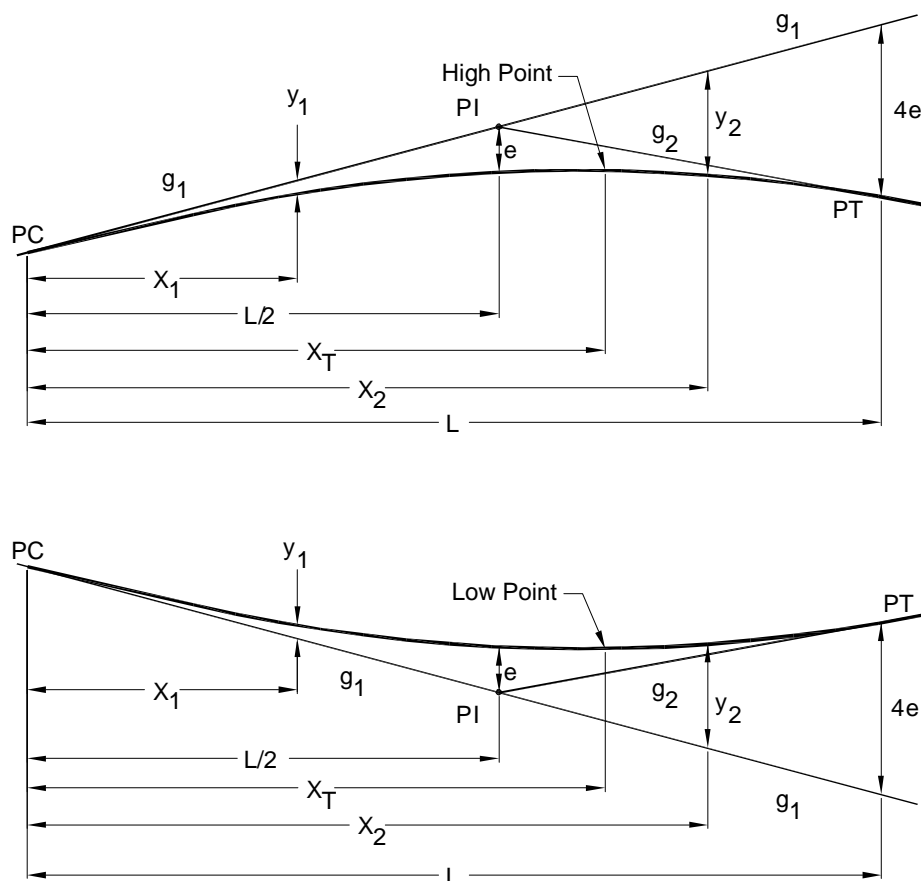


FIGURE 5.3-25 VERTICAL CURVE RELATIONSHIPS

The equation below provides the location, X_T , of the curve turning point -- the high point or low point on the curve. This equation is only applicable when g_1 and g_2 are not of the same sign, algebraically.

$$X_T = (g_1 L) / (g_1 - g_2)$$

2. Sight Distance Requirements

Sight distance is the continuous length of street ahead visible to the driver. For vertical alignment design, two sight distances are considered: passing sight distance and stopping sight distance. Stopping sight distance is the minimum sight distance to be provided at all points on multi-lane streets and on 2-lane streets when passing sight distance is not economically obtainable as approved by city staff. Stopping sight distance needs to be provided in the vicinity of intersections. [Appendix 5-3A](#) and [Appendix 5-3B](#) list the minimum passing and stopping sight distances for the various street classifications and design speeds.

a. Stopping Sight Distance

The minimum stopping sight distance is the distance required by the driver of a vehicle, traveling at a given speed, to bring the vehicle to a stop after an object on the road becomes visible. Stopping sight distance is measured from the driver's eyes, 3.5 feet above the pavement surface, to an object 2.0 feet high on the roadway, or per currently accepted AASHTO standards.

b. Passing Sight Distance

Passing sight is the minimum sight distance that must be available to enable the driver of one vehicle to pass another vehicle safely, without interfering with the speed of an

oncoming vehicle. The sight distance available for passing at any one place is the distance at which a driver, whose eyes are 3.5 feet above the roadway surface, can see the top 0.8 feet of an object 4.35 feet high on the road (corresponding to an object height of 3.5 feet high), or per currently accepted AASHTO standards.

3. Minimum Vertical Curve Lengths

Minimum vertical curve lengths are determined by sight distance requirements for a given design speed.

a. Crest Vertical Curve Lengths

Minimum crest curve lengths are determined by either the stopping sight distance or the passing sight distance, whichever provides the greatest curve length.

b. Minimum Crest Vertical Curve Length Determined by Stopping Sight Distance

The following equations are to be used to determine the minimum crest vertical curve lengths based upon stopping distance requirements, or per currently accepted AASHTO standards:

$$\begin{aligned} \text{When } S_s < L, L &= (AS_s^2)/2158 \\ \text{When } S_s > L, L &= (2S_s) - (2158/A) \end{aligned}$$

L = Length of curve in feet.

S_s = Stopping sight distance in feet for a given design speed.

A = Algebraic grade difference in percent.

c. Minimum Crest Vertical Curve Length Determined by Passing Sight Distance

The following equations are to be used to determine the minimum crest vertical curve lengths based upon sight distance requirements:

$$\begin{aligned} \text{When } S_p < L, L &= (AS_p^2)/2800 \\ \text{When } S_p > L, L &= (2S_p) - (2800/A) \end{aligned}$$

S_p = Passing sight distance in feet for a given design speed.

L = Length of curve in feet.

A = Algebraic grade difference in percent.

4. Sag Vertical Curve Lengths

Minimum sag vertical curve lengths are determined by either the stopping sight distance or comfort factors. The longer of the two possible minimum curve lengths will be used.

a. Minimum Sag Vertical Curve Length Determined by Stopping Sight Distance

The following equations are to be used to determine the minimum sag vertical curve length based upon stopping sight distance requirements:

$$\begin{aligned} \text{When } S_s < L, L &= (AS_s^2)/(400 + 3.5S_s) \\ \text{When } S_s > L, L &= (2S_s) - \{(400 + 3.5S_s)/A\} \end{aligned}$$

S_s = Stopping sight distance in feet for a given design speed.

L = Length of curve in feet.

A = Algebraic grade difference in percent.

b. Minimum Sag Vertical Curve Length Determined by Comfort Factors

The following equation is to be used to determine the minimum sag vertical curve length based upon comfort factors:

$$L = (AV^2)/46.5$$

L = Curve length in feet.

A = Algebraic grade difference in percent.

V = Design speed in miles per hour.

5-3.118**COMBINED HORIZONTAL AND VERTICAL CURVES**

When horizontal and vertical curves are combined, the horizontal curve needs to lead and follow the vertical curve, and not be introduced near the top or bottom of a crest vertical curve or bottom of a sag vertical curve. For additional information on this topic, see the AASHTO's Policy on Geometric Design.

5-3.119**INTERSECTIONS**

Although all intersections share certain common elements, they are not subject to generalized treatment. To minimize conflicts and provide for anticipated traffic movements, each intersection must be evaluated based on individual characteristics and designed based on the following factors:

1. Traffic factors such as capacities, turning movements, vehicle size and operating characteristics, vehicle speed, pedestrian and bicycle movements, transit operations and accident history.
2. Physical factors such as topography, existing conditions, channelization requirements and available sight distance.
3. Human factors such as driving habits, reaction to surprises, decision and reaction time, and natural paths of movement.

A. Intersection Spacing

Intersections along major streets should be kept to a minimum. Along arterial streets, the minimum intersection spacing should be 1/4 mile (1320 feet). Along collector streets (major collectors and minor collectors), the minimum spacing should be 1/8 mile (660 feet). Along local streets (local residential and local collectors), the minimum spacing should be 250 feet. New intersections on major streets should be located to align with planned median openings. New intersections on minor streets should be located to avoid creating conflicting turning movements with existing intersections or driveways.

B. Angle of Intersection

A right-angle intersection provides the shortest crossing distance for intersecting traffic streams. It also provides the most favorable condition for drivers to judge the relative position and speed of intersecting vehicles. Where special conditions exist, intersection angles may diverge from a right-angle by a maximum of 2 degrees (up to 4 degrees with approval of the Transportation Department) on arterial streets and major collector streets; and by a maximum of 4 degrees (up to 15 degrees with approval of the Transportation Department) on minor and local collector streets, couplets and local streets.

C. Alignment and Profile

Intersections occurring on horizontal or crest vertical curves are undesirable. When there is latitude in the selection of intersection locations, vertical or horizontal curvature should be avoided. A line or grade change is frequently warranted when major intersections are involved. If a curve is unavoidable, it should be as flat as site conditions permit. Where the

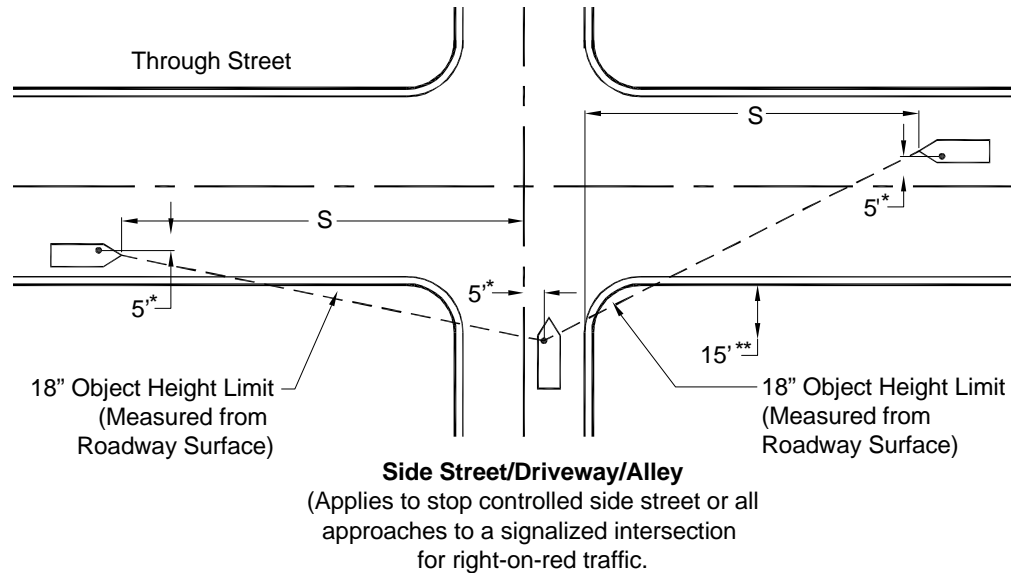
grade of the through roadway is steep, flattening through the intersection is desirable as a safety measure.

The maximum profile grade through an intersection is 6 percent for arterials and collector streets and 8 percent for local streets. The intersecting streets' profiles and cross slopes need to be coordinated with one another to ensure a safe and comfortable driving surface. Typically this may mean extending grades through the intersection for approximately 75 feet to 150 feet. Short vertical curves may be necessary in lieu of grade breaks.

D. Intersection and Driveway Sight Distance

In order to provide the opportunity for vehicles at an intersection to safely cross or make left or right turns onto a through street, **adequate sight distance must be provided.** Sight distance must also be provided for left turning traffic turning from the main street as described in AASHTO Intersection Sight Distance Case F. If opposing left turn lanes are present, the opposing left turns must be off-set in a positive way to allow for sight distance when opposing vehicles are present. See [Figure 5.3-28](#) and [Figure 5.3-29](#) for options. Sight distance should be based on the design speed for the roadway. Design speeds for new roadways should conform to those identified in [Section 5-3.100](#) and [Appendix 5-3A](#) and [Appendix 5-3B](#). Typically design speeds are 10 m.p.h. higher than the anticipated posted speed limit. The sight distance requirements outlined below are required for all private and public street intersections and at all intersections of driveways onto public or private streets. Internal driveway intersections on private property are excluded from these requirements.

[Figure 5.3-26](#) depicts the technique used to determine the driver's eye location and an approaching vehicle; a line is then drawn to connect these 2 points. Continuous unobstructed line of sight must be provided along this line and throughout the approach to the intersection, providing an unobstructed sight triangle to the side street driver. Sight lines are to be drawn on roadway and landscaping plans to represent the areas that must be free of all objects and topography in excess of 18 inches above the roadway surface, however, certain vegetation will be allowed. Vegetation placed within the sight triangle will be of a low variety that remains below 18 inches when mature. Trees can be considered within the triangle as long as the canopies are above 8 feet, they are a single trunk variety, and they are not spaced in a configuration that creates a "picket fence" effect.



* 5 feet measured to nearest lane line or centerline.

**15 feet measured from face-of-curb or edge-of-travelway.

S = Intersection sight distance in feet on drivers left and right for right turns, left turns and through traffic.
(See 2004 AASHTO *Geometric Design of Highways and Streets* for additional sight distance requirements.)

(See [Appendix 5-3A](#), [Appendix 5-3B](#) and [Appendix 5-3C](#) for distance S.)

FIGURE 5.3-26 INTERSECTION & DRIVEWAY DEPARTURE SIGHT DISTANCE REQUIREMENTS

1. Right-Angle Intersections

Right-angle intersections are those whose legs meet at an angle of 88 to 90 degrees. For these right-angle intersections the sight distances shown in [Appendix 5-3A](#), [Appendix 5-3B](#) and [Appendix 5-3C](#) are to be used with [Figure 5.3-26](#) to calculate the sight triangle. Appendices 5-3A and 5-3B present the intersection sight distances for all street classifications which were determined assuming passenger car traffic. [Appendix 5-3C](#) presents the sight distance requirements for varying roadway widths and design speeds for passenger cars, single unit trucks and combination trucks. If high volumes of truck traffic are anticipated, sight distances given in [Appendix 5-3C](#) will be used. Sight distances for vehicles turning left from the main street should also be considered and calculated based on the AASHTO *Geometric Design of Highways and Streets*.

2. Skewed Intersections

For skewed intersections where the intersection angles are less than 88 degrees, sight distances must be calculated in accordance with the procedures described in AASHTO's *Geometric Design of Highways and Streets*. Skewed intersection design must include appropriate design for pedestrian crossings and the location of curb ramps.

3. Intersections Within or Near a Curve

Sight distance measurements, identified as S in [Figure 5.3-26](#), need to follow the curved street alignment when the intersection is within or near a horizontal curve.

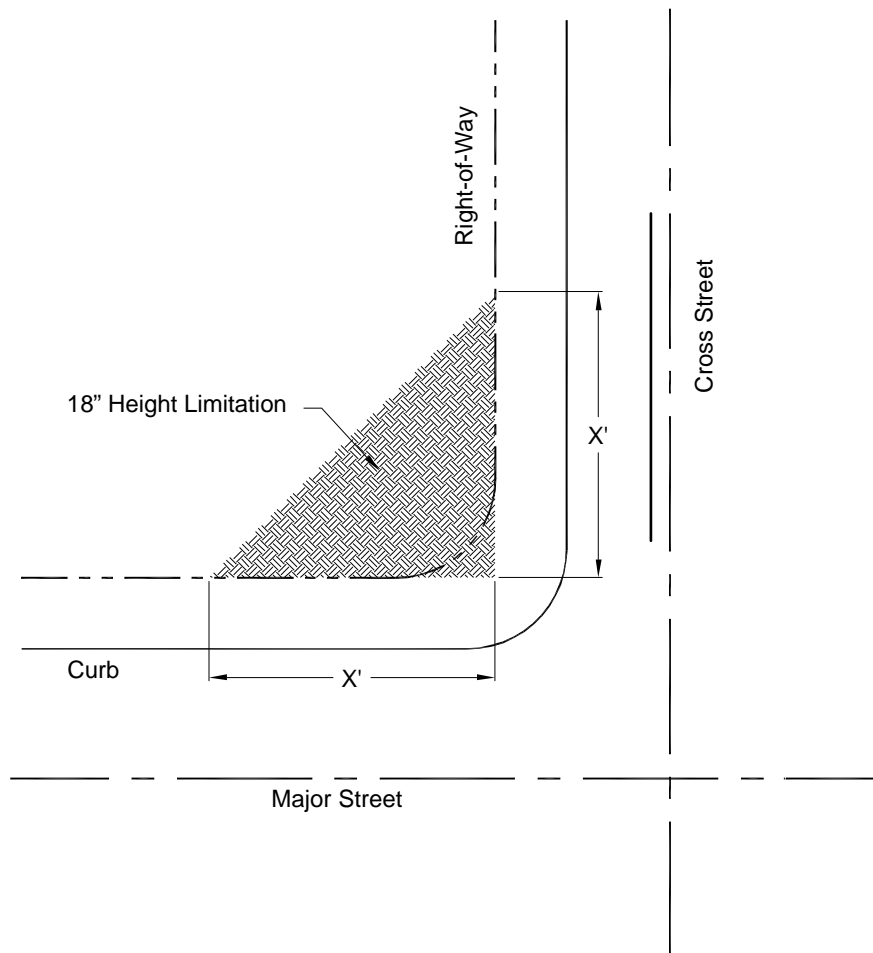
4. Traffic Safety Triangles

Traffic Safety Triangles should be used as a means to limit the height of structures, vegetation and other improvements on corner properties immediately adjacent to intersections. **Safety triangles are not to be used as a substitute for intersection sight distance!** Safety triangles provide additional visibility around corners for all intersection approaches and should be applied to the design of perimeter walls and

landscape features. Items within the safety triangle cannot be higher than 18" measured from the roadway surface. [Figure 5.3-27](#) depicts the method used to determine the safety triangle location. The sight distance requirements contained in both [Figure 5.3-26](#) and [Figure 5.3-27](#) are applied at all corner lots.

5. Right-of-Way at Corners

A minimum of 25-foot radius rights-of-way shall be dedicated at street intersections to provide room for traffic control and sight distance.



Major Street Classification	X (in feet)
Parkway, Expressway, Arterials, Major Collector	25
Minor Collector	35
* Local Streets	35 / 60 / 70

* If the standard right-of-way (46 ft. local residential, 60 ft. local collector) is not available, the safety triangle (X) shall measure 60 ft. on local residential streets and 70 ft. on local collector streets from the centerlines of the streets.

FIGURE 5.3-27 TRAFFIC SAFETY TRIANGLE ON CORNER PROPERTY

E. Auxiliary Lanes

An exclusive turning lane permits separation of conflicting traffic movements and removes turning vehicles from the flow of through traffic. [Figure 5.3-28](#) and [Figure 5.3-29](#) depict the

design standards for auxiliary lanes. These standards apply for right and left turn lanes at street intersections and for deceleration lanes at mid-block driveways. The requirement for an auxiliary lane may necessitate additional rights-of-way. Modifications to the storage and transition lengths may be allowed by the Transportation Department where the conditions do not allow the full design standard to be met.

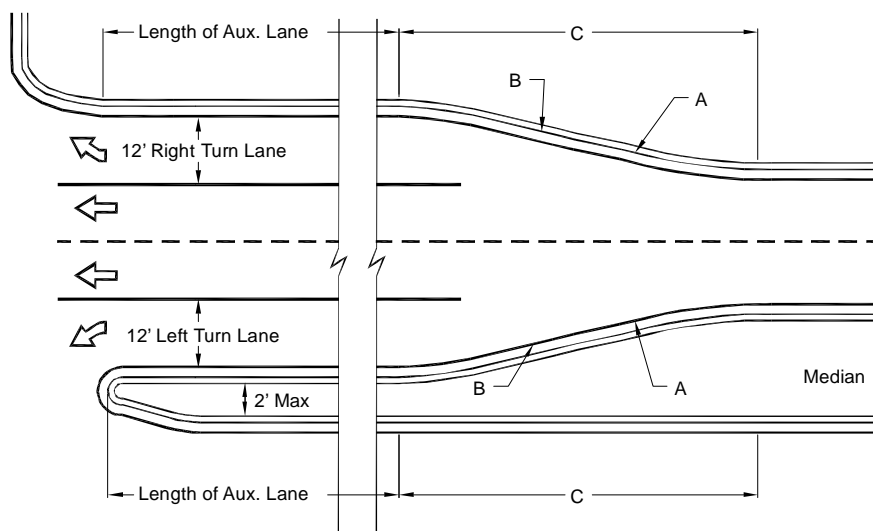
1. Right-Turn Lanes

Right-turn lanes are required at all street intersections on major arterials. Right-turn lanes may be required by the Transportation Department on minor arterial and collector street intersections. The lane lengths should be determined based on the anticipated turning volume and whether there is signalized or unsignalized traffic control. The standard storage length for a right-turn lane is 150 feet, with a 100-foot minimum length. The taper prior to the storage area shall be accomplished by two reverse curves with a total length of 90 feet minimum, 140 feet maximum.

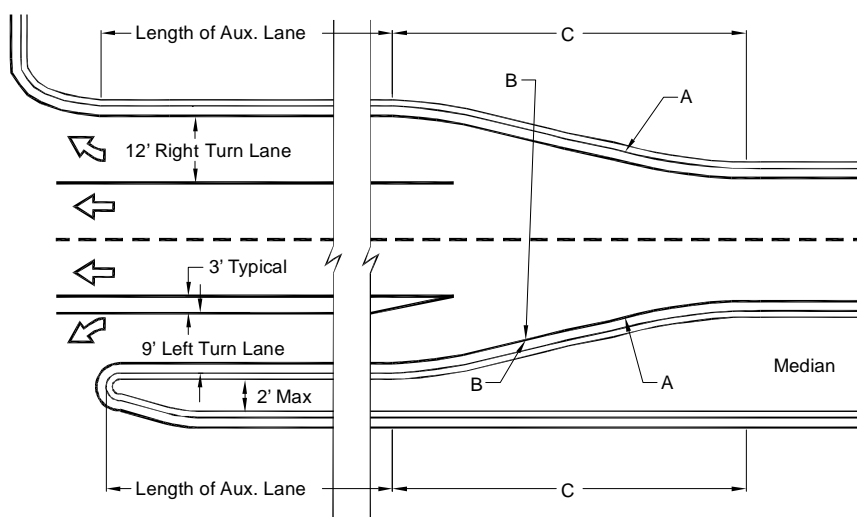
2. Left-Turn Lanes

Left-turn lanes are required at all street intersections on major collectors and arterials. Left-turn lanes may also be required at street intersections on minor collectors based on the projected left-turn volume and conflicting through volume. The lane lengths should be determined based on the anticipated turning volume and whether there is signalized or unsignalized traffic control. For left turn lanes at signalized intersections, dual turn lanes should be considered when the turn volume exceeds 300 vehicles per hour, the opposing through volume exceeds 1,000 vehicles per hour, or the delay to left turning vehicles exceeds 45 seconds. Sight distance must be considered and calculated for these movements based on the AASHTO Policy on Geometric Design in order to determine the allowance of permitted left turns. Guidance for the length of taper, determination of the gap and storage length of the lane can be found in Section 430 of the ADOT Traffic Engineering Policies, Guidelines and Procedures Manual.

OPTION 1

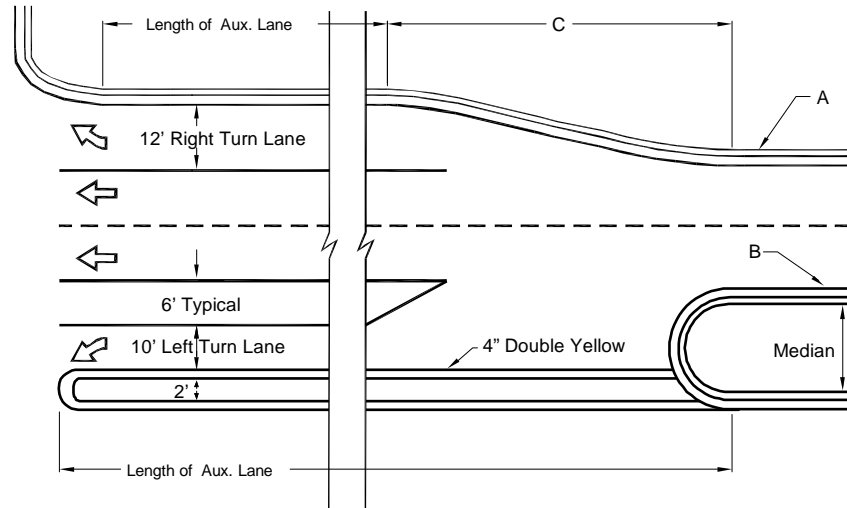
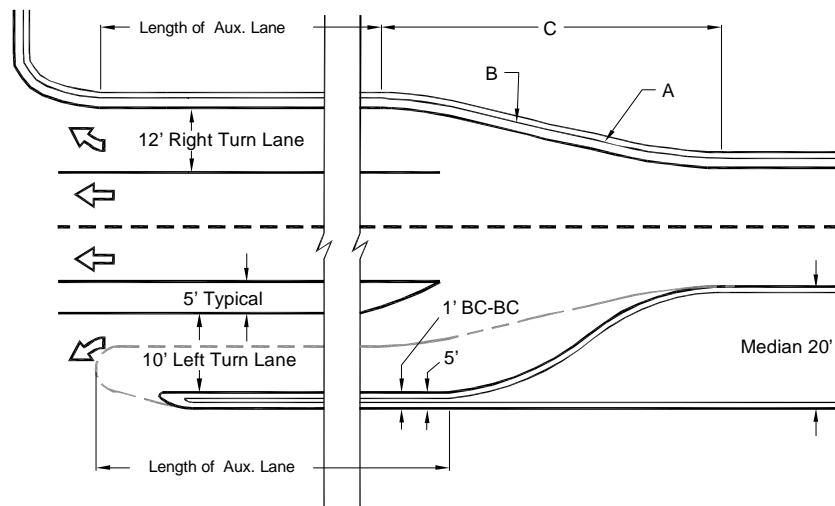


OPTION 2



Note: See COS Supplement to MAG Detail No. 2225 for radius and dimensions,
www.ScottsdaleAZ.gov/design/COSMAGSupp.

FIGURE 5.3-28 AUXILIARY LANES - OPTIONS 1 & 2

OPTION 3**OPTION 4**

Note: See COS Supplement to MAG Detail No. 2225 for radius and dimensions

www.ScottsdaleAZ.gov/design/COSMAGSupp.

FIGURE 5.3-29 AUXILIARY LANES - OPTIONS 3 & 4

F. Median Design

Raised medians are required on arterial streets and some major collector streets to separate traffic flows, channelize left turns and reduce conflicts. On most collector streets, flush or painted medians provide space between the through traffic lanes for left turning vehicles. Standard median widths are listed for each street classification in [Appendix 5-3A](#) and [Appendix 5-3B](#) and as shown in [Figure 5.3-30](#) through [Figure 5.3-34](#). Variations to these standards may be approved through the master plan process or by the Transportation department.

1. Raised Medians

Raised medians, where required, must be provided in accordance with the applicable City of Scottsdale standard details, with the appropriate median width as noted above.

a. Spacing and Location of Median Openings

If a street has a raised median, it is not possible to provide an opening in the median for every street intersection or driveway location. Full median openings should occur at not less than 1/4 mile intervals (1320 feet) on major arterial streets. Partial median openings, which allow only left turns off the major street, are acceptable at 1/8 mile spacing (660 feet). On minor arterials, full median breaks should be no closer than 1/8 mile intervals with preferable 1/4 mile spacing. In built up areas, where reasonable alternate access is not available, median openings may be provided at smaller intervals with the approval of the Transportation Department.

b. Configuration of Median Openings

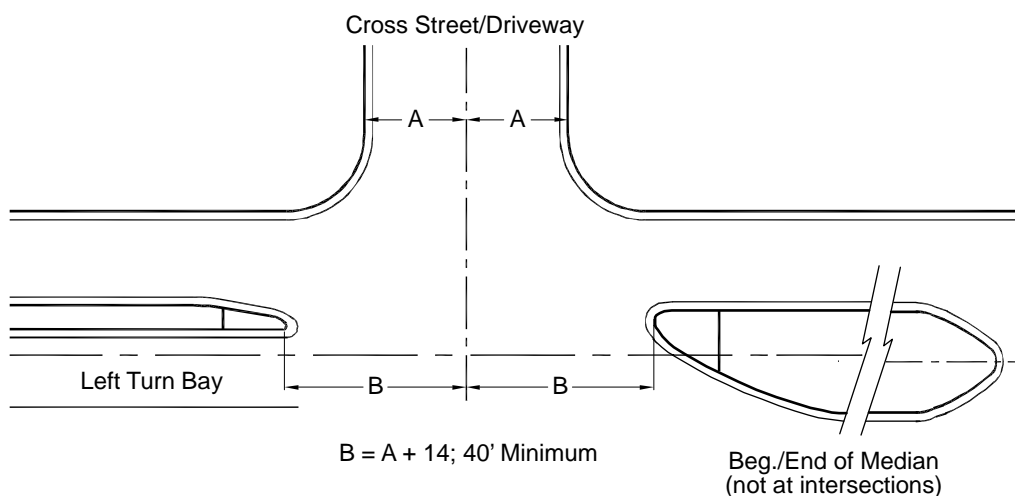
If the street intersection legs intersect at an angle of 88 to 90 degrees, the configuration of the median opening will be determined by the information shown below on Figure 5.3-30. If the streets intersect at an angle less than 88 degrees, the median opening configuration will have to be determined to the satisfaction of the Transportation department.

c. Cross-Slope

The cross-slope in the median opening is limited to 0.02 ft./ft. Median openings on curves with superelevation exceeding 0.02 feet/foot will not be permitted.

2. Flush Medians

Flush, painted medians are required on major and minor collector streets without raised medians. Median widths for these streets are listed in [Appendix 5-3A](#) and [Appendix 5-3B](#).

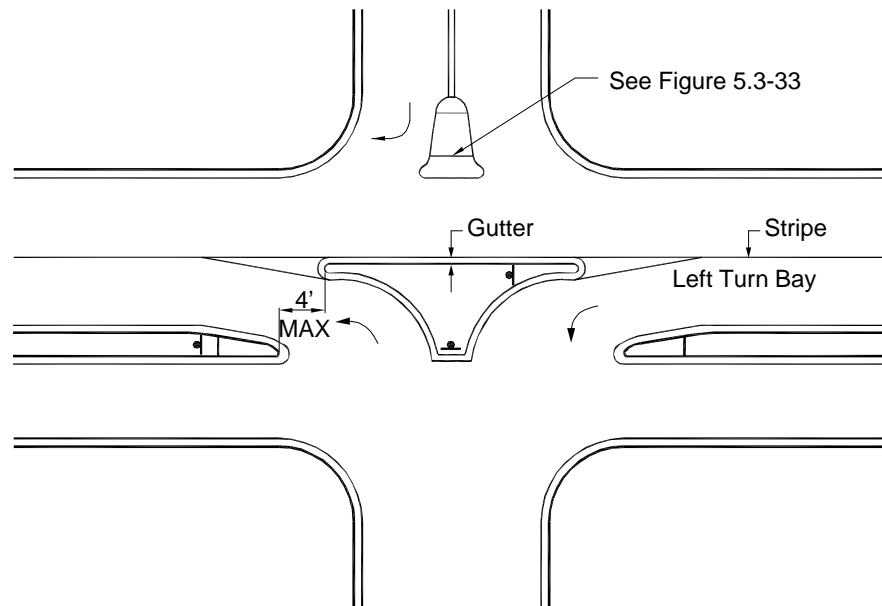


Notes:

1. This sketch is for a three leg intersection. If the intersection has four legs, the right side will also have an auxiliary lane for left turns, and the median on the right side will have the same configuration as the one on the left side rotated 180 degrees.

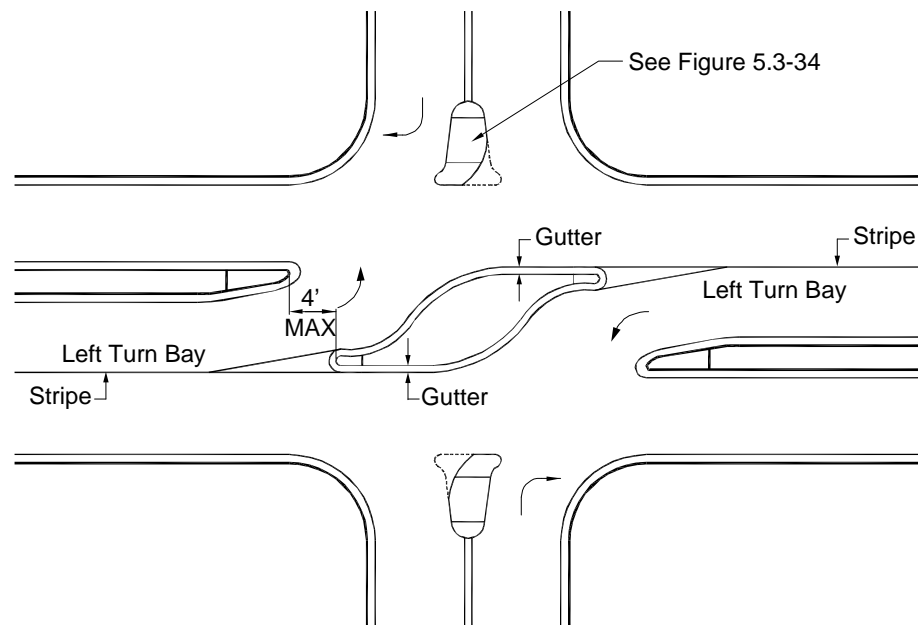
2. See COS Standard Details for median dimensions.

FIGURE 5.3-30 MEDIAN OPENINGS FOR INTERSECTIONS



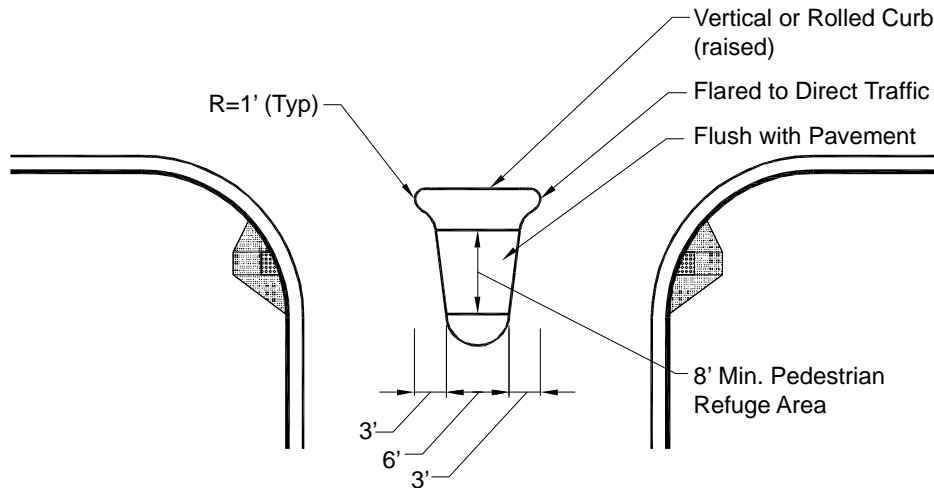
Note: Curbs may be vertical, rolled or painted to match existing roadway design or construction.

FIGURE 5.3-31 LEFT IN / LEFT OUT MEDIAN OPENINGS FOR INTERSECTIONS



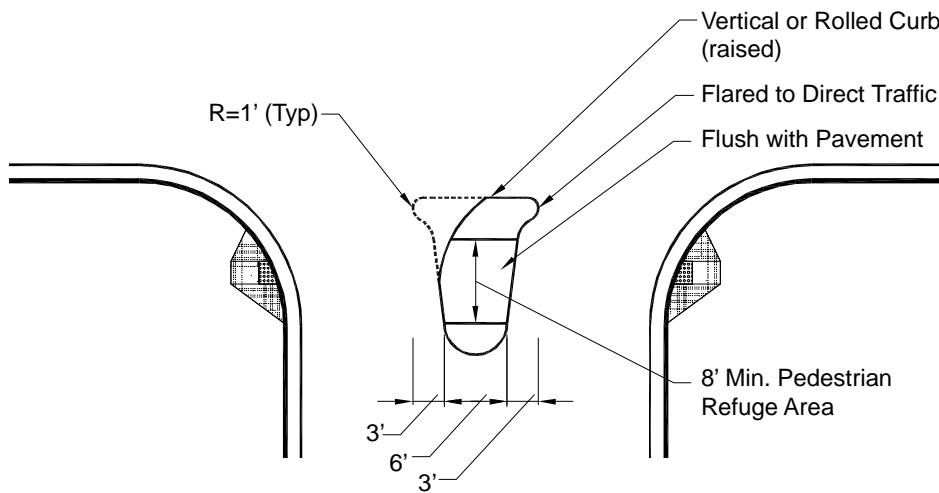
Note: Curbs may be vertical, rolled or painted to match existing roadway design or construction.

FIGURE 5.3-32 LEFT IN / LEFT IN MEDIAN OPENINGS FOR INTERSECTIONS



Note: Area of entire island must be a minimum of 30'.

FIGURE 5.3-33 RIGHT IN / RIGHT OUT MEDIAN WITH PEDESTRIAN REFUGE



Note: Area of entire island must be a minimum of 30'.

FIGURE 5.3-34 LEFT IN / RIGHT OUT MEDIAN WITH PEDESTRIAN REFUGE

G. Traffic Control

Traffic control at all new intersections should initially be stop controlled on the minor street. Any higher means of traffic control, 4-way stop, or a traffic signal will require approval by Traffic Engineering based on an approved engineering study. Guidelines for 4-way stop and traffic signal controlled intersections are outlined below. Intersections of local residential streets within subdivisions are assumed to be stop controlled and will typically not need signage.

1. Four-Way Stop Controlled Intersections

Four-way (or multi-way) stop controlled intersections are allowed only when based on an engineering study approved by the Traffic Engineering based on the criteria contained in the MUTCD. Four-way stop control is generally utilized for the intersections of two similar classification streets where volumes are approximately equal or at intersections where there is a safety concern (such as limited sight distance).

2. Traffic Signal Controlled Intersections

a. Traffic Signal Warrants

New traffic signal controlled intersections are allowed only when based on an engineering study approved by Traffic Engineering using MUTCD criteria. Traffic signals warrants are generally based on existing traffic volumes, not projected traffic volumes. Contributions for future traffic signal construction are required for developments that are located at major intersections where traffic signal control is anticipated. Payment toward future construction should not be interpreted to mean a traffic signal is warranted. New intersections where a traffic signal is anticipated will require a preliminary traffic signal design to determine the proper location for the installation of underground conduit and pull boxes.

b. Traffic Signal Spacing

Traffic signals should be spaced no closer than 1/2 mile on major arterials and minor arterials, with 1 mile spacing desirable. Traffic signals should be spaced no closer than 1/4 mile on collector streets, with 1/2 mile spacing desirable. Closer spacing will interfere with traffic progression and signal coordination. Any deviation from these standards requires approval from the Transportation Department based on an approved study that indicates no significant deterioration in traffic progression.

H. Intersections with an Unpaved Leg

If an intersection has a leg that is unpaved, the paving needs to extend to the end of the normal curb return location on the unpaved leg (at a minimum) with a desired length of 50 from the edge of the roadway.

I. Valley Gutters at Street Intersections

Valley gutters may only be used across minor and local collector streets and local residential streets. Exceptions must be approved by the Transportation Department. Valley gutters should be constructed in accordance with City of Scottsdale standard details.

5-3.200

STREET ACCESS & DRIVEWAYS

Driveway types are determined by land use type and street classification, as shown below in Figure 5.3-35. The standards for these driveway types are illustrated in [Figure 5.3-37](#) through [Figure 5.3-43](#). Refer to [Figure 5.3-36](#) for driveway grade standards. Pedestrian ramps shown in [Figure 5.3-38](#) through [Figure 5.3-43](#) are illustrative only and should be designed and constructed per COS Supplement to MAG Details.

Land Use	Street Classification	Driveway Type*	Location**
Single Family	Local Residential / Local Collector	S-1	All
Multifamily	Local Residential / Local Collector	M-1	All
	Minor Collector	M-2 / CH-1	All
	Major Collector	M-2 / CH-1	All
	Minor Arterial / Major Arterial	M-2 / CH-1	Right-In, Right-Out
		CH-2, CH-3	Full Access
Commercial	Local Commercial	CL-1	All
	Minor Collector / Major Collector	CH-1	All
	Minor Arterial / Major Arterial	CH-1	Right-In, Right Out
		CH-2, CH-3	Full Access
Industrial	Local Industrial	CL-1	All
	Minor Collector / Major Collector	CH-1	All
	Minor Arterial / Major Arterial	CH-1	Right-In, Right-Out
		CH-2, CH-3	Full Access

* See City of Scottsdale Standard Details and [Figure 5.3-37](#) through [Figure 5.3-43](#).

** Right-In, Right Out driveways on arterial streets are where left-turns out of the driveway are prohibited by a median or an island. Full access driveways on arterial streets align with an approved median opening. Modifications to these standards are allowed by approval of city staff.

FIGURE 5.3-35 DRIVEWAY TYPES

DRIVEWAY SPACING

Minimum driveway spacing will generally conform to the following standards. This minimum spacing applies to proposed site driveway separation as well as separation from existing or planned driveways on adjacent parcels.

Street Type	Minimum Distance Driveway Spacing
Local Residential/Local Collector	50 feet
Local Industrial/Local Commercial	165 feet
Minor Collector	165 feet
Major Collector	250 feet
Minor Arterial	330 feet
Major Arterial	500 feet

For sites that have frontage on two streets, primary access should be onto the minor street frontage. A maximum of two driveway openings is permitted to a particular site or parcel from the abutting street(s). The Transportation Department may permit additional driveway entrances when projected travel demands indicate it is in the interests of good traffic operation, and when adequate street frontage exists to maintain the above guidelines.

Where new development adjoins other similarly zoned property or compatible land uses, a cross access easement may be required to permit vehicular movement between the parcels and reduce the number of access points required onto the adjacent public street. This may be required regardless of the development status of the adjoining property, unless the cross access is determined to be unfeasible by city staff.

5-3.201

5-3.202

DRIVEWAY LOCATION LIMITATIONS

A new access driveway will not be allowed (measured to the driveway centerline):

1. Within 30 feet of any commercial property line, except when it is a joint-use driveway serving two abutting commercial properties and access agreements have been exchanged between, and recorded by, the two abutting property owners;
2. When the total width of all driveways serving a property exceeds 50% of the curb line frontage;
3. Within 50 feet of the rights-of-way line of an intersecting non-arterial street;
4. Within 100 feet of the rights-of-way line of an intersecting arterial street;
5. Within 100 feet of an approved median opening location on an arterial street;
6. Less than the minimum spacing as established under [Section 5-3.201](#);
7. When adequate sight distance cannot be provided to vehicles on the driveway attempting to access the street, see [Figure 5.3-26](#), [Appendix 5-3A](#) and [Appendix 5-3B](#).

5-3.203

PROTECTION OF ACCESS

For proper control of driveway access, a vehicular non-access easement (V.N.E.) is to be granted to the city, except at approved access points, along all collector and arterial streets when abutting property develops.

5-3.204

RESIDENTIAL DEVELOPMENT DRIVEWAYS**A. Single Family Residential Development**

Driveways serving single-family residential units should be S-1 type driveways as shown in [Figure 5.3-37](#). Only one driveway per lot street frontage is allowed except where the street frontage is of sufficient length to maintain a separation of 50 feet between driveways. The minimum driveway length is 18 feet, measured from the face of the garage opening to the back of sidewalk or the back of curb if no sidewalk is provided. See [Section 2-2.308](#) for additional discussion on driveways.

B. Multifamily Residential Development

Driveways serving multifamily residential units should be CL and CH type driveways, as shown in [Figure 5.3-38](#) through [Figure 5.3-41](#). Type CL-1 and CL-2 are low-volume driveways to be used on local streets. Type CH-1, -2 and -3 are high volume driveways to be used on collector and arterial streets. The minimum driveway length is 50 feet, measured from the entrance to the off-street parking area to the back of sidewalk, or to the back of curb if no sidewalk is provided.

C. Limitations on Residential Access

Residential properties that have frontage on a local street, an arterial, or collector street are limited to local street access.

In some instances, residential parcels fronting only on arterial or collector streets may be given access if alternate public access is not available. When such access is allowed, the driveway must be circular or it must have a turn-around area to ensure there is no need for backing onto the street.

5-3.205

COMMERCIAL AND INDUSTRIAL DEVELOPMENT DRIVEWAYS

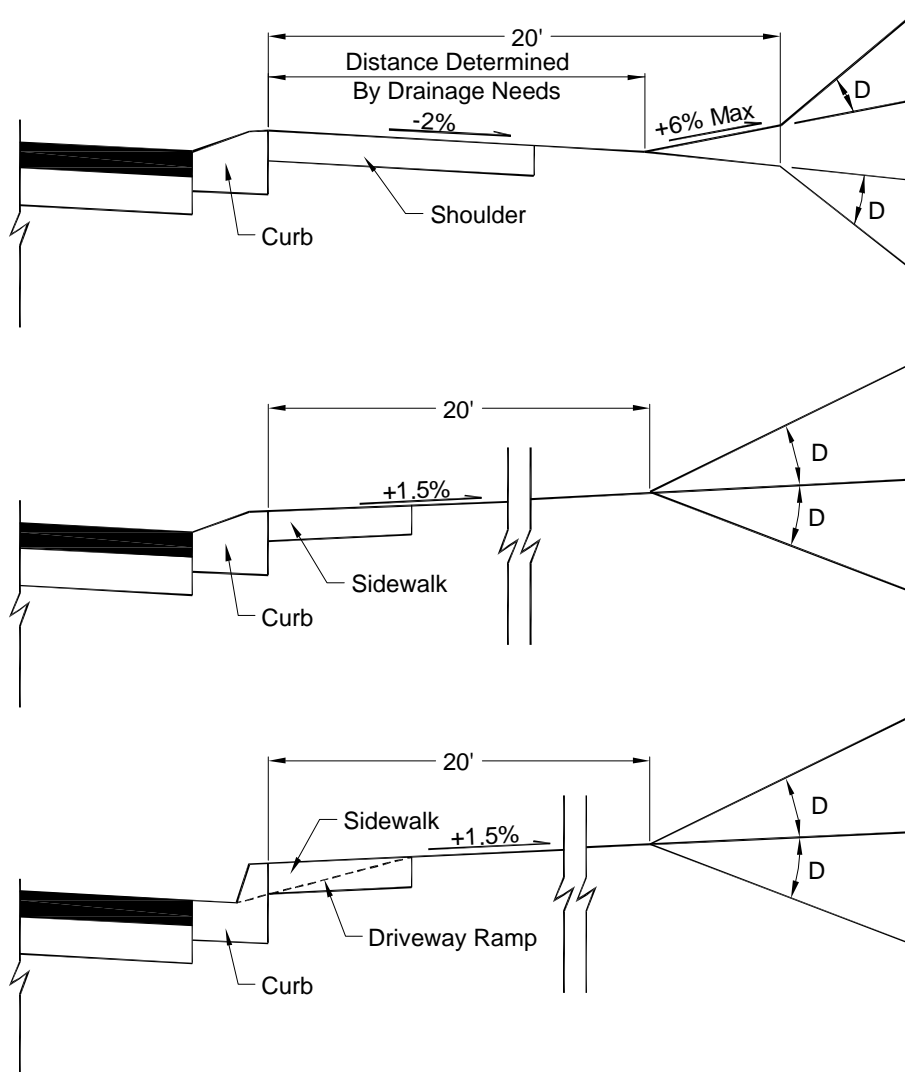
Driveways for commercial and industrial development are shown on [Figure 5.3-38](#) through [Figure 5.3-43](#). The minimum length for a commercial or industrial driveway is 50 feet, measured from the entrance to the off-street parking area to the back of sidewalk or the back of curb if no sidewalk is provided. Driveway designs need to include a level path of travel across the driveway for pedestrians in conformance with ADA requirements.

A. Commercial Driveways

The “CL” and “CH” type driveways are designed to serve commercial properties. A “CL” type driveway is used for low-volume driveways on low volume streets. A “CH” type driveway is used for driveways on arterials, major collectors and high volume minor collectors, or at other locations when required by the Transportation Department. The CH-2 and CH-3 driveways are used at all access driveways opposite median openings.

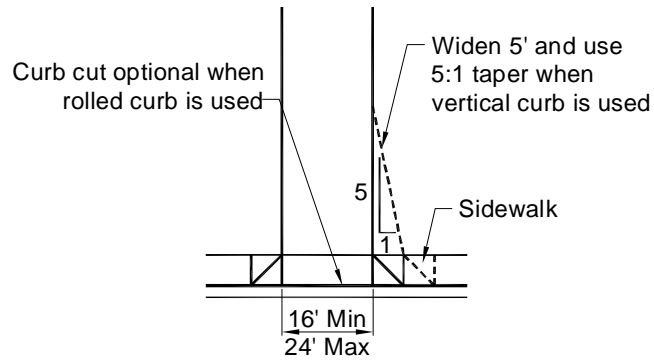
B. Industrial Driveways

The CL-1 and CH-1 type driveways are typically used to serve industrial properties. Normally industrial access is not permitted on arterial or major collector streets; however, if such access is allowed, commercial driveway standards apply.



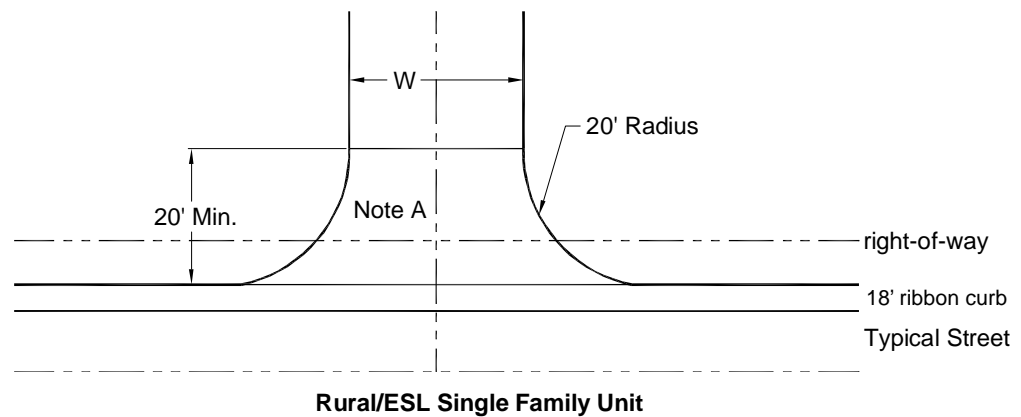
A.D.T. For Driveway		Grade Difference, D	
		Desirable	Maximum
Low Volume	1-500	6%	10%
Medium Volume	500-1500	3%	10%
High Volume	1500 or More	0%	10%

FIGURE 5.3-36 DRIVEWAY GRADE STANDARDS



Suburban Single Family Unit

NOTE: See COS Standard Details for more specific information.



Rural/ESL Single Family Unit

- W=16' for driveway serving one lot
- W=24' for driveway serving two lots
- Note A: Pavement section-2" A.C./6" A.B.C. Minimum

FIGURE 5.3-37 TYPE S-1 DRIVEWAY STANDARDS

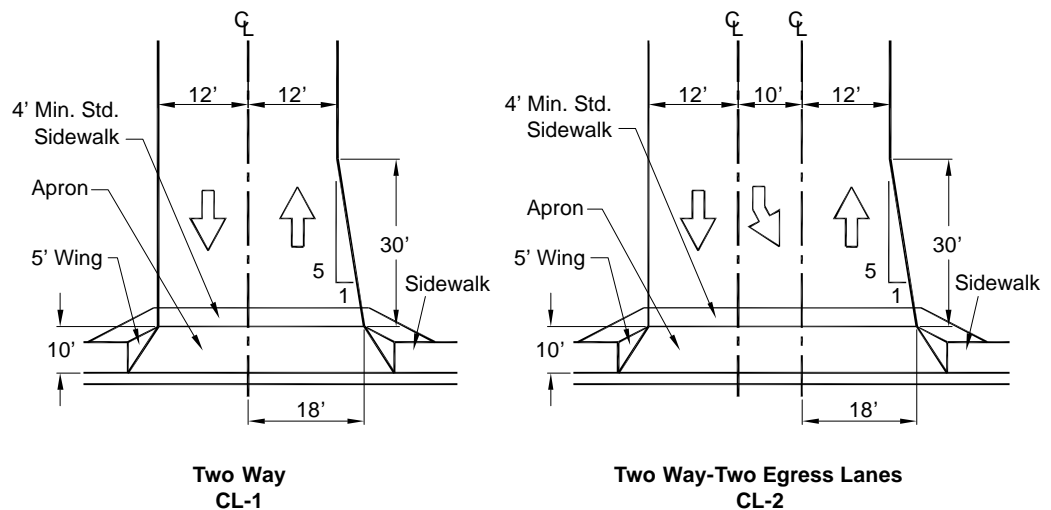


FIGURE 5.3-38 TYPE CL TWO WAY DRIVEWAYS

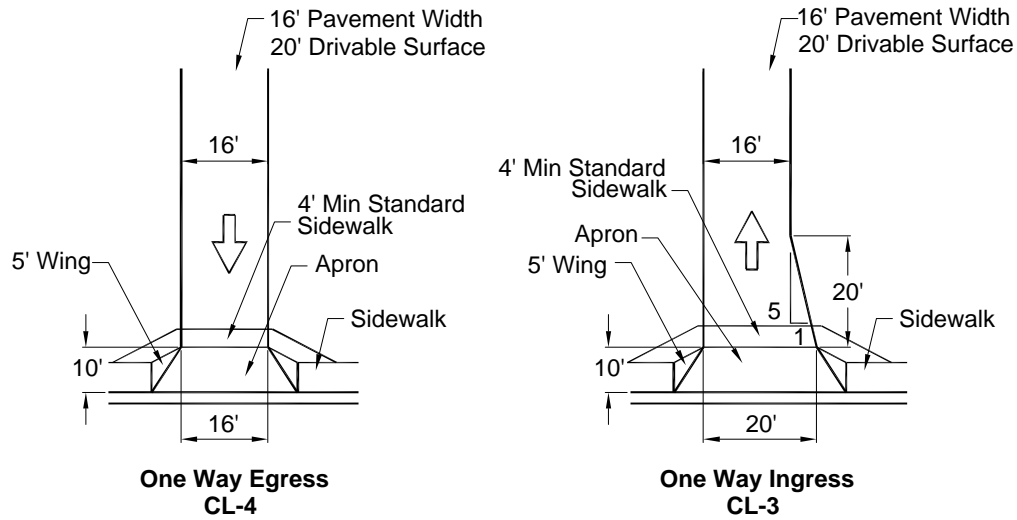
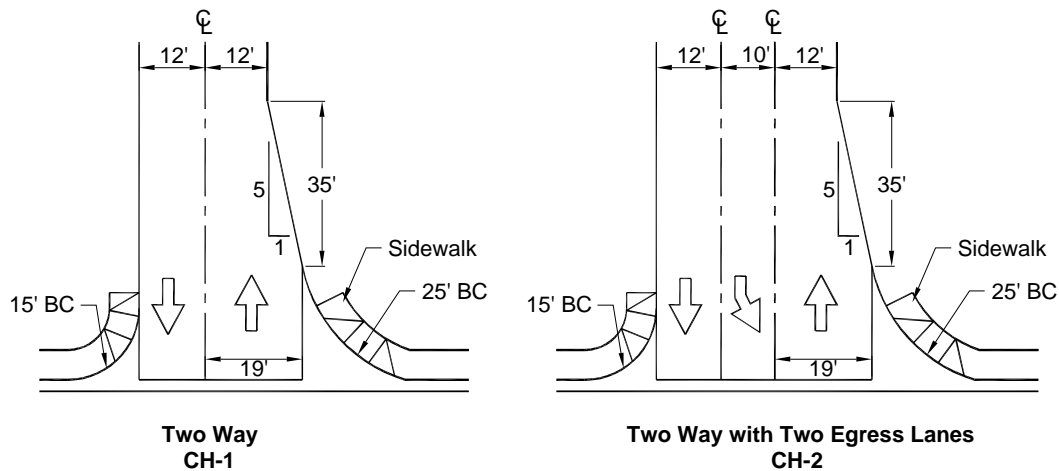
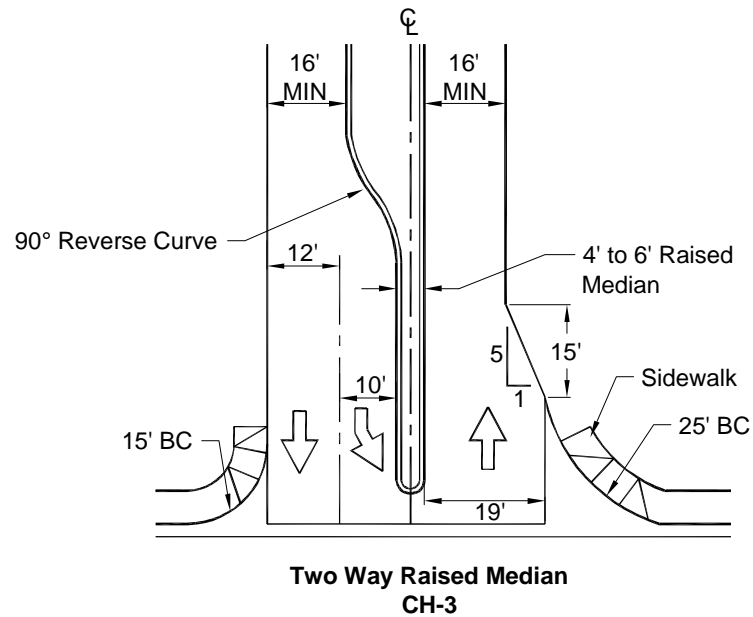


FIGURE 5.3-39 TYPE CL ONE WAY DRIVEWAYS



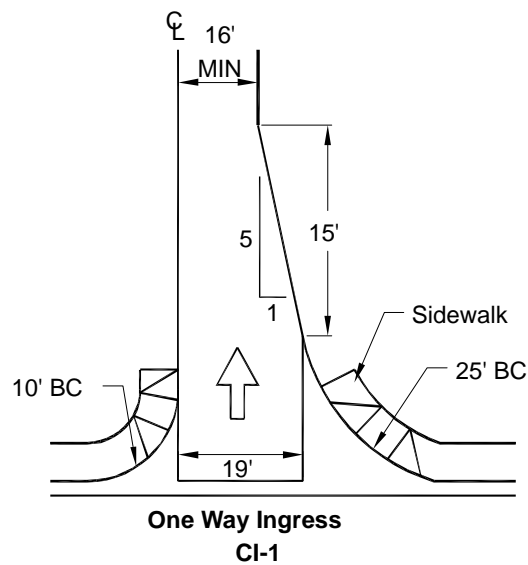
*Note: Pedestrian ramps in this figure are illustrative only and should be designed and constructed per COS Supplement to MAG Details.

FIGURE 5.3-40 TYPE CH TWO WAY DRIVEWAYS*



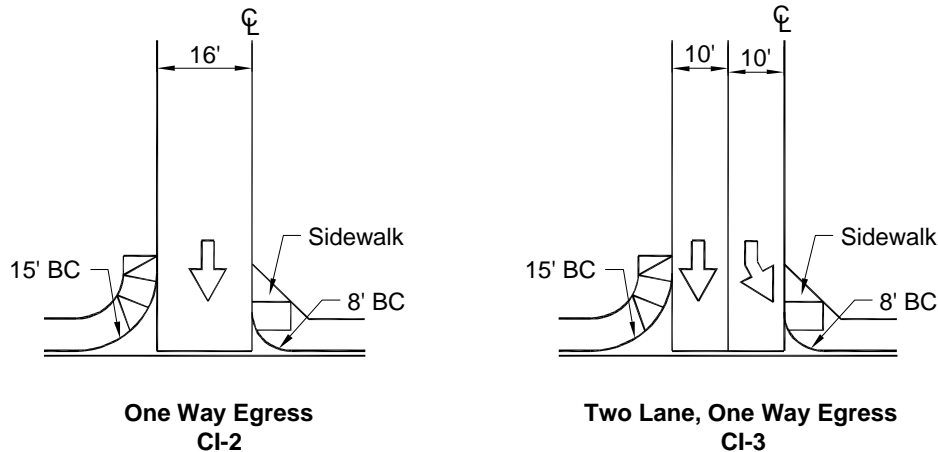
*Note: Pedestrian ramps in this figure are illustrative only and should be designed and constructed per COS Supplement to MAG Details.

FIGURE 5.3-41 TYPE CH TWO WAY DRIVEWAYS WITH RAISED MEDIAN*



*Note: Pedestrian ramps in this figure are illustrative only and should be designed and constructed per COS Supplement to MAG Details.

FIGURE 5.3-42 TYPE CI ONE WAY INGRESS DRIVEWAYS*



*Note: Pedestrian ramps in this figure are illustrative only and should be designed and constructed per COS Supplement to MAG Details.

FIGURE 5.3-43 TYPE CI ONE WAY EGRESS DRIVEWAYS*

DECELERATION LANES

Figure 5.3-28 and Figure 5.3-29 depict the design standards for auxiliary lanes. These standards apply for right and left turn lanes at street intersections and for deceleration lanes at mid-block driveways. The requirement for an auxiliary lane may necessitate additional rights-of-way. The standard storage length for a deceleration lane is 150 feet, with a 100-foot minimum length. Modifications to the design standard are allowed by the Transportation Department where the conditions do not allow the full taper or storage length.

Deceleration lanes are required at all new driveways on major arterials and at new commercial/retail driveways minor arterials. Deceleration lanes for driveways may also be required on collector streets and for non-commercial/retail driveways on minor arterials. The lane length should be based on the distance needed to allow the vehicle to exit the through lane and slow to a 15 m.p.h. travel speed. To determine the need for a deceleration lane on streets classified as a minor arterial or collector, see the following criteria:

- At least 5,000 vehicles per day are expected to use the street;
- The 85th percentile traffic speed on the street is at least 35 m.p.h.; or 45 m.p.h. for a 2 lane (1 lane each direction) roadway;
- At least 30 vehicles will make right turns into the driveway during a 1-hour period.

SIDEWALKS

A. Sidewalk Standards

Sidewalks adjacent to all city streets are required to meet the standard cross sections contained in Figure 5.3-1 through Figure 5.3-21 and the Streets Master Plan except as noted below.

Walkways that connect main building entrances to the sidewalks on adjacent streets should have a minimum clear width of six (6) feet - excluding any parking overhangs or other obstructions. The walkway should be continuous between the street and building, and clearly recognizable by both pedestrians and drivers. Wider widths may be required by staff in

5-3.206

5-3.300

locations where significant pedestrian traffic is anticipated and where wider sidewalk exists or is planned along the street.

In cases where a sidewalk width of six feet cannot be provided due to existing physical barriers or other constraints, a five (5) foot wide clear and continuous sidewalk width may be allowed if approved by the Planning and Development Services General Manager or designee.

Sidewalk separation is required along all streets except local streets (local residential, local collector, local commercial/industrial). Sidewalks may be located at the back of curb in urban area where additional sidewalk width is provided. See [Section 5-8.000](#) Pedestrian Facilities for more detail regarding sidewalk design and requirements.

B. Sidewalk Locations

All new sidewalks constructed adjacent to public and private streets shall be separated from the back of curb unless right-of-way or other constraints make this impossible. The minimum separation from the back of curb should be four feet. Wherever possible, the sidewalk should be located adjacent to the right-of-way line (with a one foot clearance). Sidewalk may be located within adjacent easements, such as scenic corridors or public access, where available. The sidewalk width shall be constructed at the back of curb, except adjacent to local streets (local residential, local collector and local commercial/industrial). In no circumstances shall sidewalk be located within the clear zone for arterials streets without vertical curb.

C. Sidewalk Exemptions

Sidewalks will be provided on all streets except under any of the following conditions:

1. Along local residential and local collector streets in rural, low density areas – lot widths are 150 feet or more, or parcels are 20,000 square feet or more on both sides – where improved shoulders are provided along both sides of the street.
2. Along the side of a street where a multiuse path is required. The multiuse path will also serve as a sidewalk.
3. In the outer separation between an arterial and a frontage road.
4. With the approval of the Development Review Board in an area that has been substantially developed without sidewalks and a required sidewalk would create a spot location.
5. In conformance with a street cross section that has been approved as part of a master circulation plan.

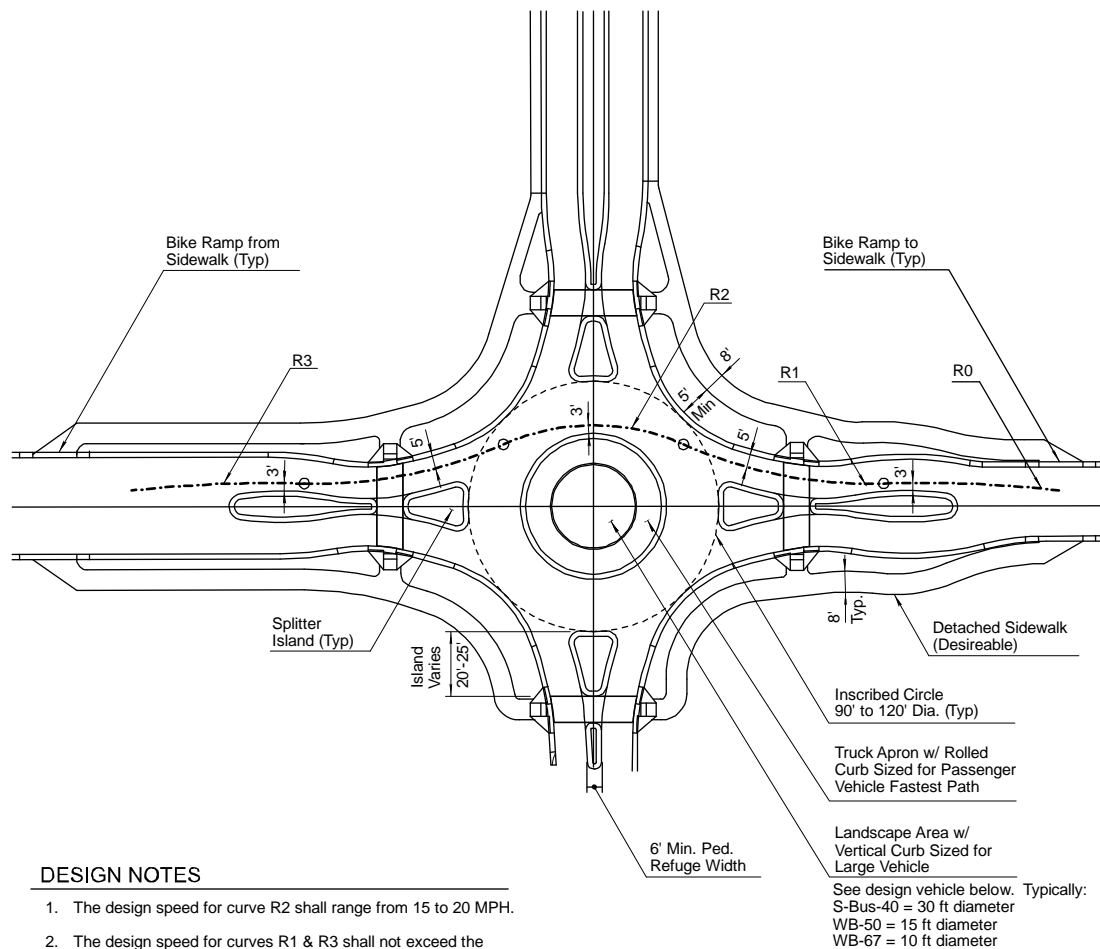
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ROUNDABOUTS

A. Roundabout Intersections

Roundabouts can reduce accidents and improve traffic flow at intersections. The city considers the use of roundabouts on a case by case basis. Roundabouts are typically used as an alternative to traffic signals or 4-way stop control. All city roundabout designs will follow the most current guidelines for roundabouts, including proper treatment of pedestrian crossings, bicycle lanes and signage. See [Figure 5.3-44](#) for Roundabout Design, [Figure 5.3-45](#) for Signing and Markings, and [Figure 5.3-46](#) and [Figure 5.3-47](#) for sight distance and design guidance.

The FHWA Roundabout Guideline defines six types of modern roundabout: Mini, Urban compact, Urban single, Urban double, Rural single and Rural double. See the Federal Highway Administration's Roundabouts: An Informational Guide (Publication No. FHWA-RD-00-67) and their Manual on Uniform Traffic Control Devices for further information.



DESIGN NOTES

1. The design speed for curve R2 shall range from 15 to 20 MPH.
2. The design speed for curves R1 & R3 shall not exceed the design speed of curve R2 by more than 12 MPH.
3. The design speed for curve R0 shall not exceed the design speed of curves R1 & R3 by more than 12 MPH.
4. The existing posted speed limit shall not exceed the design speed of curve R0 by more than 12 MPH.

LEGEND:

Fastest Path - - - - -

FIGURE 5.3-44 ROUNDABOUT DESIGN

1. Main Design Considerations

- a. Design all legs to yield to traffic in center
- b. Provide channelized approaches/splitter islands for all legs
- c. Design geometry to slow speeds to less than 30 m.p.h.
- d. Discourage pedestrian crossing to the center island
- e. Provide pedestrian refuge in splitter islands

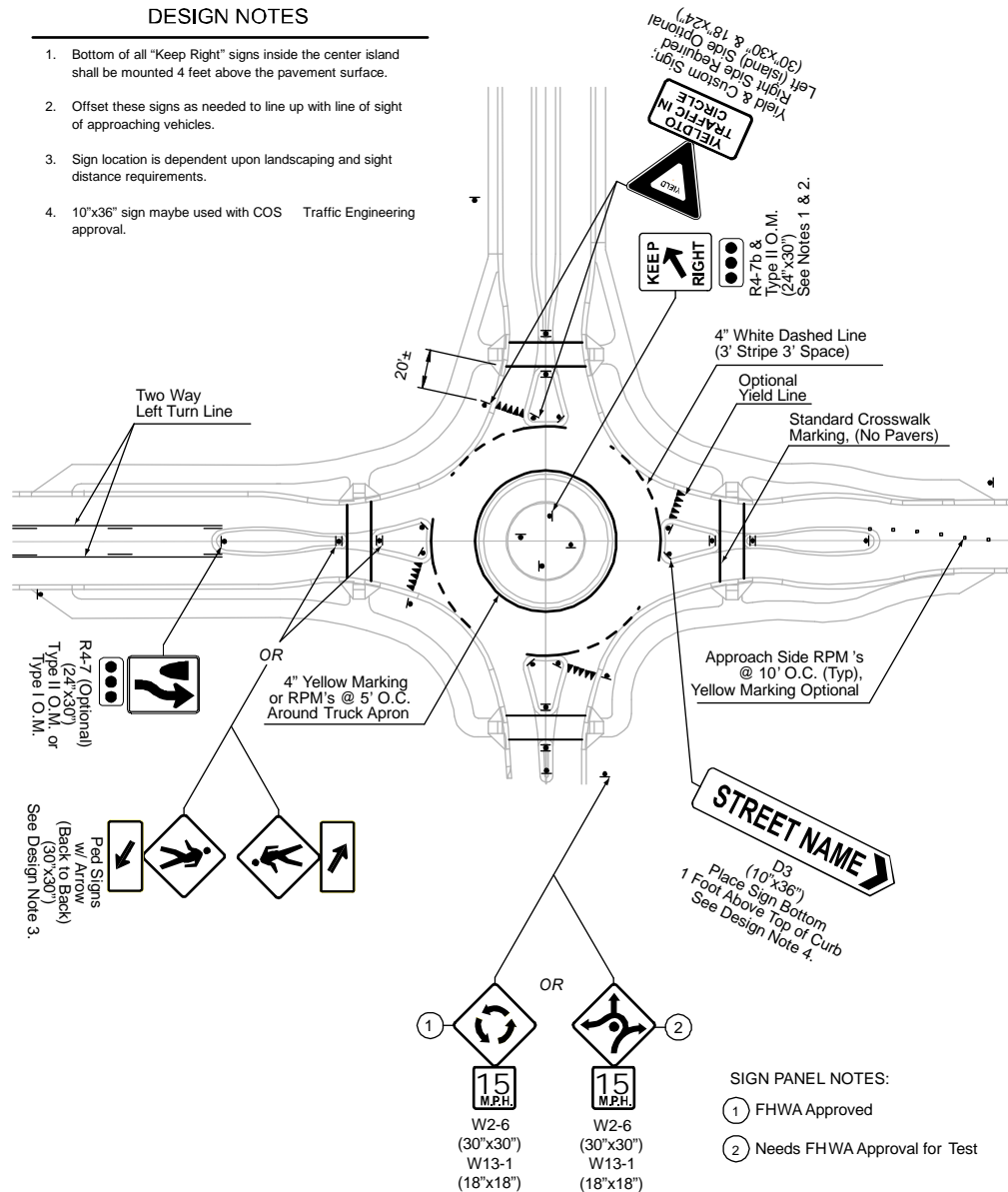
2. Other Typical Design Guidance

- a. Design Vehicle:
 - Local or minor collector intersections with less than 5,000 vehicles per day shall accommodate an S-Bus 40 (which will accommodate fire trucks, sanitation trucks and most large residential trailers) for all turning movements and should accommodate a WB-50 for through movements to prevent errant vehicles from getting stuck.
 - Minor collectors and up with over 5,000 vehicles per day shall accommodate a WB-50 (which will accommodate fire trucks, sanitation trucks and most trailers) for all

turning movements and should accommodate a WB-67 for through movements to prevent errant vehicles from getting stuck.

- b. Truck Apron (rolled curb/exterior designed for passenger car path, vertical curb interior designed for truck path).
- c. Slow vehicles prior to the circle using curve to produce fastest path radii R1, R2, R3, see [Figure 5.3-44](#).
- d. R2 fastest path of 15 to 20 m.p.h.
- e. R1 should be within 12 m.p.h. of R2 and posted or 85th percentile speed. If R1 is not within 12 m.p.h. of posted or percentile consider an "R0" prior to R1.
- f. Use splitter islands (rolled curb typical).
- g. Splitter island (6 foot minimum at pedestrian refuge; 7 foot preferred) and tangent to inner circle. Pull sidewalk away from curb near circle to encourage crossing at splitter crossing.
- h. Allow bikes to merge with vehicular traffic or exit to sidewalk/path or trail as available.
- i. Provide a directional curb ramp for bikes where the splitter island starts (or before the R1) so they have the option of using sidewalk or mixing with the vehicles.
- j. Single lane circulating roadway is typically 14 to 18 feet wide.
- k. Single lane inscribed circle is typically 90 to 120 feet in diameter.
- l. Geometric layout should be checked with AutoTurn or by similar method.
- m. Intersection circle and splitter islands should follow the forgiving roadway design principles as described in the AASHTO Roadside Design Guide and should avoid structural elements that could likely be in the path of an errant driver.

Further guidance can be found in the draft versions of the proposed 2009 MUTCD published by the FHWA.

**FIGURE 5.3-45 ROUNDBOUT SIGNING & MARKINGS****B. Typical Signage**

- a. All-Way Yield
- b. Supplement Yield with regulatory "Yield to Traffic in Circle"
- c. Offset regulator "Keep Right" signs in center island to line up with driver.
- d. Consider pedestrian crossing signs in splitter/median.
- e. Object marker and optional keep right at beginning of splitter/median
- f. Advance roundabout warning sign with advisory speed plaque

C. Typical Lighting (minor collector or greater)

- a. Minimum 2 lights for single lane approaches
- b. Minimum 4 lights for major collector or greater

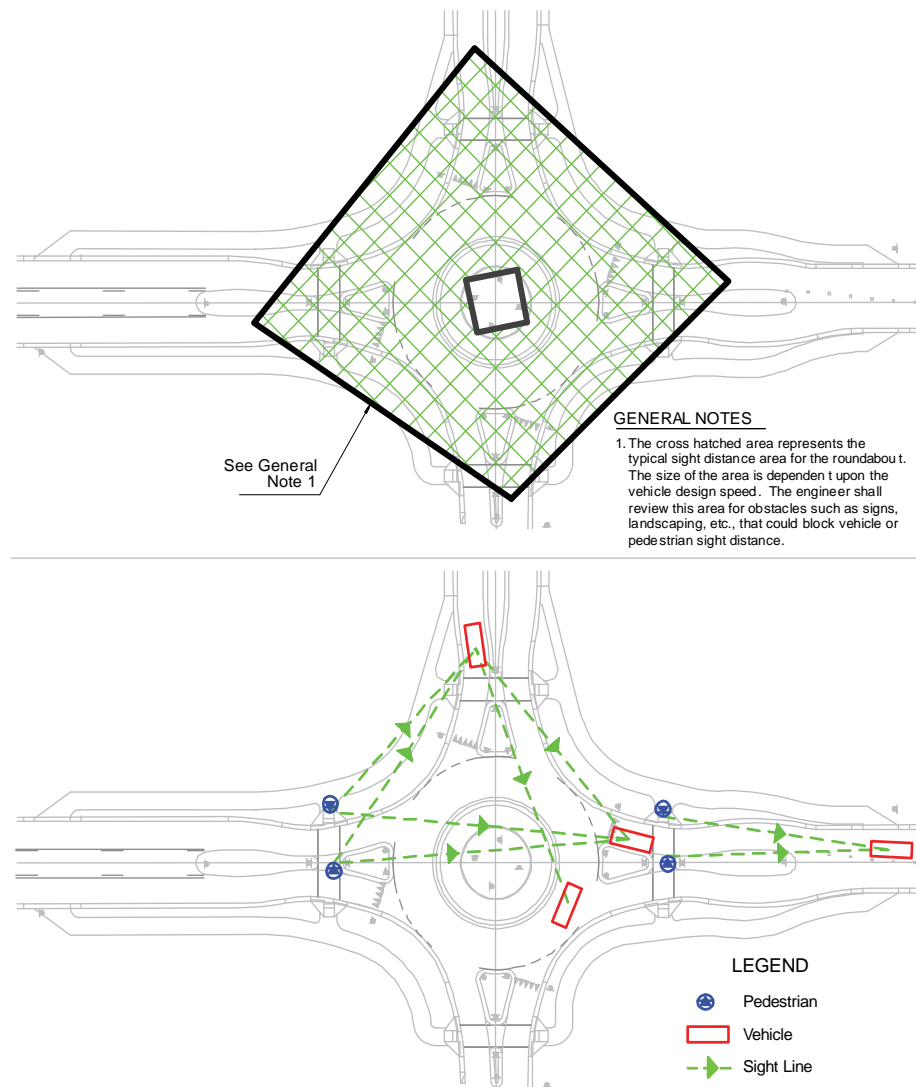


FIGURE 5.3-46 ROUNDABOUT SIGHT DISTANCE



FIGURE 5.3-47 ROUNDABOUT STANDARD CONCEPT DESIGN

5-3.500

5-3.501

BRIDGES, RETAINING WALLS & STRUCTURAL CLEARANCES

BRIDGES

A. Bridge Roadbed Width

The clear width of all bridges, including grade separation structures, needs to equal the full width of the physical improvements consisting of sidewalk, street, median and curb and gutter.

B. Approach Guardrail

If a vehicular railing or safety-shaped barrier is within 10 feet of a traveled way with or without a sidewalk, approach guardrails are to be installed on all approach ends in accordance with AASHTO guidelines and the below paragraph, E. Railings.

C. Cross Slope

The crown is normally centered on the bridge except for 1-way bridges, where a straight cross slope in one direction is used. The cross slope needs to be the same as for the approach pavement.

D. Median

On multi-lane divided highways, a bridge median that is 26 feet wide or less needs to be decked. The decking of all medians greater than 6 feet wide needs to be grated to allow natural light into the structure. Exceptions must be submitted to the Transportation Department for approval.

E. Railings

The railings to be used are the State of Arizona or State of California Department of Transportation standard design railings. There are four types of railings as described below:

1. Vehicular Barrier Railings

The primary function of these railings is to retain and redirect errant vehicles.

2. Combination Vehicular and Pedestrian Railings

These railings perform the dual function of retaining both vehicles and pedestrians on the bridge. They consist of two parts:

- a. A concrete barrier railing with a sidewalk, and
- b. A metal hand railing or fence-type railing (must be ADA compliant).

3. Pedestrian Railings

These railings prevent pedestrians from accidentally falling from the structure and, in the case of the fence-type railing, prevent objects from being thrown to the roadway below the bridge (must be ADA compliant).

4. Bridge Approach Railings

Approach railings are required at the ends of bridge railings exposed to approach traffic. On divided highways, with separate 1-way traffic structures, they need to be placed to the left and right of approach traffic.

- a. On 2-way roadbeds with a clear width less than 60 feet across the structure, approach railings need to be placed on both ends of the structure.
- b. When the clear width is 60 feet or more, approach railings need to be placed only to the right of approach traffic.
- c. Several types of approach railings are available, including Metal Beam Guardrail, Bridge Approach Guardrail (Types I and II) and Safety-Shape Barriers. The type of approach railing selected should match the rail to be used on the bridge. When long

runs of guardrail (such as embankment guardrail) precede the bridge, the guardrail should connect to the bridge railing to serve the approach railing function.

- d. Approach railings need to be flared or attenuation devices provided at their exposed end. (For detailed information see the AASHTO publication, Roadside Design Guide.)
- e. Approach railing end treatments that use energy absorbing terminals should be flared by 2 feet for design speeds of 45 m.p.h or above.

5-3.502

RETAINING WALLS

A. Types and Uses

Recommended types of retaining walls include reinforced concrete and structural masonry. Heavy timber construction is not encouraged except when approved by the Transportation Department General Manager. The walls need to include integral attachments for railings and weep drainage where applicable.

B. Aesthetic Considerations

In general, the materials and design of retaining walls need to match or blend with the adjacent natural features, landscaping and/or buildings. The surface of the retaining wall should have a low light reflectance. Suggested surface treatments include exposed aggregate, stucco or mortar wash and native stone, or other surfaces as approved by the Development Review Board.

The height of retaining walls within city rights-of-way cannot exceed 6 feet except when approved by the Transportation Department General Manager. If approved to retain above 6 feet, terracing is encouraged and the length of the alignment of the retaining walls should be foreshortened by vertical grooves, periodic offsets and height changes, or other configurations as approved by the Development Review Board. See [Section 2-1.100](#) for more information.

C. Safety Railings

A safety railing is required on or adjacent to vertical faces such as retaining walls, wing-walls and abutments, etc., and where the vertical fall is 2 feet or more. The safety railing needs to be constructed per City of Scottsdale standard details and placed on top of the vertical face structure of the vertical drop.

5-3.503

STRUCTURAL CLEARANCES

A. Horizontal Clearance

1. Clear roadside design is recommended for all arterials and collectors whenever practical. Where the roadway is curbed, the clearance between curb face to edge of the object should be a minimum of 1.5 feet. A clearance of 3 feet should be provided near the turning radii at intersections and driveways to provide clearance for the overhang of trucks. For further guidance, refer to the AASHTO Roadside Design Guide.
2. The horizontal clearance to bridge piers, abutments, headwalls and retaining walls on all streets can be no less than 10 feet from the edge of the traveled way and may require protection depending on the roadway design speed.
3. Drainage structures (pipes, box culverts, etc.) are to be extended to a distance of 10 feet from the edge of the travel way. A lesser clearance may only be allowed when rights-of-way limitations make the desired clearance unreasonable and appropriate traffic barriers are installed in accordance with the AASHTO Roadside Design Guide.

B. Vertical Clearance

Minimum vertical clearance shall be 16.5 feet over the entire width of the traveled way of an arterial street or major collector street. On other streets, the minimum shall be 14.5 feet. The Transportation Department General Manager must approve exceptions.

5-3.600

SIDE SLOPES

A. Side Slope Standards

Side slopes should be designed for functional effectiveness, ease of maintenance and pleasing appearance. For areas greater than 10 feet back of curb, slopes of 4:1 or flatter will be provided. Steeper slopes may be approved in areas more than 30 feet back-of-curb when soils are not highly susceptible to erosion, or when a cut is not more than 4 feet. Consult the AASHTO publication, Roadside Design Guide for further details. The Development Review Board must review cuts or fills greater than 4 feet. See [Section 2-1.100](#) for more information.

B. Slope Rounding

The top of all cut slopes needs to be rounded where the material is other than solid rock. A layer of earth overlaying a rock cut also will be rounded. The top and bottoms of all fill slopes for, or adjacent to, a traveled way, sidewalk, or bicycle path also need to be rounded. See [Section 1-2](#) for more information.

5-3.700

PARTIAL STREET IMPROVEMENT

A full street cross-section is required for interior streets of a development and a complete half-street cross-section for perimeter streets. However, if the street is a major arterial, 4 of the 6 lanes of the full street, or 2 of the 3 lanes of the half-street, may be required subject to rights-of-way availability. Determining if the unimproved lanes will be on the outer edge of the cross-section or adjacent to the median location will be made on a case-by-case basis and approved by the Transportation Department.

5-3.800

CONSTRUCTION OF HALF-STREETS

A. Design of Cross-Section for Half-Streets

Half-street construction consists of a minimum 24-foot wide pavement section for major streets (major collector classification or higher) and a 20-foot wide pavement section for minor streets (minor collector classification or lower). For half-street construction, the engineer needs to design the full cross-section of the street. The plans need to include, in dashed lines, the half-street, which will be constructed in the future. The half street construction needs to provide adequate transitions and tapers to the adjoining roadways.

B. Joining Existing Street Pavement

The half-street must be designed to match existing construction as much as possible unless doing so is likely to create an unsatisfactory condition. If changes are needed to correct conditions on an existing half-street to properly construct the other half of the street, the solutions must be developed with Transportation Department staff on a case-by-case basis. The plans for the new half-street must contain sufficient information on the profile and cross-sections of the existing street to demonstrate that the new construction will match the old construction and result in a full street with proper cross-sections.

C. Culverts Under Half-Streets

A culvert to be provided in conjunction with half-street construction must extend a minimum of 10 feet beyond the edge of the traveled way into the area where the other half of the street will be constructed in the future (subject to rights-of-way availability). The 10-foot distance is measured perpendicular to the street alignment. The culvert capacity, flow line slope and alignment must be based upon the ultimate design requirements for the culvert if it were to be built under the full cross-section where it could be considerably longer. The culvert ends shall

be protected in accordance with the AASHTO Roadside Design Guide. Temporary installation of culvert safety end section may be considered for an interim condition.

5-3.900

PAVEMENT TRANSITIONS

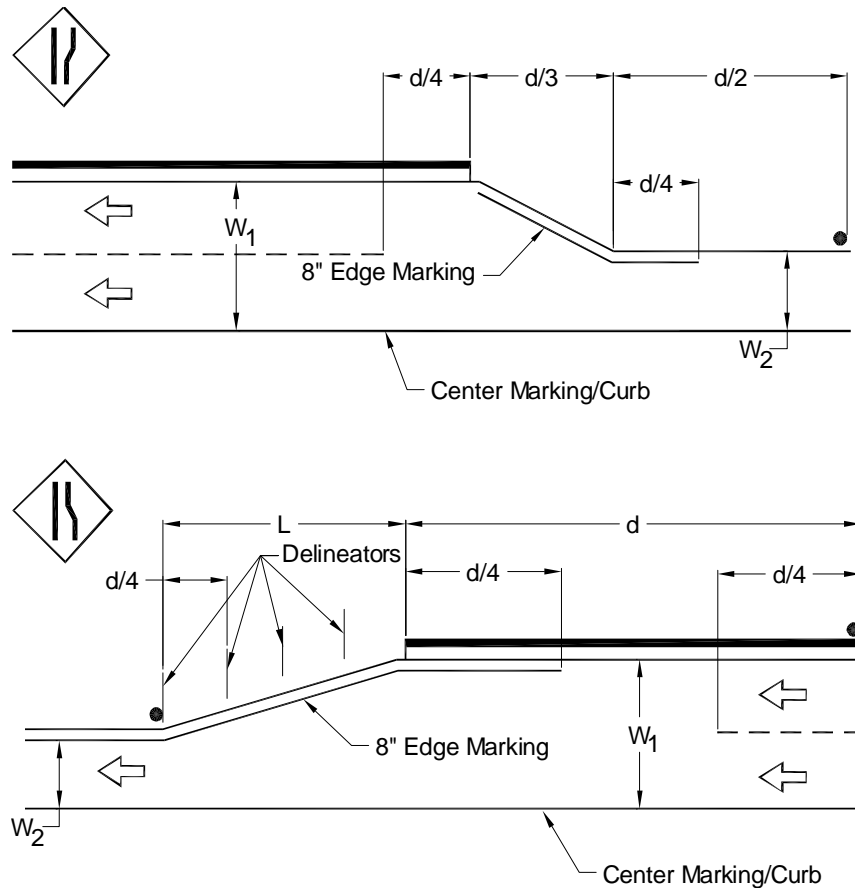
When development causes the widening of a portion of the pavement of an existing road, pavement transitions are required at each end of the widened portion. Design of the various features of the transition between pavements of different widths should be consistent with the design standards of the superior facility. The transitions should be made on a tangent section whenever possible. Locations with horizontal and vertical sight distance restrictions should be avoided. Whenever feasible, the entire transition should be visible to the driver of a vehicle approaching the narrower section. Intersections at grade within the transition area should be avoided.

A. Transition to a Wider Pavement Section

A transition from a narrower cross-section to a wider cross-section needs to be a length that is 5 times the street design speed in miles per hour. See Figure 5.3-48.

B. Transition to a Narrower Pavement Section

A transition from a wider cross-section to a narrower cross-section needs to be a length equal to the difference of the 2 widths in feet times the street design speed in miles per hour, or the 85th percentile speed in miles per hour, whichever is greater. Figure 5.3-48 illustrates this requirement.



S = Design Speed or 85 Percentile Speed, whichever is higher
 $W = W_1 - W_2$

$L = WS$
 $d = 15S$

FIGURE 5.3-48 PAVEMENT WIDTH TRANSITIONS

FRONTAGE ROADS

Generally there are two types of frontage roads, those along freeways that provide commercial access and those along arterials that provide residential access. The city does not typically have jurisdiction over freeway frontage roads.

A. Freeway Frontage Road Access

Any proposed freeway frontage roads, or access to existing or planned frontage roads, should be coordinated with the city's Transportation Department and the Arizona Department of Transportation. The city must be consulted to ensure the frontage road, or access to such, does not have a detrimental impact on the adjacent city street system.

B. City Street Frontage Roads

New frontage roads for residential access are not encouraged and must be approved by the Transportation Department. Frontage road geometrics are to be based upon specific project requirements, but generally should not be less than 20 feet in width. Connections to the intersecting side street need to be out of the intersection influence area as outlined in the Access Management Manual.

5-3.1000

5-3.1100

SUBDIVISION STREET PLANNING

Subdivision street plans should produce the minimum number of intersections and wash crossings and discourage through traffic. Figure 5.3-49 illustrates a number of concepts associated with desired subdivision street design. The following paragraphs describe certain other concepts and requirements.

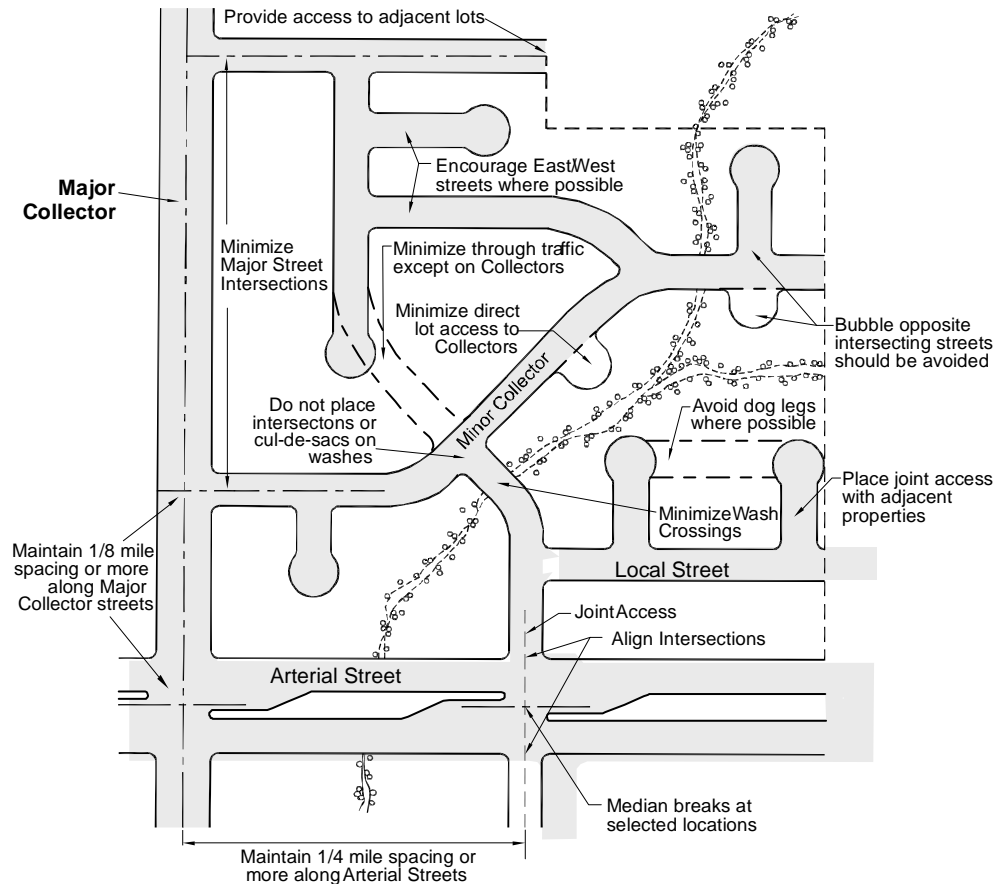


FIGURE 5.3-49 SUBDIVISION STREET PLANNING

A. Existing and Proposed Streets

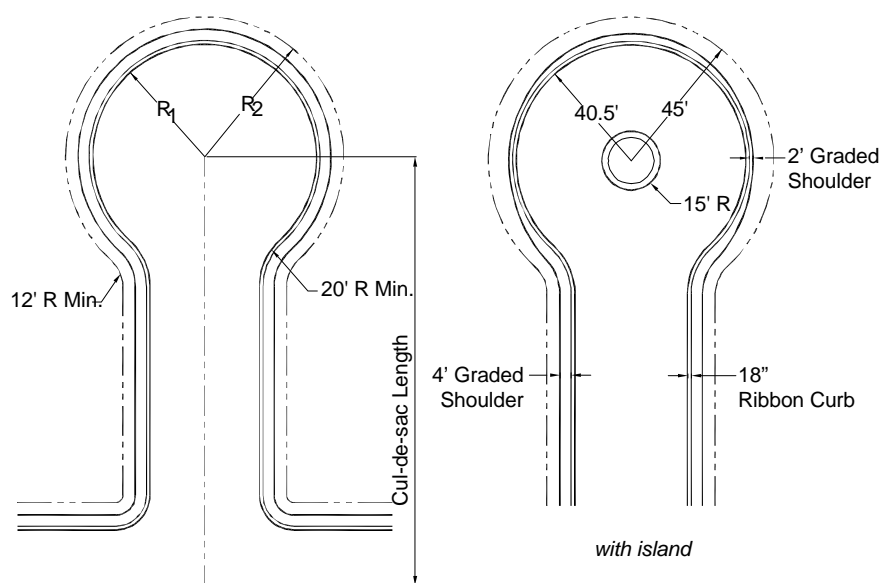
Existing streets and proposed streets of the Mobility Element of the General Plan, the Streets Master Plan, or any applicable Master Circulation Plan or Area Plan should be incorporated into the design of new subdivisions. Exceptions must be approved by the Transportation Department and may require the approval of the Transportation Commission.

B. Street Abandonment

An existing public street may be abandoned if it is not a street indicated in the Mobility Element of the General Plan or an Area Plan, and if it will not eliminate reasonable access to existing adjacent properties. The abandonment should alleviate a significant traffic problem and not create a new problem. If a street abandonment is approved, the abandonment must occur prior to submitting a final plat to the City Council.

C. Cul-de-Sac Street Lengths

A cul-de-sac street is a street that serves more than one property owner and has only one direct access to the public street system. The following requirements apply to both public and private streets. The length of a cul-de-sac is measured between the centerline of an intersecting street and the radius point of the cul-de-sac, as shown below in Figure 5.3-50; the minimum length of a cul-de-sac is two times radius R1, as illustrated. A cul-de-sac street cannot be longer than 1,500 feet and it cannot serve more than 25 single-family dwelling units; in these situations a secondary access may be required or the street may need to be upgraded to a collector level classification.



Classification of Cul-de-sac	Bubble Radii (ft.)	
	R1 (B.C.)	R2 (P.L.)
Local Residential	40.5	50
Local Commercial/Multi-family Residential	60.5	70
Local Industrial	60.5	70

Minimum Length = $2R$

Maximum Length = 1500 ft.

ADT = 250 vpd maximum

Maximum number of units served = 25

Cul-de-sac radii are the same for private streets

FIGURE 5.3-50 CUL-DE-SAC STREET LENGTH

D. Dead-End Streets

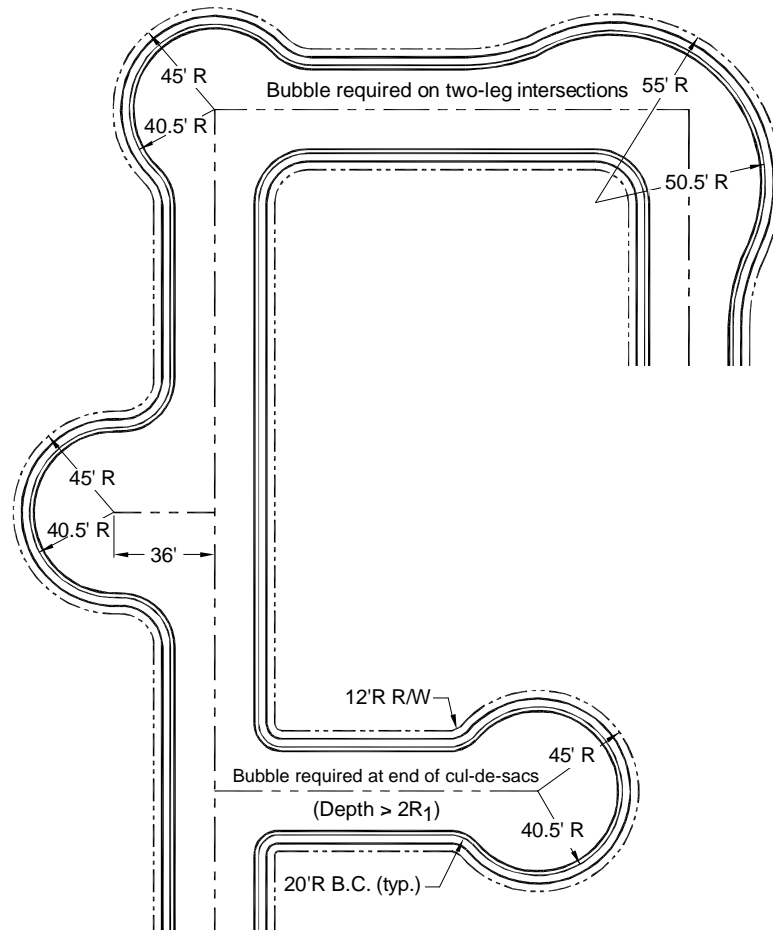
Dead-end streets are required where a street connection is necessary to serve adjacent properties that will develop at a future date. When a dead-end street is required, a temporary cul-de-sac needs to be provided. A dead-end street may not exceed 300 feet in length without an approved turn-around.

E. Bubbles

Bubbles are areas on the roadway expanded to provide a turn-around and additional access or lot frontage on minor collector and local streets. Bubbles are required at intersections where each street extends in only 1 direction from the intersection. Bubbles are permitted between

intersections to improve accessibility to odd-shaped sites, or on minor collector streets where direct access is not permitted. The bubble radii for local residential streets are shown on [Figure 5.3-50](#). Radii for cul-de-sac bubbles for other street classifications are shown below in Figure 5.3-51.

The use of bubbles (except for on a cul-de-sac) on other than local residential streets must be approved by the Transportation Department. Radii appropriate for these bubbles will be established as part of that approval.



The bubble radii shown on this figure are for local residential streets. Radii for cul-de-sac bubbles for other street classifications are shown on [Figure 5.3-50](#). The use of bubbles (except for a cul-de-sac) on other than local residential streets must be approved by the Transportation Department. Radii appropriate for these bubbles will be established as part of that approval.

FIGURE 5.3-51 BUBBLES FOR STREETS

F. Alleys

Alleys are discouraged and are subject to Transportation Department approval; however, alleys may be required where other alleys exist or where the extension of an existing alley or alley system is necessary. Dead-end alleys will not be permitted.

1. Alley Widths

Residential alleys abutting single-family uses need to be 16 feet in width. For other abutting uses, the alley provision is 20 feet in width.

2. Alley Intersections

Alley intersections and sharp changes in alignment should be avoided. When intersections or alignment changes are allowed, the inside corners need to be cut off on each side to provide a tangent section between the two sides at least 20 feet long, as shown in Figure 5.3-52 below.

3. Alley Paving

All alleys are to be fully paved with at least 2.5 inches of asphaltic concrete over 6 inches of ABC.

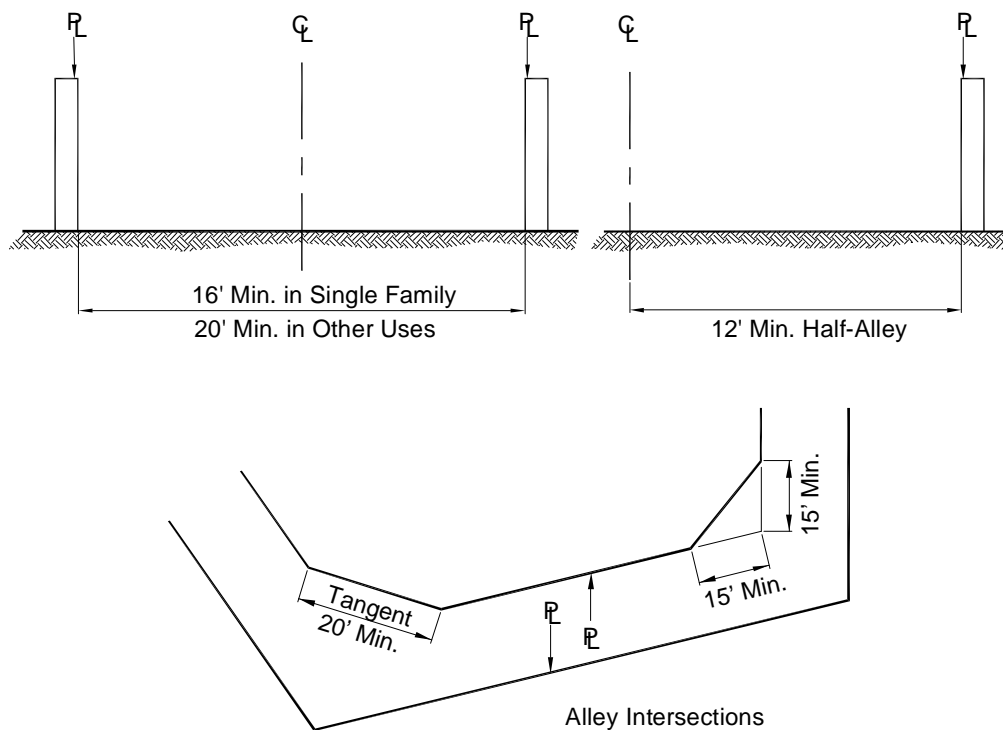


FIGURE 5.3-52 ALLEY WIDTHS AND INTERSECTIONS

G. Offset Intersections

Street jogs with centerline offsets less than 250 feet are not permitted along arterial and major collector streets, or on minor collector and local commercial and industrial streets where interlocking left turns will occur. Offsets as small as 125 feet are allowed on local residential streets and on minor collector and local commercial and industrial streets where interlocking left turns will not occur.

H. Intersecting Tangents

A tangent section of roadway is desirable prior to an intersection on a curvilinear street. Minor street intersections with major streets need to have a minimum tangent outside the intersecting rights-of-way. See [Appendix 5-3A](#) and [Appendix 5-3B](#) for design criteria.

SPECIAL STANDARDS

A development may desire a special set of standards that differs from the city standards contained in this document. This request is typically made for master planned communities as part of their associated master circulation plan. In such a case, a qualified traffic engineer, registered in the State of Arizona, must prepare a preliminary and final traffic design report

5-3.1200

and secure city approval of the reports before plans incorporating the special standards can be submitted for review and approval.

A. Preliminary Design Report

A preliminary design report needs to be submitted prior to or at the time of preliminary plat submittal. At a minimum, the preliminary report must address the following subjects:

- Vehicle Trip Generation
- Traffic Control Device Requirements
- Pedestrian, Bicycle and Equestrian Requirements
- Auxiliary and Additional Lane Requirements
- Special Features and their Influence
- ADA Access
- Design Speeds
- Roadway Classification
- Parking Requirements
- Transit Facility Requirements
- Pavement Design

Where possible the Preliminary Design Report should include a discussion of the elements required in the Final Design Report so that the city may comment and suggest changes prior to submission of the Final Design Report.

B. Final Design Report

A final design report needs to be submitted prior to or concurrently with the improvement plan submittal. The report must include a refinement of the preliminary design report and address the following subjects as a minimum:

- Horizontal and Vertical Alignment
- Intersection Location
- Traffic Control Devices
- Treatment of Special Features

C. City Review and Approval of Special Standards

The following factors will be considered by the city in its review of the report:

- Relationship of the proposed standards to national, state and city standards
- Similarity of the proposed standards to standards utilized in other communities
- Comparison of the proposed standards with alternatives
- Sensitivity of the proposed standards to safety, environmental and law enforcement concerns

5-3.1300

ESL STREET STANDARDS

Streets that are constructed within the area designated as Environmentally Sensitive Lands (ESL) should be designed to minimize the impact on the adjacent topography and landscape. The following standards have been developed specifically for streets that are constructed within the ESL land areas and vary from design standards for the non-ESL streets that are contained in the previous sections of this document. Additional information is contained in [Appendix 5-3B](#) and [Section 2-2.100](#), Environmentally Sensitive Lands; [Figure 2.2-1](#) depicts the areas within the city where these criteria apply.

A. Design Vehicle

For ESL areas, the basic design vehicle for all non-arterial streets is the Single Unit Truck as defined by AASHTO.

B. Horizontal Curves

Tangent sections between horizontal curves (compound or reverse) are not required for local residential streets in the ESL areas.

C. Street Grades

Longitudinal street grades within the ESL areas may range from 0.4 percent to 12 percent. In general, the maximum street grade should be 5 percent for major collectors, 10 percent for minor collectors and 12 percent for local residential streets. In areas with steep slopes and no alternative access provisions, steeper grades may be approved as shown in Figure 5.3-53. Lengths of flatter grades should break up steeper grades in order to provide a recovery area for emergency and service vehicles. Steeper grades may be approved in areas where it can be shown they would be less disruptive to the surrounding area and emergency and service vehicle access can be maintained. The city will not approve exceptions for any federally-funded projects.

Street Classification	Maximum Grade
Major Collector	9%
Minor Collector	12%
Local Collector	12%
Local Residential	15%

Gradient	Maximum Grade Length
7 – 9%	1400 ft.
9 – 12%	700 ft.
12 – 15%	350 ft.

FIGURE 5.3-53 STREET GRADES AND LENGTHS

D. Cross Slope

Cross slope should not exceed 4 percent. In ESL areas it may be necessary to use roadway cross slope to control drainage. Shoulder slopes should match the pavement cross slope.

E. Street Intersections

Right-angle intersections, those that intersect at an angle of 90 degrees, are the most desirable. They provide the shortest crossing distance and the best driver sight distance. Intersection angles that diverge by five degrees or more from 90 degrees are not allowed on minor collector or higher classified streets without approval from the Transportation Department. Local streets may have an angle divergence up to 15 percent at street intersections. If an intersection occurs along a curve, the side street centerline must be radial (no divergence) to the curve of the through street.

The minimum intersection spacing along local collector and local residential streets should be a minimum distance of 165 feet.



DESIGN SPECIFICATIONS FOR STANDARD URBAN AND SUBURBAN STREETS

Street Design Element*	Major Arterial	Minor Arterial & Couplet	Major Collector	Minor Collector	Local Collector	Local Residential	Local Commercial/Industrial
Full right-of-way width †	150	110	100	70	60	46	60
Type of Curb - <u>V</u> erticle, <u>R</u> olled †	V	V	V	V	R	R	V
Design speed (m.p.h.)	55 (45 m.p.h. posted)	45	45	35	30	20	20
Length of transition for 2% superelevation	320	210	210	135	150	150	150
Minimum radius of horizontal curve without superelevation	1800	1800	1100	650	450	200	200
Minimum radius of horizontal curve without superelevation (Federally-funded projects)	10,000	8000	8000	5000	3500	1600	1600
Minimum radius of horizontal curve with 2% superelevation	1350	1350	850	500	350	150	150
Minimum radius of horizontal curve with 2% superelevation (Federally-funded projects)	6500	5000	5000	3000	2500	1200	1200
Minimum length of tangent between reverse curves	300	300	250	200	150	100	100
Minimum length of tangent between curves in same direction	660	660	500	400	300	250	250
Minimum horizontal curve length	500	500	500	400	250	100	100
Stopping sight distance	500	500	365	250	200	125	125
Stopping sight distance (Federally-funded projects)	495	360	360	250	200	115	115
Passing sight distance	1990	1990	1650	1300	1100	800	800
Passing sight distance (Federally-funded projects)	1985	1625	1625	1280	1190	800	800
Intersection sight distance on drivers left and right turns, left turns, and through traffic**	770	730	595	415	355	280	295
Min. tangent length approaching intersection (measured from edge of roadway)	300	300	250	200	150	100	100

*Unit of measure in feet unless otherwise noted.

†These first four design elements may vary for modified cross section, such as the Urban Character streets, with approval from the Transportation Department.

‡Measured from back-of-curb to back-of-curb.

**If high volumes of truck traffic are anticipated, sight distances given in [Appendix 5-3C](#) will be used.



DESIGN SPECIFICATIONS FOR STANDARD RURAL / ESL STREETS

Street Design Element*	Major Arterial	Minor Arterial	Major Collector	Minor Collector	Local Collector	Local Residential
Full right-of-way width†	150	110	90	70	50	40
Type of Curb - <u>M</u> ountable, <u>R</u> olled, or <u>R</u> ibbon†	M, Ro, or Ri	M, Ro, or Ri	M or Ro	Ro	Ro or Ri	Ro or Ri
Design speed (m.p.h.)	55 (45 m.p.h. posted)	45	45	35	30	20
Length of transition for 2% superelevation	320	210	210	135	150	150
Minimum radius of horizontal curve without superelevation	1800	1800	980	475	250	100
Minimum radius of horizontal curve without superelevation (Federally-funded projects)	10,000	8000	8000	5000	3500	1600
Minimum radius of horizontal curve with 2% superelevation	1350	1350	760	385	255	85
Minimum radius of horizontal curve with 2% superelevation (Federally-funded projects)	6500	5000	5000	3000	2500	1200
Minimum length of tangent between reverse curves	300	300	250	200	150	None
Minimum length of tangent between curves in same direction	660	660	500	400	300	None
Minimum horizontal curve length	500	500	500	400	250	100
Stopping sight distance	500	500	365	250	200	125
Stopping sight distance (Federally-funded projects)	495	360	360	250	200	115
Passing sight distance	1990	1990	1650	1300	1100	800
Passing sight distance (Federally-funded projects)	1985	1625	1625	1280	1190	800
S Intersection sight distance on drivers left and right turns, left turns, and through traffic**	770	730	595	415	335	280
Min. tangent length approaching intersection (measured from edge of roadway)	300	300	250	200	150	100

*Unit of measure in feet unless otherwise noted.

†These first four design elements may vary for modified cross section, such as the Urban Character streets, with approval from the Transportation Department.

‡Measured from back-of-curb to back-of-curb.

** If high volumes of truck traffic are anticipated, sight distances given in [Appendix 5-3C](#) will be used.



INTERSECTION & DRIVEWAY SIGHT DISTANCE REQUIREMENTS

Six Lane Roadway

Sight Distance (S)						
Design Speed	Passenger Car (ft)		Single Unit Truck (ft)		Combination Truck (ft)	
	TH	LT	TH	LT	TH	LT
25	350	350	470	455	540	530
30	420	420	560	545	650	635
35	490	490	655	635	760	740
40	560	560	780	725	865	845
45	630	630	840	815	975	950
50	700	700	935	905	1080	1055
55	770	770	1030	995	1190	1160

Three Lane Roadway

Sight Distance (S)						
Design Speed	Passenger Car (ft)		Single Unit Truck (ft)		Combination Truck (ft)	
	TH	LT	TH	LT	TH	LT
25	260	295	340	375	415	450
30	310	355	410	450	495	540
35	360	415	475	525	580	630
40	415	470	545	600	660	720
45	465	530	610	675	745	810
50	515	590	680	750	825	900
55	570	650	745	825	910	990

Four Lane Roadway

Sight Distance (S)						
Design Speed	Passenger Car (ft)		Single Unit Truck (ft)		Combination Truck (ft)	
	TH	LT	TH	LT	TH	LT
25	315	335	415	430	490	500
30	375	400	500	515	590	600
35	440	465	585	600	685	700
40	500	530	665	685	785	800
45	565	565	750	770	880	900
50	625	665	835	855	980	1000
55	690	730	915	940	1075	1100

Two Lane Roadway

Sight Distance (S)						
Design Speed	Passenger Car (ft)		Single Unit Truck (ft)		Combination Truck (ft)	
	TH	LT	TH	LT	TH	LT
25	240	280	315	350	390	425
30	290	335	375	420	465	510
35	335	390	440	490	540	595
40	385	445	500	560	620	680
45	430	500	565	630	695	765
50	480	555	625	700	775	845
55	530	610	690	770	850	930

Notes:

- TH=Through Movement, LT = Turn Movement
- Design speed by roadway classification is shown in [Appendix 5-3A](#) and [Appendix 5-3B](#). Typically design speed is equal to the speed limit +10 mph.
- Refer to the 2004 AASHTO Geometric Design of Highways and Streets for additional information.

TRAFFIC SIGNAL DESIGN

This section presents the process and criteria for preparing traffic signal plans for the city. It identifies traffic signal design criteria, plan content, and equipment requirements and specifications.



DEPARTMENT RESOURCE INFORMATION

Aviation/Airport	15000 N. Airport Dr.	480-312-2321
Advance Planning Services	7506 E. Indian School Rd.	480-312-7990
Capital Project Management	7447 E. Indian School Rd., Suite 205	480-312-7250
Current Planning	7447 E. Indian School Rd., Suite 105	480-312-7000
Customer Service	7447 E. Indian School Rd., Suite 100	480-312-7800
Downtown Group	4248 N. Craftsman Ct.	480-312-7750
Facilities Management	9191 E. San Salvador Dr.	480-312-5999
Fire & Life Safety/ Inspections	8401 E. Indian School Rd.	480-312-1855
Fire Plan Review	7447 E. Indian School Rd., Suite 125	480-312-7080
Inspections & Land Survey	9191 N. San Salvador Dr.	480-312-5750
Parks Department	7340 Scottsdale Mall	480-312-2915
One Stop Shop/Permit Services	7447 E. Indian School Rd., Suite 100	480-312-2500
Plan Review	7447 E. Indian School Rd., Suite 125	480-312-7080
Records Division	7447 E. Indian School Rd., Suite 100	480-312-2356
Solid Wastewater Management	9191 N. San Salvador Dr.	480-312-5600
Stormwater Management	7447 E. Indian School Rd., Suite 205	480-312-7250
Street Operations	9191 N. San Salvador Dr.	480-312-5626
Transportation	7447 E. Indian School Rd., Suite 205	480-312-7696
Water Resources	9388 E. San Salvador Dr.	480-312-5685
City of Scottsdale	www.scottsdaleaz.gov	

TRAFFIC SIGNAL DESIGN

GENERAL INFORMATION

A. Scottsdale Traffic Signal Policies

The following policies have been adopted by the City of Scottsdale (COS) City Council. Requests to deviate from these policies must be submitted in writing to the Scottsdale Traffic Engineering Division for consideration.

1. Install warranted traffic signals to maintain 1/2 mile signal spacing on expressways, parkways and major and minor arterials. Spacing must be consistent with the city's traffic control system plan.
2. Install warranted traffic signals to maintain 1/4 mile spacing on major collectors. Spacing must be consistent with the city's traffic control system plan.
3. Install warranted left-turn arrows based upon established City of Scottsdale criteria.
4. Require a complete traffic signal plan when a new traffic signal is to be constructed, or when an existing signal or any part of an existing signal is to be modified in any way.
5. Require any traffic signal construction, private or public, to be supervised by one certified IMSA Level II Signal Technician and one IMSA Level I Signal Technician.

B. Reference Documents

The current version of the following publications, adopted by Arizona Department of Transportation (ADOT), is to be used in conjunction with the design criteria in this document.

- Manual on Uniform Traffic Control Devices For Streets and Highways - USDOT, FHWA
- Standard Specifications for Road and Bridge Construction and General Specifications for Traffic Signals and Highway Lighting - Construction Specifications, ADOT
- Traffic Signals and Lighting and Signing and Marking - Standard Drawings, ADOT
- Traffic Control Design Guidelines - ADOT
- Manual of Signs Approved for Use on State Highway System - ADOT
- Traffic Engineering Policies, Guide and Procedure Manual - ADOT
- Informational Guide for Roadway Lighting - AASHTO
- Guide to Standardized Highway Lighting Pole Hardware - AASHTO
- Uniform Standard Specifications for Public Works Construction - MAG
- Uniform Standard Details for Public Works Construction - MAG
- COS Supplement to MAG Uniform Standard Specifications for Public Works Construction
- COS Supplement to MAG Uniform Standard Details for Public Works Construction
- COS Traffic Signal Special Requirements

C. Other References

- United States Access Board Revised Draft Guidelines for Accessible Public Rights-of-Way, www.access-board.gov/prowac/draft.htm

- United States Access Board Interfacing Accessible Pedestrian Signals (APS) with Traffic Signal Control Equipment www.access-board.gov/research/APS/report.htm#_Toc38768660
- NCHRP Accessible Pedestrian Signals: Synthesis and Guide to Best Practice, www.walkinginfo.org/aps/pdf/APS-Synthesis.pdf
- walkinginfo.org: Pedestrian and Bicycle Information Center, www.walkinginfo.org

D. Pre-Design Conference with Traffic Engineering Division

Prior to beginning traffic signal design, a pre-design conference may be requested by either Traffic Engineering or the design consultant.

E. Pre-Construction Conference with Traffic Signal Division

Prior to start of work, the contractor must contact COS Traffic Signal at 480-312-5635 to arrange a pre-construction conference.

5-4.100

TRAFFIC SIGNAL DESIGN CRITERIA

Refer to www.ScottsdaleAZ.gov/design/trafficsignalspecs.

All equipment and materials specified must be listed on the COS Qualified Products List (QPL) as shown in [Appendix 5-4B](#) or include the required documentation to comply with the COS QPL and the traffic controller requirements shown in [Appendix 5-4C](#). Items not on the Scottsdale QPL must be submitted for approval to Traffic Engineering Division, 30 working days prior to signal construction.

Scottsdale Intelligent Transportation Systems (ITS) designs are not listed in guidelines. However, reference to ITS special provisions, plans or details may be called out on the signal plans for coordination requirements. To obtain ITS details and special provisions, the applicant must submit a separate plan and special provisions document to the Scottsdale Traffic Engineering Department, Traffic Management Center. For information call 480-312-2358.

5-4.101

SPECIFICATIONS/PROVISIONS

The COS “Boiler Plate” construction specifications need to be used. Traffic Engineering and/or the designer will determine the need for project-specific construction special provisions. Notes may be added to the construction plans if the designer feels that it is necessary to deviate from these listed requirements.

5-4.102

SIGNAL STRUCTURES

1. Poles and foundations need to adhere to ADOT’s Traffic Signals and Lighting– Standard Drawings, ADOT Standard Specifications for Road and Bridge Construction and must meet the COS QPL.
2. A sufficient pedestrian landing meeting the MAG Supplement and Americans with Disabilities Act (ADA) requirements must be provided. See [Section 5-4.104](#) for details.
3. The preferred configuration of poles is one pole per corner, located at the center of the curb return, at the back edge of the sidewalk. Situations requiring multiple poles per corner or poles (traffic signal or pedestrian) within medians should be discussed with Traffic Engineering.
4. Traffic signal installations along the east and west couplet require trombone style poles and mast arms.
5. Combination poles, bracket arms, mast arms, bases and foundation entrance conduit need to be included on the traffic signal plan.

5-4.103

SIGNALS

1. All design elements must comply with Manual on Uniform Traffic Control Devices (MUTCD) standards unless directed otherwise by Traffic Engineering.
2. Twelve-inch signal faces are required for all through indications and for all left-turn indications. Eight-inch signal faces shall not be used. Refer to [Figure 5.4-1](#).
3. Typically, a minimum of 3 heads is required for control of a through movement (1 overhead mount and 2 far-side, side-mounts – left and right). Typically, a minimum of 2 heads is required for control of other movements. The overhead indications need to be centered on the lane lines to increase sight distance.
4. Typically, a minimum of 2 heads is required to control a left-turn movement. One head shall be overhead-mounted on the mast arm containing the heads that control the corresponding through movement (or median mounted if the median width is greater than 6 feet) and the other head shall be side-mounted or pole-mounted on the far-side left corner facing the corresponding through movement.
5. One mast, arm-mounted signal head is required for freeway off-ramp terminals.
6. All indications shall be wide-angle LED type lamps. All pedestrian indications shall also be LED type lamps. LEDS shall be model 430-1315 or approved equivalent.

Wattage is as follows:

12-inch red ball = 15 watts	12-inch yellow ball = 15 watts	12-inch green ball = 11 watts
12-inch red arrow = 9 watts	12-inch yellow arrow = 9 watts	12-inch green arrow = 11 watts
16-inch pedestrian man/hand signal module = 11 watts		

Questions regarding indication type should be directed to Field Services, 480-312-5634.

7. Fiber optic indications cannot be used unless directed otherwise by Traffic Engineering. All ITS elements, existing or new, will require a meeting with Traffic Engineering to discuss design requirements and special provisions.
8. Either aluminum or polycarbonate signal heads may be used with glass lenses only.
9. Heads and mounting brackets shall be black.
10. Back plates and tunnel visors shall be installed on all signal faces and need to be black.
11. Base-mount mounting height of 4 and 5 section heads should be adjusted to avoid conflict with mast arm. The aiming of the head cannot conflict with the mast arm or mast arm connection. These side-mount heads should be mounted on the backside of the pole, at a 45-degree angle and at a height of 115 inches.
12. A maximum of 3 heads may be installed on a mast arm that is 40 feet in length or less. A maximum of 4 heads may be installed on a mast arm that is 45 feet in length or longer. (A mast arm that is 40 feet in length or less needs to include a minimum of three tenons. A mast arm that is 45 feet in length or greater needs to include a minimum of four tenons.) All mast arms tenons shall be installed at 12 feet intervals, with the outboard (left) tenon at 14 feet from the first inboard tenon.
13. Traffic Engineering must approve the use and placement of right-turn arrow heads. Right-turn heads need to be 4-section "G" heads.
14. ADOT type eleven (XI) mounting hardware will not be used in Scottsdale signal designs, see [Figure 5.4-2](#). Modified 4-section "G" heads must be used instead of 5-section "Q" heads for all locations where permitted/protected left turn phasing is designed, see [Figure 5.4-1](#).
15. All hardware shall be mounted on pole "backside at 45 degrees" or per COS Traffic Signal Inspector requirements.

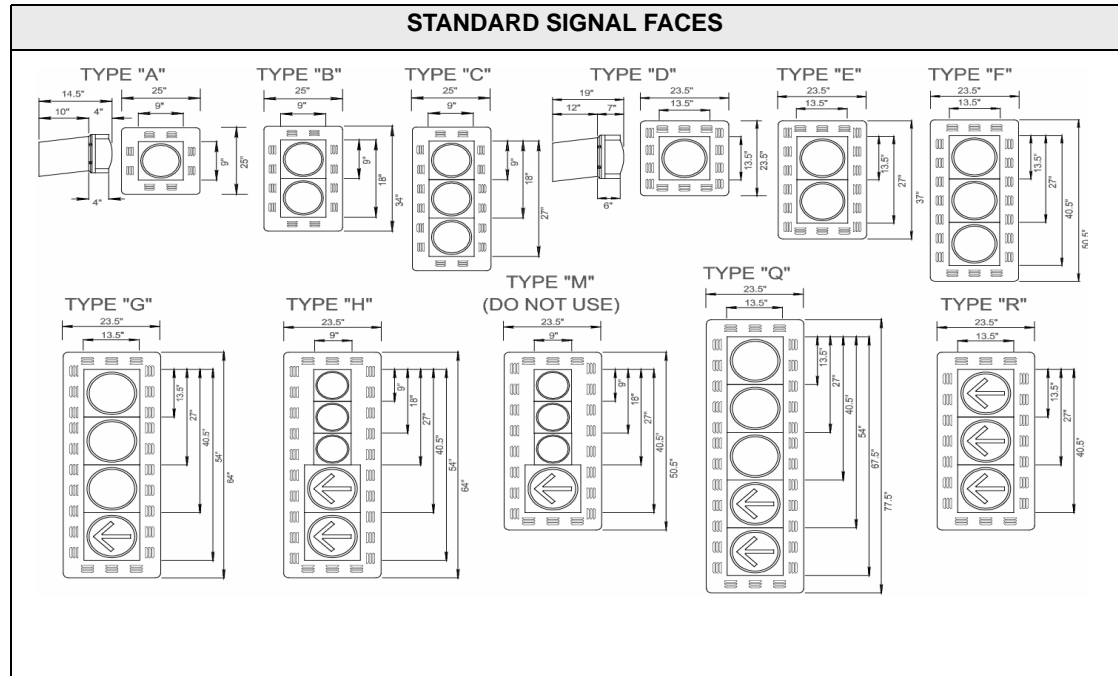


FIGURE 5.4-1 STANDARD SIGNAL FACES

MOUNTING ASSEMBLIES					
Type	Plan Symbol	Ref.	Type	Plan Symbol	Ref.
I		ADOT T.S. 9-1	VII		ADOT T.S. 9-5
II					
III		ADOT T.S. 9-2	VIII		ADOT T.S. 9-6
IV		ADOT T.S. 9-2	IX		ADOT T.S. 9-7
V		ADOT T.S. 9-3	X		ADOT T.S. 9-8
VI		ADOT T.S. 9-4	XI		ADOT T.S. 9-9
			do not use		

FIGURE 5.4-2 MOUNTING ASSEMBLIES PLAN SYMBOLS

5-4.104

PEDESTRIAN SIGNALS

1. Pedestrian signals should be installed at ALL intersections unless directed otherwise by the Traffic Engineering Division.
2. Pedestrian push buttons should be installed for ALL directions unless directed otherwise by the Traffic Engineering Division.
3. Pedestrian push buttons shall meet ADA requirements.
 - Provide a concrete slab immediately adjacent to the pole and directly under the pedestrian signal button for ADA access route, minimum 48 inches X 48 inches.
 - The slab shall have no more than a 2% slope in any direction.
 - Mount pedestrian signal button at 36" to center of button.
 - Pedestrian signal buttons shall be the large slap buttons.
4. Use the ADOT pedestrian push-button post when necessary in accordance with the MUTCD. Follow the same guidelines as above.
5. Pedestrian signals must be 16-inch LED "Man/Hand" indication and have bottom hinges.
6. The required pedestrian push button placard design, as shown below in Figure 5.4-3, needs to be included in the design. Contact Field Services Division at 480-312-5635 for details.



FIGURE 5.4-3 PEDESTRIAN PUSH BUTTON PLACARD

CONTROLLER

5-4.105

1. The Controller shall be a 170E system unless otherwise directed by the Traffic Engineering Division.
2. The Controller input rack needs to be wired as shown in the MAG Supplement, COS Standard Detail 2140.

CONTROLLER CABINET

5-4.106

The controller cabinet must be model 330 with extender base and access panel, unless otherwise directed by the Traffic Engineering Division. Intersections with ITS cameras may require an additional communications cabinet or a combined 332 cabinet. Traffic Engineering Division must review and approve all cabinets prior to installation.

Typically, the cabinet shall be located on the same corner as the power cabinet, usually on the corner closest to the power source as specified by the power provider. To the extent possible, the cabinet should be shielded and protected from the threat of errant vehicles. The cabinet should be positioned to allow a technician working within the cabinet a clear view of the intersection under control. Provide ADA accessible route to all pedestrian push buttons.

The cabinet foundation dimensions need to be 30 inch x 30 inch, project 6 to 8 inches above the adjacent (ultimate) ground elevation and extend 32 to 36 inches below the adjacent (ultimate) ground elevation. See COS Standard Detail 2139 for Traffic Signal Controller Cabinet Base Extender. A Tech Pad needs to be installed in front of the cabinet with the dimensions of 30 inch x 36 inch x 4 inch. Installation of an 8 feet x 5/8 inch copper ground rod needs to be installed in the cabinet using 1 inch PVC conduit.

A. Electric Service Cabinet

1. The electric service cabinet needs to be MEYERS model MEUG16-100TB (dual) or approved equivalent unless otherwise directed by the Traffic Engineering Division. The electric service cabinet must include the following: lightning arrest (ground rod), photocell receptacle rated for 20 amps or more, sub-breakers and test/auto switch. Mount a permanently affixed metal address tag on the front side underneath the meter window. Photo cell shall be oriented in the North direction.
2. Install a #7 pull box adjacent to the electric service cabinet. Also, install a power run from the pull box to the cabinet. Power run design shall be per utility company requirements.
3. When the power source is an overhead power drop, use a 2-inch galvanized conduit above ground and through the first underground sweep. Power run design shall be per utility company requirements.
4. The cabinet foundation should have dimensions of 30 inch x 30 inch and project 6 to 8 inches above the adjacent (ultimate) ground elevation. Extend the cabinet foundation 32 to 36 inches below the adjacent (ultimate) ground elevation. Install a tech pad in front of the cabinet with dimensions of 30 inch x 36 inch x 4 inch. Locate the service cabinet no closer than 10 feet from the traffic signal control cabinet (edge-to-edge).
5. Permanently attach the service address to the electric service cabinet.

B. Loop Detectors

1. All loop detectors shall be wire-in-duct type wire. (Orange Jacketed Detect-a-Duct or approved equivalent, #14 stranded inside a ¼ inch PVC tubing and must meet IMSA 51-5.)
2. Center all loop detectors in the middle of the applicable traffic lane. Loops must be sufficiently dimensioned on the plans. Extend loop detectors 5 feet into the crosswalk unless directed otherwise by the Traffic Engineering Division.
3. Use a rectangular loop with 3 turns (6 feet x 40 feet) for all through lanes.
4. Use a quadrapole loop with 2 outside turns and 4 inside turns (6 feet x 40 feet) in all exclusive left-turn lanes. (Wire in middle cut shall run the same direction.)
5. Do not install loop detectors in exclusive right-turn lanes unless directed by the Traffic Engineering Division.
6. Locate permanent count detector loops only as specified by the Traffic Engineering Division. Count detector loops shall consist of a minimum 4 turns (6 feet x 6 feet).
7. Pre-formed loop detectors (conforming to the latest ADOT specification) shall be used under decorative pavement, pavers, concrete or other special roadway surfaces or as directed by the Traffic Engineering Division. Do not splice lead-in cable between the loop and the cabinet.
8. The lead-in cable between the loop wire and controller shall meet IMSA 50-2, 14 AWG specification or approved equivalent. Lead-in shall be continuous back to controller.
9. Twist loop lead-in and splices in pull box a minimum 8-10 turns per foot and solder. Use only Griggs Loop Detector Sealant, 3-M Loop Sealant or approved equivalent.
10. Install loops prior to installing the final pavement lift (if part of a paving project).
11. Prior to city acceptance, the contractor must inspect and test loops, per ADOT test requirements, in the presence of the Traffic Inspector.

12. Contractor is responsible for layout of all loop detectors.

C. Conductors

1. IMSA 19-1 stranded cable shall be used for all signal and pedestrian conductors. Two cables shall be installed in all street crossings and in the cabinet home run. Pole/mast arm runs require seven conductor and four conductor cables. Install the 7 conductor cables on the outboard mast arm mounted head and all side mount heads.
2. Signal pole and conduit grounding wire shall be #8, solid bare copper wire.
3. Belden 9418 or approved equivalent loop lead-ins shall be used between telephone drop point and the controller. IMSA 50-2 or approved equivalent shall be used between detector- loop pull box and the controller shall be continuous back to control cabinet.
4. Opticom model 138 detector cable shall be used for emergency vehicle pre-emption. Do not splice 138 detector wire between pole connection and cabinet termination.
5. Re-pull completely with new wire and remove old wire if any existing conduit run is disturbed. The use of wire pulling lubricant is required in all conduits. Install pull strap in every conduit run.
6. Do not splice wires except in pull boxes, terminal compartments, control cabinet and electric service cabinet. Twist wire splices prior to installing wire nuts. Dip all splices in 3M Scotch Kote or approved equivalent, a minimum of two times to eliminate any air bubbles. Fill 100% completely with sealer any wire nut. Solder all pull box loop detector connections. Twist loop wire to first pull box a minimum of 8-10 turns per foot prior to soldering to lead-in cable.
7. Where cables loop through pullboxes, they shall be marked with white tape to designate cable or cable two or appropriate phasing tape for other conductors. Conductors and cables have a minimum of 36 inches of slack in all pullboxes.
8. All future conduits and mast arm tenons shall have a pull strap installed.

D. Conduits

1. All conduits except telephone drops shall be 2 ½-inch with 2 conduits installed for all street crossings and pole runs. Conduit for telephone drops and loop stubouts shall be 2-inch; 2 additional 4 inch conduits or one 6-inch conduit are now required in pole foundations to later incorporate the installation of Cell Tower conductors if approved by Traffic Engineering and Field Services for installation.
2. Use galvanized conduit for exposed, above-ground runs through the first sweep below grade.
3. Place red warning tape in all conduit trenches, 12 inches below final grade, witnessed by the city's traffic signal inspector.
4. Use Schedule 40 PVC, except for service runs above ground.
5. Avoid installing conduit in the medians, unless otherwise directed by Traffic Engineering.
6. Install loop stubout conduit for all approaches regardless of the requirement for loops. Loop stubout conduit shall be 2-inch.
7. Traffic signal conduit sweep radius shall be a minimum of 12 inch and ITS conduit sweep radius shall be 36 inch minimum.

E. Pull Boxes

1. All pull boxes shall be concrete/fiber composite type and shall include minimum 8 inch extension on main pull box. All pull boxes require sump #57 rock, per ADOT standards.
2. Size all boxes in accordance with ADOT sized # 7 or ADOT sized # 5 as called for on the prints or as specified by the Traffic Signal Inspector. As a general rule, #5 boxes are to be used only for communication and end runs. All inside the horseshoe pull boxes and main pull boxes shall be sized # 7.

3. Do not place pull boxes in traveled roadways. Conduit must be extended where necessary to relocate pull box to a non-traveled area. However, if the conduit cannot maintain a straight route, install a new conduit run.
4. Use concrete pull boxes in sidewalks. Do not use fiber-composite boxes.
5. When possible, locate pull boxes adjacent to sidewalks rather than in the sidewalk.
6. Mark all traffic signal pull boxes "Traffic Signal" on the lid.
7. Use pull boxes at all corners and in island noses.

F. Lighting

Luminaries shall be provided on all signal poles unless there is a utility conflict or unless directed otherwise by the Traffic Engineering Division. Luminaire wire connections will only be made in pull boxes and not brought into the signal controller cabinet.

G. Emergency Vehicle Pre-Emption

1. Emergency vehicle pre-emption shall be used for all directions and at all locations, unless otherwise directed by the Traffic Engineering Division. Additional sensors may be necessary if approaches are offset or vision is obstructed. All receivers shall be 3-M model 721, dual sensor detectors.
2. Opticom model 138 detector cable shall be used for emergency vehicle pre-emption. Do not splice 138 detector wire between pole connection and cabinet termination.
3. Tape and color-code all Opticom detector cables.
4. Phase selector shall be 3-M Model 752.

H. Phasing Standard

1. The Traffic Engineering Division will determine all intersection phasing. Left-turn phasing will operate as lag-left unless otherwise directed by Traffic Engineering. Typical phasing standards are shown in [Appendix 5-4A](#).
2. Corresponding permitted/protected left-turn phasing shall be wired together in the cabinet and operate simultaneously to avoid the left-turn trap.
3. The signal controller must be wired by an IMSA Level 2 certified signal electrician.

I. Electrical Power

1. Contact the applicable power provider to determine source for traffic signal power and to coordinate applicable requirements.
2. Show the electrical service address on the signal plan. The address may be obtained from the COS (One Stop Shop) Records Department, 480-312-2500.
3. The contractor must obtain an electrical service permit (No Fee) from the COS One Stop Shop, www.ScottsdaleAZ.gov/bldgresources/countreresources.

J. Traffic Signal System (Communications)

1. Interconnect all traffic signals to the COS Traffic Signal System by means of a 4-wire, conditioned telephone landline, unless directed otherwise by the Traffic Engineering Division. Contact Traffic Engineering Division at 480-312-2358 for circuit number and other applicable information.
2. Contact the applicable communications provider to determine location for telephone drop and to coordinate applicable requirements.
3. Install a separate 2-inch conduit from the point of phone service (phone drop) to the nearest pull box. Belden 9418 or approved equivalent, shall be used for the telephone run.
4. Show the telephone service address on the signal plan. The address may be obtained from the communications provider or from COS Records Office.

K. Signing

All regulatory, warning and route marker signs shall be provided with the traffic signal installation and shall be in accordance with the Manual on Uniform Traffic Control Devices. Metro street name signs or LED lighted signs, as required, shall be installed on signal poles per COS criteria. See COS Standard Detail 2134-3, www.ScottsdaleAZ.gov/design/COSMAGSupp.

L. Striping

All necessary striping shall be provided with the traffic signal installation and shall be in accordance with the Manual on Uniform Traffic Control Devices. Crosswalks shall be installed prior to the intersection being energized. See [Section 5-5.000](#), Signs and Markings for details.

M. Removal and Salvage

1. Keep all existing traffic signal equipment and streetlights in operation until new installations are operational.
2. Remove foundations to at least 36 inches below grade or as directed by the COS inspector.
3. Keep all traffic signal approaches that have vehicle detection in operation during construction. Construction staging to avoid existing detectors or the installation of temporary detectors will be required to maintain detection during construction.
4. In most cases, the Traffic Engineering Division will require temporary detection to be installed in intersections that are being reconstructed, if normal detection cannot be restored in a timely manner.
5. Keep existing Telco in operation during construction.

CONSTRUCTION PLAN SUBMITTALS

5-4.200

Traffic signal plans shall be submitted to the One Stop Shop and must comply with all requirements of this manual. Two sets of Mylar signal plans are required to receive final project approval. One set will be approved and returned to the submitter; one set will be forwarded to the Traffic Engineering Division.

A final signal plan shall be submitted in Microstation format, Ver. 8 and must be submitted to the Traffic Engineering Division no later than 10 working days after final approval. All intersections shall be as-built by the designer no later than 15 working days after the signal is turned on and submitted to Traffic Engineering Division in the same Microstation format. Any changes reflected on the plans shall be X'd out and new locations shown in bold.

TRAFFIC SIGNAL PLAN CONTENTS

5-4.300

PLAN CONTENT

Traffic signal plans shall be developed in accordance with the requirements of [Section 1-2.100](#), and conform to ADOT standard practices. As a general guide, the traffic signal plan layout shall be drawn at **1 inch = 20 feet scale**, and shall include the following items:

1. Locate and identify ALL existing and/or proposed improvements, above and below ground, within 200 feet of the intersection. **INCLUDE ALL UTILITIES.**
2. Locate and identify ALL existing and/or proposed pavement marking and signing, include turn-arrows for exclusive turn lanes.
3. Locate existing vegetation (trees, etc.), which could be in conflict with any proposed equipment locations or impact required signal visibility distances.

4. Provide a profile layout when vertical roadway alignment may impact traffic signal visibility requirements. (1 inch = 40 inches-scale for profile is acceptable.)
5. Provide bearings for each leg of the intersection when deflection is greater than 2 degrees. Provide roadway curve data if applicable.
6. Locate all traffic signal equipment (poles, controller cabinet, electric service cabinet and telephone drop, etc.) by station and offset dimension.
7. All traffic signal poles, conduits and equipment must be located within public rights-of-way or easement.
8. Controller and cabinet must be type 170ATC/HC11 system with type 330 cabinet, with extension base and access panel.
9. Electric service cabinet shall be MYERS, MEUG16-100TB (dual) or approved equivalent. UPS, if specified, shall be US Traffic Powerback 2000 in 336 cabinet.
10. Designer shall coordinate the location of electric service with SRP or APS and provide detail on the plan with appropriate notes.
11. Provide address for electric service cabinet, available through COS Records Department.
12. Locate telephone drop and run conduit with communication cable back to signal controller. Provide address for telephone service, available through COS Records Department.
13. Provide emergency vehicle signal pre-emption, using 3M Opticom optical detectors model 721 and model 138 detector cable or approved equivalent.
14. Provide phasing diagram for initial signal operation and ultimate 8-phase operation, unless directed otherwise by the Traffic Engineering Division. See [Figure 5.4-4](#) for layout.
15. Provide conductor schedule indicating conduit run number, conduit size, wire type/size, phase and any other pertinent information.
16. Details of any items not covered by standards.
17. All Q or R pole foundations shall have two 2-½ inch PVC conduits leading to adjacent pull box, and two 4 inch or one 6 inch conduit stubbed out of the foundation for future cell tower installation. All A, E and F foundations shall have one 2-½ inch PVC conduit. Verify with Traffic Engineering at 480-312-7641 before designing foundation conduits.
18. All plans must include a signal system number on the plan set. Contact 480-312-7935 to acquire the signal system number.
19. All plans must include the Traffic Signal Approval Block, as shown in [Figure 5.4-4](#).


Date	Revision			By	
Project Title					
Review By		Designed By		Drawn By	
Date	As-Built Date	Bid No.	Scale	Sheet OF	
Engineers Stamp		 TRANSPORTATION DEPARTMENT TRAFFIC ENGINEERING 7447 E Indian School Road Scottsdale, AZ 85251			
TRAFFIC SIGNAL APPROVAL BLOCK					
Engineering Coordination Manager (or designee)		Engineering Review		Traffic Engineering Director (or designee)	

FIGURE 5.4-4 TRAFFIC SIGNAL APPROVAL BLOCK

GENERAL NOTES

All traffic signal equipment and all construction in public rights-of-way or in easements granted for public use shall conform to:

- The Arizona Department of Transportation (ADOT) standard drawings and specifications,
- The Maricopa Association of Governments (MAG) Uniform Standard Specifications and Details for Public Works Construction,
- The COS Supplement to MAG Standard Specifications and Details for Public Works Construction, and
- The COS Traffic Signal requirements

Include the following General Notes ([Figure 5.4-5](#)) on all COS Traffic Signal Construction Plans. Also see [Section 1-2.100](#), for additional notes that may also be required.

5-4.302

GENERAL CONSTRUCTION NOTES	
1.	Traffic control shall conform to the City of Phoenix Traffic Barricade Manual and/or as directed by the city Public Works Inspector.
2.	Utility locations shown are based upon the best available information. The Contractor shall contact Blue Stake at 602-263-1100 before construction and verify actual utility locations.
3.	Traffic signal poles, mast arms and service cabinets shall be painted with 2 coats of white enamel paint meeting ADOT Specification Section #1002.
4.	All pull boxes shall be ADOT standard type #7 as previously noted. The main pull box shall be an ADOT #7Ext., with 18 inch drainage, consisting of #57 rock, per ADOT spec.
5.	A ground rod shall be installed within the customer side of the electrical service panel and in the control cabinet foundation and a #4 bare bond conductor attached.
6.	Pavement replacement shall conform to COS Standard Detail 2200 and 2001. Sidewalk replacement shall conform to MAG Standard Detail 230.
7.	Metro Street Name Signs shall be installed on traffic signal mast arms per COS Supplement to MAG Specifications, Section 402.3.4 and COS Standard Detail 2134-3.
8.	Applicable signal and pedestrian indications shall be wide angle LED type lamps in accordance with the COS Design Standards and Policies Manual.
9.	Emergency Vehicle Pre-Emption shall be field-adjusted to optimize reception. All detectors shall be model 721 only.
10.	All existing traffic control devices (including traffic detectors, Telco and stop signs) and street lights shall remain in operation until new installations are energized and operational. Any traffic detectors disturbed during construction shall be replaced with temporary detectors until the final detection system is in place and operational. Any removed COS equipment shall be salvaged and returned to the COS Traffic Signal Shop at 9191 E. San Salvador (Scottsdale). All salvaged equipment shall be dismantled.
11.	Questions concerning traffic signal design should be directed to the "Signal Designer, Address, Phone Number."
12.	The electrical service address is: XXXXXXXXXXXX.
13.	The Telephone drop address is: XXXXXXXXXXXX.
14.	At START of construction the contractor shall contact the COS Signal Supervisor at 480-312-5635 to coordinate power authorization, cabinet set-up, inspection requirements and the pre-construction meeting. COS Traffic Signals shall be called 48 hours prior to all inspection points, as called for in the traffic signals special requirements as found in www.ScottsdaleAZ.gov/design/ .
15.	At START of construction the contractor shall contact the electric power provider to confirm power location and to schedule inspection.
16.	At START of construction the contractor shall contact the telephone service provider to confirm telephone drop location and to schedule inspection.
17.	The controller input rack shall be wired as shown in COS Standard Detail 2140.
18.	All wires shall be color coded with tape as shown in COS Standard Detail 2141.
19.	All signal foundations shall be flat, not dished or blocked/out. Foundations shall be no lower than back of sidewalk and/or 6-½ inch above the edge of the road and shall not be grouted.
20.	All traffic signal poles, new, borrowed or existing, shall be brought to "like new" condition, including unused holes welded, pole painted, wire upgraded to IMSA cable.

FIGURE 5.4-5 GENERAL CONSTRUCTION NOTES BLOCK

5-4.303

VEHICLE DETECTION DURING CONSTRUCTION

For all construction projects in the City of Scottsdale with duration of 15 days or more, temporary vehicle detection will be required for all approaches at signalized intersections that currently have loop detection which will be disturbed by the construction. In addition, traffic signal communications (telephone or other) to the central signal computer and CCTV (if present) shall be maintained continuously during the course of the project. The contractor or sub-contractor through the life of the project shall maintain the detection zones and communications by ensuring full functionality 24 hours a day, 7 days a week.

The contractor shall be responsible for the ongoing operation of the detection equipment, which may require redeployment of detection zones as traffic barricading and lane use changes require. For more detailed information and specific requirements for all projects that meet this requirement, please see www.ScottsdaleAZ.gov/design/trafficsignalspecs.

5-4.400

STANDARD TRAFFIC SIGNAL CIRCUITRY**A. Phase Color Coding**

Each signal phase wire shall be coded with colored tape in the pull box as shown in COS Standard Detail No. 2141 and Figure 5.4-6 below through [Figure 5.4-8](#).

20 CONDUCTOR IMSA CABLE				
Cable #1	Cable #2	Conductor Cable		Signal Interval
		Basic Color	Tracer Stripe	
Phase 1	Ph 5 OR Overlap A	Red	Solid	Red
		Orange	Solid	Yellow
		Green	Solid	Green
Phase 2	Ph 6 OR Overlap B	Red	Black	Red
		Orange	Black	Yellow
		Green	Black	Green
Phase 3	Ph 7 OR Overlap C	Red	White	Red
		Blue	White	Yellow
		Green	White	Green
Phase 4	Ph 8 OR Overlap D	Red	Green	Red
		Orange	Red	Yellow
		Blue	Red	Green
Phase 1 or 2 PED*	Ph 5 Or 6 PED*	Blue	Solid	Walk
		Black	Solid	Don't Walk
Phase 1 or 2 PB*	Ph 5 Or 6 PB*	White	Red	Push Button
Ph 3 Or 4 PED*	Ph 7 Or 8 PED*	Blue	Black	Walk
		Black	White	Don't Walk
Ph 3 Or 4 PB*	Ph 7 Or 8 PB*	Black	Red	Push Button
All Phases	All Phases	White	Solid	P.B. Common
		Blue	Black	Spare

Cable #1 Shall Be Marked With An Individual Wrap Of White Tape. Cable #2 Shall Be Marked With Two Individual Wraps Of White Tape, Side By Side With A ½" Gap Between Wraps. Cables Shall Have 12" Of Black Insulation Jacket Extending Past Conduit Bell End. Individual Conductors In The Cable Shall Be Tagged As To Assigned Phase.

* Refer To Engineering Timing Sheet To Determine PED Phases as 2, 4 or 1, 3, 5, 7 or 2, 4, 6, 8. All Wire Groups In Pull Boxes Must Be Tape Coded Per Scottsdale Directional Tape Color Code.

FIGURE 5.4-6 IMSA CABLE 19-1, #14 AWG (STRANDED) 20 CONDUCTOR

4 CONDUCTOR & 7 CONDUCTOR IMSA CABLE (STRANDED)			
SIGNAL HEADS FOR 5 SECTION HEAD FUTURE OR INITIAL		SIGNAL HEADS INBOARD & SIDE MOUNT	
7 Conductor Cable		4 Conductor Cable	
Basic Color	Signal Interval	Basic Color	Signal Interval
Red	Red	Red	Red
Black	Yellow	Black	Yellow
Green	Green	Green	Green
Orange	Yellow Arrow	White	Veh. Common
Blue	Green Arrow		
White	Veh. Com		
White	Veh. Com		
PEDESTRIAN HEADS		PUSH BUTTON	
4 Conductor Cable		4 Conductor Cable	
Basic Color	Signal Interval	Basic Color	Push Button Station
Red	Don't Walk	Red	Push Button
Green	Walk	White	P.B. Common
White	Ped. Com.	Green	Spare
Black	Spare	Black	Spare

Cables Shall Be Tagged As To Assigned Phase, Per Scottsdale Directional Tape Color Code. Cable Shall Be Pulled To All Tenons On M/A. Any Unused Tenons Shall be Capped. Cables Shall Extend 18" Into Signal Head With 8" Of Black Insulation Jacket. Cables Shall Have 12" of Black Insulation Jacket Extending Past Conduit Bell End. Cables Shall Be Identified In Pull Boxes By Individual Wraps Of Colored Tape, Incrementing By One, Starting With Inboard Side Mount As #1.

**FIGURE 5.4-7 IMSA CABLE 19-1, #14 AWG (STRANDED)
4 & 7 CONDUCTOR (STRANDED)**

THROUGHS	PEDESTRIAN CROSSINGS
NB = Red EB = Green	Pedestrian Heads = Color + Purple Examples: NB = Red + Purple EB = Green + Purple
SB = Yellow WB = Blue	
TURNS	PEDESTRIAN PUSH BUTTONS
Left Turn = Color + White Right Turn = Color + Black Example: WBLT = Blue + White	Color + Orange
	OVERLAPS
	Color + Brown

Telco is marked orange. All Tape Shall be 3M Scotch 35 Model or Super 33.

FIGURE 5.4-8 DIRECTIONAL TAPE COLOR CODE

GENERAL REQUIREMENTS & SPECIFICATIONS

5-4.500

All traffic signals and lighting equipment, in addition to meeting the requirements of this specification, shall conform to the current version of the following documents:

- Standard Specifications for Road and Bridge Construction - ADOT
- Traffic Signals and Lighting, Standard Drawings - ADOT
- Traffic Signal Control Equipment Specifications - CALTRANS
- Wire and Cable Specifications - International Municipal Signal Association
- Traffic Control Systems, Standards Publications – Nat. Electrical Manufacturers Assoc.
- Manual on Uniform Traffic Control Devices - USDOT/FHWA
- Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals - American Assoc. of State Highway and Transportation Officials
- Type 170 Traffic Signal Controller System - Hardware Specification - USDOT/FHWA
- COS Traffic Signal Special Requirements.

LIGHTING SPECIFICATIONS

5-4.501

Intersection lighting shall be: 120 volt, 250 watt, two door, 90-degree cutoff with filter, GE model M 250 or ITT model 25-5232DJ or approved equivalent per specifications. Luminaires shall include one solid-state photocell ALR model 2172 NP3 or approved equivalent for each luminaire. All wire to the installation shall be THHN/THWN or approved equal.

ELECTRIC SERVICE CABINET

5-4.502

Use approved alternate with lighting arrest installed. Photocell receptacle should be rated for 20 amps. Install Grounding Rod within the customer side of the electric service cabinet.

TRAFFIC SIGNAL STRUCTURES

5-4.600

A. Qualified Products List (QPL)

A Qualified Products List has been established for Scottsdale traffic signal structures, see [Appendix 5-4B](#). Qualified product contractors are not required to submit documentation for review by the city. Bids submitted without product documentation will be deemed non-responsive and WILL NOT BE OPENED.

All contractors submitting bids for traffic structures not on the QPL must provide documentation for city review in advance of their bid submittal. Submit the following for city's review:

1. Traffic signal structure drawings and specifications.
2. Traffic signal structure load calculations, signed and sealed by an engineer registered in the State of Arizona (based on the maximum city loading).
3. Documentation of all deviations from ADOT specifications.
4. A letter signed and stamped by a State of Arizona registered, professional engineer stating that the signal structure will safely support the maximum loading as described by the city.
5. Recommended foundation designs and specifications for all traffic signal structures, except the ADOT/Scottsdale traffic signal structures.

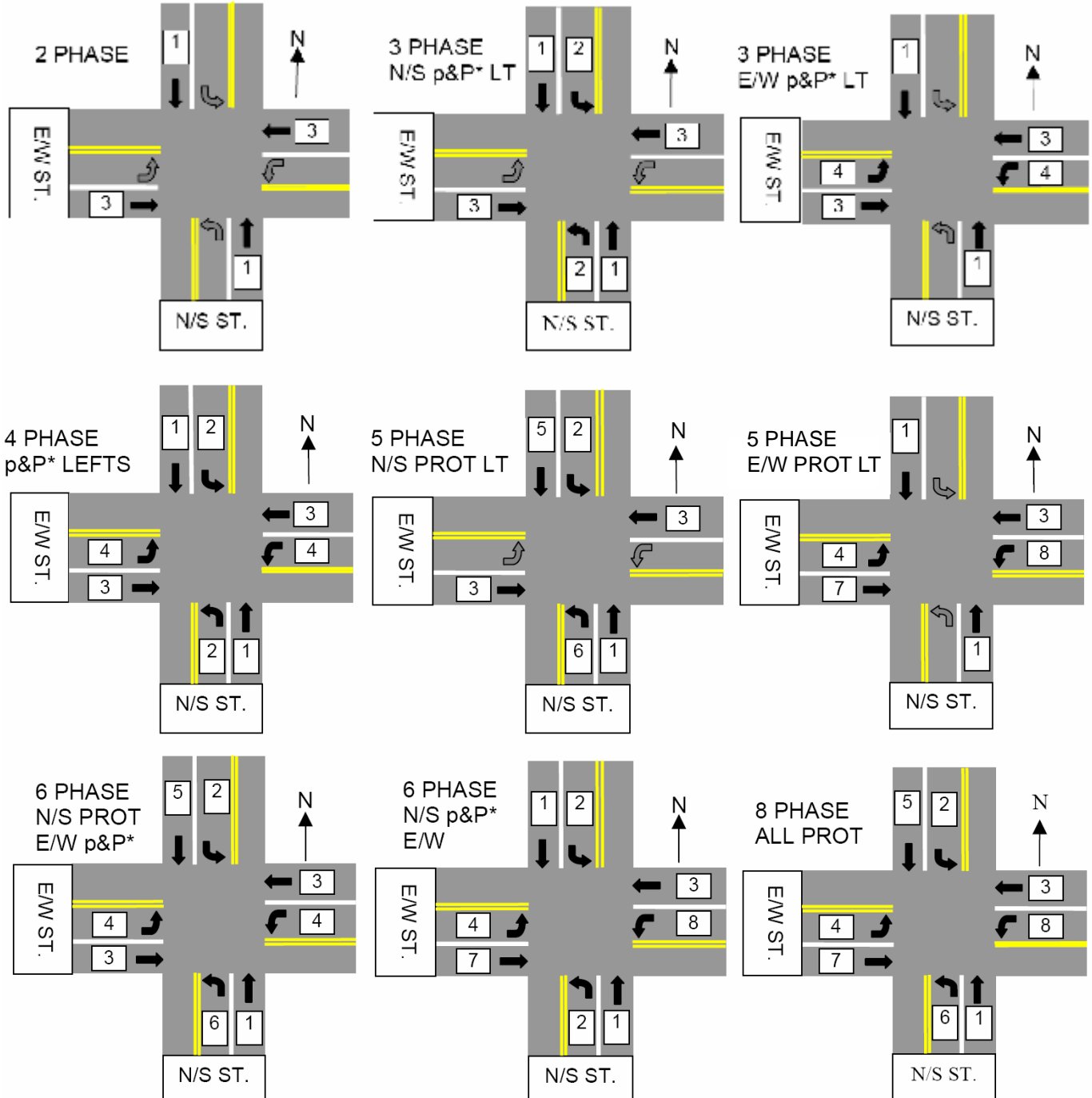
B. Traffic Signal Structures ADOT/Scottsdale

The base specification and warranty requirements for the ADOT/Scottsdale traffic signal structure shall be:

- Standard Specification for Road and Bridge Construction - ADOT (Current)
- Traffic Signals and Lighting, Standard Drawings - ADOT (Current)

TYPICAL PHASING PLAN

All left turns are **LAGGING** unless otherwise specified due to special circumstances; exceptions approved on a case-by-case basis.



* p&P = *permissive* / *PRO*Tected left turn operation.



Appendix 5-4B

QUALIFIED PRODUCTS LIST

Scottsdale Transportation Systems Department, Operations Division

<p>Type 170 System Cabinet: Model 330 Cabinet Safetran Traffic Systems, Inc. McCain Traffic Supply US Traffic Systems, Inc.</p> <p>Type 170 Controller Unit Software: Wapiti Micro Systems Corp. W4IKS, current Rev. Wapiti Micro Systems Corp. Traffic View, current Rev.</p> <p>Model 204 Flashers – Category 1: PDC – SSF-87 Solid State Devices 204K</p> <p>Traffic Signal Pre-emption Devices: 3-M Model 721, Detector 3-M Model 752 Phase Selector 3-M Cable 138 3-M Model 792 Emitter. (Requires purchasing approval from Traffic Engineering to the Supplier)</p> <p>Model 242 Two Channel DC Isolators: General Devices & Instruments Model 242 PDC Model 242 Detector Systems</p> <p>Loop Lead-in Cable: IMSA Model 50-2, #14 AWG</p> <p>Traffic Signal Conductor Cable: IMSA 19-1 “14 AWG” stranded cable, in 20, 7 or 4 conductor.</p> <p>Model 721 Optical Detector: 3-M Safety and Security System Division</p> <p>Model 195 Low Priority Emitter Assembly: 3-M Safety and Security System</p>	<p>Type 170 Controller Units: Safetran Traffic Systems, Inc. 170ATC-HC11 McCain Traffic System, Inc. 170ATC-HC11</p> <p>Model 200 Load Switch – Category 1: PDC – SSS-87 Solid State Device 200K</p> <p>Model 204 Flashers – Category 2: PDC – SSF-88-X Solid State Devices 204D</p> <p>Model 222 Detectors – Category 1: 3M Canoga Model P422T Detector Systems Model 222D 3M Canoga Model C422 or C424</p> <p>Loop Wire: IMSA 51-5 with orange jacket #14 AWG</p> <p>Photo Electric Cell: ALR Model 2172 NP3</p> <p>Uninterruptible Power Supplies (UPS): US Traffic/Meyers Powerback – 2000 System in model 336S cabinet, painted white.</p> <p>Model 252 Two-Channel AC Isolators: PDC Model ACI-88 Detector Systems</p> <p>Model 752 Phase Selector: 3-M Safety and Security System Division</p> <p>Model 138 Optical Detector Cable: 3M Safety and Security System Division</p>	<p>Telemetry Units: General Devices, Inc. (G.D.I.), Model 400 modem, Rev. E</p> <p>Model 200 Load Switch – Category 2: PDC – SSS-88 Solid State Device 200D</p> <p>Model 210 Conflict Monitor: Solid State Devices Model 210P Solid State Devices Model 210PC Eberle Design, Inc., Model 210E</p> <p>Model 222 Detectors – Category 2: Detector Systems Model 222B Indicator Control Corp., Part #3DLD827B 3M Canoga Model C422 or C424</p> <p>Telephone Cable: Beldon 9418</p> <p>Audio Crosswalk ADA Device: Mallory VSB 110-1 (north/south) Mallory VSB 110-2 (east/west)</p> <p>Model 430 Relays: Magnecraft Model W21 ACPX-2 Midtex 136-62T3A1 Traconex Model W21 ACPX-2</p> <p>Model 196 High Priority Emitter Assembly: 3-M Safety and Security System Division Model 195 Low Priority Emitter Assembly: 3-M Safety and Security System</p> <p>Electric Service Cabinet, Models: Meyers MUEG16-M100-A2 Milbank CP3B11115AWSP3 Pacific Utility Products USP-M100-112CTB</p>
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Appendix 5-4B QUALIFIED PRODUCTS LIST

Scottsdale Transportation Systems Department, Operations Division

The effective period this QPL is indeterminate. Manufacturers are required to notify the 170 Program Coordinator of any proposed changes affecting design or performance in the product that has been approved. This includes all components listed in manuals and all engineering changes.

Manufacturers not on the list who want their assemblies or units tested so as to be added to the QPL for future bids should submit a written request to the 170 Program Coordinator*.

Failure to perform satisfactorily on purchase orders by failing to meet delivery schedules or maintain a high rate of acceptance will result in being removed from the QPL.

Scottsdale Traffic Signal Maintenance Supervisor

Phone: 480-312-5635

E-mail: jdye@scottsdaleaz.gov

City of Scottsdale
Municipal Services Department
9191 E. San Salvador
Scottsdale, AZ 85258

Traffic Signal Structures:

ADOT/Scottsdale

Valmont Industries, Inc.

Valmont Industries, Inc.

Drawing #DB00181, no Rev.

Drawing #DB00182, no Rev.

Couplet "Trombone" Type Pole

Valmont Industries, Inc.

Drawing #DB00243

Type "R" Mod-Cell Tower Monopole

Drawing #DB00707



CALTRANS REQUIREMENT

Scottsdale Transportation Systems Department, Operations Division (STED)

QUALIFIED PRODUCTS LIST (QPL):

Controller Assemblies for the Model 170 Traffic Controller

Any controller submitted to the City of Scottsdale for addition to the Scottsdale QPL must first be tested and passed by CALTRANS and/or the Oregon DOT.

The assemblies listed on the current CALTRANS QPL have been tested by the California Transportation Laboratory and found to be compliant to the "Traffic signal Control Equipment Specifications" (TSCES), dated April 1978, and applicable addendum. When these assemblies are to be purchased, only those listed on that document will be considered.

QUALIFIER TO QUALIFIED PRODUCTS LIST:

A manufacturer's listing on the QPL does not waive any of the requirements of the specifications or relieve the manufacturer/contractor of any obligation thereunder. Defective work, materials, and equipment will be rejected. In short, all equipment submitted must comply to current specifications.

The effective period of this QPL is indeterminate. Manufacturers are required to notify the 170 Program Coordinator of any proposed changes affecting design or performance in the product that has been approved. **THIS INCLUDES ALL COMPONENTS LISTED IN MANUALS AND ALL ENGINEERING CHANGES.**

Manufacturers, not on the list, who want their assemblies or units tested so as to be added to the QPL for future bids should submit a written request to the 170 Program Coordinator.

Failure to perform satisfactorily on purchase orders by failing to meet delivery schedules or maintain a high rate of acceptance will result in removal from the QPL.

ROBERT MCMILLAN
170 Controller Program Coordinator
(916) 654-4385
Calnet 646-4385
FAX: (916) 653-3053
Calnet FAX: 800-453-3053

DEPARTMENT OF TRANSPORTATION
Division of Traffic Operations
1120 N. Street
Sacramento, CA 95814

SIGNS & MARKINGS



This section provides the procedures and criteria for designing traffic signs and pavement markings within the city. It presents standards for plan layout, signing, and striping.



DEPARTMENT RESOURCE INFORMATION

Aviation/Airport	15000 N. Airport Dr.	480-312-2321
Advance Planning Services	7506 E. Indian School Rd.	480-312-7990
Capital Project Management	7447 E. Indian School Rd., Suite 205	480-312-7250
Current Planning	7447 E. Indian School Rd., Suite 105	480-312-7000
Customer Service	7447 E. Indian School Rd., Suite 100	480-312-7800
Downtown Group	4248 N. Craftsman Ct.	480-312-7750
Facilities Management	9191 E. San Salvador Dr.	480-312-5999
Fire & Life Safety/ Inspections	8401 E. Indian School Rd.	480-312-1855
Fire Plan Review	7447 E. Indian School Rd., Suite 125	480-312-7080
Inspections & Land Survey	9191 N. San Salvador Dr.	480-312-5750
Parks Department	7340 Scottsdale Mall	480-312-2915
One Stop Shop/Permit Services	7447 E. Indian School Rd., Suite 100	480-312-2500
Plan Review	7447 E. Indian School Rd., Suite 125	480-312-7080
Records Division	7447 E. Indian School Rd., Suite 100	480-312-2356
Solid Wastewater Management	9191 N. San Salvador Dr.	480-312-5600
Stormwater Management	7447 E. Indian School Rd., Suite 205	480-312-7250
Street Operations	9191 N. San Salvador Dr.	480-312-5626
Transportation	7447 E. Indian School Rd., Suite 205	480-312-7696
Water Resources	9388 E. San Salvador Dr.	480-312-5685
City of Scottsdale	www.scottsdaleaz.gov	

GENERAL INFORMATION

5-5.000

USE OF NATIONAL STANDARDS

5-5.001

The following current publications are to be used in conjunction with the design criteria in this manual for traffic signs and markings design work.

- Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)- USDOT/ FHA, Current Revision.
- Signing and Marking - Standard Drawings - ADOT
- ADOT Traffic Control Design Guidelines - ADOT
- Manual of Approved Signs (MOAS) - ADOT
- Traffic Engineering Policies, Guidelines and Procedures - ADOT
- Supplement to MAG Uniform Standard Specifications for Public Works Construction - City of Scottsdale (COS)
- Supplemental Standard Details for Public Works Construction - COS
- Uniform Standard Specifications for Public Works Construction - MAG
- Uniform Standard Details for Public Works Construction - MAG
- Traffic Barricade Manual - City of Phoenix

DESIGN STANDARDS

5-5.100

Design is to be in accordance with the MUTCD unless modified by the city as noted. The requirements of the MUTCD apply to privately owned facilities where the public is able to travel without restrictions.

SIGNING

5-5.101

1. All sign posts are to be telespar prepunched square steel tubing per COS Supplement to MAG Uniform Standard Specifications Detail No. 2131, www.ScottsdaleAZ.gov/design/COSMAGSupp. ASTM Type IV Sheeting (minimum) shall be used for all warning, regulatory and street name signs. All advance street name and metro signs shall be proposed Type XI sheeting. School warning signs and accompanying placards must be ASTM proposed Type XI fluorescent yellow green sheeting.
2. Streetlight poles should be used for sign mounting when the light pole is within 50 feet of the proposed sign location.
3. "No Parking" signs shall only be used when the following site conditions exist.
 - a. When any right hand lane (curb lane) is 16 feet or wider, or if a paved shoulder area is present.
 - b. Where on-street parking could be expected to occur, such as commercial areas where businesses have direct frontage on the street.

When the above criteria exists “No Parking” signs (R8-3a 12 inch x 18 inch) with an arrow (single direction or bi-directional) below the “P” symbol on the sign to designate the direction of the restriction shall be installed approximately every 350-400 feet along the length of the project. No parking signs shall be installed approximately 5 feet from the back of curb at a 45 degree angle to the curb. Street light poles should be used for sign mounting when a light pole is within 50 feet of the proposed sign location.

4. Speed limit signs (R2-1) are to be installed at 4 per side per mile.
5. Stop signs (R1-1) are to be 30 inch x 30 inch minimum size.
6. Street name signs in subdivisions must conform to the City of Scottsdale Supplement to MAG Uniform Standard Specifications for Public Works, see www.ScottsdaleAZ.gov/design/COSMAGSupp.
7. Advance street name signs are to be installed at a height of 4 feet to the bottom of sign and placed so they are not obstructed by vegetation. Signs are to be installed in medians whenever possible, see www.ScottsdaleAZ.gov/design/COSMAGSupp.
8. Median nose signing is to be installed per COS Supplemental Detail No. 2133 www.ScottsdaleAZ.gov/design/COSMAGSupp as follows:
 - Type “A” is to be installed at signalized intersections and the first median nose in a succession of medians, or where the gap between medians exceeds 250 ft.
 - Type “B” is to be used at all other median nose locations.

5-5.102

STRIPING

1. All permanent longitudinal pavement striping (centerlines, lane lines, bay lines) shall be 90 mil extruded thermoplastic. Reflective beads shall be applied in accordance with section 704 of ADOT’s Standard Specifications for Road and Bridge Construction. All permanent lateral pavement striping (stop lines, crosswalk lines) shall be 90 mil extruded thermoplastic. Reflective beads shall be applied as per Section 704 above.
2. All temporary pavement markings shall be reflective traffic paint.
3. All median noses shall be painted with reflectorized traffic paint and have Type D yellow RPMs per COS Supplemental Detail No. 2225 and 2226, www.ScottsdaleAZ.gov/design/COSMAGSupp.
4. COS striping and marking standards are shown in [Figure 5.5-1](#) through [Figure 5.5-12](#).

A. Skip Lines

- Striping: 4 inch wide lines, ten feet long, gaps 30 feet
- Include RPMs centered within gaps:
 - Yellow Type D 2-way reflective
 - White Type G 1-way reflective



FIGURE 5.5-1 SKIP LINES MARKINGS

B. Guide Lines

- Striping: 4 inch wide lines, 2 feet long, gaps 6 feet



FIGURE 5.5-2 GUIDE LINES MARKINGS

C. Lane Drop Lines

- Striping: 8 inch wide lines, 2 feet long, gaps 4 feet



FIGURE 5.5-3 LANE DROP LINES

D. Edge Lines

- 4 inch wide White off the edge of pavement where curbs are omitted
- 6 inch wide White between travel lane and bike lane
- 8 inch wide White where asphalt tapers for a lane drop, etc.



FIGURE 5.5-4 EDGE LINES MARKINGS

E. Two-Way Left Turn Lanes

- All lines 4 inch wide Yellow, skip lines to follow typical skip dimensions
- Include RPMs centered within gaps: Yellow Type D 2-way reflective

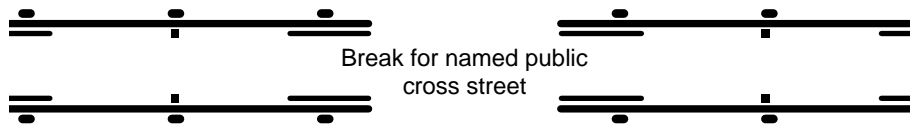


FIGURE 5.5-5 TWO WAY LEFT TURN LANE MARKINGS

F. Left Turn Bay

- Used at signalized intersections and major cross streets
- Arrow and "ONLY" to be painted in left turn bays which do not align with opposing left turn bays
- If bay line is longer than 150 feet, then a second arrow is placed at the top of the bay*
- Use White RPMs type G 1-way reflective **

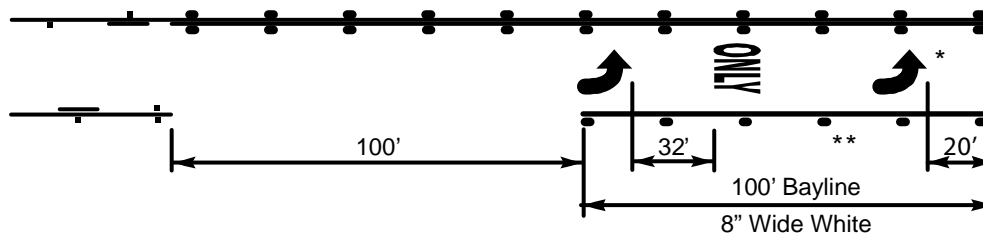
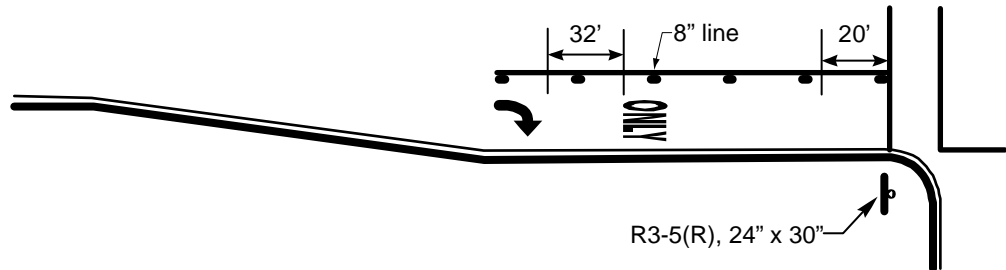


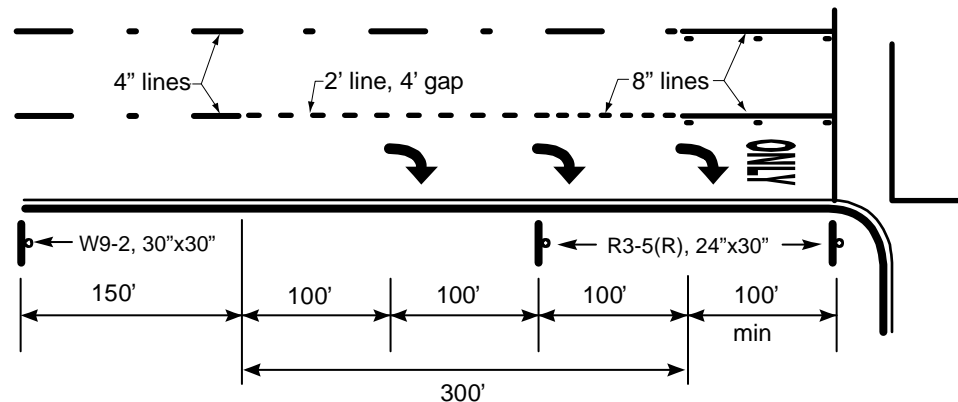
FIGURE 5.5-6 LEFT TURN BAY MARKINGS

G. Right Turn Bay

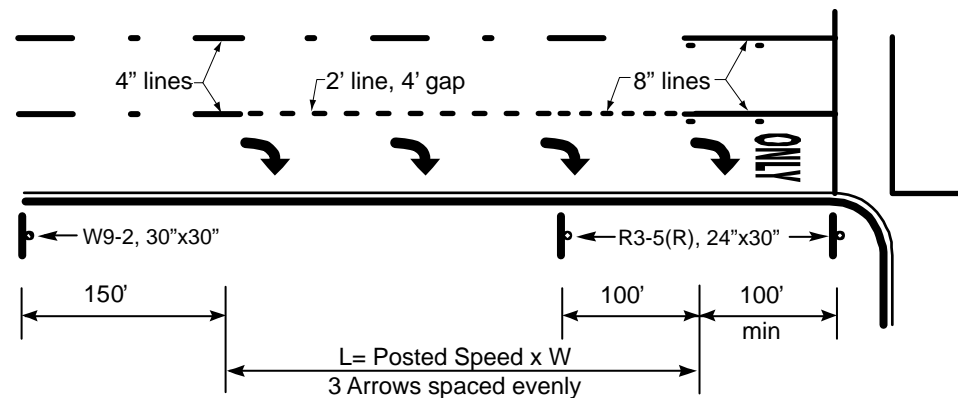
- 100 feet bay line, 8 inch wide White lines
- Minimum one R3-5(R), 24 inch x 30 inch
- Two R3-5(R)s if bay is 150 feet or more
- One arrow, 1 "ONLY" marking at beginning of bay
- If bay is 150 feet or more, second arrow to be installed at end of bay
- For turn bays at stop sign, R3-5(R) not to obstruct stop sign.

**FIGURE 5.5-7 RIGHT TURN BAY MARKINGS****H. Trap Lanes**

- 40 mph or less:

**FIGURE 5.5-8 TRAP LANE MARKINGS - 40 MPH OR LESS**

- 45 mph or greater:

**FIGURE 5.5-9 TRAP LANE MARKINGS - 45 MPH OR GREATER**

I. Crosswalks

- Crosswalks are to be used at signalized intersections only, unless otherwise specified.

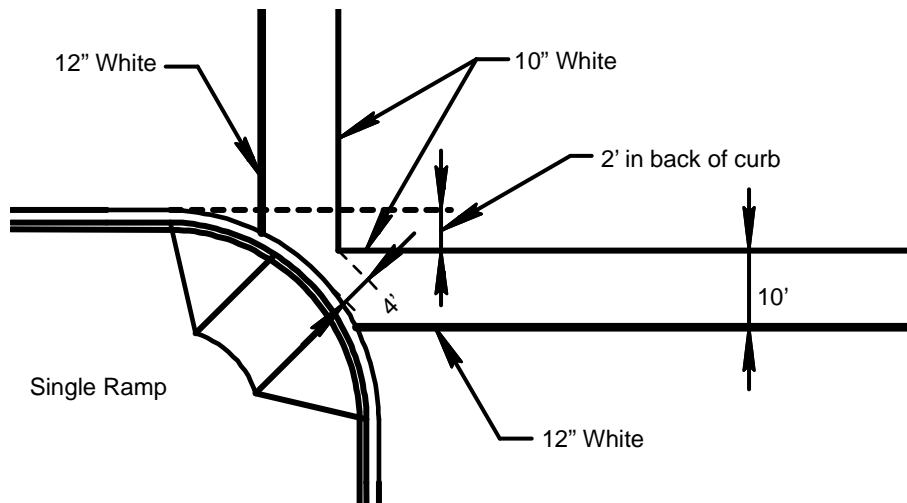


FIGURE 5.5-10 SINGLE RAMP CROSSWALK MARKINGS

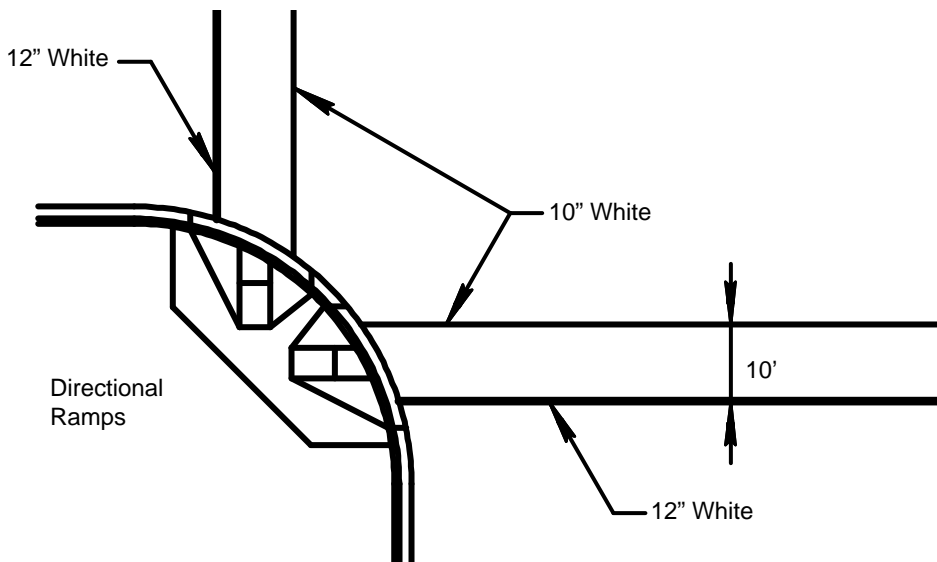


FIGURE 5.5-11 DIRECTIONAL RAMP CROSSWALK MARKINGS

J. Dual Left Turn Movement

- Paint short skips through intersection
- Space RPMs to align with lane lines or centered in lanes (as shown).

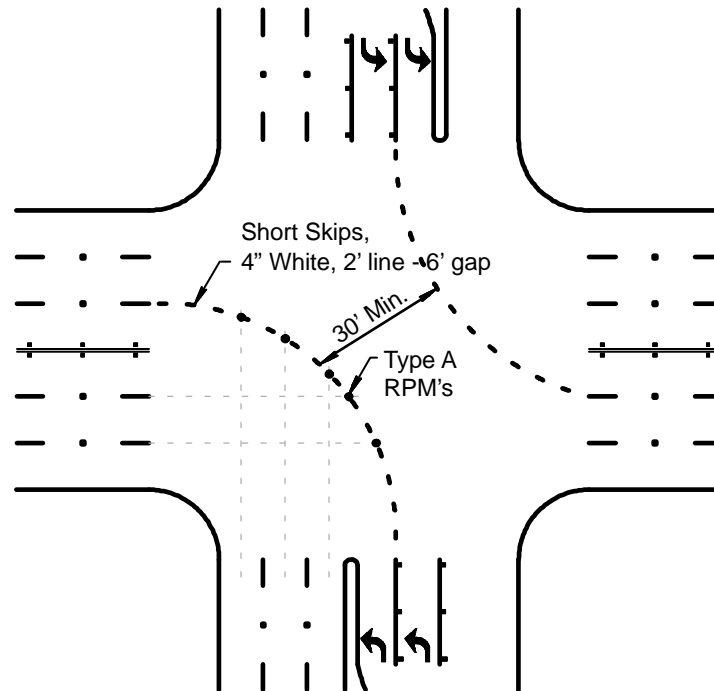


FIGURE 5.5-12 DUAL LEFT TURN INTERSECTION MARKINGS

K. Roundabouts

- See [Section 5-3.400](#)

5-5.200**STANDARD PLAN LAYOUT****5-5.201****GENERAL REQUIREMENTS**

1. Signing and pavement marking design should be shown in the same plan view on the same plan sheet if practical.
2. Plan sheets are to be complete and to scale, no smaller than 1 inch = 40 feet unless otherwise approved by the city Traffic Engineering Division.
3. Entire length of project is to be shown in plan view. Typical Sections representative of striping and/or signing will not be accepted.
4. Signing and pavement marking plans need to include all existing signing and pavement markings for a minimum of 300 feet past the limits of construction (except those devices that are to be removed), and include adequate transitions and tapers to existing pavement markings to maintain traffic at the design speed.
5. The city requires a specific title and signature block to be placed in the lower right corner of each sheet, see [Figure 5.4-4](#) Traffic Signal Approval Block. The Consultant's title block is placed adjacent to the city block. The signature block includes the Traffic Engineering Director.
6. Rights-of-way lines are to be clearly identified.

SIGNING**5-5.202**

1. All signs should be graphically depicted in the direction of travel.
2. All signs shall be stationed and referenced to the appropriate MUTCD sign designation with size noted, see <http://mutcd.fhwa.dot.gov/Signs/index.htm>.
3. New and existing signs shall be visible to traffic for a value equal to 4 times (4x) the existing or proposed posted speed limit to provide adequate approach visibility.
4. Existing or proposed speed limit should be posted to provide adequate approach visibility. Existing or proposed roadway improvements, vegetation or structures shall not block traffic sign visibility.
5. All existing signs shall be identified to remain, be removed, or be relocated and shall be stationed and referenced to the appropriate MUTCD sign designation, see <http://mutcd.fhwa.dot.gov/Signs/index.htm>.
6. All existing advance or approach signing applicable to the project shall be field verified and referenced signs on the plan sheets, including location and/or station and proposed status of sign.

STRIPING**5-5.203**

1. All existing striping that is to remain shall be fully shown (as screened lines or lightly inked pen lines), identified by type and width, and completely dimensioned across roadway.
2. Raised pavement markers shall be graphically shown in plan view and referenced by construction notation.
3. All new striping shall be clearly identified noting color, line width, beginning station, ending station and intermediate stations at all directional changes.
4. Striping to be removed needs to be identified as such on the plans.
5. All striping shall be fully dimensioned across roadway and tied to a construction centerline or monument line at each side of an intersection.
6. All pavement arrows, legends and crosswalks, etc., shall be located by station or dimension lines.

5-5.204

STANDARD PLAN SHEET NOTES

These notes along with any additional project specific notes are to be placed on the lead signing and pavement marking plan sheet.

STANDARD PLANS SHEET NOTES BLOCK	
1.	All pavement markings, signing and work zone traffic control type and layout need to conform to the latest edition of the Manual on Uniform Traffic Control Devices, http://mutcd.fhwa.dot.gov/index.htm .
2.	Work zone traffic control needs to conform to the city of Phoenix Traffic Barricade Manual and/or as directed by the city Public Works Inspector or Traffic Engineering Division.
3.	Signs are to be installed on telespar prepunched square steel tubing posts per COS Standard Detail No. 2131, www.ScottsdaleAZ.gov/design/COSMAGSupp .
4.	Dimensions to signs need to include the sign post, or in the case of multiple posts, the plan view center of the sign.
5.	<p>"No Parking" signs shall only be used when the following site conditions exist.</p> <ol style="list-style-type: none"> When any right hand lane (curb lane) is 16 feet or wider, or if a paved shoulder area is present. Where on-street parking could be expected to occur, such as commercial areas where businesses have direct frontage on the street. <p>When the above criteria exists "No Parking" signs (R8-3a 12 inch x 18 inch) with an arrow (single direction or bi-directional) below the "P" symbol on the sign to designate the direction of the restriction shall be installed approximately every 350-400 feet along the length of the project. No parking signs shall be installed approximately 5 feet from the back of curb at a 45 degree angle to the curb. Street light poles should be used for sign mounting when a light pole is within 50 feet of the proposed sign location.</p>
6.	All longitudinal striping (edge line, lane line and centerline) shall be .090" (90 mil) extruded thermoplastic, unless otherwise noted on the plans.
7.	All transverse striping (stop lines, crosswalk lines) shall be a minimum of .090" (90 mil) extruded thermoplastic, unless noted otherwise on the plans.
8.	All plan view striping dimensions are measured to the center of the line or center of the double line.
9.	All pavement symbols, arrows and legends shall be Type 1 permanent, high performance pre-formed pavement tape. (Tape must perform as 3M 380I-ES series or equivalent.)
10.	Raised pavement markers (RPMs) shall be used on all striped streets. RPMs shall be installed per COS Standard Detail No. 2132, www.ScottsdaleAZ.gov/design/COSMAGSupp , and ADOT Standard Drawing M-19, with a city approved bituminous adhesive.
11.	Blue Type F (2-way reflective) RPMs shall be used to indicate the location of all fire hydrants and remote fire department connections, per COS Standard Detail No. 2363, www.ScottsdaleAZ.gov/design/COSMAGSupp .
12.	All existing pavement markings that conflict with proposed markings shall be removed by sandblasting, hydroblasting or grinding prior to the installation of new pavement markings. Removals shall be to the satisfaction of the city Inspector.
13.	ASTM Type IV Sheeting (minimum) shall be used for all warning and regulatory and street name signs. All advance street name and metro signs shall be proposed Type XI sheeting. School warning signs and accompanying placards must be ASTM proposed Type XI fluorescent yellow green sheeting.
14.	The contractor is responsible for layout of all pavement markings using control points spaced no more than 50 feet apart. Pavement marking layout shall be approved by Traffic Engineering prior to the application of the final product. All pavement marking drawings are schematic only. The contractor shall follow all dimensions, details and standards when installing pavement striping, marking and markers.

FIGURE 5.5-13 STANDARD PLANS SHEET NOTES BLOCK

TRANSIT



This section documents transit facility guidelines for Scottsdale's public works projects and for developers working on projects that impact the transit system. This includes projects that create high-activity centers such as shopping malls or high-density living areas. Criteria are documented for locating bus stops and transit amenities such as bus benches and transit shelters. It includes street geometrics for bus bays, standard signage, submittal and review requirements, and a brief discussion on landscaping as it relates to transit amenities. The guidelines consider the needs of the transit user, bus operator, the general public, and neighbors adjacent to bus stops.



DEPARTMENT RESOURCE INFORMATION

Aviation/Airport	15000 N. Airport Dr.	480-312-2321
Advance Planning Services	7506 E. Indian School Rd.	480-312-7990
Capital Project Management	7447 E. Indian School Rd., Suite 205	480-312-7250
Current Planning	7447 E. Indian School Rd., Suite 105	480-312-7000
Customer Service	7447 E. Indian School Rd., Suite 100	480-312-7800
Downtown Group	4248 N. Craftsman Ct.	480-312-7750
Facilities Management	9191 E. San Salvador Dr.	480-312-5999
Fire & Life Safety/ Inspections	8401 E. Indian School Rd.	480-312-1855
Fire Plan Review	7447 E. Indian School Rd., Suite 125	480-312-7080
Inspections & Land Survey	9191 N. San Salvador Dr.	480-312-5750
Parks Department	7340 Scottsdale Mall	480-312-2915
One Stop Shop/Permit Services	7447 E. Indian School Rd., Suite 100	480-312-2500
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Records Division	7447 E. Indian School Rd., Suite 100	480-312-2356
Solid Wastewater Management	9191 N. San Salvador Dr.	480-312-5600
Stormwater Management	7447 E. Indian School Rd., Suite 205	480-312-7250
Street Operations	9191 N. San Salvador Dr.	480-312-5626
Transportation	7447 E. Indian School Rd., Suite 205	480-312-7696
Water Resources	9388 E. San Salvador Dr.	480-312-5685
City of Scottsdale	www.scottsdaleaz.gov	

CRITERIA FOR BUS STOP LOCATIONS

5-6.000

BUS STOP SPECIFICATIONS

5-6.001

Frequency of bus stops is dictated by the distance bus patrons are willing to walk to board a bus. The minimum standard for bus stop locations in Scottsdale is at 1/4 mile intervals for residential areas and 1/8 mile intervals for major activity centers, as shown in Figure 5.6-1.

To provide the greatest convenience and safety for passengers, bus stops are generally located as close to intersections as possible. This minimizes walking distance for transferring passengers and encourages the use of crosswalks. Far side stops, those located immediately past an intersection, are optimal for the following reasons:

- Minimal interference with traffic flow
- Minimal interference with intersection sight distance
- Less likelihood of passengers crossing in front of a bus
- Less conflict for automobile right turns
- Less obstruction for vehicles entering the intersection from a side street
- More effective bus re-entry into the traffic stream

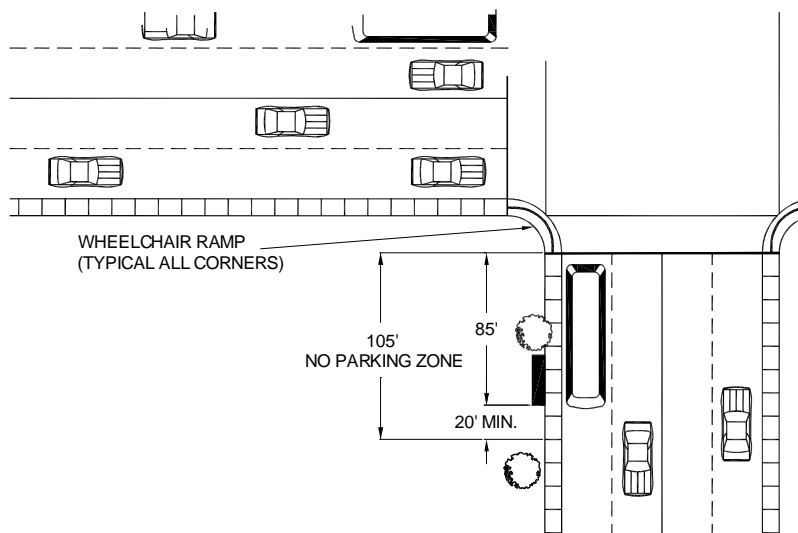


FIGURE 5.6-1 STANDARD BUS STOP LOCATION

The location of a transit stop is generally 85 feet, plus or minus 25 feet from the curb of an unsignalized intersection, and 105 feet plus or minus 25 feet from a signalized intersection. In some circumstances, due to the location of major generators, driveways, or unusual landscape issues, other locations can be submitted to the Transportation Department for consideration and approval. Some circumstances are illustrated in [Figure 5.6-2](#) and [Figure 5.6-3](#).

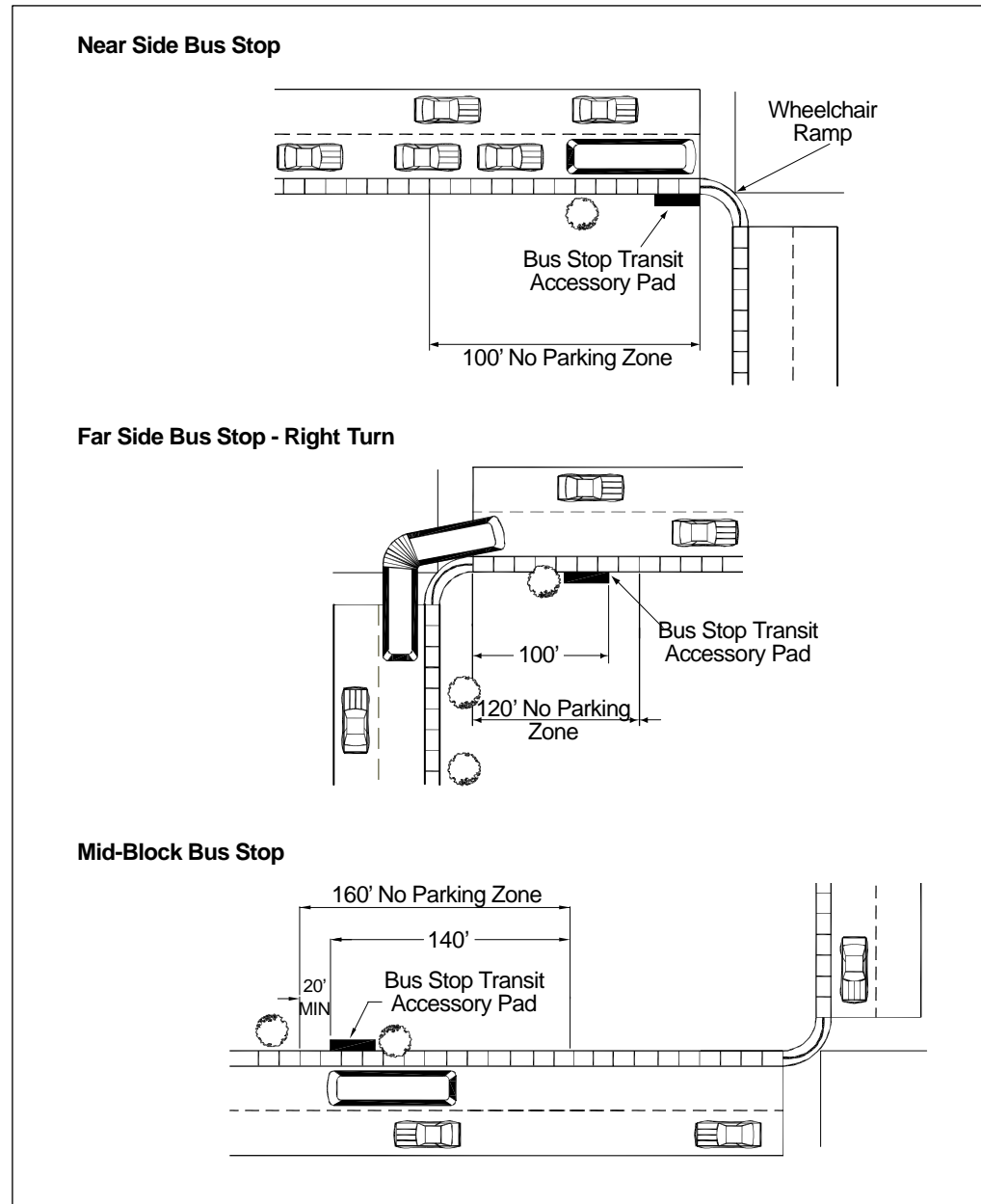


FIGURE 5.6-2 SPECIAL CONDITIONS BUS STOP LOCATIONS

Near side bus stops (those located immediately before an intersection) are considered when placement of far-side stops is not feasible or when that stop will be located near buildings with high volumes of transit riders. These types of stops may also be located where a high-volume bus transfer location would otherwise require a pedestrian crossing at a busy street.

On occasion, a mid-block bus stop may be utilized to provide access to a major generator, but it is generally discouraged due to the likelihood that pedestrians would cross streets mid-block rather than at intersections.

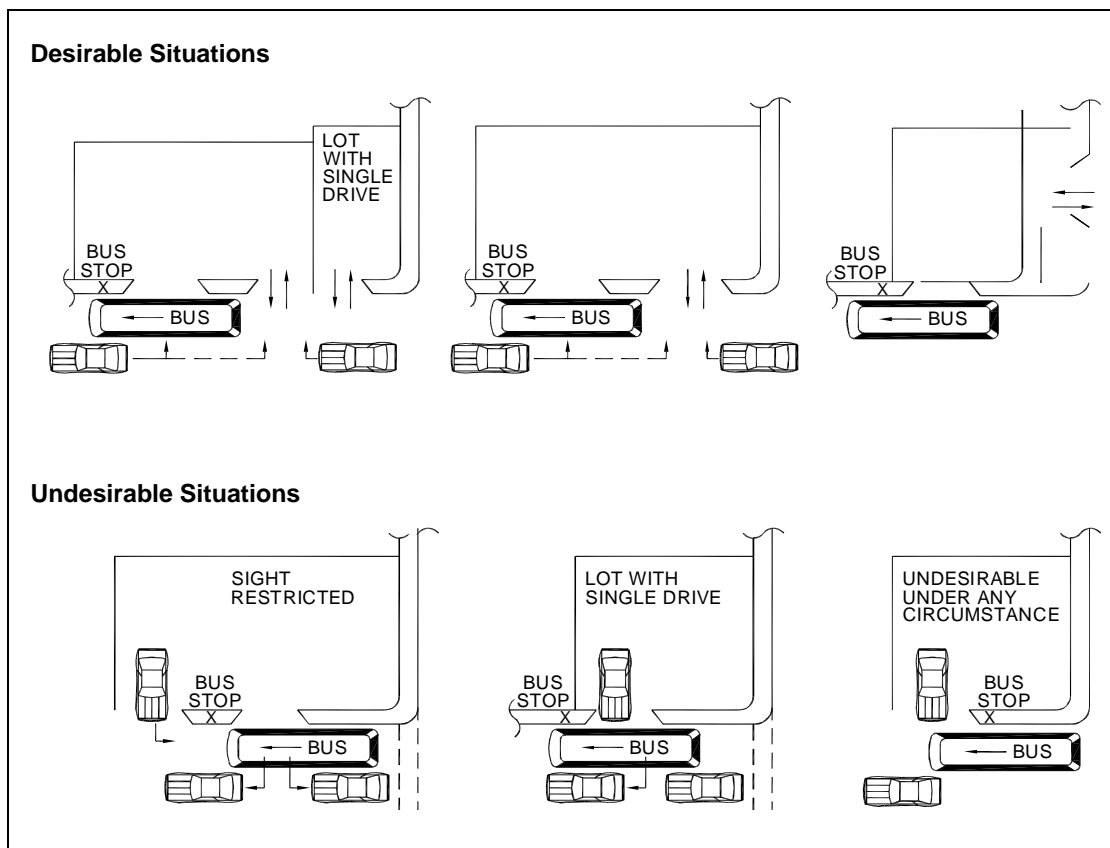


FIGURE 5.6-3 DRIVEWAY LOCATIONS NEAR BUS STOP

Where a development or subdivision is walled-off from the street, steps should be taken to allow easy pedestrian access. This could include a pedestrian access path linking various sections of the development to the bus stop or a system of offset walls around developments, which allow pedestrian passage.

ACCESSIBILITY

All transit facilities must comply with the applicable provisions of the Americans with Disabilities Act and associated guidelines, as updated, whenever technically feasible. At all transit stop locations where an accessible pedestrian route is available or where major improvements have been made to an existing inaccessible stop, the following elements shall be incorporated:

Surface. Bus stop boarding and alighting areas shall have a firm, stable and slip resistant surface.

Dimensions. Bus stop boarding and alighting areas shall provide a clear length of 10.0 feet minimum, measured perpendicular to the curb or vehicle street or highway edge, and a clear width of 10.0 feet minimum, measured parallel to the vehicle street or highway.

Connection. Bus stop boarding, alighting areas and bus shelters shall be connected to streets, sidewalks or pedestrian paths by an unobstructed pedestrian access route at least 4-feet wide.

Grade. Parallel to the street or highway, the grade of the bus stop boarding and alighting area shall be the same as the street or highway, to the maximum extent practicable. Perpendicular to the street or highway, the grade of the bus stop boarding and alighting area shall not be steeper than 2 percent.

5-6.002

Bus Shelters. Bus shelters shall provide a minimum clear space of 3 by 4 feet within the shelter. See MAG Standard Detail No 230 and COS Standard Detail No. 2232* for related information, www.ScottsdaleAZ.gov/design/COSMAGSupp/.

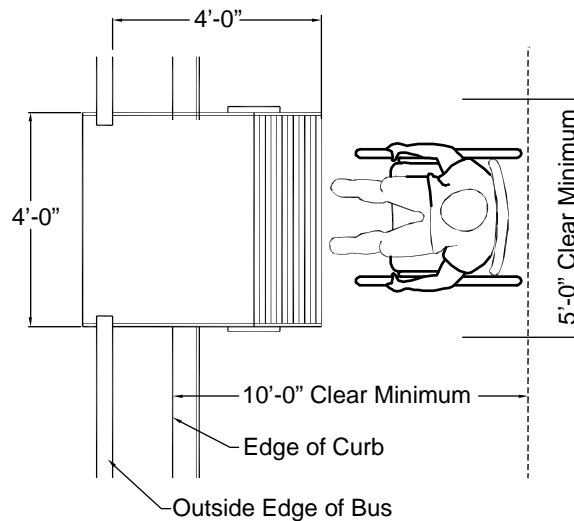


FIGURE 5.6-4 BUS STOP CLEARANCE ZONES

5-6.100

TRANSIT AMENITIES

Comfortable and secure passenger waiting areas should be provided at as many bus stops as feasible. The waiting areas may include a varying range of improvements depending upon ridership and specific site needs. All transit stop furniture must be placed outside the standard sidewalk. A minimum 4 foot clearance is required between transit components, fire hydrants, switch boxes and mail boxes, etc. Below are typical transit amenities and conditions under which they should be employed. Advertising and placards are not allowed.

5-6.101

BENCHES

Benches should be located at all bus stops. Several styles of benches have been approved for placement in Scottsdale depending on location. Specialty benches are used in downtown Scottsdale. See COS Standard Detail No. 2268 for slab requirements, www.ScottsdaleAZ.gov/design/COSMAGSupp/. A standardized bench with matching trash receptacle is used in all other areas except for those bus stops affected by the Environmentally Sensitive Lands Ordinance (ESLO). Interested parties may contact the Transportation Department for the most recently approved standard. Transit amenities located within ESLO boundaries must conform to its guidelines, see www.ScottsdaleAZ.gov/codes/ESLO. Additional styles may be acceptable but require city staff approval and may need Development Review Board approval.

Design of benches shall have backrests for support and spacers between the seats to discourage people from lying on the seats. Seats should be 17 to 19 inches above finished floor. A minimum of 6 linear feet of seating should be used. More seating is required at higher usage stops. Please contact the Transportation Department to determine if a location is a high usage stop. A clear space of 3 feet by 4 feet must be provided adjacent to the bench seating for wheelchair seating.

5-6.102

SHELTERS

A shelter shall be provided at all bus stops. In a development, city staff may waive any requirement for passenger shelters if there is adequate exterior shading and architectural shelter.

Shelters should be arranged with considerations to the sun's angles. Coverage should allow for maximum shade during the peak use hours of the summer morning and afternoon. However, the shelter should also be oriented to allow the bus driver clear visibility of the passengers and to allow passengers a view of oncoming traffic.

Scottsdale has a standard shelter design; contact the Transportation Planning Division to obtain copies. See [Figure 5.6-5](#) for a typical foundation and [Figure 5.6-6](#) for a photograph of a typical shelter. The dimensions of the bus stop and the minimum for a Bus Stop Easement are 11 x 28 feet; this allows a 2 foot working area around the actual passenger shelter. Other shelter designs may be used if approved by city staff and possibly, the Development Review Board.

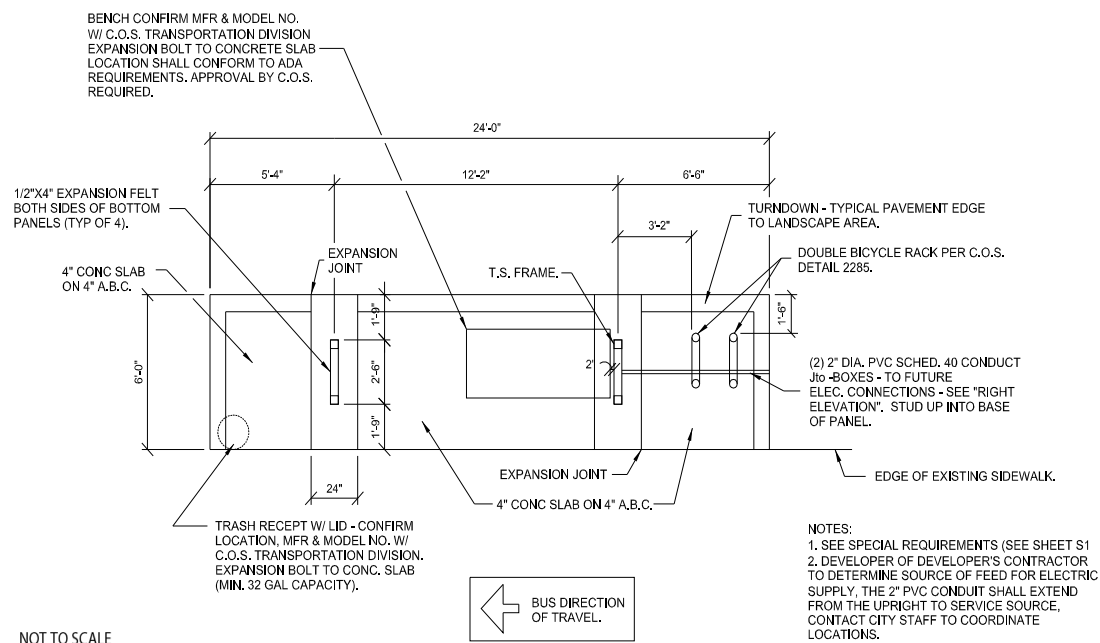


FIGURE 5.6-5 BUS SHELTER FOUNDATION PLAN

A. Shelter Design

Shelter designs must meet the following criteria:

1. Minimum canopy of 65 square feet with a minimum width of 5.5 feet.
2. Minimum 7-foot clearance between underside of roof and sidewalk surface.
3. Waterproofed shelter canopy with provisions for drainage away from transit users.
4. Shaded seating areas.
5. Sight distance into and out of the shelter.
6. Minimum 6 inches of vertical clearance from the sidewalk to avoid trash and debris collection.
7. Fixed components to prevent unauthorized removal.
8. Materials that allow for air circulation and avoid hot air containment.
9. Materials finished to prevent overheating.

10. Insulated canopy materials that collect and radiate heat.
11. Materials, coatings and surfaces that are graffiti-resistant.
12. Components of the shelter that are readily replaceable.
13. Colors appropriate to the architectural character of the development and the transit system (per review and approval of Development Review Board).
14. Minimum 2-foot clearance between roof canopy and face of curb.
15. Arrangement of furniture that allows a 3 by 4 foot barrier-free access for wheelchair users.
16. Minimum 4 foot unobstructed pedestrian accessible route path into the shelter and connecting to streets, sidewalks or other pedestrian paths.

B. OTHER

1. Trash receptacle to provide a minimum capacity of 30 gallons.
2. Bus stop graphics to meet city requirements.
3. A minimum of two bike loops to be installed. Refer to [Section 5-7.000](#) Pathways and COS Standard Detail No. 2285, www.ScottsdaleAZ.gov/design/COSMAGSupp.



FIGURE 5.6-6 TYPICAL BUS SHELTER

5-6.103

BUS BAYS (PULLOUTS)

Bus bays enable buses to pull completely out of the traffic lane while loading and unloading passengers. Bus bays are recommended under the following conditions:

1. At or near transfer points,
2. When average peak period dwell time exceeds 30 seconds per bus.

Two types of bus bays are allowed: open-ended and closed. Closed bus bays are the preferred option. Generally, open-ended bays are used on far-side stops where space is limited. See COS Standard Details 2266-1, 2266-2 and 2267 for specific dimensions, www.ScottsdaleAZ.gov/design/COSMAGSupp.

5-6.200

LANDSCAPING

Wherever possible provide shade trees and other protective landscaping. This landscaping could be considered part of the development's frontage landscape and could count towards any landscaping requirements that may apply. Considerations for selection and location of landscaping include:

1. Trees should be mature and have an adequate canopy to shade the seating area.
2. Low-water consumption trees and shrubs should be used.
3. Tree location should consider the solar orientation of the transit stop. Priority should be given to shading afternoon summer sun.
4. Transit landscaping should be compatible with other frontage landscaping.

Carefully locate all landscaping needs, so they do not obstruct the visibility of either the transit user or the bus operator. The developer/property owner is responsible for the maintenance of landscaping at bus stops.

SIGNAGE

5-6.300

BUS STOP SIGNS

5-6.301

A bus stop sign is an important passenger convenience and an operations and marketing tool for transit systems. It serves as a reference for passengers, bus operators, and as a point of identity for the transit system.

The bus stop sign is generally not a traffic sign (except as noted below) since it is not displayed to regulate or warn motorists.

A regional bus stop sign is currently in use throughout the Valley (see Figure 5.6-7 below). The sign is 18 inches wide x 24 inches high, reflectorized for nighttime visibility and is double-faced so that it can be seen from both directions. The upstream side of the sign contains "No Parking" information for motorists approaching the bus stop.

The standard regional sign identifies a location as a bus stop, includes the name and number of the bus route(s) being served, and displays the transit information telephone number.

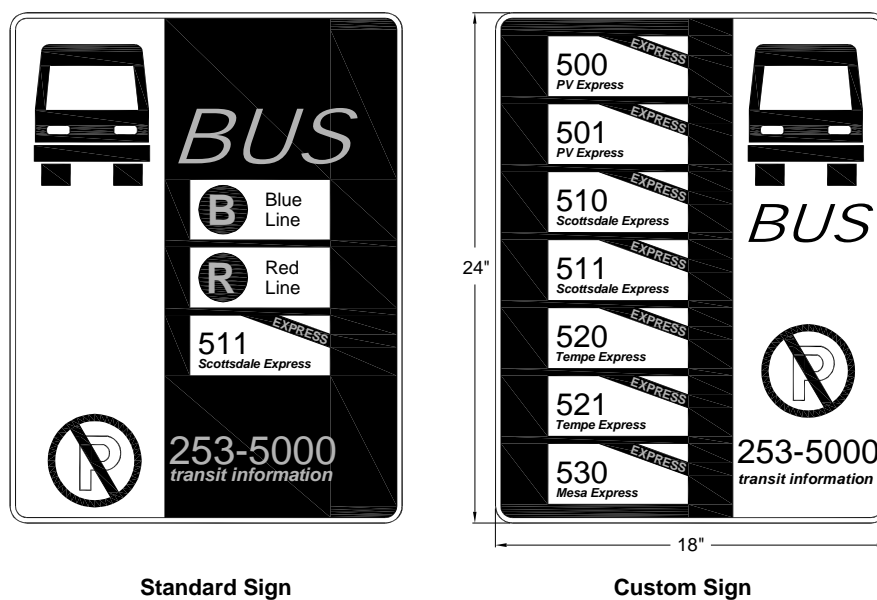


FIGURE 5.6-7 BUS STOP SIGNS

5-6.302

SIGN PLACEMENT

Bus stop signs must be placed at the location where people board at the front door of the bus. In cases where the bus stop sign is incorporated into the design of a transit shelter, the need for a separate sign may be eliminated.

Ideally, bus stop signs should be placed independently of all other signs to maintain the importance of the bus stop identity. Each sign should be installed with its own signpost, although non-wood light poles may be used if it is at the proper stop location and if the sign face is visible from both sides. **Do not** place signs on wood poles as it poses a hazard to linemen who climb the poles.

Bus stop signs should be installed on signposts or metal poles so that the sign is “flagged.” In other words, the sign should be attached to the post by its edge. This allows both sides of the sign to be viewed without obstruction. The bottom of the sign should be 7 feet above ground level, at least 2 feet from the curb face, and away from obstructions such as landscaping or other signs. The standard regional sign has been designed so that it may be mounted by its edge to a 2-inch post without obscuring the backside message. Where metal street light poles are at the proper location but too close to the curb, the signs may be flagged away from the street (see Figure 5.6-8 below).

Usually, the city will be responsible for the installation of bus stop signs. For more information, contact the Transportation Department.

5-6.303

SIGN CLEARANCES

Sign clearance dimensions vary by sidewalk / curb relationships, as shown in Figure 5.6-8.

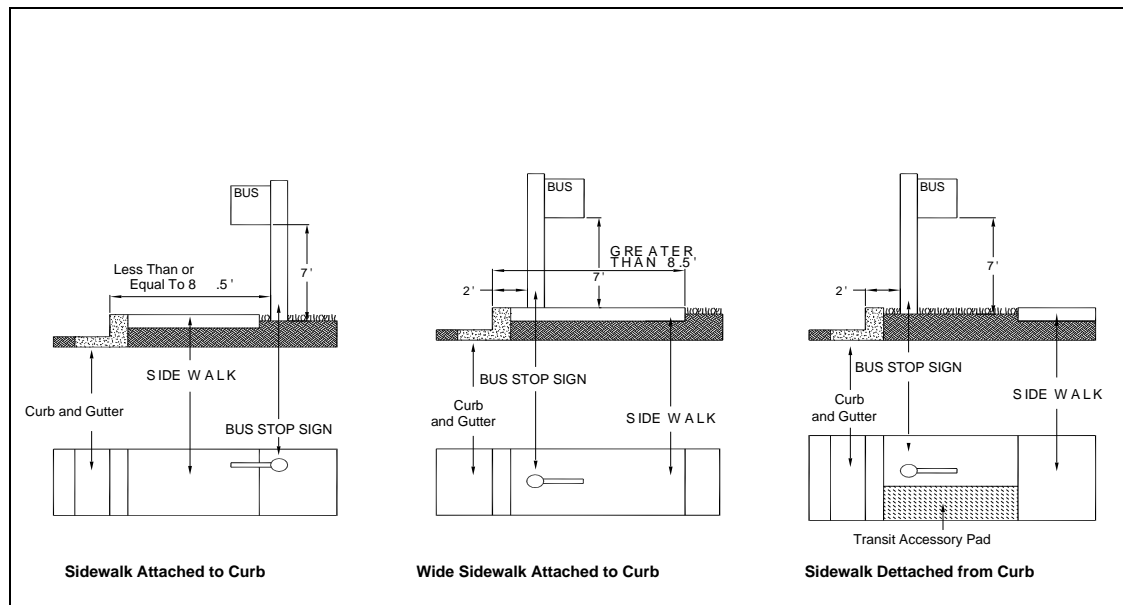


FIGURE 5.6-8 BUS STOP SIGN CLEARANCES

5-6.304

OTHER FACILITIES

Other facilities, such as park and ride lots or transfers centers, may be planned at special locations, usually high activity centers or a focal point of several transit routes. These facilities, are unique and must be planned through discussion and negotiation between the city's Transportation Department and the developer and/or adjacent property owners/users. In general, the same criteria (as well as transit industry standards) apply for turning radii, passenger loading platforms and parking space requirements, etc.

5-6.400

BUS STOP MAINTENANCE

Well-maintained bus stops are crucial to the image of the transit system. The following applies regardless of who is responsible for the maintenance. Damaged furniture and trash build-up should be addressed immediately to ensure a positive environment for transit patrons and the general public.

Regular maintenance should include:

- Full wash down of shelter and accessories
- Removal of all dirt, graffiti and pasted material
- Squeegee wipe down of glass surfaces
- Removal and replacement of trash bag
- Litter pick up around stop or shelter/accessories to a distance of ten feet
- Manual or chemical removal of weeds
- Pruning of obstructing tree growth
- Touch up of paint scratches
- Maintain a stable, firm, slip resistant accessible route.

PLEASE NOTE: Safety problems should be repaired within 24 hours.
Repairs that do not pose safety problems should be completed within 3 days.

SUBMITTAL REQUIREMENTS & REVIEW PROCEDURES

5-6.500

The following facilities must be delineated on all site plans or the preliminary plat submitted to the city:

- | | | |
|-------------|--------------------------|----------------------|
| • Bus bays | • Shelter sites | • Park-and-ride lots |
| • Bus stops | • Major transfer centers | |

Transit staff must approve the design and location of the above facilities during the project review process. Bus stop easements need to be completed during the project review process.

Developers may deposit funds in lieu of construction and installation of stipulated transit amenities. The amounts of funds to be deposited are determined during the project review process and are in force upon City Council approval of the project. Fees are to be paid at the One Stop Shop, in Bus Shelter Deposit Account, when other permit fees are paid.

BIKEWAYS

This section provides design criteria for bicycle and multiuse paths within the city. It presents information for planning, facility design, traffic controls, bicycle parking, and bikeway maintenance.



DEPARTMENT RESOURCE INFORMATION

Aviation/Airport	15000 N. Airport Dr.	480-312-2321
Advance Planning Services	7506 E. Indian School Rd.	480-312-7990
Capital Project Management	7447 E. Indian School Rd., Suite 205	480-312-7250
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Street Operations	9191 N. San Salvador Dr.	480-312-5626
Transportation	7447 E. Indian School Rd., Suite 205	480-312-7696
Water Resources	9388 E. San Salvador Dr.	480-312-5685
City of Scottsdale	www.scottsdaleaz.gov	

GENERAL INFORMATION

5-7.000

COMPONENTS OF BIKEWAY SYSTEM

5-7.001

1. Bike Lanes

Bike lanes are integral sections of a roadway that are marked for exclusive bicycle use and are always 1-way.

2. Bike Routes

Bike routes may include shared streets, bike lanes or shared-use or multiuse paths, in any combination. Routes may be designated by signing or by placement on a map.

3. Grade-Separated Crossings

Crossings are underpasses or overpasses that serve to isolate motorized and non-motorized traffic from each other at points of intersections.

4. Shared-use or Multiuse Paths

Shared-use or multiuse paths are paved pathways set aside for the exclusive use of nonmotorized travel and are generally intended for 2-way traffic. Paths are typically separate from the road infrastructure.

5. Shared-use or Multiuse Trails

Shared-use or multiuse trails are unpaved and designed to accommodate equestrians, pedestrians and bicyclists. See [Section 8-3.000](#) for trail information.

6. Shared Streets

Shared streets are all streets that do not have bike lanes where bicycles and motor vehicles share the same roadway. This includes all public streets except those specifically posted to prohibit bicycles.

DOCUMENTS AND REFERENCES

5-7.002

The following publications or their current revisions are to be used in conjunction with the design criteria in this manual when designing bicycle or shared-use or multiuse paths for the City of Scottsdale:

- American Association of State Highway & Transportation Officials (AASHTO) Guide for the Development of Bicycle Facilities, 1999.
- City of Scottsdale Transportation Master Plan, 2008.
- COS Community Mobility Element of the General Plan, 2001.
- COS Zoning Ordinance, Section 9.100.
- Manual of Uniform Traffic Control Devices (MUTCD) Section IX, Traffic Controls for Bicycle Facilities.
- MAG Regional Bicycle Plan, 1999.
- MAG Regional Off-Street System Plan (ROSS), 2001.
- MAG Uniform Standard Specifications for Public Works Construction.
- COS Supplement to MAG Uniform Standard Specifications for Public Works Construction.

5-7.100

PLANNING BIKEWAYS

5-7.101

LOCATIONS

It is a goal of the Scottsdale bikeway system to provide facilities on a minimum of a:

- Half-mile grid south of Shea Blvd.
- One-mile grid between Shea Blvd. & the CAP Canal.
- Two-mile grid north of the CAP Canal.

Providing equal grids for both on- and off-street types of bikeways is encouraged, as it will accommodate the widest possible range of users, purposes and trip destinations. The COS Bicycle/Pedestrian Transportation Plan (1994) contains maps of planned on-street and off-street bikeways.

5-7.102

FACILITY SELECTION: ON-STREET

Bike lanes are the most desirable facility for any street with a classification of minor collector or higher. For these streets with higher volumes of traffic, the classification of a street will determine its cross-section, see [Section 5-3.100](#). Major arterials, minor arterials, major collectors, minor collectors and certain special neighborhood and rural streets have standard cross-sections that include bicycle lanes. Bike lanes would, therefore, be included on these streets whenever they are built or reconstructed.

For streets that provide a connection for local or regional bikeway systems, but where a full cross-section with bicycle lanes cannot be accommodated, the following measures should be considered, in order of desirability:

- Edge line stripe with route signs;
- Edge line stripe with no signs;
- Route signs with no edge stripe.

5-7.103

FACILITY SELECTION: OFF STREET

In planning for off-street shared-use or multiuse paths, the following hierarchy should apply, starting with the most desirable:

- Ten or 12 foot shared-use or multiuse path well separated from streets and in a natural setting;
- Ten or 12 foot pathway set off from the street by at least 10 feet of landscaping;
- Ten or 12 foot shared-use or multiuse path protected from the street with a traffic barrier & railing.

Connections between different types of facilities are very important to ensure an efficient and functional system. In places, shared-use or multiuse paths may be used to connect sections of roadways that would otherwise dead-end. However, it is critical not to attempt to substitute a path or a sidewalk where bike lanes are warranted. Bike lanes allow direct, higher-speed travel for cyclists, unimpeded by pedestrians. Bike lanes are also 1-way, going with the adjacent traffic. Since paths are typically 2-way, designing a path to connect with bike lanes and not have cyclists riding the wrong way (against traffic) in one of the bike lanes requires very careful study and design.

Opportunities to provide bicycle access may occur in conjunction with public or private development, greenbelts, canal banks, flood control projects, vista corridors or any place with available open space or rights-of-way. It is the intention of Scottsdale's bicycle planning efforts to remain flexible and open to new opportunities.

EASEMENTS, DEDICATIONS & ABANDONMENTS

5-7.104

In the case of on-street facilities, the bike lane or route is typically located within the street rights-of-way (ROW). Sometimes on-street facilities may need to be connected with short sections of paved path. An example of this would be cul-de-sacs that have only one direct access to the public street system. Sometimes the cul-de-sac street can be connected to allow bicycle and foot access to reach adjacent streets, paths, trails or property.

If a private, gated community will cut off functional access for cyclists, means should be explored to maintain a public use easement, on the streets and through the gates, for pedestrians and cyclists.

For off-street paths, the applicant may obtain a ROW through development stipulations or purchase. Any easements or dedications for paths should include a clear statement of maintenance responsibilities for (1) the actual concrete path, (2) any adjacent landscaping or lighting and (3) for maintaining proper grades and drainage along the path. Dedication of rights-of-way or public use easements for paths must be noted in the stipulations and on the site plan. This should occur in the Project Review process for new developments.

If the applicant proposes changing the classification of an existing/planned street or abandon a street easement or ROW, current and potential pedestrian and cyclist connections shall be reviewed, see [Section 3-1.000](#). The proposed changes will be evaluated against the needs of the bicycle program. If needed, some means of bicycle and/or foot access such as a public use easement should be obtained.

FACILITY DESIGNS

5-7.200

While every effort has been made to ensure the accuracy and completeness of these guidelines, the City of Scottsdale shall not be held responsible for any errors or omissions. It shall be the sole responsibility of the design engineer to ensure a proper design and the accuracy and completeness of construction documents containing his or her signature.

Any substitutions or exceptions must provide the same functions and be approved by the Transportation Department.

SHARED STREETS AND BIKE ROUTES

5-7.201

It is assumed that cyclists will ride on all streets, unless such use is expressly prohibited and posted. Many neighborhood streets function quite well as bikeways with no additional signing or marking. If these streets are needed to complete some part of the bikeway system or to provide a connection for cyclists, the street may be designated by edge stripes, signs or on a map.

Since cyclists will tend to use the right side of the outside lane, this area should always be built and maintained to accommodate that use. Drainage grates should be designed and installed in a manner that will not trap wheels. Longitudinal cracks, potholes, rough paving, etc., should be eliminated.

BIKE LANES

5-7.202

Streets such as major arterials, minor arterials, major collectors, minor collectors and certain neighborhood and rural streets have cross-sections that include bicycle lanes. These cross-sections are in [Section 5-3.100](#).

1. The recommended minimum width of a bike lane is 5 feet from the face of the curb. A minimum of 4 feet of asphalt is preferred. A minimum of 3 feet of asphalt is acceptable with approval of the Traffic Engineering Director. A solid 8 inch white stripe will be used to mark the bike lane. An alternative method is to combine the lane and gutter pan as one concrete strip. In these cases it is desirable to exceed the 4-foot minimum as measured to the face of the vertical curb, see [Figure 5.7-1](#) through [Figure 5.7-4](#).

2. Any grade separation structure should allow the full width of the physical improvements, including standard bike lanes. Also note that most surface streets, even without designated bike lanes or shoulders usually allow for some "shy distance" or permit an emergency move off the road. Bridges and underpasses with solid barriers alongside often become dangerous constriction points for bicycle travel. Therefore consideration should be given to maintaining extra width on bridges and in tunnels even if the street does not have bike lanes.
3. In rural areas, a paved shoulder can serve the function of a bike lane, in which case it should have a minimum of 5 feet of paving. A bicycle lane can also be delineated with striping between an area for parallel parking and a traffic lane. In this case the bicycle lane should be at least 5 feet, see [Figure 5.7-3](#).
4. Whenever a half-street is constructed, if the ultimate street classification has a cross-section with bike lanes, then the half-street construction should also provide a bike lane on each side.
5. Parking is not permitted in marked bicycle lanes.
6. Raised pavement markers or curbing should never be used to delineate bike lanes.
7. [Figure 5.7-1](#) through [Figure 5.7-4](#) give examples of bike lane configurations for various situations. These cross sections are compatible with [Section 5-3.000](#), Geometrics.
8. For additional information concerning bike lanes and routes not covered in this manual, please refer to the AASHTO Guide for the Development of Bicycle Facilities, 1999.

A. Curbed Street Where Parking is Prohibited

- 4 foot lane is exclusive of curb and gutter.

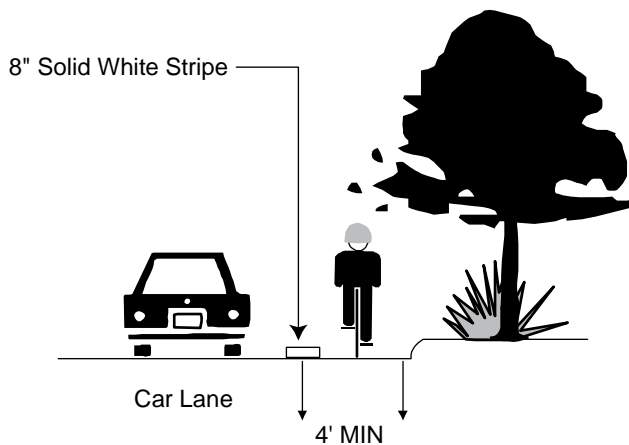
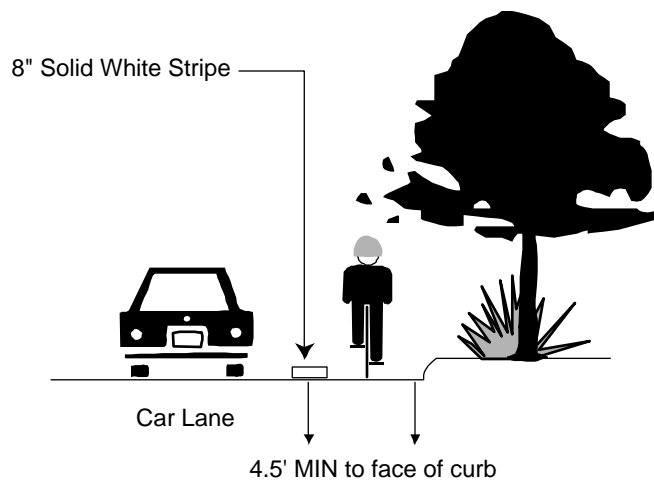


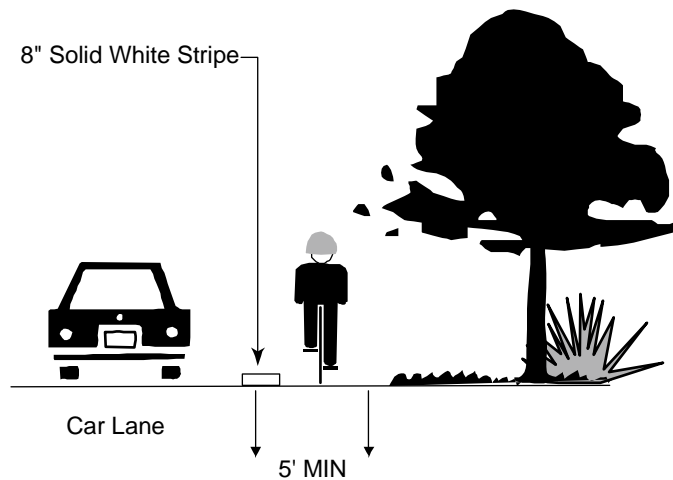
FIGURE 5.7-1 BIKE LANE WHERE PARKING IS PROHIBITED

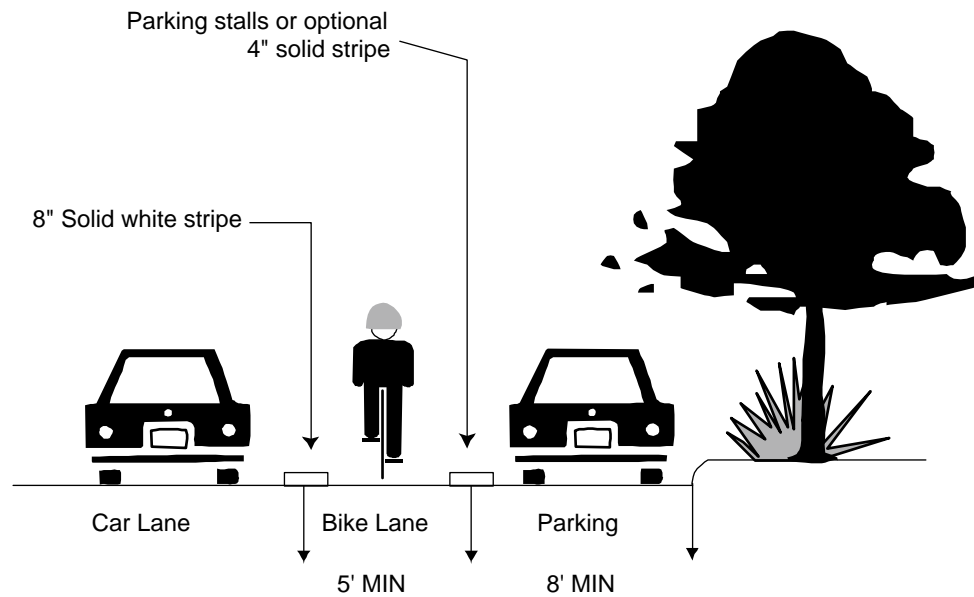
B. Wide Curb Lanes

- Monolithic concrete curb, gutter and bike lane. No longitudinal joints.

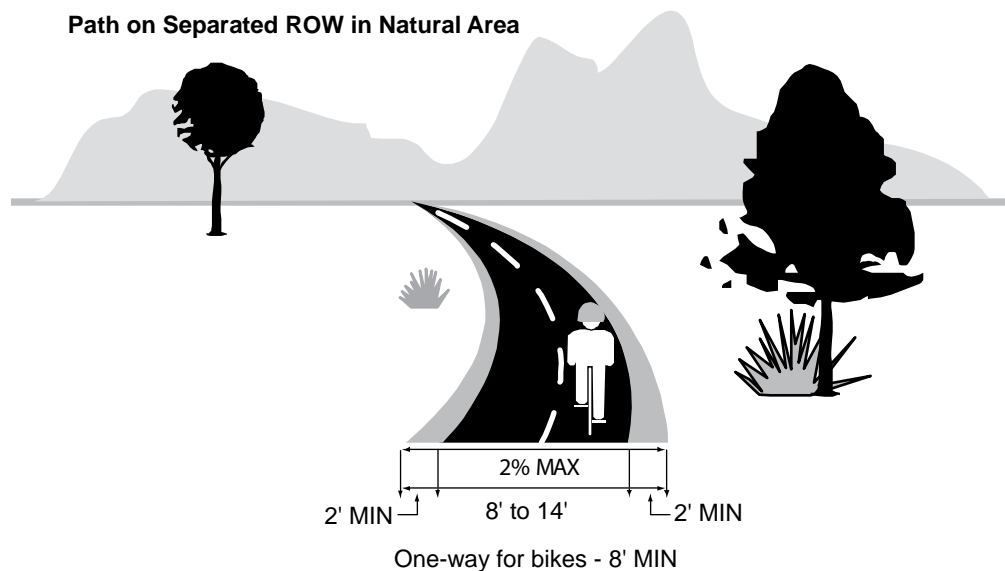
**FIGURE 5.7-2 BIKE LANE WITH WIDE CURB LANES****C. Street with Paved Shoulder**

- Curb and gutter is not present. Shoulder functions as bike lane.

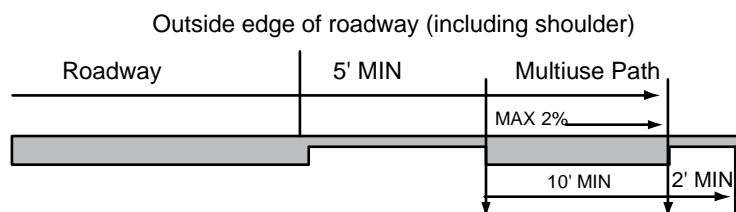
**FIGURE 5.7-3 BIKE LANE ON PAVED SHOULDER**

D. Curbed Street with Parking**FIGURE 5.7-4 BIKE LANE WITH PARKING****5-7.203****SHARED-USE OR MULTIUSE PATHS**

1. Operation and use of shared-use or multiuse paths are covered by COS Revised Code, Article IV, Chapter 17.
2. COS Standard Details Nos. 2281 - 2285 for shared-use or multiuse paths are available online at www.ScottsdaleAZ.gov/design/COSMAGSupp.
3. Placement of a shared-use or multiuse path may correspond/overlap with a trail underpass. Refer to the COS Trails Master Plan to verify trail underpass locations and design standards.
4. For additional information not covered in this manual, please refer to the AASHTO Guide for the Development of Bicycle Facilities, 1999. This guide provides technical information on minimum radii for curves, grades, sight distances and stopping sight distances under various conditions.



Path Separate but Near Roadway



Path Next to Roadway

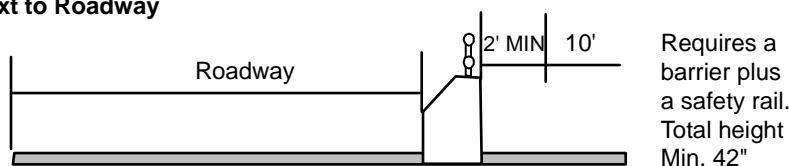


FIGURE 5.7-5 SHARED-USE OR MULTIUSE PATH PERSPECTIVES

A. Shared-use or Multiuse Path Requirements

1. The path should have a minimum design speed of 20 mph.
2. The path should have a typical width of 10 feet with a 2-foot shoulder on each side.
3. There should be a width of 8 feet where paths can be paired so each can have 1-way travel, plus 2-foot shoulders.
4. There should be a width of 12 feet where heavy use is expected, especially with a high percentage of pedestrians/skaters.
5. There should be a medium broom finish on the surface. It is desirable to provide traction, but not to a degree that impedes skaters.
6. There should be material for the shoulders that can allow for recovery if a user runs off the path. Substances such as turf, decomposed granite, exposed aggregate or various ground covers are appropriate. No spiny/thorny plants.

7. Landscaping beyond the 2 foot shoulders shall not consist of vegetation that are spiny/thorny or that have horizontal growth patterns which could encroach onto the path.
8. Irrigation systems will be installed in a manner that will not result in water spraying onto or across the path.
9. The area should be clear of fixed objects such as poles or tree trunks for another 3 feet beyond the shoulder.
10. Handrails for paths or bikeways should be minimum 42 inches in height and be flared at the ends.
11. There should be a vertical clearance of 8 feet over the path and shoulder areas, see [Figure 5.7-9](#).
12. Vertical clearance in tunnels should be 10 feet whenever possible, see [Figure 5.7-11](#).
13. Grades should be 5 percent or less. Where this is not feasible, refer to the AASHTO Guidelines. The Transportation Department will make the final decision. Maximum side slope is 2 percent.
14. Alignment should be as linear as possible; avoid compound curves, see [Figure 5.7-6](#). Excessive meandering reduces the effective width of the path and can create sight distance problems which may increase the possibility of users running off the path.
15. Adjacent grades should always direct water away from the path surface, such as using a small swale on the up-slope side.
16. Underpasses shall be designed to keep nuisance water off the path and allow the water to rapidly drain or be removed. One solution is a small channel constructed with a sloping side, built on one side of the tunnel. Sump pumps are needed in areas prone to flooding. See [Figure 5.7-11](#) and [Figure 5.7-12](#).
17. Underpasses should be lighted.
18. Path ramp design requires that the pan for any curb ramp shall be as wide as the path. The ramp should be aligned with the path and not require users to make sudden swerves or to be directed towards oncoming traffic. Refer to COS Standard Details.
19. Signage providing general location information should be located at a minimum of 1/4-mile intervals. Placement of these signs should be on or adjacent to the path. Contact the Transportation Department for specifics.

**Paths shall be constructed to be as linear as possible.
Avoid compound curves.**

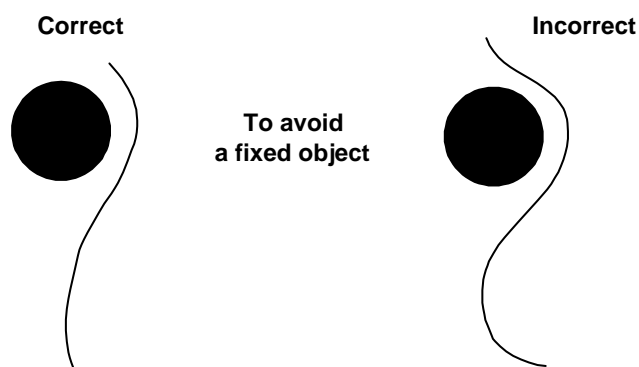
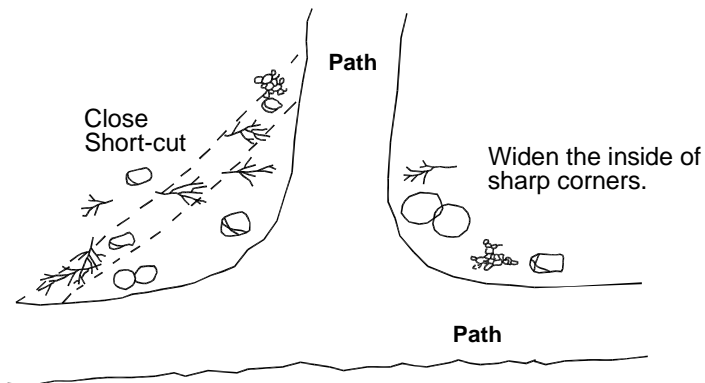
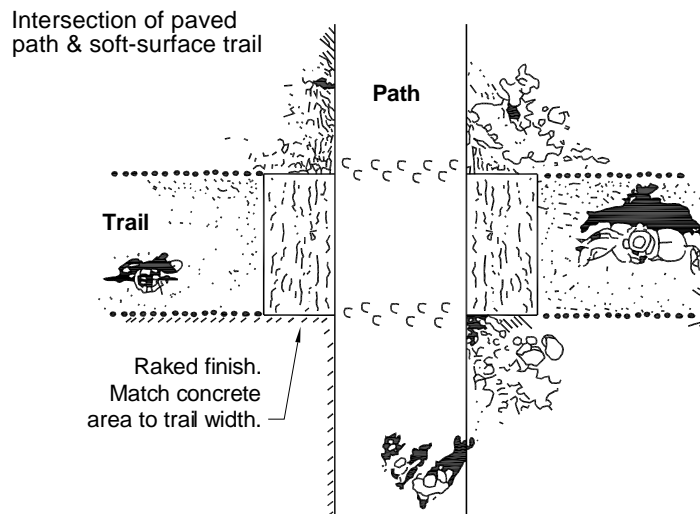


FIGURE 5.7-6 AVOIDING FIXED OBJECTS



Use proper signage and wider inside curves.
Maintain landscape for sight distance.

FIGURE 5.7-7 PATH - PATH INTERSECTIONS



Use a concrete transition between trail and path to prevent dirt drag-out.

FIGURE 5.7-8 PATH - TRAIL INTERSECTIONS

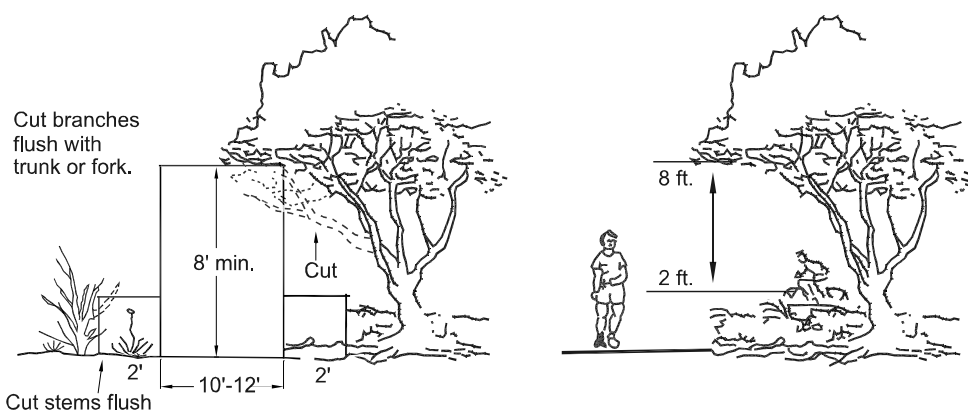


FIGURE 5.7-9 PATH VEGETATION CLEARANCE

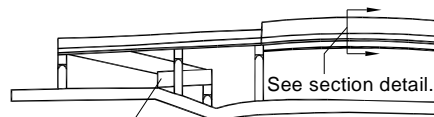
B. Other Special Conditions

Every attempt should be made to avoid having a shared-use or multiuse path directly adjacent to a street. If this is unavoidable, try to achieve a separation of at least 5 feet, with landscaping. If the path and street separation will be less than 5 feet, then a combination vehicular and bicycle railing and traffic barrier should be used. The top of the barrier and rail must be at least 42 inches. These railings perform the dual function of retaining both vehicles in the street and cyclists on the path, see [Figure 5.7-5](#). For path/street intersections, use grade-separated crossings (either over or underpasses) where feasible.

The majority of these crossings will be at-grade. However, certain design practices can greatly improve these at-grade crossings, whether or not they are mid-block, controlled intersections or driveway exits. Some practices found helpful in Scottsdale include making crossings of contrasting material, striping each side of the crossing, restricting median bullnoses from the path or elevating the path on a speed table. See [Figure 5.7-6](#), through [Figure 5.7-8](#) and [Figure 5.7-12](#) and COS Standard Detail No. 2281, see www.ScottsdaleAZ.gov/design/COSMAGSupp.

Approach to Overpass

See design standards for appropriate upgrades.



Check landing area for stopping sight distance requirements. Avoid direct entry into streets.

Multiuse Path Bridge Section

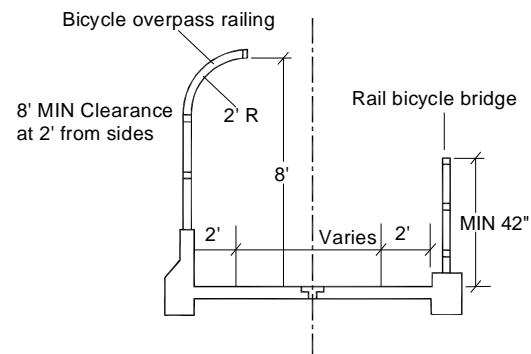
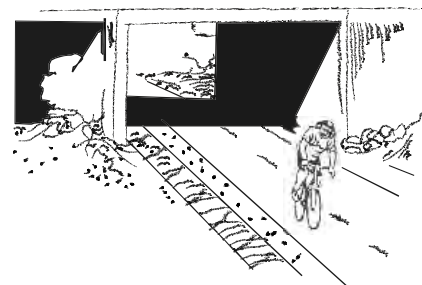
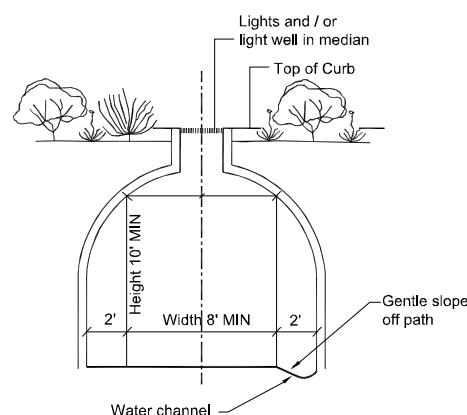


FIGURE 5.7-10 SHARED USE OR MULTIUSE PATH – BRIDGES



Path should not be reduced through the underpass.

FIGURE 5.7-11 SHARED USE OR MULTIUSE PATH – TUNNELS

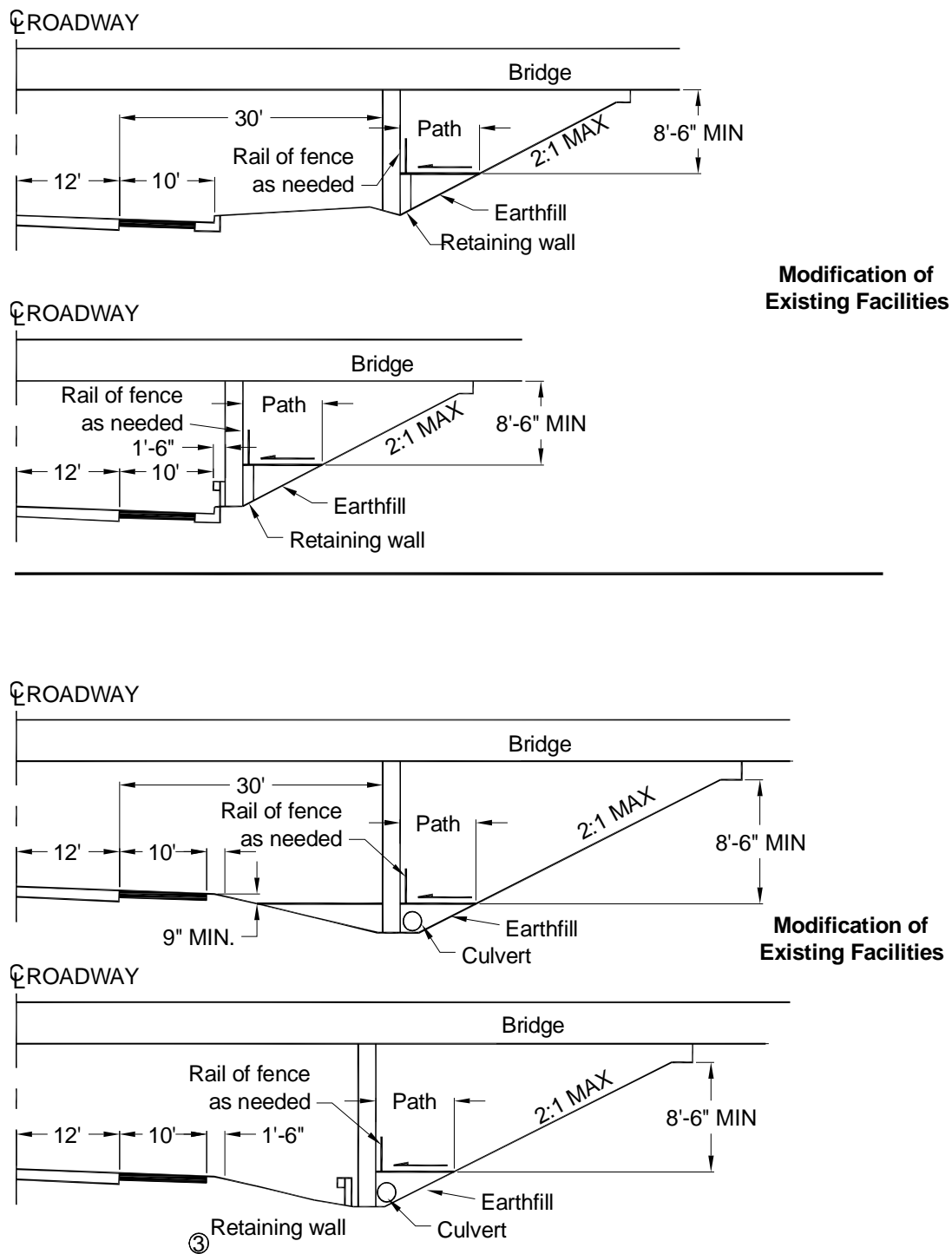


FIGURE 5.7-12 SHARED USE OR MULTIUSE PATHS UNDER BRIDGE STRUCTURES

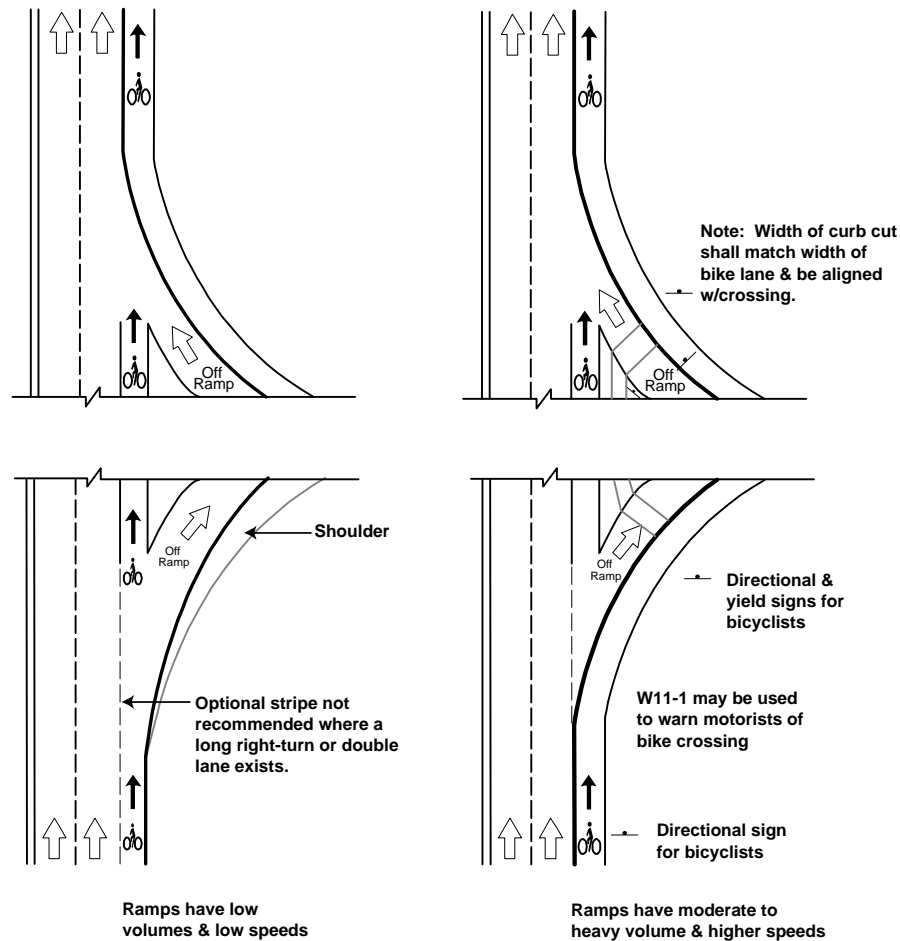


FIGURE 5.7-13 RAMP CROSSINGS

5-7.204

RIDING SURFACES

Careful attention should be made to the choice of riding surface paving materials and other objects within the riding surface. Typical riding surface materials are either Portland Cement Concrete or Asphaltic Concrete Paving.

1. Portland cement concrete is desirable for paths with frequent contact with water. Paths constructed of Portland cement concrete will have a medium broom finish. The width of expansion joints should be minimized and the joints tooled with a small radius.
2. Asphalt concrete is desirable when dictated to complement aesthetics suitable to the surrounding area. Paths constructed of asphalt concrete pavement shall conform to Section 343 of the City of Scottsdale Supplement to MAG Specifications. Paving for bike lanes should meet MAG standard for surface smoothness of asphalt paving. Asphalt concrete shall include an epoxy-coated surface.

Rumble strips, raised pavement markers, or raised curbs should never be used to delineate bike lanes or shared-use or multiuse paths. They should also never be placed in bikeway crossings.

Obstructions within the riding surface should be minimized. Drainage grates within the riding surface should be avoided whenever possible. Any drainage grates that must be placed in the riding path shall have bicycle safe grating.

TRAFFIC CONTROLS

SIGNS AND MARKINGS

Traffic control devices for cyclists, whether they are for an on- or off-street system, must adhere to the same five basic requirements for motorists:

- Fulfill a need
- Command attention
- Convey a clear, simple meaning
- Command respect from users
- Give adequate time for a proper response

The use of colors should conform to code specifications for signs and markings:

- Yellow – General Warning,
- Red – Stop or Prohibition,
- Blue – Service Guidance,
- Brown – Recreation,
- Black – Regulation,
- White – Regulation.

See Figure [Figure 5.7-13](#) for an example.

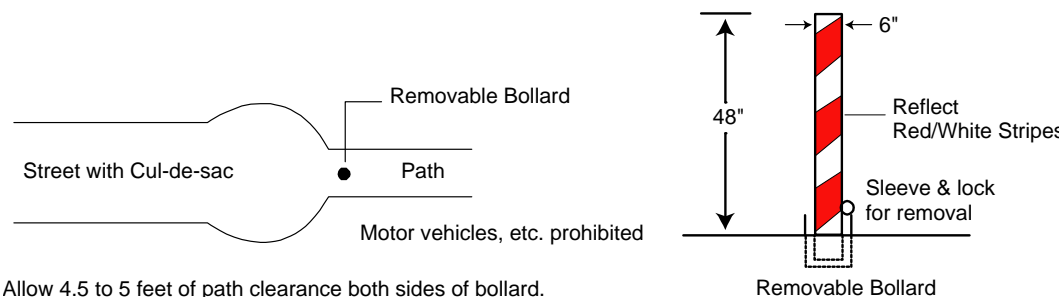


FIGURE 5.7-14 VEHICLE CONTROL PATH ENTRANCE (WHERE NEEDED)

All regulatory, warning and route marker signs will be provided in accordance with the standards in the Manual on Uniform Traffic Control Devices, Section IX. In addition, the City of Scottsdale has developed signs for particular situations; see COS Standard Details Nos. 2281, 2282 and 2284, www.ScottsdaleAZ.gov/design/COSMAGSupp/.

Signing and marking for bike lanes are shown in [Figure 5.7-1](#) through [Figure 5.7-4](#), [Figure 5.7-13](#) and [Figure 5.7-16](#). Shared-use or multiuse paths are shown in [Figure 5.7-13](#) and COS Standard Detail Nos. 2281, 2282 and 2284, www.ScottsdaleAZ.gov/design/COSMAGSupp/. Other information is in the AASHTO Guidelines.

For bike lanes, pavement markings shall consist of a directional arrow and a bike/rider symbol. In urban areas, pavement markings shall be placed 50 to 75 feet after every major intersection or at ¼ mile intervals, whichever is less. In rural areas, the distance may change as judged appropriate by the COS Transportation Department.

Where a bike lane continues past the left side of a right-turn-only lane, a pair of pavement symbols shall be placed in that continuation.

On leaving an intersection, the lane stripe should start at the crosswalk or where the crosswalk would be. Approaching an intersection, with no right-turn lane, the stripe should be dashed 50 -75 feet before the intersection. See [Figure 5.7-15](#).

Paint and thermoplastic stripes or markings used for lanes, routes or paths should be reflective and highly non-slip.

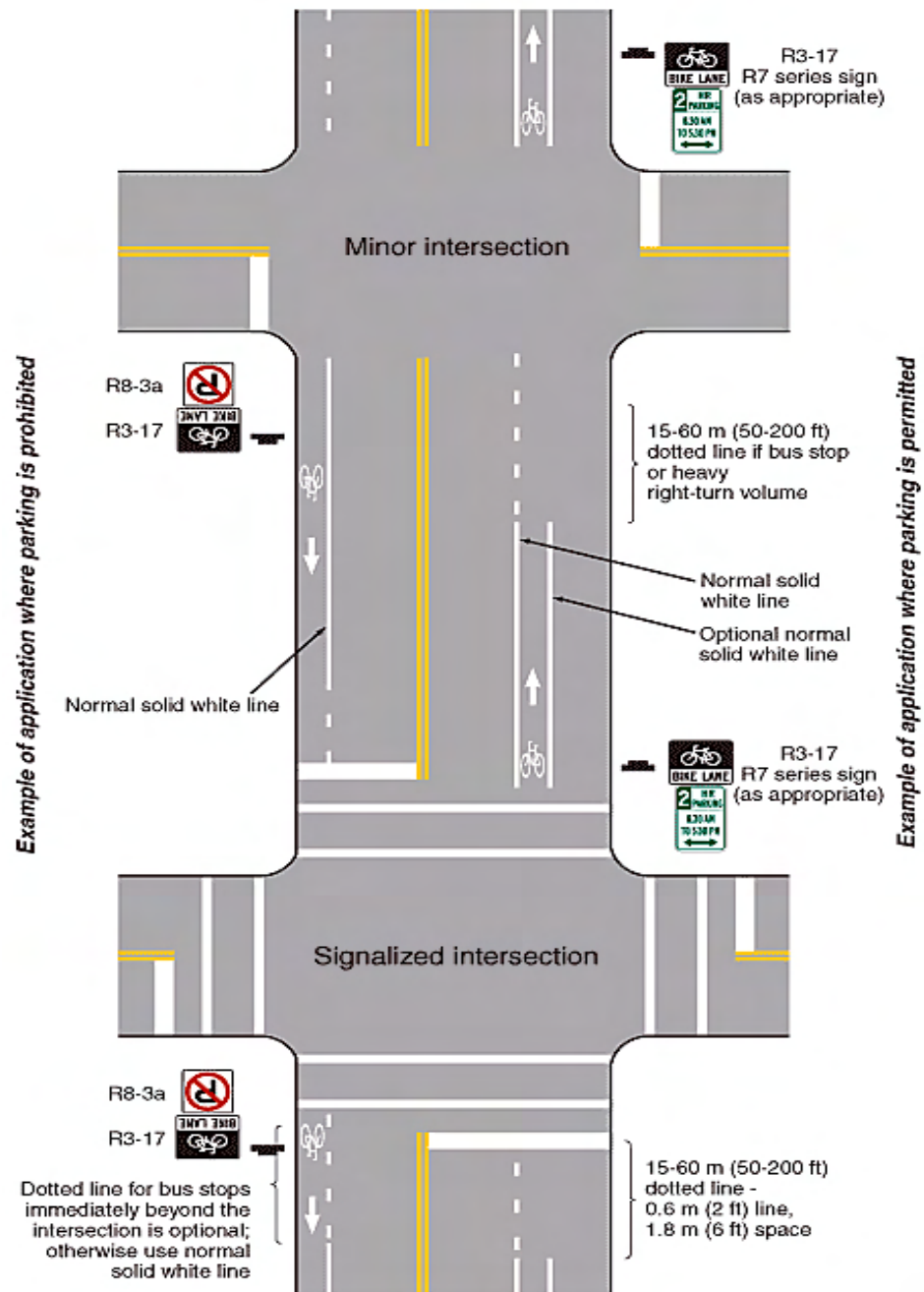


FIGURE 5.7-15 EXAMPLE OF PAVEMENT MARKINGS FOR BICYCLE LANES ON A TWO-WAY STREET

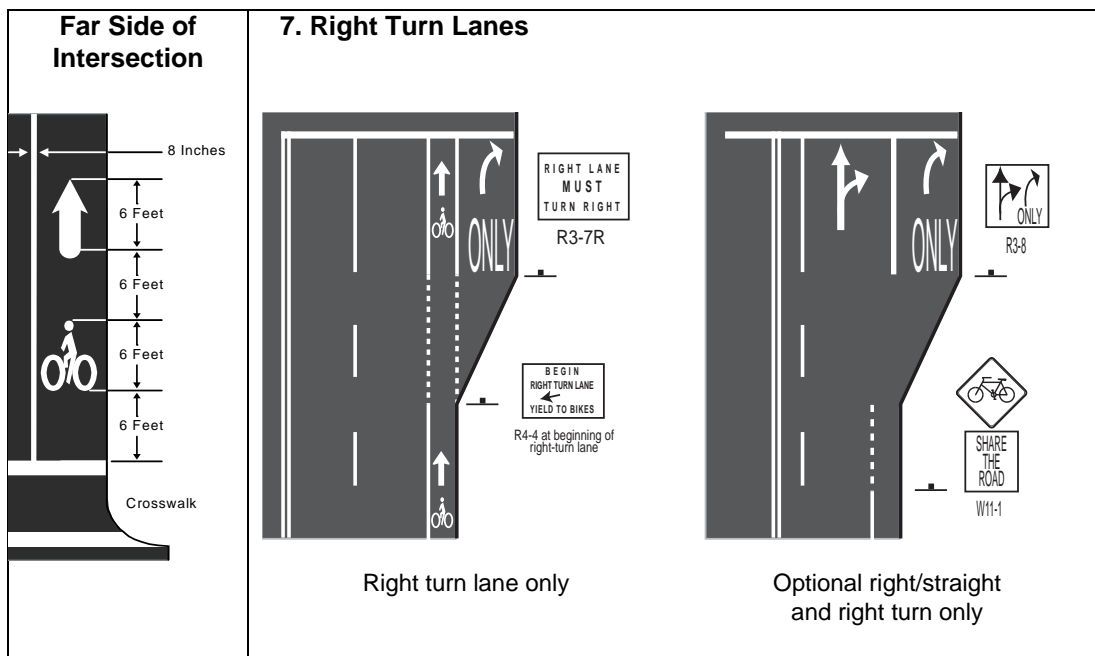


FIGURE 5.7-16 BIKE LANE MARKINGS

DETOURS & CONSTRUCTION

5-7.302

A. Public Information

Any signage, publication, map, web posting, public service announcement or other information concerning a construction closure, restriction or change always include expected effects on cyclist or pedestrian movements. This includes, but is not limited to, changes in the operation of sidewalks, shared-use or multiuse paths, bike lanes or any other bikeways.

Ideally, detours should be identified or built and well signed. Bikeway detours should only be used when the same type of facility can be provided, such as a bike lane directed to other lanes or shoulders or to a suitable shared street. Path detours should be directed to another path or suitable sidewalk, not to an on-street facility.

B. Shared Streets, Bike Lanes and Shared-use or Multiuse Paths

If a bike lane is closed, it shall be signed "Bike Lane Closed" and also signed "Bikes on Roadway" for the portion where cyclists will be forced to use the traffic lane. This applies to shoulders with high bicycle use, as well as cases where the work is confined to the bicycle lane.

If the traffic lanes are narrowed for construction detours, so that a car and bicycle cannot safely pass side-by-side; then cyclists and motorists should be directed as in the previous paragraph.

Special attention needs to be paid to work, such as utility, taking place only in the bike lane or shoulder area. Sometimes precautions are ignored because the vehicular traffic is not affected. However, proper signing and barricading, with lights for night warning, is still essential. Irregular surfaces, such as raised metal plates on shoulders or hoses laid across paths, can be especially hazardous and must always be well barricaded.

Signing and barricading should anticipate night use and speeds up to 25 mph. Barricades and signs should be posted at points where people are able to choose an alternate route.

Barricades, signs, etc., should not be placed or stored in bike lanes or on shoulders or paths.

Bike lanes/shoulders shall always be restored to an excellent paving condition. MAG Standard 321.5.4, Asphalt Base and Surface Course, should apply (when not in use).

5-7.400

BICYCLE PARKING

The City of Scottsdale Zoning Ordinance, Section 9.103, specifies bicycle parking requirements, see www.ScottsdaleAZ.gov/codes/zoning.

Bicycle parking shall be located within 50 feet of the main entrance(s), in a convenient, highly visible location. Ideally, bicycle parking will be more convenient to destinations than motor vehicle parking. On a site with several businesses, bike parking should be dispersed to be convenient to individual entrances. A portion of the required parking may be located by an employee entrance.

The COS Standard Detail No. 2285 bike rack is designed to provide:

1. Secure support for the entire frame of the bike by allowing numerous contact points with the frame and one wheel, with those points being spread out both horizontally and vertically. These contact points are all in one plane. This helps prevent damage to paint, eliminates metal points that could stick out to cause damage or injury and the bicycle is prevented from sliding down or flopping over.
2. Accommodation of any size or type of bicycle with any type of luggage or equipment. The bicycle does not have to be lifted up or supported by a kickstand.
3. Ease of use and manner of use, is clear without instructions. A poor design, such as the "ribbon" or "wave" rack, allows bikes to be placed either perpendicular or parallel to the rack. Bikes parked parallel to the rack typically reduces the effective parking spaces to two bikes.
4. Secure locking with any type of lock or cable, including the "U" locks. If the front wheel is removed and repositioned, then it should be possible to lock the frame and both wheels to the rack. The rack should not require that the lock be fastened close to the bicycle chain.
5. The city rack may be painted and may be placed on concrete, turf or gravel. It may be used as singles, doubles or in rows. Each loop accommodates 2 bikes.

PEDESTRIAN FACILITIES



This section provides resources for pedestrian facility planning and design. It provides guidance for pedestrian connections, safety, and information on accessibility, including curb ramps.



DEPARTMENT RESOURCE INFORMATION

Aviation/Airport	15000 N. Airport Dr.	480-312-2321
Advance Planning Services	7506 E. Indian School Rd.	480-312-7990
Capital Project Management	7447 E. Indian School Rd., Suite 205	480-312-7250
Current Planning	7447 E. Indian School Rd., Suite 105	480-312-7000
Customer Service	7447 E. Indian School Rd., Suite 100	480-312-7800
Downtown Group	4248 N. Craftsman Ct.	480-312-7750
Facilities Management	9191 E. San Salvador Dr.	480-312-5999
Fire & Life Safety/ Inspections	8401 E. Indian School Rd.	480-312-1855
Fire Plan Review	7447 E. Indian School Rd., Suite 125	480-312-7080
Inspections & Land Survey	9191 N. San Salvador Dr.	480-312-5750
Parks Department	7340 Scottsdale Mall	480-312-2915
One Stop Shop/Permit Services	7447 E. Indian School Rd., Suite 100	480-312-2500
Plan Review	7447 E. Indian School Rd., Suite 125	480-312-7080
Records Division	7447 E. Indian School Rd., Suite 100	480-312-2356
Solid Wastewater Management	9191 N. San Salvador Dr.	480-312-5600
Stormwater Management	7447 E. Indian School Rd., Suite 205	480-312-7250
Street Operations	9191 N. San Salvador Dr.	480-312-5626
Transportation	7447 E. Indian School Rd., Suite 205	480-312-7696
Water Resources	9388 E. San Salvador Dr.	480-312-5685
City of Scottsdale	www.scottsdaleaz.gov	

PEDESTRIAN FACILITIES

5-8

GENERAL INFORMATION

5-8.000

The City of Scottsdale (COS) is dedicated to improving the quality of life for its citizens by enhancing their mobility choices and enjoyment of the community. Pedestrians are an integral part of the transportation system because all people are pedestrians at one time or another. For example, a driver becomes a pedestrian upon leaving a vehicle. Public transportation users are pedestrians when they walk to a transit stop and again when walking to their final destination. Planning for the needs of pedestrians is an essential element of providing an efficiently functioning transportation system.

In general, people will choose to walk a ten minute trip or a quarter mile to a destination, and even longer, up to twenty minutes or a half mile, if the route is comfortable and safe or if the need is great. Site planning should consider walking distance of pedestrians from nearby transit routes or other adjacent locations, such as employment centers or residences. Like all transportation users, pedestrians seek direct, convenient travel routes.

Pedestrian facilities should provide accommodations for a wide array of users including but not limited to walkers, joggers, wheelchair users, strollers, rollerbladers, bicyclists and equestrians. These pedestrian facilities need to be universally accessible, safe, convenient, direct and designed to encourage use by this wide variety of potential users.

Minimizing curb cuts and consolidating driveways helps to maintain continuity of pedestrian routes and helps to ensure pedestrian comfort and safety. In addition, pedestrians like to be separated from moving traffic with a buffer, such as on-street parking, landscaping, or bicycle lanes. Walkways should be designed with sufficient capacity dependent on the anticipated level of use, intensity and speed of adjacent traffic, and the number of obstacles (such as utility poles, magazine stands, and street furniture) within the walkway. An effective walkway width (as usable for pedestrian travel) of at least 6 feet is required; a minimum effective walkway width of 8 feet or more is desirable in areas that will experience high pedestrian travel.

REFERENCES

Developers, staff, and other interested parties are encouraged to reference the following two documents:

- Design Sidewalks and Trails for Access, Part 1 and Part 2, Best Practices Design Guide, Barbra McMillen, et. al, U.S. Department of Transportation, Federal Highway Administration, Publication No. FHWA-EP-01-027 HEPH/8-01 (10M) E, September 2001. Available from FHWA Report Center by e-mailing report.center@fhwa.dot.gov.
- Draft Guidelines for Accessible Public Rights-of-Way, Access Board, June 17, 2002. Available online at www.access-board.gov.

The Transportation Department is available to answer questions or to discuss applications to specific circumstances or designs.

5-8.001

5-8.100**PEDESTRIAN & BICYCLE FACILITIES****5-8.101****PEDESTRIAN FACILITIES**

1. Walkways that connect main building entrances to the sidewalks on adjacent streets should have a minimum clear width of six (6) feet - excluding any parking overhangs or other obstructions. The walkway should be continuous between the street and building, and clearly recognizable by both pedestrians and drivers. Wider widths may be required by staff in locations where significant pedestrian traffic is anticipated and where wider sidewalk exists or is planned along the street.

In cases where a sidewalk width of six feet cannot be provided due to existing physical barriers or other constraints, a five (5) foot wide clear and continuous sidewalk width may be allowed if approved by the Planning and Development Services General Manager or designee.

2. Provide shade wherever possible for on-site walkways either through the use of tree canopies or structural canopies. Tree trunks and canopy supports should not encroach into the minimum six foot sidewalk width.
3. The minimum unobstructed width of walkways across the front of major retail centers or mixed-use buildings, especially in the Downtown area, should be 8 feet. In locations where street furniture, canopy supports, or other physical barriers encroach into the adjacent pedestrian facility, twelve (12) feet of walkway should be provided with a clear, continuous width of eight (8) feet provided across the frontage.

In cases where a sidewalk width of eight (8) feet cannot be provided along these frontages due to existing physical barriers or other constraints, a six (6) foot wide clear and continuous sidewalk width may be allowed if approved by the Planning and Development Services General Manager or designee.

5-8.200**MULTIPLE PEDESTRIAN CONNECTIONS**

In an effort to improve mobility and reduce congestion, multiple pedestrian options may be desirable. For example, if three potential alternatives or alignments are available to connect pedestrian destinations, often two or all three may be chosen if it is likely to improve access, increase pedestrian use, and reduce vehicular trips. The need for multiple options will be dependent upon the cost, benefit, and convenience of the alternatives available as determined by the Transportation Department. and the Planning and Development Services General manager or designee.

5-8.300**PEDESTRIAN SAFETY**

Pedestrian facilities should provide short direct access by connecting through cul-de-sacs, parks, shopping centers, dead-end streets, drainage easements, and other locations that will facilitate and encourage non-motorized travel for short trips. Pedestrian facilities should include a wide variety of choices for pedestrians to improve their safety, especially when crossing vehicular roadways. These improvements may include grade-separated crossings of high speed, high volume vehicular corridors (especially in planned or existing drainage corridors); pedestrian refuges; and signalized pedestrian push buttons on warranted signals. In addition, detectable warning devices (truncated domes) should be installed at locations where it is likely that pedestrians could enter into a vehicular area, such as at pedestrian curb ramps and raised pedestrian crossings. In order to improve safety and encourage use, sidewalks and multiuse paths should be placed away from the back of curb a minimum of 4 feet, with 8 feet desired, and sometimes greater distances based on available rights-of-way or

easement. On roadways with transit routes, the sidewalk should be brought closer to the roadway to allow boarding and deboarding at transit stops.

CURB RAMPS

5-8.400

Curb ramps shall be placed wherever a pedestrian access route crosses a sidewalk/street transition; at intersections, medians and alleys; and where a public sidewalk ends and pedestrian travel continues on the roadway. Curb ramps shall be wholly contained within the crosswalk markings, if they exist. Curb ramps should be flush with the street surface without "lips". Alterations in retrofit development areas shall follow guidelines for new construction unless technically infeasible as determined by the Transportation Department.

The city, to improve pedestrian access and safety, requires the use of directional ramps at all intersections. Per the COS Details, directional ramps are preferred and should be installed at all intersections where there is room for both the ramps and the required 4-foot landing area. Where there is not room for the full directional ramp treatment, diagonal ramps with a minimum 8-foot width and 4-foot landing are acceptable; however, if there is not room for the landing, a blended transition ramp should be used. Detectable warning devices (truncated domes) should be installed in conjunction with these ramps.

NEIGHBORHOOD TRAFFIC MANAGEMENT



This section identifies the process and criteria for reviewing and resolving neighborhood traffic concerns. It identifies goals for this program and options for resolving conflicts.



DEPARTMENT RESOURCE INFORMATION

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Current Planning	7447 E. Indian School Rd., Suite 105	480-312-7000
Customer Service	7447 E. Indian School Rd., Suite 100	480-312-7800
Downtown Group	4248 N. Craftsman Ct.	480-312-7750
Facilities Management	9191 E. San Salvador Dr.	480-312-5999
Fire & Life Safety/ Inspections	8401 E. Indian School Rd.	480-312-1855
Fire Plan Review	7447 E. Indian School Rd., Suite 125	480-312-7080
Inspections & Land Survey	9191 N. San Salvador Dr.	480-312-5750
Parks Department	7340 Scottsdale Mall	480-312-2915
One Stop Shop/Permit Services	7447 E. Indian School Rd., Suite 100	480-312-2500
Plan Review	7447 E. Indian School Rd., Suite 125	480-312-7080
Records Division	7447 E. Indian School Rd., Suite 100	480-312-2356
Solid Wastewater Management	9191 N. San Salvador Dr.	480-312-5600
Stormwater Management	7447 E. Indian School Rd., Suite 205	480-312-7250
Street Operations	9191 N. San Salvador Dr.	480-312-5626
Transportation	7447 E. Indian School Rd., Suite 205	480-312-7696
Water Resources	9388 E. San Salvador Dr.	480-312-5685
City of Scottsdale	www.scottsdaleaz.gov	

NEIGHBORHOOD TRAFFIC MANAGEMENT

5-9

GENERAL INFORMATION

5-9.000

Continued growth in Scottsdale and the region has increased Scottsdale residents' concerns regarding traffic, specifically in neighborhoods. To promote safe and pleasant conditions for residents including motorists, bicyclists, pedestrians, schoolchildren, and other users on neighborhood streets, Scottsdale's Transportation Department has created a Neighborhood Traffic Management Program (NTMP).

One component of the quality of life expected by Scottsdale residents is the safe, efficient, and economical movement of people and goods. The goal of the NTMP is to use the three "Es" (Education, Enforcement, and Engineering) to address the transportation concerns of residents who are negatively impacted by vehicular traffic in their neighborhood.

APPLICATION

5-9.001

Application of the NTMP shall be limited to local, paved, public streets that:

- Have or are planned to have no more than one travel lane in each direction, and
- Function primarily to connect an origin or destination to an arterial (local residential & some minor collectors).

REFERENCES

5-9.002

- MAG Standard Drawings - Maricopa Association of Governments (MAG)
- COS Supplement to MAG - City of Scottsdale (COS)
- DS&PM [Section 5-3.400](#), Roundabout Intersections
- Traffic Calming: State of the Practice - Institute of Transportation Engineers
- Manual on Uniform Traffic Control Devices - Federal Highway Administration
- A Policy on the Design of Highways and Streets - American Association of State Highway and Transportation Officials
- Roundabouts: An Informational Guide - Federal Highway Administration

GOALS

5-9.100

The City of Scottsdale has developed its Neighborhood Traffic Management Program (NTMP) with the following goals:

1. Minimize negative impacts of traffic in neighborhoods through ongoing monitoring and improvement of the overall transportation system.
2. Work to ensure that proposed land uses, and their associated travel demands, do not negatively impact surrounding/adjacent residential neighborhoods.

3. Protect Scottsdale's residential neighborhoods from "unwanted" vehicle traffic. "Unwanted" vehicle traffic is defined as any one of the following:
 - Traffic operating at excessive speeds
 - Vehicles with an origin and destination outside the neighborhood
 - An excessive volume of traffic on a residential local or collector street
4. Balance the often-conflicting needs of calming traffic and maintaining emergency response capability. Emergency vehicle access must be preserved.
5. Address resident traffic concerns while minimizing any negative affects to other citizens and neighborhoods.
6. Encourage and enhance bicycle, pedestrian, and other non-motorized travel modes.
7. Accommodate direct bicycle, pedestrian, and other non-motorized access through drainage channels, dead ends, walls, cul-de-sacs, open space, and other barriers to reach neighborhood destinations such as homes, schools, parks, libraries, retail centers, civic spaces, and trip generators. Generally, an easement is required to accomplish these purposes.
8. The NTMP is not designed to address dangerous intersections, mitigate noise, or to redesign the overall transportation/street classification system, as these concerns should be addressed separately.
9. Achieve broad-based citizen participation, which is an essential element in the development of an effective Neighborhood Traffic Management Program.

More information is available online at www.ScottsdaleAZ.gov/safety/speed/.

5-9.200

PROCEDURES

Traffic calming requests will be initially forwarded through the Speed Awareness Program (SAP) within the Citizen and Neighborhood Resources Department (CNR). The SAP coordinator will forward traffic calming requests that need further attention to Traffic Engineering for review.

Traffic Engineering will then make recommendations as to the issues, potential remedies, and procedures.

All traffic calming requests related to development activity will be reviewed by Transportation Department as part of the development review process. Developers are not to make proposals directly to residents without consulting Traffic Engineering staff. Traffic Engineering staff will review and make recommendations that may include:

- Design mitigation
- A formal Traffic Impact Mitigation Analysis (TIMA) process – see [Section 5-1.100](#)
- Neighborhood meetings
- Review by Transportation Commission

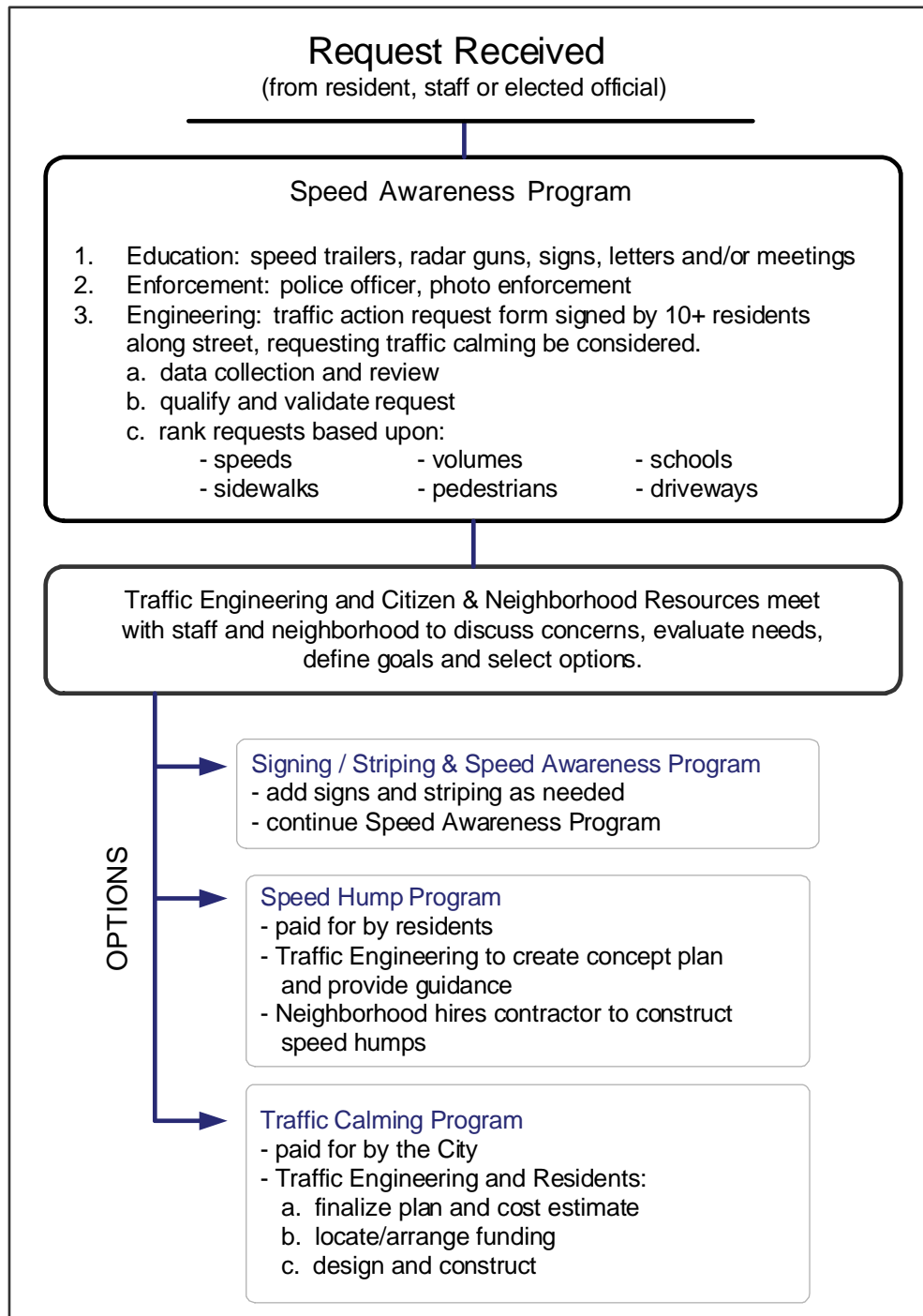


FIGURE 5.9-1 NEIGHBORHOOD TRAFFIC MANAGEMENT PROGRAM FLOWCHART

FLEXIBLE PAVEMENT

This section describes procedures for designing structural sections of flexible pavements constructed within the city's public rights-of-way. Developers of private property normally do this construction as a condition of development as stipulated by the city.



DEPARTMENT RESOURCE INFORMATION

Aviation/Airport	15000 N. Airport Dr.	480-312-2321
Advance Planning Services	7506 E. Indian School Rd.	480-312-7990
Capital Project Management	7447 E. Indian School Rd., Suite 205	480-312-7250
Current Planning	7447 E. Indian School Rd., Suite 105	480-312-7000
Customer Service	7447 E. Indian School Rd., Suite 100	480-312-7800
Downtown Group	4248 N. Craftsman Ct.	480-312-7750
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Inspections & Land Survey	9191 N. San Salvador Dr.	480-312-5750
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Water Resources	9388 E. San Salvador Dr.	480-312-5685
City of Scottsdale	www.scottsdaleaz.gov	

FLEXIBLE PAVEMENT

5-10

ASPHALTIC CONCRETE

5-10.100

5-10.101

DEPTH AND MIX REQUIREMENTS

The asphalt concrete portion of a flexible pavement shall have a minimum depth, number of courses, and mix design called for by street classification in Figure 5.10-1. The mix design references are taken from the East Valley Asphalt Committee Design Standards and from Section 710 of the MAG Specifications and the City of Scottsdale (COS) Supplements to MAG and city of Phoenix Asphaltic Concrete Design Specifications. Mix designs and course thicknesses other than those specified in Figure 5.10-1 may not be used unless approval to do so is provided by the Chief Development Officer or appointed designee. Minimum lift thicknesses are also outlined in Table 710-1 of the COS Supplements to MAG Specifications. The mix design and course thicknesses are to be clearly indicated on paving plans for public rights-of-way improvements.

STREET CLASSIFICATION	MIN. DEPTH	TYPE OF MIX (From MAG TABLE 710-1)		
		Asphalt Base - 1st Lift	Asphalt Base - 2nd Lift	Rubberized Asphalt Surface Course**
Local Residential Minor Collector Local Commercial Local Industrial	3"	2" of R-12.5mm		1" of 12.5 gap graded rubberized asphalt **
Major Collector	5"	2-1/2" of A-19mm	1-1/2" of A-12.5mm	1" of 12.5 gap graded rubberized asphalt **
Minor Arterial Major Arterial	6-1/2"	3" of 25mm	2-1/2" of A-19mm	1" of 12.5 gap graded rubberized asphalt**

***Reference city of Phoenix specifications*

FIGURE 5.10-1 MINIMUM ASPHALT CONCRETE DEPTH REQUIREMENTS

USE OF RECYCLED ASPHALT CONCRETE

5-10.102

Recycled asphalt concrete may not be used in the construction of asphalt concrete pavements.

5-10.200

SOIL TESTING REQUIREMENTS

5-10.201

SUBGRADE SAMPLING LOCATIONS

There should be at least one sample taken at the depth of the planned subgrade for each type of soil found on the project site. There should also be at least one sample for each type of soil used as fill material on which a roadway is to be built. The engineer responsible for the pavement design should take samples in locations that will provide an accurate representation of the subgrade lying beneath the pavement.

5-10.202

TYPE OF TESTS

The following tests are required for design procedures indicated and must be performed in accordance with the American Society for Testing Materials (ASTM) procedures.

1. To use the base course design standards and policies for minor streets described in [Section 5-10.300](#), the following tests are required:
 - a. Sieve analysis is needed to determine the percent passing #200 sieve.
 - b. Atterberg-Limits tests for each sample (this determines the liquid limit and plastic limit to establish the plasticity index.)
2. To use the base course design procedures for major streets described in [Section 5-10.400](#), or to use the structural section design procedures described in [Section 5-10.500](#), R-value testing is required.
 - a. R-value determination shall be made for exudation pressure of 3000 psi. Each pavement thickness design must be based on the R-values determined by the tests, and for each length of pavement to be constructed with a constant thickness design, the lowest R-value within that length of pavement will be used. If the engineer elects not to run R-value tests on every subgrade sample, the design report must indicate the basis on which the engineer selected the samples for the R-value tests.
3. Swelling tests are needed if the soil type indicates the presence of soils tending to swell significantly with added moisture.

5-10.203

PAVEMENT DESIGN REPORT

A pavement design report is required for each development or project in which paving in the public rights-of-way will be done. This report must be submitted with the paving plans (or be a part of them) and must describe the soil test results and design choices.

The report must include the following:

1. A map of the project area showing identification and location of each sample taken.
2. A description of the soil conditions.
3. A listing of the test results on each sample.
4. A statement of conclusions applicable to the pavement design.

5-10.300

BASE COURSE FOR MINOR STREETS

5-10.301

BASE COURSE DESIGN CHARTS

The two design charts for the base courses of minor streets are shown in the following two figures:

1. [Figure 5.10-2](#) is a chart for the design of base courses for Local Residential Streets.

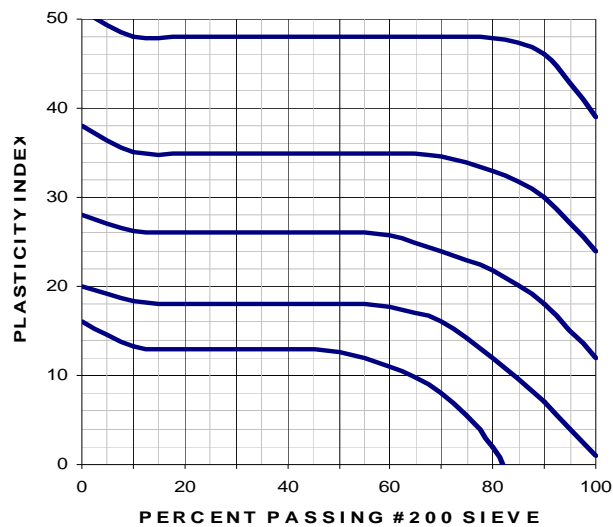


FIGURE 5.10-2 MINIMUM DEPTH OF BASE COURSE FOR RESIDENTIAL STREETS

2. Figure 5.10-3 is a chart for the design of base courses for:

- Minor Collector Streets
- Local Commercial Streets
- Local Industrial Streets

Note: The top 4 inches of the base course shall be Aggregate Base Course (ABC) and the balance shall be ABC or select material.

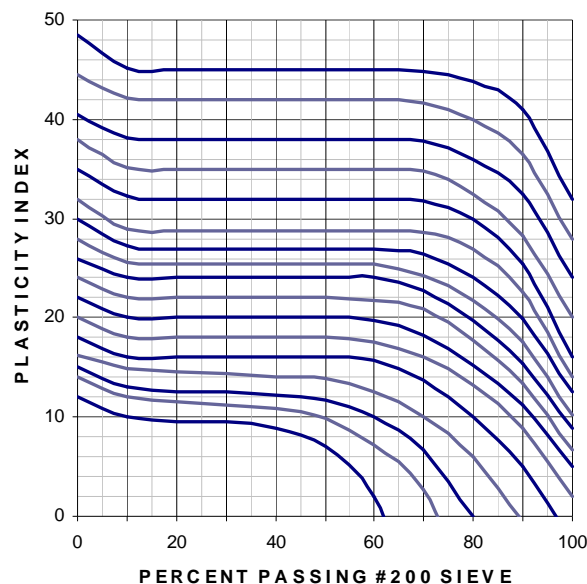


FIGURE 5.10-3 BASE COURSE FOR LOCAL & MINOR COLLECTORS, LOCAL COMMERCIAL, & LOCAL INDUSTRIAL STREETS

5-10.302

BASE COURSE SELECTION PROCEDURE

Determine a minimum base course depth by cross-referencing the plasticity index to the percent of soil passing the #200 sieve (determined by the subgrade soils tests).

Example:

If building a minor collector street on subgrade soil with a Plasticity Index of 12, and 60% of the soil passes the #200 sieve, the base course depth will be 9 inches ([Figure 5.10-3](#)). A local residential street on the same subgrade soil will have a base course of 7 inches ([Figure 5.10-2](#)). Referring to [Figure 5.10-1](#), we find that at least 3 inches of R-19 mm asphalt concrete will be placed over either of these two bases.

5-10.303

SUBSTITUTION OF ASPHALT CONCRETE

If the total structural section depth determined with the use of [Figure 5.10-1](#) through [Figure 5.10-3](#) is undesirable, a deeper asphalt concrete section can be used in lieu of some or all of the aggregate base material at a rate of 1 inch of asphalt concrete for 3 inches of aggregate base material. The design for a minor collector street described in the example above could be changed to a 3-1/2-inch-deep asphalt concrete course over a 6-inch-deep base course. This reduces the structural section from 11-1/2 inches to 9-1/2 inches.

5-10.400

BASE COURSE FOR MAJOR STREETS

5-10.401

BASE COURSE DESIGN CHART

The base course depths listed in Figure 5.10-4 below are arranged in accordance with the street classifications and the R-values determined in the subgrade testing. The depths are determined by the procedures used for design of structural sections described in [Section 5-10.500](#). For a given street classification, the street with the heaviest current and projected traffic loading was used to determine the range of base course depths for all streets of that classification; therefore, the base course depths listed in this chart will provide conservative pavement designs.

Street Classification	R-Values										
	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 - 30	30 - 35	35 - 40	40 - 45	45 - 50	50+
Major Collector	26	24	22	20	18	16	14	12	11	10	9
Minor Arterial Major Arterials	29	27	25	23	20	18	16	14	12	10	9

FIGURE 5.10-4 MINIMUM DEPTH OF BASE COURSE

5-10.402

BASE COURSE SELECTION PROCEDURE

A base course depth is selected for a major street by finding the depth in inches for the appropriate street classification under the proper R-value range.

Example:

If a major collector street were built on subgrade soil with an R-value of 38, the base course would be 12 inches deep. According to [Figure 5.10-1](#), at least 5 inches of asphalt concrete must be laid over the base course.

SUBSTITUTION OF ASPHALT CONCRETE

5-10.403

If the total structural section depth determined with the use of [Figure 5.10-1](#) and [Figure 5.10-4](#) is undesirable, a deeper asphalt concrete section can be used in lieu of some or all of the aggregate base material at the rate of 1 inch of asphalt concrete for 3 inches of aggregate base material.

DESIGN OF STRUCTURAL SECTIONS

5-10.500

MODIFIED AASHTO DESIGN PROCEDURES FOR EXPRESSWAYS

5-10.501

The American Association of State Highway and Transportation Officials (AASHTO) published a guide for the design of pavement structures in 1961 and a revised guide in 1972. The Arizona Department of Transportation (ADOT) modified the procedures provided in the AASHTO design guide to meet requirements for the State of Arizona. The city of Phoenix uses the ADOT modified procedures and has selected certain design coefficients appropriate to the Phoenix metropolitan area. The City of Scottsdale also uses the ADOT-modified procedures with the city of Phoenix coefficients.

A. Assumptions

ADOT uses its own adoption of the procedures outlined in the “AASHTO Guide for Design of Pavement Structures” published in 1961 and revised in 1972. The following assumptions must be made:

1. The soil support capacity of the subgrade soils can be predicted adequately by testing to determine R-values.
2. The R-values can be effectively related to a soil-bearing capacity rating scale called the soil support value (SS).
3. A suitable pavement depth is determined by a procedure that considers the soil support value in conjunction with projected traffics loading, environmental conditions, and weighted structural values for the various components of the pavement structure.

DESIGN PARAMETERS

5-10.502

1. Soil Support Value

The soil support value represents the bearing capacity of the subgrade soil. It is determined by a relationship established between its scale and the R-value scale, as shown in [Figure 5.10-5](#). This relationship is not uniform throughout the country. ADOT has established the relationship determined by the following equation.

$$SS = 0.094R + 1.75$$

SS = Soil Support Value

R = R-Value

2. Serviceability Index

Serviceability Index is a number that represents the surface condition of roadway in terms of ride-ability, cracking, patching, and rutting at some point in its design life. It is used in the design equation to represent the theoretical loss of serviceability over the 20-year design period. **The Initial Serviceability Index is 5.0.** The Terminal Serviceability Index varies, depending upon the level of service desired. **Scottsdale uses a Terminal Serviceability Index of 2.5.**

R-Value	Soil Support Value	R-Value	Soil Support Value	R-Value	Soil Support Value
0	1.750	30	4.570	60	7.390
1	1.844	31	4.664	61	7.484
2	1.938	32	4.758	62	7.578
3	2.032	33	4.852	63	7.672
4	2.126	34	4.946	64	7.766
5	2.220	35	5.040	65	7.880
6	2.314	36	5.134	66	7.954
7	2.408	37	5.226	67	8.048
8	2.502	38	5.322	68	8.142
9	2.596	39	5.416	69	8.236
10	2.690	40	5.510	70	8.330
11	2.784	41	5.604	71	8.424
12	2.878	42	5.698	72	8.518
13	2.972	43	5.792	73	8.612
14	3.066	44	5.886	74	8.706
15	3.160	45	5.980	75	8.800
16	3.254	46	6.074	76	8.894
17	3.348	47	6.168	77	8.958
18	3.442	48	6.262	78	9.082
19	3.536	49	6.358	79	9.176
20	3.630	50	6.450	80	9.270
21	3.724	51	6.544	81	9.364
22	3.818	52	6.638	82	9.458
23	3.912	53	6.732	83	9.552
24	4.006	54	6.826	84	9.646
25	4.100	55	6.920	85	9.740
26	4.194	56	7.014	86	9.834
27	4.288	57	7.108	87	9.928
28	4.382	58	7.202	88+	10.000
29	4.476	59	7.296		

**FIGURE 5.10-5 ADOT MATERIAL SERVICES
R-VALUE & SOIL SUPPORT VALUE RELATIONSHIPS**

3. The Structural Number

The Structural Number is derived from an analysis of traffic, subgrade soil conditions, and environmental conditions, and is used in conjunction with structural layer coefficients (related to the type of material used in each layer) to calculate the thickness of a flexible pavement structure consisting of various flexible layers.

The following is the equation for the structural number developed from data accumulated by AASHTO:

$$SN = -1 \left[\frac{(10504)(W_t)^{0.10684}(R)^{0.10684}}{(10^{0.039714(SS-3)})(10^{0.10684(Gt/B)})} \right]$$

SN = Structural Number

W_t = Total 18,000 pound, single-axle loads

R = Regional Factor=1.0

SS = Soil Support Value

$$B = 0.40 + \left[\frac{(0.081 \cdot 19^{3.23})}{(SN+1)^{5.19}} \right]$$

$$Gt = \left[\frac{(P_o - P_t)}{(P_o - 1.5)} \right]$$

P_o = Initial Serviceability Index = 5.0

P_t = Terminal Serviceability Index = 2.5

Since "SN" appears on both sides of the equation, the solution can be most rapidly done by nomograph. Figure 5.10-6 is a nomograph developed by ADOT for this purpose, with a **Terminal Serviceability Index of 2.5** and a **Regional Factor of 1.0**.

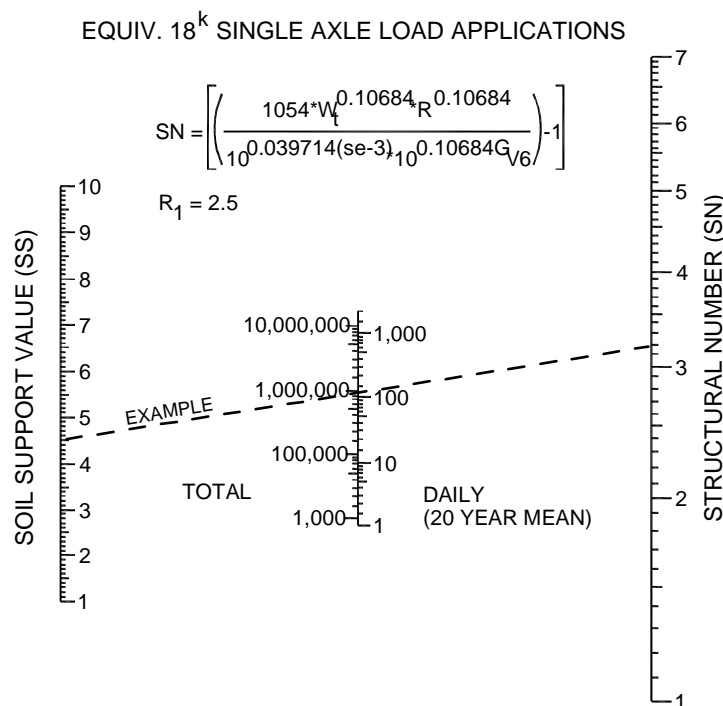


FIGURE 5.10-6 FLEXIBLE PAVEMENTS, 20-YEAR TRAFFIC ANALYSIS

Example:

Soil Support Value = 4.5

Equivalent 18^k single axle load app. daily (20 year mean) = 140

SN = 3.2

5-10.503

PROJECTED TRAFFIC LOADING

The Projected Traffic Loading is an equivalent daily application of 18,000-pound (18K) single-axle loads. All vehicle use data during a 20-year period of time must be converted to equivalent 18K single-axle load applications to use with [Figure 5.10-6](#). The load applications can be expressed either as a daily 20-year mean or as the total of the load applications applied over a 20-year mean, times 365, times 20. The data required consists of the following:

- Current Average Daily Trips (ADT) (traffic flowing in both directions)
- The 20th year ADT (traffic flowing in both directions)
- Percentage of each type of vehicle classification

The steps described below will provide the vehicle load information used in [Figure 5.10-6](#).

1. Average ADT in One Direction

Determine the average of the current ADT and the terminal year ADT, then divide by 2 to arrive at an average ADT in one direction. Express this quantity in terms of thousands of vehicles.

Example:

Current ADT = 19,500 vehicles

Terminal ADT = 33,000 vehicles

$$[(19.5+33.0) / 2] (0.5) = 13.125$$

2. Equivalent Single Axle Loads

Calculate the 18K equivalent single-axle load applications using the vehicle distribution percentages determined by a traffic survey and the 18K single-axle load for each type of vehicle listed in [Figure 5.10-7](#).

Notation	Type of Vehicle	18k Single-Axle Equiv. Per 1000 Vehicles
C	Passenger cars	0.8
B	Buses	250.0
2P	Light 4-tire trucks	1.2
2S	Heavy 4-tire trucks	5.8
2D	2-axle, 6-tire trucks	163.2
3D	3-axle trucks	598.7
2S1	2-axle tractor, 1-axle semi-trailer	408.2
2S2	2-axle tractor, 2-axle semi-trailer	956.5
3S2	3-axle tractor, 2-axle semi-trailer	514.3
2-2	2-axle truck, 2-axle semi-trailer	304.3
3-2	3-axle truck, 2-axle full trailer	936.8
3-3	3-axle truck, 3-axle full trailer	936.8
2S1-2	2-axle tractor, 1-axle semi-trailer, 2-axle full trailer	846.7
3S1-2	3-axle tractor, 1-axle semi-trailer, 2-axle full trailer	958.0

FIGURE 5.10-7 18K SINGLE-AXLE EQUIVALENT LOADS BY TYPE OF VEHICLE

Example:

If commercial vehicles make up 23.9% of all vehicles using the roadway, heavy four-tire trucks (Type 2S) make up 18.3% of all commercial vehicles, and the Type 2S 18K single-axle equivalent per 1,000 vehicles is 5.8, as indicated in [Figure 5.10-7](#), then the load application for this type of vehicle per 1,000 vehicles is:

$$(0.239)(0.183)(5.8) = 0.254$$

3. 20-Year Mean

The sum of all such loads is the equivalent 18K single-axle load per 1,000 vehicles traveling the road. This sum must be multiplied by the average ADT for traffic in one direction calculated above in Step 1. The result of this multiplication is the number of daily, 20-year mean, equivalent 18K single-axle loads produced by traffic moving in one direction.

4. Lane Load

For streets with more than one lane in each direction, multiply the load calculated in Step 3 above by the following appropriate factor to calculate the design lane load:

- If the street is to have 2 lanes in each direction, multiply the number of equivalent 18K single-axle loads by 0.90 to arrive at a design lane equivalent 18K single-axle loading.
- If the street is to have 3 lanes in each direction, multiply the number of equivalent 18K single-axle loads by 0.70 to arrive at a design lane equivalent 18K single-axle loading.

The calculations described above provide the number of daily equivalent 18K single-axle (20-year mean) loads to be used in [Figure 5.10-6](#).

REGIONAL FACTOR

The Regional Factor is used to adjust the Structural Number for climatic and environmental conditions different from those of the AASHTO road test site. The Regional Factor is 1.0. The nomograph shown on [Figure 5.10-6](#) is an abbreviated form of the nomograph prepared by ADOT; no adjustment of the Structural Number for regional conditions is needed.

STRUCTURAL COEFFICIENTS

The components of the pavement structure are assigned structural coefficients to be used with the structural number in developing the design of pavement section. The coefficients shown below were developed by the city of Phoenix from experience, tests, and correlation with information in ADOT design manuals and MAG Specifications.

Local Pavement Component	ADOT Range	Local Coefficient
Asphaltic Concrete (plant mix)	0.34 to 0.46	0.39
Bituminous Treated Base	0.30 to 0.35	0.31
Cement Treated Base*	0.15 to 0.29	0.23
Aggregate Base	0.08 to 0.14	0.12
Select Material	0.05 to 0.12	0.11

*The Cement Treated Base coefficient is for plant mix. If a road mix is used, the percentage of cement to be used must be increased by 0.5%.

FIGURE 5.10-8 STRUCTURAL COEFFICIENTS

5-10.504

5-10.505

5-10.506

THE DESIGN PROCEDURE

1. Determine the Structural Number (SN) for the pavement to be designed, using the following method:
 - a. Determine the R-values by testing and select an R-value for the design, using the formula found in [Section 5-10.502\(1\)](#).
 - b. Calculate the equivalent 18K single-axle load application for the length of the street for which the pavement design is required, using the calculation described in [Section 5-10.503](#).
 - c. Using the Soil Support Value obtained in Step 1-a above, plot that value on the Soil Support Value Scale in [Figure 5.10-6](#).
 - d. Using the equivalent 18K single-axle, 20-year load total or the daily, 20-year mean traffic loading data obtained in Step 1-b above, plot the traffic load on the appropriate scale on [Figure 5.10-6](#).
 - e. Draw a straight line from the point plotted on the Soil Support Value Scale of [Figure 5.10-6](#) through the point plotted on the equivalent 18K single-axle load scale until it intersects the Structural Number Scale. Use the Structural Number that can be read at its intersection for the pavement design.
2. Use the Structural Number to calculate the thickness of the structural components with the following equation:

$$C1D1 + C2C2 + C3D3...CNDN = SN$$

C1,C2,C3 = Structural Coefficient (from [Section 5-10.505](#))

D1,D2,D3...= Thickness of Component

Example:

From [Section 5-10.505](#), we find that the structural coefficients are 0.39 for the asphaltic concrete, 0.12 for the ABC and 0.11 for the select material. The calculation of the thickness of the select material (SM) is accomplished in the following manner:

$$C1D1 + C2D2 + C3D3 = SN$$

$$(0.39)(5)+(0.12)(4)+(0.11)(SM) = 3.2$$

Solving for SM and rounding off to the nearest inch:

$$SM = 7.0 \text{ inches}$$