Complete Transportation

G U I D E B O O K

ADOT

FEBRUARY 2016

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Chapter 1: Overview

The Complete Transportation Guidebook is a reference tool for integrating sustainable practices into transportation planning, scoping, and design throughout the Arizona Department of Transportation (ADOT) project development process. ADOT understands how transportation infrastructure shapes our communities and quality of life. The Guidebook provides strategies and techniques for identifying transportation choices that provide mobility to connect communities and economic opportunity to maximize a limited set of resources, time, and money.

Transportation is not just about moving vehicles, but also about moving people—leveraging their modal choices, connecting goods and markets, and building infrastructure that complements the natural and built environments. ADOT defines transportation solutions that meet these objectives as complete transportation.

The Guidebook is designed to complement existing ADOT initiatives, processes, and standards that guide technical and operational areas. ADOT laid the groundwork for complete transportation with the Building a Quality Arizona (bqAZ) 2010 Statewide Transportation Planning Framework (ADOT 2010). The bqAZ initiative established a vision for linking transportation with land use, the economy, and the natural environment. ADOT further advances this vision by implementing an approach to planning and designing transportation facilities that considers all users—freight transporters, motorists, bicyclists, pedestrians, and transit.

Complete transportation aims to help ADOT and the state transportation system "work smarter, not harder." Transportation facilities that support economic opportunities, community values, and system user goals are sustainable facilities. Working smarter extends resources by considering a broader range of solutions and modal choices as well as the environment, land use, and economic vitality.

This Guidebook presents a set of strategies and tools to improve the Arizona transportation system's level of sustainability. It draws on transportation practices such as complete streets, context-sensitive design, land use integration, and green infrastructure. Opportunities for implementing these practices are identified by exploring the following essential questions:

What is complete transportation?

Why should we invest in it?

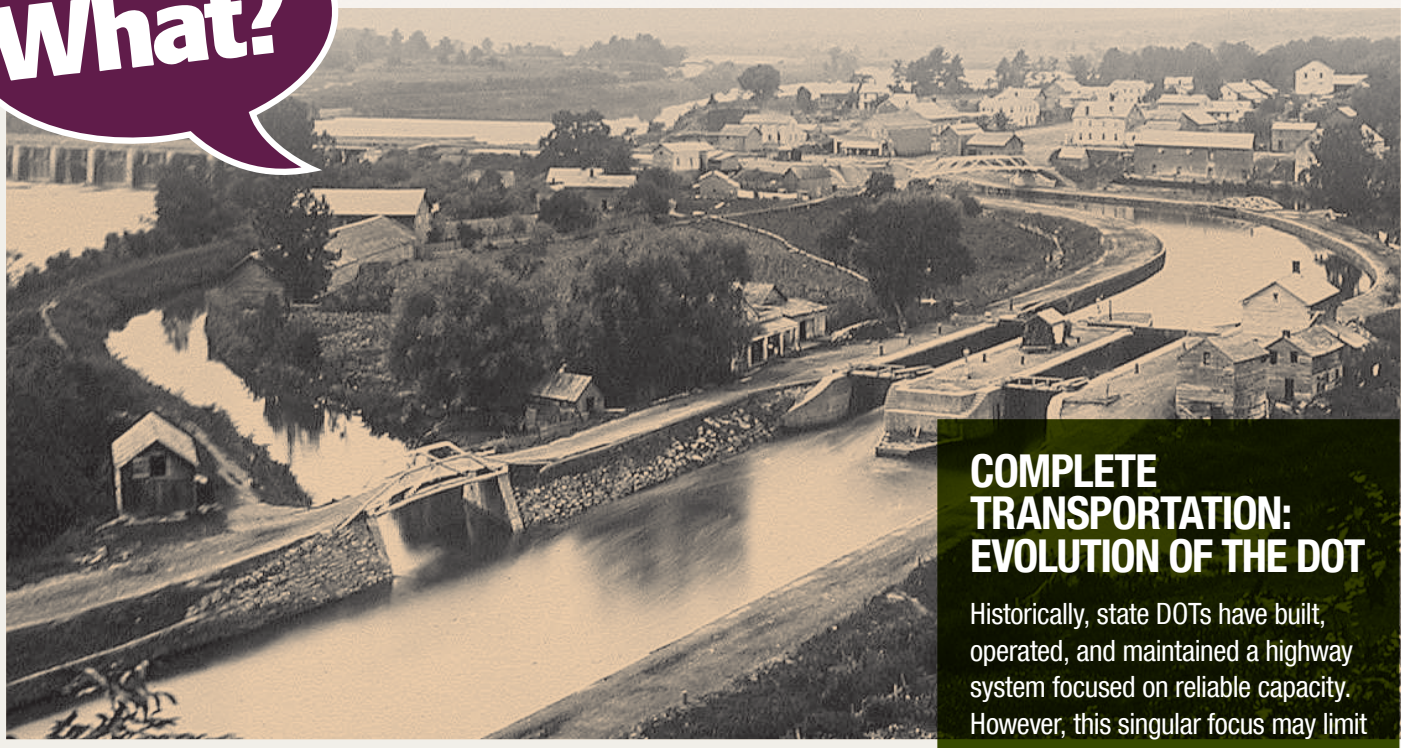
How do I plan/design/build complete transportation solutions?

When should I apply complete transportation concepts?

The chapters that follow detail specific concepts, strategies, and tools for incorporating complete transportation elements into the analyses, decisions, and designs of project development.

What?

WHAT IS COMPLETE TRANSPORTATION?



Since cities were first built on accessible waterways and trade routes, people have long understood the relationship between transportation, economy, and environment. How and why people travel from place to place influences what is developed and where. While our communities often reflect the natural environment, they are absolutely shaped by transportation choices, both natural and built. Transportation is not an end in itself—it provides the means to participate in the economy and to efficiently use our natural resources. It serves as an organizing network for our built environment.

Complete—or "sustainable"—transportation has been broadly defined as "effective and efficient system performance, with positive impacts on the triple-bottom-line goals of social quality of life, economic competitiveness, and the preservation of the natural environment" (FHWA 2011). Today, many DOTs, including ADOT, are analyzing transportation investments using this triple-bottom-line framework.

Evaluating transportation choices according to the objectives of sustainability means considering solutions that support multiple goals and objectives, including those of ADOT, system users, and communities. It can also help direct and prioritize investments that:

- Optimize performance of existing infrastructure.
- Enhance mobility choices, safety, and economic opportunities for all users.
- Support public priorities such as community and the environment.

The triple bottom line is illustrated in Figure 1 on the following page (AASHTO 2009).

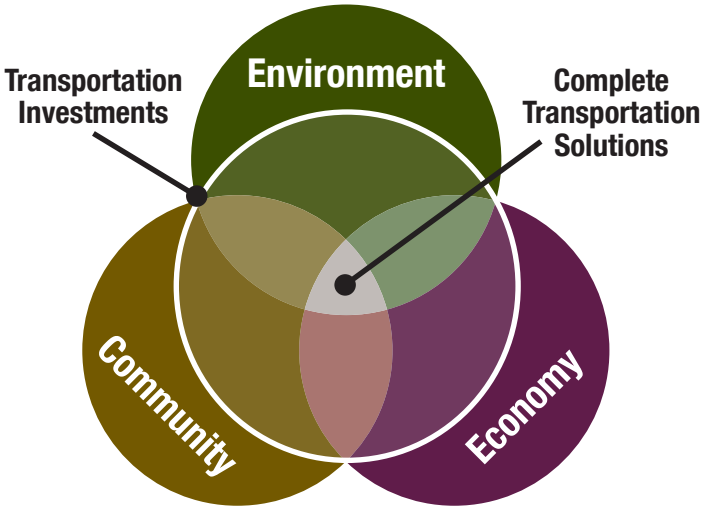
COMPLETE TRANSPORTATION: EVOLUTION OF THE DOT

Historically, state DOTs have built, operated, and maintained a highway system focused on reliable capacity. However, this singular focus may limit opportunities to address Arizona's transportation needs and ability to compete in a connected economy.

From initial public funding commitments for transportation infrastructure, state DOTs were created to manage a road building program connecting farms to markets and people to jobs. This initial mission was especially focused on roadways during the interstate era, when a highway network was considered a means of national mobility and defense.

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) was a turning point in transportation policy. One of its main goals was to develop a "National Intermodal Transportation System that is economically efficient and environmentally sound, provides for the nation to compete in the global economy, and will move people and goods in an energy-efficient manner." This act launched a new post-interstate era by concentrating on intermodal solutions, flexibility, innovation, and collaboration.

Figure 1: Triple-bottom-line benefits



COMPLETE TRANSPORTATION SOLUTIONS help direct transportation system investments to consider a range of public priorities, including economic prosperity, environmental stewardship, and community values.

Economy: Support economic vitality while developing infrastructure in a cost-efficient manner. The cost of infrastructure must be within a society's ability and willingness to pay.

Environment: Create solutions that are compatible with and can enhance the natural environment, reduce transportation system emissions and pollution, and diminish the material resources required to support transportation.

Community: Meet social needs by making transportation accessible, safe, and secure; include mobility choices for all users (including the economically disadvantaged); contribute to community health and well-being; and develop infrastructure that is an asset to communities.

RELATIONSHIP TO OTHER INITIATIVES

In December 1991, the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) was signed into law, providing authorizations for highways, highway safety, and mass transit. Additional initiatives have supported and built on ISTEA's goals. In 1998, the American Association of State Highway and Transportation Officials (AASHTO) and FHWA introduced Context-Sensitive Design, which evolved into Context-Sensitive Solutions (CSS). CSS (Figure 2A) aims to develop transportation facilities that fit the physical setting and preserve historic and environmental resources while maintaining safety and mobility. It focuses on flexible design to minimize impacts to the specific context of the location.

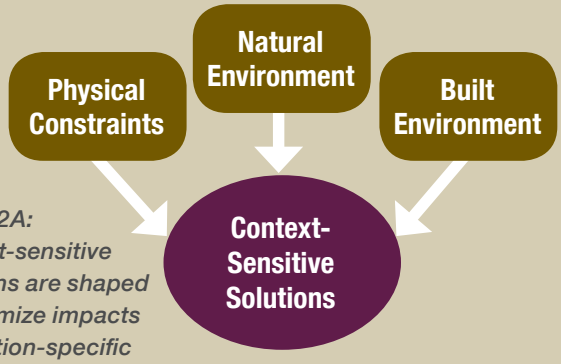


Figure 2A: Context-sensitive solutions are shaped to minimize impacts to location-specific context

A second wave of initiatives, including complete streets and living streets, originated outside the federal DOT realm. These initiatives built upon CSS to encourage modal and network connectivity in support of community goals.

Each of these initiatives recognizes the interdependence of our transportation choices, community character and land use, the environment, and economic opportunity (Figure 2B). This Guidebook provides an approach for ADOT to balance these elements in developing transportation solutions.

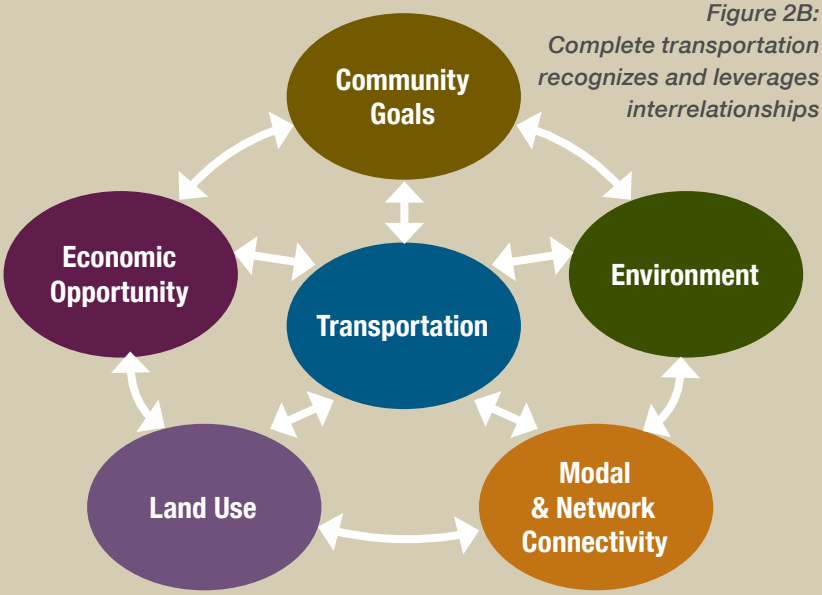


Figure 2B: Complete transportation recognizes and leverages interrelationships

WHY SHOULD WE INVEST IN IT?

NEW CHALLENGES REQUIRE NEW SOLUTIONS

Today's economic and demographic trends point to an increasing public demand for mobility options, accessible land use, and a more comprehensive and sustainable transportation network. Fiscal challenges also require new approaches to effectively and efficiently use resources.

Funding Challenges

Like many states, Arizona faces significant transportation funding challenges. The 25-year needs identified in ADOT's long-range plan total $88.9 billion. Baseline revenues to meet these needs are projected to be $26.2 billion from Fiscal Year 2010 to Fiscal Year 2035, yielding a $62.7 billion funding gap in revenues under ADOT control (ADOT 2011b).

The real value of the federal gas tax, which funds a significant portion of ADOT spending, has fallen each year. Inflation has eroded the value of the collected funds. Arizona's gas tax of 19 cents per gallon has not been increased in 22 years and today represents a buying power of just 11 cents when adjusted for inflation. Arizona will need to find ways to do more with less.

Population

Now exceeding 6.6 million, Arizona's population continues to grow and is projected to increase to more than 11 million by 2035. Two-thirds of the development that will be on the ground in 2050 to accommodate this growth has yet to be built (ADOT 2010). This presents an opportunity for ADOT and local communities to shape future growth and development.

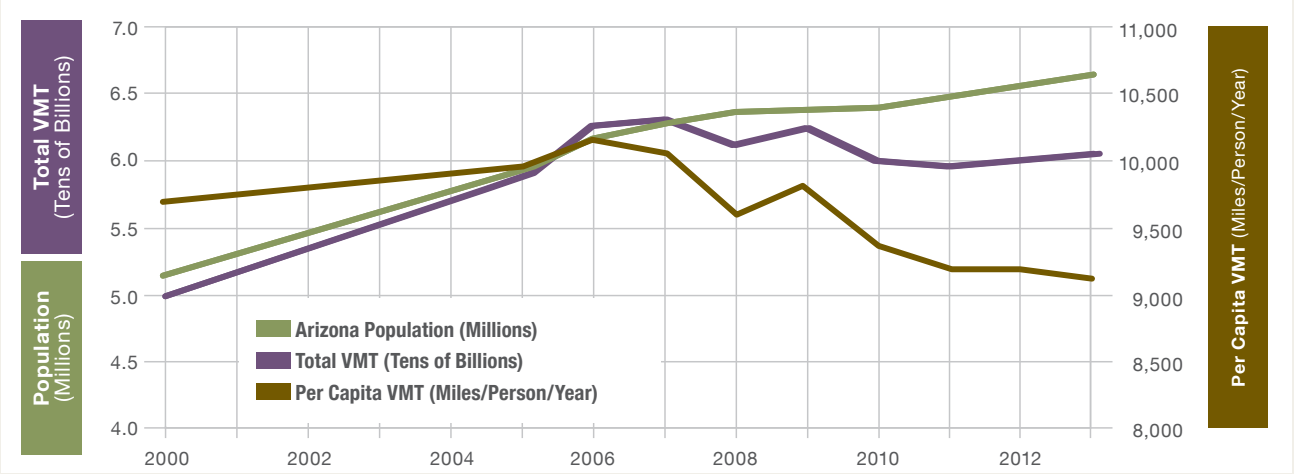
Evolving Travel Preferences

Vehicle miles traveled (VMT), both per capita and in total, rose steadily for decades in Arizona and in the United States as a whole. State DOTs responded by expanding the vehicle capacity of roadway systems.

Nationally, total VMT peaked in 2007 and then declined, largely due to economic recession. Per capita VMT has also declined sharply since the mid-2000s and, notably, has yet to increase even as the economy has recovered. Recent data indicate a potential trend toward less driving.

Similar patterns have held true in Arizona. Total VMT grew by over 25% from 2000 until a peak in 2007 of 63 billion miles traveled (Figure 3). However, despite continued population growth since 2007, total VMT has declined by approximately 4% and per capita VMT by over 9%. These trends are significant, particularly in urban areas, and may point to changing demographics, shifts to other modes of transportation, increased use of mobile technologies, and a rising preference for mixed-use neighborhoods—all of which reduce the need for driving.

Figure 3: Trends in Arizona population and annual vehicle miles traveled (VMT)



Sources: Arizona Motor Vehicle Crash Facts 2014 (ADOT 2015a); state and U.S. population data (ADOA 2009; U.S. Census Bureau 2013).

BENEFITS OF COMPLETE TRANSPORTATION

Household Transportation Costs

The average American commuter spends 25 minutes commuting one way to work each day (U.S. Census Bureau 2014b). Households in auto-dependent locations spend 25% of their income on transportation costs, whereas those who live near employment, shopping, and other amenities spend only 9% (FHWA 2014c).

Communities with greater access to services and jobs, walkable destinations, and transportation choices have lower household transportation costs, which frees up resources to meet other needs (FHWA 2014c). As illustrated in Figure 4, the annual cost of vehicle ownership is significantly more than the cost of an annual transit pass or purchasing and maintaining a bicycle.

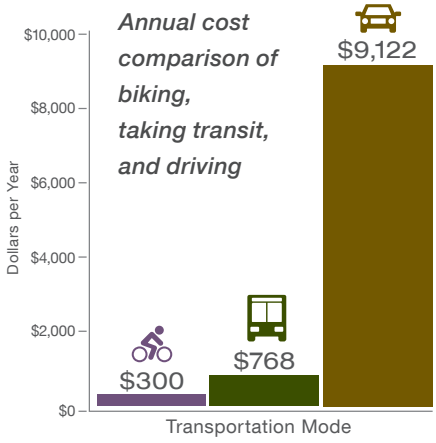


Figure 4: Annual cost comparison of biking, taking transit, and driving

Sources:

Bicycle costs: Victoria Transport Policy Institute (VTPI 2013).

Transit costs: Based on an annual transit pass costs in Flagstaff, Phoenix, Sierra Vista, Tucson, and Yuma.

Automobile costs: AAA (AAA 2013).

Land Use Integration

Historically, DOTs addressed roadway congestion and met travel demand by expanding roadway capacity (Figure 5). However, development often adds traffic faster than roadway capacity can be increased. Wider and faster roads alone will not solve the problem.

While expanding roadway capacity remains a viable option under the right circumstances, complete transportation both manages capacity and improves the efficiency of the system as a whole by integrating land use decisions with transportation planning. This culminates in responsible land use decisions that yield multimodal options and roadway designs, promote local and regional mobility, provide access to homes and businesses, and support economic growth.

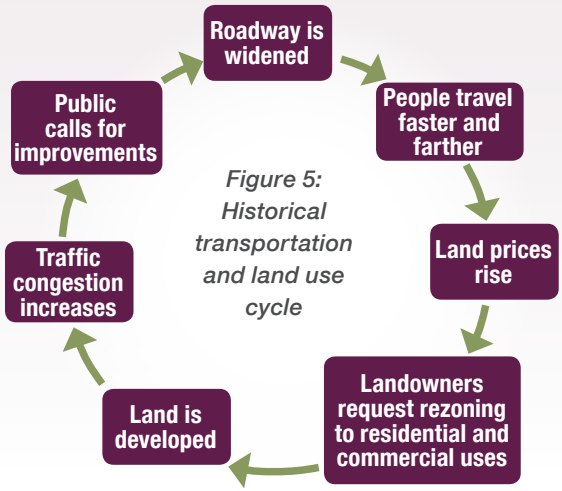


Figure 5: Historical transportation and land use cycle

Road Safety

In Arizona in 2014, crashes involving pedestrians and bicyclists accounted for just 3% of all crashes, but over 20% of all fatalities (ADOT 2015a). Designing streets with speed limits in accordance with the human-scale context, reducing roadway widths, or narrowing travel lanes to minimize pedestrian crossing distance can result in fewer and less severe crashes. Roadway design elements such as signalized pedestrian crossings, raised medians, and pedestrian crossing islands also respond to the needs of the community, help facilitate mobility for all users, and improve safety.

Environmental Impacts

Motor vehicle emissions contribute to 53,000 premature deaths each year in the United States (Caiazzo et al. 2013). Communities that provide transportation options that are closer to services have lower driving rates, which lessens air pollution. By designing communities that reduce traffic and encourage walking and bicycling, planners can help mitigate these environmental impacts. The complete transportation approach also focuses on construction practices that minimize impacts to the environment. Examples include the use of recycled materials and dust and noise mitigation efforts.

Healthy Communities

In Arizona, nearly 1.2 million adults are physically inactive and 1.4 million are obese. Since 1990, the percentage of obese residents has increased from 10.8% to 26% of Arizona's population (United Health Foundation 2014). Less than half of Americans get the daily recommended amount of exercise. By contrast, people who take public transportation log 19 minutes daily walking to and from transit; 29% achieve greater than 30 minutes of physical activity a day solely by walking to and from transit (Besser and Dannenberg 2005). Complete transportation solutions may include transit, and also encourage everyday physical activities such as walking and bicycling. The complete transportation approach helps create active places in communities, preserving the natural beauty of the environment and enhancing quality of life. These features attract tourism and additional investments that support a healthy economy.

WHEN DO I START?

ADOT's approach to complete transportation considers the entire range of potential solutions available at each phase of project development. Potential solutions, though, are inherently tied to the time required to implement them. With this in mind, applying complete transportation strategies early in the project development process allows more time to consider their value, context, and potential solutions.

For example, the range of solutions that can be explored during long-range planning is much broader than during design (Figure 6). Solutions presented during the planning phase offer opportunities to influence land use, network connectivity, and other alternatives. Conversely, solutions that require decisions made at the planning level are usually not available during design.

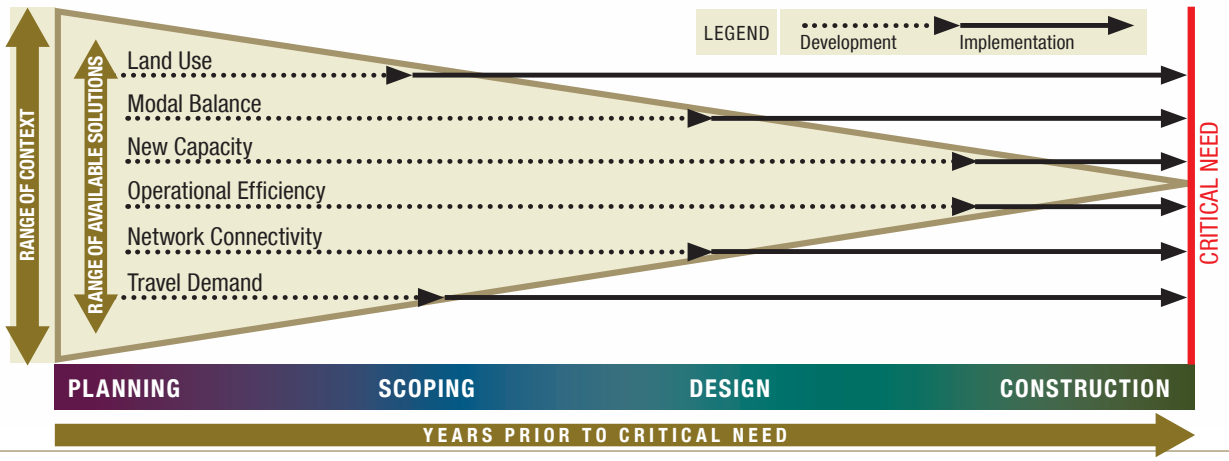
However, complete transportation design choices can build on planning and scoping decisions to provide specific project features that meet the transportation needs and support the triple bottom line.

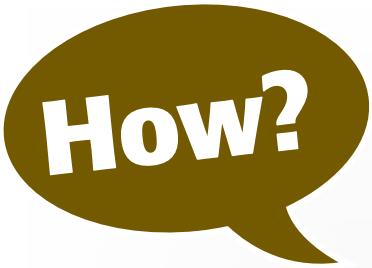
EXAMPLE PROJECT: SR 179 IMPROVEMENTS *SEDONA, ARIZONA*

The State Route 179 improvements culminating in 2010 were the result of a partnership among local businesses, environmental community advocates, local governments, and the state. The primary goal was to maintain the visual character of this important international destination and economic engine while improving roadway safety, reducing vehicular congestion, providing travel options and reliable roadway travel times for commuters, and enhancing access to local businesses. To achieve these objectives, ADOT adopted a flexible approach to planning, design, and construction in working with environmental, business, bicycle, residential, and jurisdictional stakeholders. The public was consulted through a variety of formats including interviews, charrettes, forums, and a telephone hotline. Agency stakeholders included FHWA, Yavapai County, Coconino National Forest, city of Sedona, and Coconino County—all of whom were consulted extensively during design. ADOT used an innovative approach called a needs-based implementation plan to strategize improvements along SR 179. This was subsequently highlighted as a national model and showcased on FHWA's CSS website (FHWA 2005).

This process yielded a two-lane road with roundabouts at intersections, a raised median, left-turn lanes, and shoulders. Sidewalks run the full length of the project, which also includes marked crosswalks and transit stops. Relatively narrow roadway sections minimize the impact on scenic areas and natural resources. Pull-off areas support tourism. Access through local commercial areas was enhanced, increasing local revenues and supporting local businesses.

Figure 6: Complete transportation approach





HOW DO I PLAN/DESIGN/BUILD COMPLETE TRANSPORTATION?

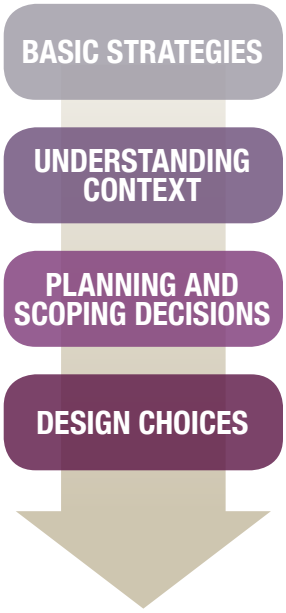
At its core, complete transportation challenges us to examine the context and conditions of any investment decision from the perspectives of all users of the transportation system. The analysis should consider:

- How context may change over time.
- How transportation choices may impact or support community goals and public priorities.
- Solutions that consider the safety and mobility of people, not just vehicles.

To meet this challenge, ADOT has developed seven core strategies. Applied consistently and throughout the project development process, these seven strategies represent a complete transportation approach to project development. The added perspectives and insights gained from following a complete transportation approach help identify solutions that optimize existing infrastructure, manage transportation demand and distribute it across modes, and add capacity. The seven strategies are:

- Understand the context.
- Establish and cultivate partnerships.
- Define wide-ranging measures of success.
- Establish a full spectrum of project needs and objectives.
- Consider a full set of alternatives.
- Plan for all users and modes of travel.
- Exercise available flexibility in design.

WHAT'S NEXT?



Chapter 2 describes seven core strategies for implementing a complete transportation approach. The content focuses on the benefits and application of the strategies through each phase of the ADOT project development process.

Chapter 3 explores the importance of the context in which a transportation facility operates, and defines context types specific to Arizona.

Chapter 4 discusses the integration of complete transportation concepts into ADOT's existing planning and scoping processes. Critical decisions are made during these early phases of project development that impact the choices and solutions available in later phases. Thus, applying the seven strategies beginning with planning and scoping provides the best opportunity to realize the benefits of complete transportation.

Chapter 5 provides guidance when considering the design choices available in a complete transportation approach during the planning, scoping and design of transportation improvement projects. The flexibility in existing ADOT and federal design guidelines is used to illustrate available choices.

Where Should I Start?

The Guidebook is designed to apply to a wide range of users. The seven strategies and an understanding of context in Chapters 2 and 3 build a foundation and establish a common language for complete transportation. The design guidance in Chapter 5 may hold particular interest for ADOT design teams, but these details are often decided in the planning and scoping of projects. Similarly, planners must be aware of the design choices provided through the flexibility of design guidelines.

Core to the success of complete transportation is an understanding that today's planning decisions impact tomorrow's project design, just as projects built today impact future land use and the needs of tomorrow.

FOR MORE INFORMATION

In preparing this Guidebook, ADOT conducted a review of best practices, technical approaches, and complementary processes from ADOT and national sources. These information references were numerous and were used extensively in developing the Guidebook. While not an intended as an exhaustive reference listing, the list below provides a basic toolbox of resources that may be helpful in understanding and applying the concepts presented in this Complete Transportation Guidebook.

For a complete list of reference materials cited throughout the Guidebook, see the References section on page 85.

External Resources

"Coordinating Land Use and Transportation: What Is the Role of Transportation?" FHWA, 2013c
http://www.fhwa.dot.gov/planning/processes/land_use/

A Guide to Transportation Decisionmaking, FHWA and FTA, 2015
http://www.planning.dot.gov/documents/GuidetoTransportationDecisionmaking.pdf

Corridor Approaches to Integrating Transportation and Land Use, NCHRP Project 8-36, 2009
http://onlinepubs.trb.org/onlinepubs/archive/notesdocs/NCHRP08-36(86)_FR.pdf

Urban Street Design Guide, NACTO, 2013
http://nacto.org/publication/urban-street-design-guide/

What is FHWA's perspective on NACTO's Urban Street Design Guide?

NACTO's Urban Street Design Guide provides sample scenarios that build on the flexibilities in the AASHTO Policy on Geometric Design of Highways and Streets, Guide for the Planning, Design, and Operation of Pedestrian Facilities and Guide for the Development of Bicycle Facilities. The Urban Street Design Guide can be used to inform the planning and design process in conjunction with these other resources. FHWA distributed copies of the Urban Street Design Guide to all of our Division and Federal Lands Highway Offices in fall 2013. It can serve as an additional resource as communities plan and design facilities for all modes of travel. FHWA supports the use of the Urban Street Design Guide in conjunction with the other resources cited above in the process of developing nonmotorized transportation networks.

Reference: FHWA 2014a

ADOT Process Guidelines

- Roadway Design Guidelines
- Design Exception and Design Variance Process Guide
- Project Scoping Document Guidelines

Chapter 2: Complete Transportation Strategies

ADOT's goal is to provide a safe, efficient, and dependable multimodal transportation system that enables communities to grow and prosper; facilitates commerce, job access, and economic development; accommodates the needs of all roadway users; and enhances communities' quality of life.

ADOT has developed seven core strategies for creating complete transportation solutions (Figure 7). Employing these seven strategies is key to achieving ADOT's goal. These strategies can help ADOT develop projects that are responsive to both statewide mobility and local community needs.

Figure 7: Seven core strategies for complete transportation

The seven strategies can be applied from planning through design and construction, and are not necessarily sequential and discrete steps. The greatest benefits can be achieved when the strategies are applied as an interrelated decision-making tool for long-term project planning, scoping, and design.

This chapter summarizes the seven complete transportation strategies and their application to each phase of the project development process (Figure 8). Chapters 4 and 5 provide more detail on applying the strategies in planning, scoping, and design.

This Guidebook is intended to complement existing ADOT policies. Several of the seven complete transportation strategies, and elements of all of them, are already ADOT practice. Application of the seven strategies provides additional information to help planning, scoping, and design teams exercise the flexibility inherent in existing ADOT guidance.

For each core strategy, considerations are presented to help identify and capitalize on opportunities to create more holistic, context-sensitive, and community-strengthening projects. The considerations are not intended to address every situation or condition, but represent a solid starting point for a complete transportation approach.

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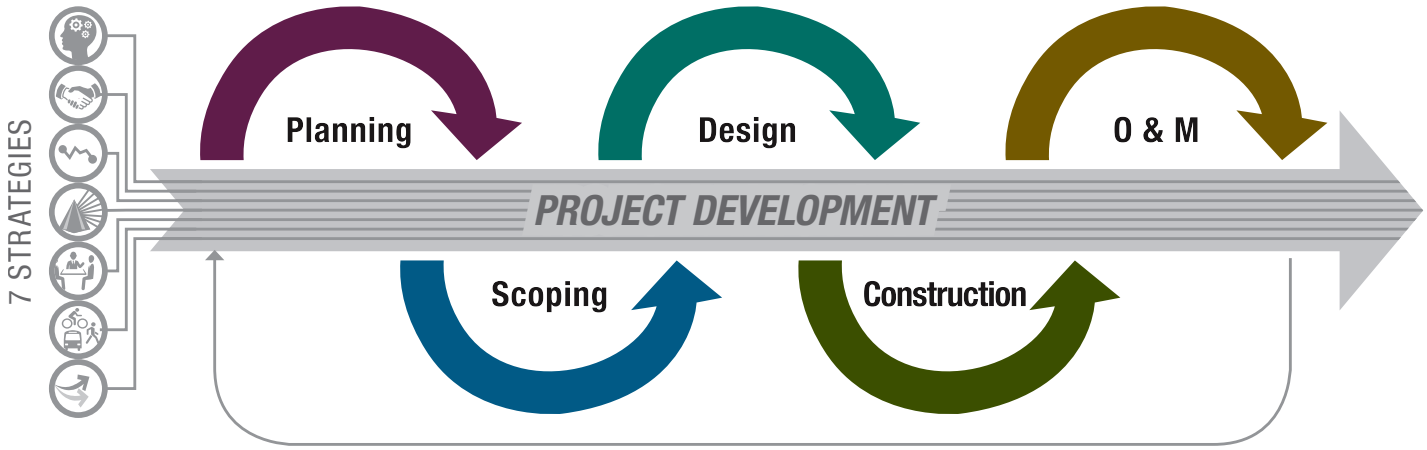


Figure 8: Complete transportation strategies are applied throughout project development. The decisions made in each phase impact the next phase.

ADOT'S PROJECT DEVELOPMENT PHASES

ADOT's project development phases consist of planning, scoping, design, construction, and operations and maintenance. The planning and scoping phases initiate, shape, and define the projects funded within ADOT's Transportation Facilities Construction Program, and provide the greatest opportunity to impact the nature and quality of projects that are ultimately constructed.

Though the project development phases are often depicted as separate steps, each phase represents its own decision-making cycle. These interrelated cycles shape future transportation investment choices. The construction, operations, and maintenance decisions of today impact tomorrow's planning and scoping decisions.

These cycles also vary in their lead time. The planning process may be initiated 15 to 30 years in advance of construction, while projects beginning construction deliver specific solutions within more immediate time frames.

As demonstrated in Figure 6 of Chapter 1, the early stages of project development offer the widest range of potential solutions, and the greatest opportunity to identify and define solutions that are consistent with complete transportation goals and objectives. Planning-level decisions consider a broad range of elements, which may point to a regional strategy or network solution rather than a single construction project. A complete transportation approach during the planning phase considers solutions that could expand highway infrastructure, reduce travel demand, or provide access to other modes or network connections. These solutions focus on personal mobility and connections to economic and community activity.

Strategy: Understand the context (also see Chapter 3)

Understanding the context of a project is fundamental to complete transportation. For a state highway project, "context" has traditionally meant the setting through which the road travels.

Context

The interrelated conditions in which something exists or occurs

(Merriam-Webster Dictionary)

A complete transportation approach reexamines this concept and more broadly defines context by considering the interrelated conditions of the physical environment through which the road travels as well as the road's varying uses, community goals, and political and economic priorities. A singular project or highway route also exists within the larger context of a multimodal transportation system that supports statewide mobility, promotes the safety of users, and connects the diverse communities of Arizona.

By fully understanding the interrelated contextual needs and conditions and their relationship to one another, we can develop sustainable solutions to support the communities that the roads serve. The relationship between land use, travel demand, and capacity is an example of interrelated highway needs and conditions. When evaluating contextual conditions such as modal preference, factors for supporting economic growth, or community goals, the relationships between competing needs and conditions may grow more complex.

It is imperative to apply this strategy during the early steps of project development. The range of context conditions and relationships that can positively impact planning decisions is much greater than those that can be effectively applied to tailor the final design of improvements.

The scope and scale of context considerations should be matched to the appropriate project development step. For example, land use or evolving demographics may provide relevant information during planning, but is likely not valuable to a scoped and programmed project.

Figure 9 illustrates context conditions related to transportation needs and the triple bottom line. Context is more fully explored in Chapter 3, which provides a framework of context types for interrelated conditions during the later phases of project development.

3 THINGS TO REMEMBER

- Context is about conditions and their interrelationships.
- Understanding context can provide more effective and sustainable solutions.
- The scope and scale of context considerations should be appropriate for the phase of project development.

Figure 9: Understanding the context

Transportation Needs and Investment Considerations

What are the primary purposes of the roadway?
Who will the roadway serve in the future?
Is the community primarily auto-dependent or multimodal?

DATA SOURCES
- Transportation master plans
- Bicycle and pedestrian master plans

Economy

Is the community population growing, stable, or declining?

What are the current economic drivers? Tourism, industry, seasonal?

Are growth plans aggressive with a record of success?

Have recent drivers been added to the economy? New industry or activity that impacts transportation?

Environment

What do plans and studies tell us about environmental resources within the project?

What natural resources are in the project area? Which require specific attention? What is the climate? Are there scenic vistas or other unique resources?

What are the specific characteristics of the built environment? Are there considerations for the specific needs and uses of the adjacent residents?

Community

What do we know and understand about the community's values?

What is the area's general character? Consider the elements the community places value on. How do they present themselves?

What are the current and future land use contexts of the roadway or corridor?

What are the anticipated land uses in a 5-year period? 10-year period? 20-year period?

Is land use consistent throughout the corridor?

Is the project in an activity center, suburban or rural area, or open space? (See Chapter 3 for more detail.)

Understanding the Context: Potential Data Sources

◆ Economic development plans ◆ Main street redevelopment plans ◆ Tourism plans ◆ Chamber of Commerce, Economic Development Council	◆ Conservation plans ◆ NEPA documents (e.g., Purpose and Need) ◆ Air quality plans ◆ Open space plans ◆ Arizona Game & Fish wildlife studies and maps	◆ Local and regional land use plans and maps ◆ General and comprehensive plans ◆ Community websites ◆ Historic district documentation ◆ Recreation master plan ◆ Community Health Improvement Plans	Planning
◆ Access management plans	◆ NEPA documents	◆ Landscape requirements ◆ Trails plan, pedestrian and bicycle plans, parks and open space plan	Scoping
◆ Development plans	◆ Green infrastructure design standards	◆ Landscape design standards	Design

Strategy: Establish and cultivate partnerships

If a full understanding of context is the foundation on which complete transportation is built, then strong partnerships represent the currency that moves the project forward.

A complete transportation approach leverages partnerships to offer flexible solutions, enhanced value to users, and/or reduced or shared project costs. Successful partnerships increase public support for ADOT and other agencies, foster mutual trust, and improve communication.

Complete transportation solutions are possible only through partnerships. Complete transportation projects require partnerships between local municipalities, regional planning organizations, and state and federal transportation and resource agencies. Partnerships begin during planning and continue throughout project design and construction, and may continue into operations and maintenance. Partnerships that openly discuss the roles and functions of the state highway within a community can proactively resolve potential conflicts and foster an environment of collaboration and accountability.

Effective partnerships also recognize specific roles and responsibilities. These are defined to share understanding, not limit results. Local government (LGA)or other agreements may be used to document the relationship and its purpose. An LGA can help bridge the gap between policy and community needs.

ADOT is responsible for providing a transportation system that meets statewide mobility needs. ADOT's partnership commitment should include working with local jurisdictions to develop and evaluate alternative strategies that meet state mobility needs and achieve local goals and objectives.

A local agency's partnership commitment may consist of supporting land use plans and local street networks that can reduce local trips on the state highway system. When ADOT and local agencies partner, land use planning and transportation planning integrate to focus on the overall transportation network rather than on a single roadway.

Partnering can also create opportunities to cultivate mutually beneficial relationships that help ADOT move projects forward. For example, incorporating complete transportation design features into projects may result in new funding partners. A local employment center may be willing to help with project funding if design options, such as improved pedestrian or transit access, benefit its customers. Health organizations may be financial partners for project elements related to health benefits.

One of the most effective ways to forge partnerships is to actively engage partners and apply complete transportation strategies together. Shared insights and effort to characterize the context, define project goals, and develop solutions builds the relationships and trust required for effective partnerships.

ADOT project managers should identify and engage potential project partners during the planning and scoping phases and strive to understand their needs as early as possible. In doing so, ADOT can gain a full understanding of wide-ranging issues and establish project objectives and goals that reflect ADOT, stakeholder, and partner needs (Figure 10).

Partnerships provide ongoing benefits from planning through construction and maintenance. Opportunities to engage partners include:

- Project kickoff meetings to set goals
- Needs identification workshops
- Alternatives analysis criteria development
- Project scoping meetings
- Design progress meetings

Cultivating partnerships requires more active involvement than just information sharing. Opportunities like those listed above allow partners to share actions or commitments that can shape more effective or sustainable solutions. Partners must be willing to allow their actions to be influenced by each other.

3 THINGS TO REMEMBER

- Complete transportation solutions are possible only through partnerships.
- Partnerships provide multiple benefits to ADOT, local communities, and system users.
- Partnerships are forged through engagement of willing partners in applying the seven strategies.

Figure 10: Establish and cultivate partnerships

Strategy: Define wide-ranging measures of success

Defining measures of success is a process for setting goals for a project. It describes what success looks like. The process is focused on translating aspirational statements into specific descriptions of what a successful project would accomplish and providing a functional system for measuring performance relative to the definition of success.

Setting measures of success has always been an important element of transportation planning and design. Traffic engineers have long defined success through measures such as:

- Improved Level of Service (LOS).
- Decreased traffic volume to roadway capacity ratio.
- Increased average vehicle operating speed.

While these measures are important, they present a perspective related to a single goal—increasing roadway capacity to allow more cars to move more quickly through a given segment. While useful for measuring improved traffic performance, these measures will almost always result in the same type of improvement being implemented and a singular focus on moving vehicles.

Defining success in this manner limits examination of other viable improvement options. For example, measuring only speed improvements and reduced congestion along a "main street" roadway forsakes the needs of other travelers and users, such as pedestrians, and suggests their needs are inferior to those of motorists. Expanding roadway capacity may improve auto speeds and LOS, but often to the detriment of others. In the context of a "main street," moving cars faster through a downtown area may actually have a negative impact on economic well-being in addition to not serving the full range of users.

Complete transportation projects have wide-ranging objectives, which suggests that no single measure of success can be used to determine the preferred solution. A complete transportation approach requires measures that represent the full spectrum of project goals, including multimodal performance and safety, economic development, community character, and land use integration. The measures should be directly related to the wide-ranging set of project goals identified while forging partnerships. The measures help define needs by clarifying deficiencies in performance relative to the definition of success.

Relatively simple measures can address the full set of project goals. For example, a goal of improving pedestrian mobility can be measured through an increase in signalized pedestrian crossings, a decrease in overall street width of pavement to be crossed, or a reduction in posted speed. The use of these straightforward measures of success enhances the transparency of decisions and the connections to project goals. Transparency helps create reproducible decisions that provide the long-term guidance sometimes required to implement wide-ranging complete transportation solutions.

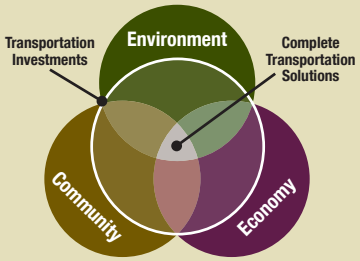
Considerations for defining wide-ranging measures of success and a range of examples are shown in Figure 11.

3 THINGS TO REMEMBER

- Wide-ranging measures identify a wider range of needs and solutions.
- Stakeholder partners' goals and objectives help tailor solutions to meet community and other goals.
- Measures of success should be transparent, reproducible, and provide ongoing guidance to meet each project goal and objective.

Figure 11: Define wide-ranging measures of success

PROJECT OR STRATEGY AREAS



CONSIDERATIONS

Measures reflect multiple goals	◆ Do the measures reflect all users and partners? ◆ Do the measures reflect all modes of transportation? ◆ Do the measures include goals for community, economy, and the environment?
Measures are functional	◆ Do all goals have corresponding measures of success? ◆ Do the measures provide insight into the roadway's context and desired outcome?
Measures communicate progress to success	◆ Are the measures easily calculable? ◆ Do the measures capture the comprehensive set of goals and objectives or dilute key project objectives?

EXAMPLE MEASURES OF SUCCESS

◆ Peak/non-peak-hour LOS	◆ Cost per trip	◆ Pedestrian/bicycle access	◆ Least right-of-way impact
◆ Travel speed	◆ Cost per VMT	◆ Crashes/crash rates	◆ Supports growth centers
◆ Travel time	◆ Businesses impacted	◆ Access to public transportation	◆ Coordinated land use
◆ Delay (recurring)	◆ Employment accessibility	◆ Managed access	◆ Citizens' concerns
◆ Mode share	◆ Consistency with local and regional plans	◆ Least environmental impact	◆ Natural resource plan consistency

Strategy: Establish full spectrum of project needs and objectives

The first step in identifying the full spectrum of project needs and objectives is to continue discussions with engaged project partners about their transportation needs. Generally, these needs are related to safety, travel delay, congestion mitigation, maintenance and rehabilitation, or breaks in the transportation network (e.g., missing sidewalk). While a traditional list of needs focuses on transportation issues, discussions with project partners should include broader perspectives that incorporate community goals such as economic development and community character and vitality. Considering such issues will help differentiate among possible alternative solutions and identify solutions that reduce demand or eliminate needs.

A full spectrum of needs and objectives may be developed by evaluating the measures of success to characterize the deficiencies or gaps between current and desired performance (Figure 12). These deficiencies represent real needs relative to a picture of success. They are defined by the combined goals of ADOT and its partners.

A list of needs and the resulting objectives does not assume solutions. For example, a four-lane section, new interchange, or a recreational trail are not needs, but represent potential solutions to a measurable deficiency from the definition of success. This approach enhances the transparency of the process, strengthens partnerships, and builds support for proposed solutions.

The project team and partner stakeholders should develop the project needs and objectives. For simple projects that involve few partners, a documented agreement may be as simple as written correspondence with a local county or municipal representative. For larger or more complex projects, the project team and stakeholders must vet the project needs and document them in writing before developing alternatives. Project needs are then translated into a comprehensive problem statement and associated objectives.

Identifying problems to be solved and developing a problem statement is the first step in the project development process. It is critical that the statement be useful for development and evaluation of potential solutions. Problems must be stated in terms of underlying causes. For example, congestion, in itself, may not be a problem, but rather a symptom. If, instead, the problem is defined as travel demand that exceeds capacity, the problem has been framed in a way that can lead to a solution—it is either possible to attack the problem from the demand side or the capacity side, or a combination of the two *(NCHRP 2002).*

Project objectives should reflect the full range of local values identified during partner outreach. A comprehensive list of project objectives will validate partner interests and help motivate them to remain invested throughout the project. An appropriate project objective is "Provide for efficient movement of people and goods from area A to area B" rather than "Widen Highway X from four to six lanes between point A and point B." A broader project objective allows the team to consider strategies other than roadway widening, such as transportation system management, demand management, and/or promotion of alternate modes, as well as a variety of roadway-based solutions.

3 THINGS TO REMEMBER

- Project needs characterize deficiencies relative to measures of success.
- Project objectives state specific desired performance improvements.
- Needs and objectives capture goals of ADOT and partners but do not assume solutions.

Figure 12: Establish full spectrum of project needs and objectives

GOAL AREAS

GOALS	EXAMPLE NEEDS	EXAMPLE OBJECTIVES
Transportation Needs	◆ Safety performance is worse than expected	◆ Reduce fatal and critical injury crashes to statewide average for similar facility
	◆ Congestion exceeds forecast condition	◆ Provide improvements that meet LOS guidelines through operational improvements and network connections
Community	◆ Pedestrian/bicycle access is incompatible with community plan	◆ Provide pedestrian access feature at all intersections and trail connections
	◆ Streetscape incompatible with land use	◆ Include landscape features from community streetscape toolbox to improve
Economy	◆ Number of businesses impacted excessive	◆ Reduce business parking spaces lost by 25%
	◆ Improve support of economic growth centers	◆ Improve access to businesses
Environment	◆ Consistency with natural resource plan	◆ Provide additional mitigation to achieve desired consistency
	◆ Does not provide for enhanced accessibility to employment	◆ Improve Americans with Disabilities Act (ADA) accessibility between job centers and mobility connections to improve score to average

Strategy: Consider a full set of alternatives

Collaborating with project partners to identify project goals and objectives establishes the foundation for identifying a wide range of alternatives. Building on this initial collaboration and continuing to engage project partners leads to the development of a broader set of alternative improvements (Figure 13).

Historically, roadway widening and capacity improvements have been a default solution for Arizona's continued growth and development. As Arizona urbanizes and cities grow and expand, this solution becomes increasingly cost-prohibitive and may also contradict community goals and objectives.

A full set of alternative improvements should increase the efficiency, effectiveness, and lifespan of the existing transportation system. This may defer or eliminate the need for new major capital investments. Alternatives to a cost-prohibitive roadway widening project may include:

- Traffic signal optimization: Traffic signal optimization and retiming is one of the most cost-effective ways to improve traffic flow along a corridor. An up-to-date timing plan can defer or mitigate the need for widening.
- Access management: Plan facilities to better accommodate local access along and across corridors to allow local traffic to follow shorter routes. This reduces congestion and travel time on state facilities and increases the viability of other modes of travel such as walking, biking, and transit.
- Local network/street connectivity: Investing in a well-connected local street network can reduce pressure on state highways and better serve local trips. ADOT and local governments must collaborate to ensure that the state and local systems work together.

During the early phases of project development, a full set of alternatives should include solutions that reflect the goals and objectives of engaged partners. Approaching long-range planning efforts with complete transportation strategies in mind affords the necessary time to investigate and pursue potential solutions such as reducing demand through land use changes, modal shifts, or regional planning efforts. However, these options are only available if we have the foresight to build partnerships and remain open to considering new or improved ADOT infrastructure, operational improvements to existing facilities, and enhanced network connectivity.

3 THINGS TO REMEMBER

- A full range of alternatives is required to meet the needs of ADOT and our partners.
- Alternatives include new or improved infrastructure and enhancing operations of existing facilities.
- Complete transportation partnerships may allow alternatives that reduce demand for highway solutions.

Figure 13: Consider a full set of alternatives

CONSIDERATIONS	
Solutions address all goals	◆ Has a broad spectrum of input from multiple disciplines been obtained and used to establish the range of alternatives? ◆ Do the alternatives address identified measures of success? ◆ Are the alternatives broad and expansive? ◆ Do the alternatives yield multiple benefits? ◆ Do the alternatives respond to the project objectives and needs identified by project partners and stakeholders?
Solutions beyond ADOT action	◆ Were the alternatives developed through a collaborative, participatory process? ◆ Are there alternatives that address needs through regional or local actions? ◆ Do the alternatives consider all modes of transportation? ◆ Are there alternatives that address needs through network capacity, demand management, and/or modal balancing? ◆ Are there alternatives that integrate multiple strategies and multilateral actions?
Solutions are cost-effective	◆ Are there operational improvements that may defer the need for roadway widening solutions? ◆ Were low-cost/low-impact alternatives considered? ◆ Are otherwise viable alternatives restricted only by policy or guidelines? ◆ Are the alternatives affordable and cost-effective?

Strategy: Plan for all users and modes of travel

A complete transportation network is an interconnected, multimodal system that provides Arizona residents and visitors with a range of travel choices such as walking, bicycling, riding transit, or driving a vehicle (Figure 14).

Nearly every transit trip begins as a walking trip. This can be problematic if that walking trip requires people to cross a busy highway or walk along the shoulder to a bus stop with no connection to obvious pedestrian facilities like sidewalks or trails. Such conditions discourage people from riding transit or walking. A complete transportation system that meets the needs of all people includes sidewalks and bus shelters. Without these facilities, many individuals—senior citizens, those with disabilities, and children—cannot travel to a bus stop in a safe, convenient, or comfortable manner. A complete transportation system that ensures safe and convenient access to public transit contributes to a comfortable trip and helps establish transit as an attractive travel option.

Walking and bicycling offer a myriad of individual and community benefits—health, environmental, quality of life, and transportation flexibility. As a result, transportation agencies are encouraged to allocate resources to support these transportation modes. In 2010, the United States Department of Transportation (U.S. DOT) issued a policy incorporating safe and convenient pedestrian and bicycle facilities into transportation projects through the following actions (U.S. DOT 2010):

- Consider walking and bicycling as equals with other transportation modes. Walking and bicycling should not be an afterthought in design.
- Go beyond minimum design standards and requirements to create safe, attractive, sustainable, accessible, and convenient bicycling and walking networks. Planning projects for the long term should anticipate likely future demand for bicycling and walking facilities and should not preclude the provision of future improvements.
- Integrate bicycle and pedestrian accommodations on new and rehabilitated bridges.
- Collect data on walking and biking trips.
- Improve bicycle and pedestrian facilities during resurfacing and other maintenance projects.

ADOT's Bicycle Policy affirms the department's commitment to develop a transportation infrastructure to support bicycle access (ADOT 2007). The department's Bicycle and Pedestrian Plan identifies strategies to improve bicycling and walking in Arizona (ADOT 2013a). These strategies include:

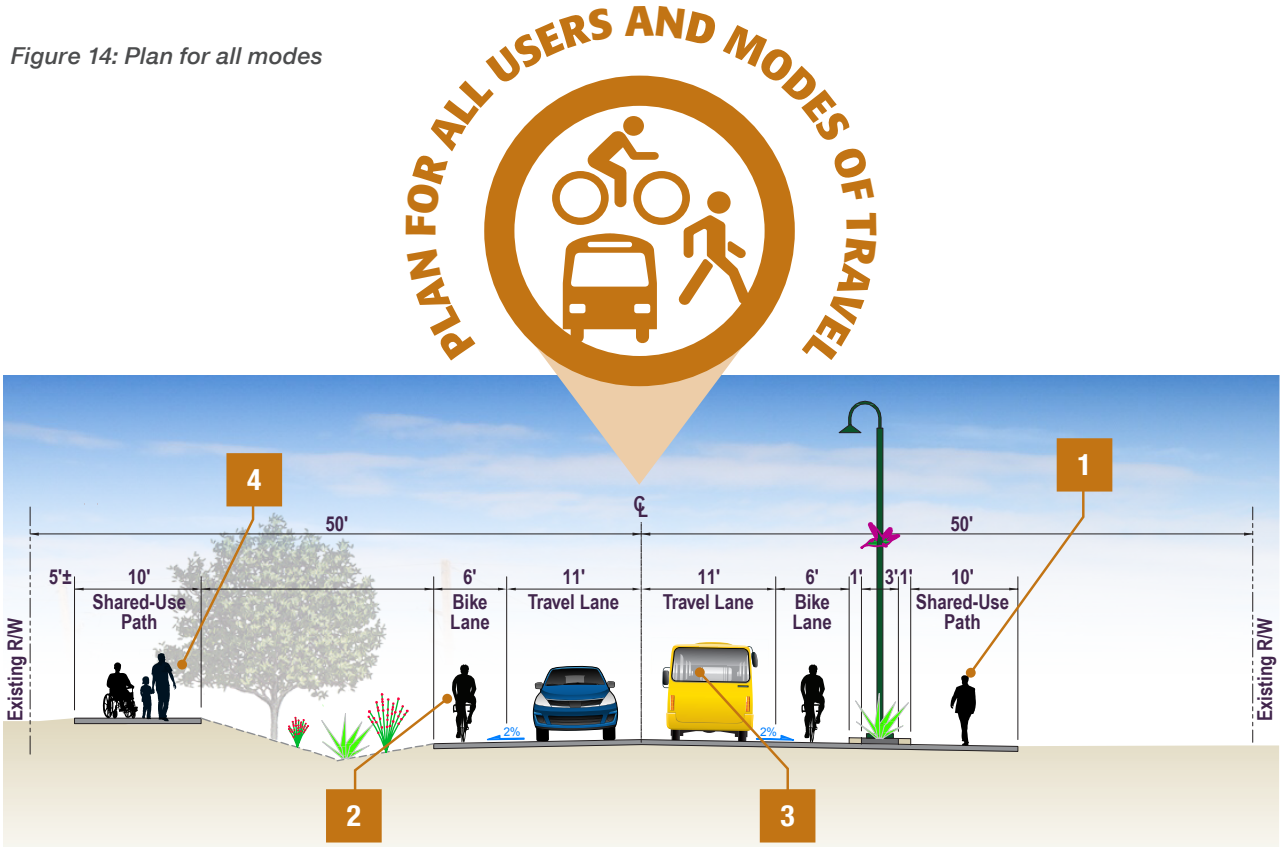
- Collaborate with local and regional jurisdictions to implement infrastructure along and crossing state highways consistent with local bicycle and pedestrian plans.
- Coordinate with the U.S. Forest Service, National Park Service, and Arizona State Parks to ensure that bicycle and pedestrian facilities connect state highways to forests and parks.
- Configure traffic signals to detect bicycles at intersections.
- Construct sidewalks in urban areas and small urbanized areas where origins and destinations present a need.
- Construct and maintain paved and striped shoulders in urban areas and on rural routes. Where rumble strips are used, ensure that they are installed to provide a minimum effective clear shoulder width of 4 feet.

Planning that focuses on people can enhance safety for everyone. Considering all modes of travel focuses attention on how people access the transportation system and the interaction of all users. Today's planning and design decisions that consider all modes are better prepared to provide safe systems for the modal choices of tomorrow.

3 THINGS TO REMEMBER

- Transportation planning should focus on moving people, not just vehicles.
- Plan and provide for current users, without precluding future modal shifts.
- Planning for all modes and users promotes everyone's safety.

Figure 14: Plan for all modes



CONSIDERATIONS

1 Pedestrians

- Are any current or planned land uses or destinations in the corridor within reasonable walking distance of one another?
- How will the project improve walking conditions along the state highway? Can nearby existing sidewalks be connected through the project?
- Are state highway crossings needed? Are destinations located on opposite sides of the roadway?
- Are community facilities (parks, schools) located within one-half mile to 1 mile of the project? Will children and others walk along or across the roadway to access the destinations?

2 Bicyclists

- Is the roadway identified as a bicycle route within a local bicycle and pedestrian plan?
- Does the project include elements to encourage people of all ages to bicycle, or will the project only serve the needs of experienced and advanced bicyclists?
- What project elements can be incorporated to enable people of all ages to bicycle on or near the project/corridor?

3 Transit users

- Are existing bus routes within the project/corridor limits?
- Are proposed bus routes within the project/corridor limits?
- Do transit users need to walk along or cross the state highway to access bus routes?

4 Other users

- Equestrians?
- Heavy machinery or agricultural equipment?
- Military vehicles?
- Recreational vehicles?
- Oversize/overweight vehicles?

Strategy: Exercise available flexibility in design

Integrating complete transportation into ADOT's project development and design processes requires building on the flexible elements in previously established design guidelines and standards (Figure 15). The foreword to the latest edition of the AASHTO publication *A Policy on Geometric Design of Highways and Streets* (commonly called the Green Book) defines flexibility as a series of design values or choices that can be reflected in standards (AASHTO 2011):

The intent of this policy is to provide guidance to the designer by referencing a recommended range of values for critical dimensions. Sufficient flexibility is permitted to encourage independent designs tailored to particular situations.

FHWA has adopted the Green Book for all roadways on the National Highway System (NHS). Both FHWA and AASHTO recommend applying the Green Book design values, particularly when considering impacts to communities (FHWA 1997, AASHTO 2004a).

FHWA has specifically expressed support for taking a flexible approach to bicycle and pedestrian facility design, including on-street bicycle facilities (FHWA 2013b):

AASHTO bicycle and pedestrian design guides are the primary national resources for planning, designing, and operating bicycle and pedestrian facilities. The National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide and the Institute of Transportation Engineers (ITE) Designing Urban Walkable Thoroughfares guide build upon the flexibilities provided in the AASHTO guides, which can help communities plan and design safe and convenient facilities for pedestrians and bicyclists. FHWA supports the use of these resources to further develop nonmotorized transportation networks, particularly in urban areas.

The ADOT Roadway Design Guidelines (RDG), April 2014 revision, provide criteria for designing multimodal projects on the state highway system (ADOT 2014). The RDG demonstrates design flexibility; its foreword notes that the document is intended to be "a guide, not a cookbook." The RDG design process allows for engineering judgment within accepted design parameters "to meet each project's objectives in the best overall public interest." Further, the RDG encourages considering and balancing a number of social, economic, and environmental issues, including:

- Need for safe and efficient transportation.
- Realistic financial estimates.
- Cost of mitigating adverse effects on natural resources, environmental values, public services, aesthetic values, and community goals and objectives.
- Cost, ease, and safety of maintaining the project after construction.

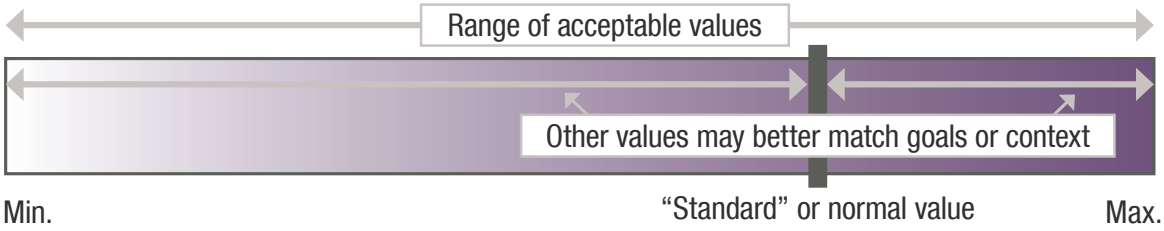
Chapter 5 of this Complete Transportation Guidebook recommends specific design considerations that emphasize flexibility within current design standards and guidelines to achieve a smart, more responsive, context-sensitive transportation system that meets the needs of all roadway users. Making full use of the flexibility available in ADOT and other guidelines may require approvals as documented in the ADOT Design Exception and Design Variance Process Guide. These design choices are best documented and approved during project scoping to allow time for consideration and implementation.

3 THINGS TO REMEMBER

- Published design references from FHWA and ADOT are guidelines and offer flexibility.
- Focus should be on project-specific design requirements driven by guidelines and context.
- Project design criteria that support complete transportation decisions should be established within project scoping.

Figure 15: Exercise available flexibility in design

Consider the Full Range of Values in Design Guidelines



- Design guidelines (ADOT, AASHTO, and other references) often provide ranges of acceptable values and a "standard" or normal value
- Values other than standard may be acceptable and may better match project goals or context
- Using non-standard values may require design variance or exception

CONSIDERATIONS

Match design and context

- Has the designer made full use of the normal range of design values?
- Are travel lane widths appropriate for the context? Narrower lanes offer several advantages on lower-speed urban roadways.
- Does the design speed equal the desired operating speed?
- Does the selection of bicycle facility type and width consider the volume of traffic on the roadway? Higher-volume and higher-speed roads require wider shoulders. Shared roadways, bicycle lanes, and shared-use paths are all design options.
- Are sidewalk widths consistent with the land use context?
- Are median widths selected to serve multiple purposes? Medians that serve as pedestrian refuge should ideally be 8 feet wide (6 feet at a minimum).
- Is the design vehicle selected to avoid oversized curb radii? Large turning radii increase the length of crosswalks and increase pedestrian exposure to vehicles. Curb radii should be designed to accommodate the largest vehicle that will *frequently* turn the corner. Occasional large vehicles can encroach into the opposing travel lane.
- Are channelizing islands designed to encourage low speeds and high pedestrian visibility?

Consult available guidelines

- AASHTO *Guide for the Planning, Design, and Operation of Pedestrian Facilities*, 2004
- AASHTO *Guide for the Development of Bicycle Facilities*, Fourth Edition, 2012
- National Association of City Transportation Officials (NACTO) *Urban Bikeway Design Guide,* Second Edition, 2014
- Institute of Transportation Engineers (ITE) *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach*, 2010

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Chapter 3: Understanding the Transportation Context

A transportation facility is never an end in itself. It is a means for connecting people to jobs, commerce, and all other aspects of daily life. In addition to moving cars, goods, and people, a complete transportation facility positively benefits a community's economy and quality of life. To achieve these priorities, ADOT must understand the context in which the facility will operate.

This chapter presents and discusses typical context types in Arizona as a tool for helping project scoping and design teams accomplish complete transportation priorities.

WHAT IS CONTEXT?

Multiple interrelated conditions such as land use, demographics, economic activities, travel patterns, population density, and environmental assets determine context. These factors influence ADOT roadway design, development, and construction. The 2013 National Association of City Transportation Officials (NACTO) *Urban Street Design Guide* defines context as "a crucial, yet often overlooked, parameter in designing streets. Street design should both respond to and influence the desired character of the public realm. Rooted in city goals and policies, designers can work to enhance their surroundings by fulfilling the visions and desires of adjacent communities through street design" (NACTO 2013). While NACTO wrote these words with cities in mind, they can apply to any agency that builds or maintains roads.

TOOLS FOR UNDERSTANDING CONTEXT

A variety of tools are available to help ADOT assess and understand a project's context. These include:

- **Land Use Plans** – Land use plans include city and town general plans, county comprehensive plans, neighborhood plans, and plans for master-planned communities or planned area developments. These plans usually involve extensive community input and help regulate land use and development. General and neighborhood plans often outline future community aspirations and identify specific projects to achieve them. Land use plans can help identify potential complete transportation partners within the community and describe the type of context the roadway will ultimately serve.
- **Strategic Plans** – Strategic plans are generally prepared by an elected body and reflect a community's agenda for a two- to five-year period. While strategic plans contain broad initiatives, they also include specific priority items. Strategic plans can identify potential partners and community improvements that may be within the context of a complete transportation project.
- **Transportation Master Plans** – A transportation master plan directs how transportation funding is spent and what projects or programs a community focuses on to provide transportation services for its residents within the context of the broader community goals.
- **Economic Development Plans** – Economic development plans outline the types of businesses a community desires and their locations. These plans may also include strategies to retain businesses or particular districts (often downtowns) and can inform the context of a complete transportation project by providing insight on access needs and employment activities.
- **Rules and Regulations** – National Environmental Protection Act (NEPA) documents include Categorical Exclusion (CE), Environmental Assessment (EA), and Environmental Impact Statement (EIS). The three levels of analysis include preparing a CE, an EA, and a Finding of No Significant Impact (FONSI) or an EIS. Developing NEPA documents and considering project-specific options requires extensively researching community demographics, the surrounding environment, and the local economy. This research can be used to inform the understanding of context. However, the majority of ADOT projects requiring environmental clearance are completed with a Categorical Exclusion. Since the CE is typically prepared in parallel with the

design (and is not completed until the design is 95% complete), design teams must collaborate with the environmental planner along the way. This collaboration allows design teams to use the environmental analysis as a tool to understand context.

- **Site Walks** – A site walk is an on-site project area review that includes potential project partners. During the site walk, participants should look at both the natural and the built environment. Which natural resources in the area require special attention? What is the climate? Are there special scenic or other unique resources?
- **Parks and Recreation Master Plans** – These plans typically identify opportunities for open space, recreation, and trail projects in a specific area. Since parks and trails are typically funded by nontraditional transportation sources, they provide opportunities to obtain diverse funding that can be used to construct a complete transportation project.
- **Bicycle and Pedestrian Master Plans** – Bicycle and pedestrian master plans identify key routes and crossings for these modes within a community, as well as nearby destinations and regional nonmotorized routes. These are often incorporated into long-range or other transportation plans.
- **Community Meetings** – The people who live, work, and recreate in an area know it best. Reading the minutes of community meetings and engaging in other types of public outreach techniques—including stakeholder interviews, focus groups, and online surveys—can be fundamental to understanding the context of a transportation project.
- **Local Codes and Design Guidelines** – Local codes and design guidelines shape the land use, form, and function of a community. Understanding these codes can help identify opportunities and strategies for integrating complete transportation measures into community development and redevelopment projects.

The people who live, work, and recreate in an area are important resources for understanding context.

- **Other Studies and Reports** – Other documents and plans that provide information about the project area may be available from stakeholders or jurisdictional staff.

WHY UNDERSTANDING CONTEXT IS IMPORTANT

Understanding context is fundamental to complete transportation. According to a recent FHWA guide, "Defining context is the first and most important step in effectively and efficiently planning, developing, delivering, operating, or maintaining transportation infrastructure" (FHWA 2012b). Since facilities that provide mobility support all aspects of a community, context contributes to ADOT's ability to design and build facilities that support a quality, safe, healthy, and economically viable environment (Figure 16).

Understanding context can help reduce the cost and time required for planning, designing, improving, or constructing a roadway, resulting in the following benefits:

- **Provides a roadway that is supported by the community** – Community support for improvement projects is important for many reasons, such as keeping costs manageable by reducing delays in design and construction due to public objections. Securing community support is also key to funding new facilities through bonds and taxes.
- **Enhances livability** – Enhancing mobility within and to a community supports the economy by making goods and services more accessible. It can also make a community more livable by providing safer or more direct access to schools, services, and employment. For example, understanding the context of the SR 179 project in Sedona (see page 6 of this Guidebook) during development led to project elements such as bicycle lanes and scenic pull-offs that benefited businesses, communities, and the environment. An ADOT post-construction stakeholder survey conducted as part of an FHWA report on this project clearly demonstrated how satisfied the local residents and businesses were with the construction approach and final product (FHWA 2013a).
- **Opportunities for partnerships** – Designing a transportation facility to leverage other goals creates opportunities for partnerships throughout the project. For example, a partnership with local artists could result in amenities for a downtown such as enhanced crosswalks and decorative planters. Similarly, a partnership with a local school could result in a safer crossing that connects a neighborhood to other facilities across a busy street, such as parks or shopping. Collaborating with a local merchants association could result in merchants taking on maintenance of city-owned right-of-way in front of their businesses.

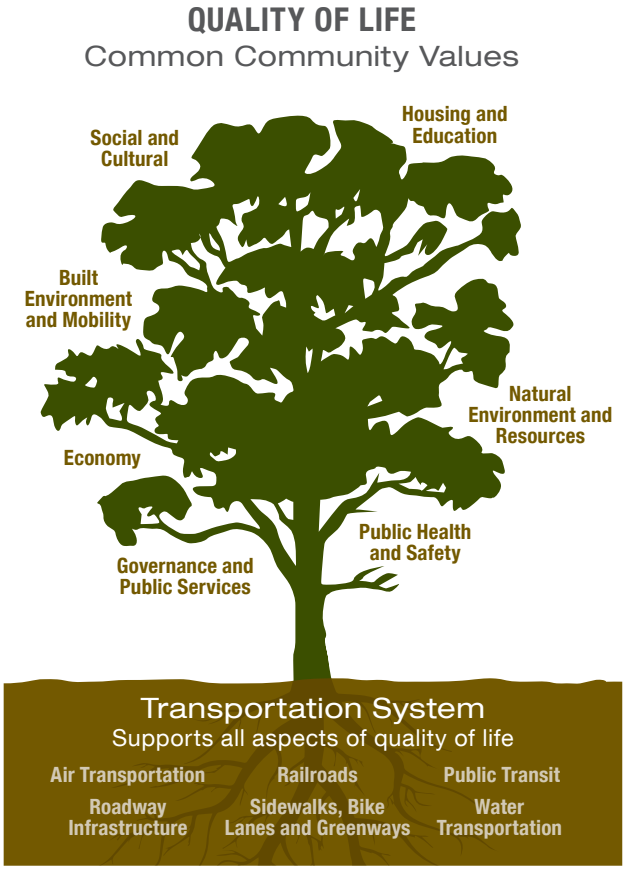

Figure 16: Quality of life (adapted from Going the Distance Together, *FHWA 2012b)*

- **Tailors mobility needs** – Different places have different needs. For example, a suburban community may have higher expectations with regard to direct connections to regional facilities; those in an urban environment may have high expectations with regard to modal choices.

WHEN IS CONTEXT IMPORTANT?

Attention to context is important at every phase of a project—from inception, planning, and scoping through construction. In general, transportation projects in Arizona can take between two and 10 years to plan, fund, design, and build. Arizona continues to be one of the fastest-growing states in the nation. In 2012, it ranked eighth nationally in percentage of population growth (U.S. Census Bureau 2012). In our dynamic state, context can change dramatically in a short period of time. For example, entire subdivisions can be planned, zoned, and constructed in two years. In five years, an agricultural area can change into a suburb and a rural intersection can become an active commercial center. In 10 years, rural highways can become busy suburban corridors and a city, town, or rural area can double in physical size and population.

It should be understood that context evolves. The understanding of context includes both what currently exists and the trends and likely changes impacting future needs. Each phase of project development should consider the appropriate forecast context. A recent FHWA guide provides a list of questions that can be asked at each stage of the project development process (FHWA 2012a).

Examples of Arizona's changing contexts are illustrated in Figure 17.

Figure 17: Examples of areas with changing contexts

In the last 20 to 30 years, SR 77 has grown from a two-lane rural highway to a six-lane divided highway through suburban Oro Valley. Once-rural segments are now lined with subdivisions and commercial development.

SR 95 in Lake Havasu City exemplifies the continued growth and development seen along many of Arizona's highways. In this example, while the roadway was previously constructed to a rural standard (without curbs, gutters, or sidewalks), adjacent development will ultimately require curbs, gutters, and sidewalks.

SR 68 in Golden Valley passes through an area that is evolving from rural to one with activity centers. These areas present opportunities to offer a wider range of transportation options that support mixed-use and higher-density development.

WHAT TYPES OF CONTEXTS ARE IN ARIZONA?

Most smart growth programs are designed to encourage higher development density and intensity of activity. However, while the majority of Arizona's population lives in urban areas, the majority of state highways are in lower-density, lower-intensity rural and suburban areas. ADOT recognizes that it is equally important to leverage the economic, environmental, and community goals of transportation investments in these lower-density and lower-intensity areas of activity. While contexts within Arizona are diverse, a few key element help distinguish basic groupings:

- Is the project within an urban area or concentrated area of use?
- Is the project within a suburban or rural area?
- Are there special uses such as designated open space or cultural and historical sites?

The basic groupings of Arizona's transportation contexts are described in Figure 18. Complete transportation triple-bottom-line goals and objectives span all contexts and recognize the defined grouping may not be fine grained enough to represent every project's specific context. However, understanding transportation context recognizes that there are:

- **Differing expectations** – Regardless of the scale of any given context, travelers (freight shippers, motorists, pedestrians, bicyclists, and transit users) have specific mobility expectations within different types of development patterns (transportation contexts). Transportation facilities must serve all users within each context.
- **Opportunities for complete transportation** – There are opportunities to accomplish complete transportation goals within any transportation context. Road improvement and enhancement projects of all types can use a complete transportation approach to incorporate transportation elements that achieve greater community benefit. However, the scale and extent to which these elements are constructed within each context may differ significantly. ***The scale of infrastructure varies with the context.***
- **Diverse options** – Arizona policymakers in small towns, large cities, and places in between understand the strong connection between land use, economic development, and providing a travel environment that supports mobility options, including facilities for pedestrians, bicyclists, and transit users. They understand that diverse travel options result in varied and vibrant economies and communities.

Infrastructure scale varies with context

In a high-density urban activity center, pedestrian needs may be best met by traffic signals at closely spaced intersections. In a less intense suburban area, a pedestrian hybrid beacon might be appropriate. In a small town in a rural area, a painted crosswalk may meet pedestrian mobility needs. The scale of facilities as appropriate to density and intensity considerations is discussed in detail in Chapter 5.

Most roadway projects are planned and designed with a 20- to 30-year life. In Arizona, population growth and new development occur within a shorter time frame than it takes to plan, program, design, and build or improve a roadway. A complete transportation approach considers the changing urbanization, form, density, and intensity of the adjacent land uses to reflect the anticipated (20- to 30-year) scale and intensity of its context—that is, how its context will change over this time frame.

For example, will an activity center with low development density require the same elements at a larger scale in 10 years, or will a suburb require additional elements that support an activity center or urban area in 10 years? Do existing land uses match those anticipated in adopted plans and policies? How can complete transportation elements be planned for and integrated into future development plans? For instance, sidewalks and bus bays could be integrated into future residential or commercial development. Anticipating and supporting planned land use and development is an important component of understanding context.

Figure 18: Arizona's transportation contexts

Transportation Context		
Activity centers, downtowns, and urban areas		
Suburban areas		
Rural areas		
Special use areas		
Open space		
Cultural and historic sites		

	Complete Transportation Objectives		
	Environmental Objectives	**Community Objectives**	**Economic Objectives**
	Create solutions that are compatible with and can enhance the natural environment; reduce emissions and pollution from the transportation system; reduce the material resources required to support transportation.	Make transportation accessible, safe, and secure; contribute to community health and well-being; develop infrastructure that is an asset to communities.	Support economic vitality while developing infrastructure in a cost-efficient manner. Provide mobility choices for all people (including those with economic disadvantages); costs of infrastructure must be within a society's ability and willingness to pay.
Activity centers, downtowns, and urban areas	◆ Reduce stormwater runoff ◆ Reduce ambient temperatures/urban heat islands ◆ Enhance air quality ◆ Encourage shift to low- or no-pollution-emitting modes	◆ Provide walking and bicycling facilities that connect housing to schools, parks, trail systems, and employment centers ◆ Provide facilities that enhance the visual quality of the community ◆ Provide intermodal connections	◆ Provide high level of nonmotorized mobility options ◆ Provide facilities that complement tourism and economic activity
Suburban areas	◆ Reduce stormwater runoff ◆ Preserve native vegetation ◆ Reduce heat gain ◆ Conserve/preserve natural features such as washes and terrain ◆ Maintain connections between open spaces	◆ Provide safe, direct pedestrian and bicycle connections across roadways and between community destinations such as schools, clinics and hospitals, shopping areas, trailheads, and parks ◆ Maximize walkability where destinations are located on both sides of the roadway ◆ Maximize motorized and nonmotorized connections between land uses along the roadway	◆ Provide enhanced crossings at commercial areas and other generators located on opposite sides of the roadway ◆ Provide direct pedestrian connections to transit from adjacent land uses ◆ Provide options to transfer between travel modes ◆ Provide facilities that support the movement of goods and services ◆ Connect to regional and national roadways
Rural areas	◆ Prevent disruption to wildlife movement ◆ Maintain natural habitats and vegetation ◆ Maintain open space connections ◆ Maintain and protect dark skies ◆ Prevent erosion	◆ Provide safe crossings and connections to trails, parks, schools, housing, and commercial areas that can be used by motorized and nonmotorized transportation ◆ Provide connections to off-road travel	◆ Provide opportunities to connect to destinations by transit and bicycle ◆ Connect to regional commercial routes ◆ Provide facilities that can support commercial traffic
Special use areas			
Open space	◆ Minimize roadway's impact on the natural environment and on wildlife movement	◆ Provide access to open spaces where appropriate	◆ Provide areas for scenic views and attractions ◆ Support tourism and visitors
Cultural and historic sites	◆ Implement roadway design that protects the resource	◆ Provide opportunities to access the resource by walking, bicycling, and transit	◆ Provide access to the resources from as many modes as practical ◆ Provide concession opportunities

Activity Centers, Downtowns, and Urban Areas

Activity centers are destination areas of concentrated commercial, residential, and/or mixed-use development, and they vary in size and intensity. In Arizona, activity centers range in scale from large-city downtown central business districts to smaller-town main street corridors and commercial nodes located along state highways.

Examples of activity centers are shown in Figure 19.

Complete transportation recognizes that in any activity center, regardless of size and intensity, travelers expect to walk from one destination to another, easily cross streets, and access the uses and developments within it through a variety of modes.

Every activity center, no matter its location, is a place where people expect facilities that enable a high degree of accessible mobility for pedestrians, bicyclists, and motorized vehicles, at a minimum.

Some activity centers must also provide transit facilities ranging from a bus station, local bus stop, or circulator stop to light-rail infrastructure in some highly developed locations. These expectations hold true for travelers in activity centers located in both urban and rural Arizona. A complete transportation approach in these contexts focuses on pedestrian and bicycle amenities and facilities that enable people to reach and travel within the activity center using a range of transportation modes.

Achieving complete transportation goals within an activity center can positively impact the environment by implementing green street infrastructure to manage stormwater runoff and reduce ambient temperatures. Sidewalks and bicycle facilities can contribute to community health. Shade and sidewalks can contribute to the economy by making the activity center an attractive destination where people may linger longer and perhaps choose to dine and shop.

In many areas throughout the state, new development on the periphery has impacted traditional downtowns and town centers that would be considered activity centers using this complete transportation approach. When these areas include large numbers of vacant buildings or lots, or have limited activity, a complete transportation approach could be a vital component to leverage economic development and support redevelopment. The 2013 NACTO *Urban Street Design Guide* describes a downtown street as "the heart of a commercial district that is the nexus of neighborhood life," with "high pedestrian volumes, frequent parking turnover, key transit routes, and cyclists all vying for limited space" (NACTO 2013). Often, providing transportation facilities—such as shaded sidewalks, bike facilities, locations for shuttles or regional bus service, and on-street parking—can create a "sense of place" that becomes a catalyst for redevelopment, contributing to a sense of community and supporting the local economy.

Activity center and urban area characteristics and mobility expectations include:

- A mix of economic and residential activities within ¼ mile of each other (or walking distance).
- Locations for a variety of activities, including public facilities and places to work, shop, and gather.
- Expectations for high levels of access to all transportation modes by visitors, residents, and businesses.
- Relatively high volumes of traffic and lower through-traffic speeds.
- Community and other facilities fundamental to the character and economic well-being of the area.

Figure 19: Examples of activity centers

A rural activity center along SR 82 in Patagonia includes a park, market, gas station, banners, and an art gallery. Sidewalks provide pedestrian mobility. Reconfiguration of parking to minimize conflicts with pedestrians would improve this activity center.

This activity node on SR 260 in Pinetop-Lakeside includes restaurants and other services. Sidewalks located directly adjacent to the roadway make it uncomfortable for pedestrians. Separating the sidewalks from the roadway and providing a striped paved shoulder or a bike lane would make it more attractive for people to walk and bike.

Historic SR 66 passes through an activity center that includes the periphery of downtown Flagstaff and Northern Arizona University. This transportation facility accommodates pedestrians, bikes, buses, and vehicles and includes pedestrian crossings, public art, and landscaping. Reducing travel speeds and providing striped paved shoulders or bicycle lanes would improve bicyclist and pedestrian accommodations.

US 89 between State Route 64 and the Little Colorado River through Cameron on the Navajo Nation serves traveling motorists as well as local residents. Located approximately 50 miles north of Flagstaff, the roadway is being improved (completion in 2016) to two-lanes in each direction, a roundabout at the intersection of US 89 and SR 64, four lighted pedestrian/livestock underpasses, and sidewalks and lighting on US 89 through Cameron.

Suburban Areas

By definition, suburbs are areas that are developed but are not "urban." In Arizona, suburban development generally includes walled and unwalled single-family subdivisions, master-planned communities, and large retail or commercial areas that are not within walking distance (approximately ¼ mile) of other facilities or destinations.

Examples of suburban areas are shown in Figure 20.

Arizona state highways and roads located in suburban contexts are generally on the periphery of a walled subdivision or provide access to four-corner commercial areas of varying sizes. A complete transportation approach in these contexts enhances mobility by providing and maintaining access for other modes such as transit and bicycles. In some suburban commercial areas, such as those clustered around a local street and a state highway or at the intersection of two state highways, a complete transportation approach could leverage pedestrian and bicycle facilities to contribute to community health, the environment (shaded areas could reduce ambient temperatures and provide permeable surfaces where groundwater can be recharged), and the economy (pedestrian environments can support active retail).

Master-planned communities include a wide variety of densities and designs. Master-planned communities in Arizona are generally designed to be unique developments separated from adjacent areas by walls and roads. These master-planned communities predominantly consist of single-family subdivisions and commercial areas connected by an arterial roadway. In some communities, there are trails, parks, and wide sidewalks that connect to shopping and recreation amenities. While some master-planned communities include areas designed to accommodate mixed uses, the majority of land within a master-planned community is devoted to housing and commercial areas that are generally separated. Exceptions to this exist throughout the state; for example, Verrado in Buckeye and McDowell Mountain Ranch in Scottsdale both include downtown areas designed to be internally walkable and primarily accessible by auto.

Subdivision developments are located throughout the state. For example, in communities including Casa Grande, Florence, Gilbert, and Kingman, state highways are typically located along the periphery of subdivisions. Subdivisions are generally single-lot residential developments or campus-style commercial and industrial developments that may include recreational trails and sidewalks. Subdivisions are usually designed as areas that are separated from surrounding uses by walls and/or roads.

A variety of commercial and retail areas are considered suburban, including:

- Shopping malls and single-use campuses with no housing or other destinations within ¼ mile. These include but are not limited to shopping centers such as the Flagstaff Mall on SR 89, Promenade at Casa Grande Mall on I-10 and SR 84, the Prescott Gateway Mall on SR 69, and other commercial campuses.
- Four-corner commercial areas with no direct pedestrian access within ¼ mile.

Suburban area characteristics and mobility expectations include:

- Single-use activities (residential, commercial, and employment) separated by parking, vacant land, and setbacks. The activities are not within walking distance of one another.
- Campus-style developments separated by walls and/or roadways.
- Single-family housing, garden apartments, and houses on large lots that are not within walking distance of services and employment.
- Retail service centers separated from each other by large parking areas or vacant lots.
- Commercial areas isolated from other uses

and not within walking distance of other commercial uses.

These characteristics and mobility expectations have been common to most suburban developments in Arizona and across the United States for the past several decades. However, many communities are now embracing approaches to suburban development that, while still relatively low-density and composed primarily of separated developments, have better street connectivity and are more oriented toward walking and biking than conventional suburban development.

In a complete transportation mindset, those designing state roadways should aim to create a facility that does not preclude more walkable suburban places, and ideally supports them. Vehicular access should not impede or supplant walking, biking, and transit. An important rule of thumb is that when a state highway passes through a place where people live, even a very low-density location, those people should have the opportunity to safely cross the road and to walk or bike along it.

Figure 20: Examples of suburban contexts

SR 92 in Sierra Vista passes through commercial and residential suburban areas. High travel speeds and a lack of sidewalks are among elements that could be improved.

SR 260 in Cottonwood serves a combination of residential and commercial suburban uses. High travel speeds and a lack of pedestrian crossings make it challenging for pedestrians to walk along and cross the roadway.

Rural Areas

According to the 2010 U.S. Census, approximately 10% of Arizona's population lives in rural areas and 98% of the state's land is considered rural (U.S. Census Bureau 2014a). The vast majority of tribal land in Arizona is rural. Rural areas have low traffic volumes and large distances between uses. Rural areas include agricultural land, desert, and areas developed at very low densities that may have outdoor storage, small-scale manufacturing, or other agriculture-based businesses on the same property as a residence.

Examples of rural areas are shown in Figure 21.

Rural areas generally have limited transit services and include a high percentage of elderly and low- and moderate-income families—groups who often have the greatest mobility needs and rely less on personal vehicles to meet those needs. In its report *Population Change in Rural America*, the Housing Assistance Council found that the population of rural Arizona grew by almost 30% between 2000 and 2010 (Housing Assistance Council 2011). The ADOT 2008 *Rural Transit Needs Study* found that in 2005, approximately 30% of the state's population was over 60 years of age and 68% of the state's over-60 population lived in rural areas (ADOT 2008a). The report also found that 32% of residents were low-income and 67% of low-income Arizonans lived in rural areas. While almost 80% of urban Arizona residents were employed, approximately 20% of rural Arizona residents had jobs.

In rural contexts, which include the majority of state facilities, transportation facilities can enhance communities by maintaining access to trailheads or providing access to trails, connecting bicycle facilities, and providing access to other transportation modes. Transportation facilities can also contribute to the environment by maintaining wildlife corridors.

A rural area is defined as:

- Scattered dwelling units mixed with agriculture-based uses that may be on the same lots as residences
- Commercial uses and public facilities
- No significant subdivisions
- Limited nonagricultural industrial or commercial land use
- Lands in agricultural or grazing use

Figure 21: Examples of rural areas

A rural context along SR 71 in Congress, Arizona. As illustrated by the worn pathway along the side of the roadway, despite the rural location, local residents still need to walk and to cross the roadways.

Rural context along US 89 near Chino Valley. Where occasional pedestrians or bicyclists may be present, a striped paved shoulder would accommodate them. In this photo, the shoulder is too narrow to accommodate bicyclists or pedestrians.

Even in rural Arizona, as evidenced by this photo, pedestrians still require facilities to safely and comfortably reach their destinations.

Open Spaces

Arizona has one of the largest reserves of federal and state land in the nation. Excluding tribal lands, these include wilderness areas, national forests, state lands, and local open spaces and parks. According to the Outdoor Foundation's 2013 *Outdoor Participation Report*, almost half of America's population enjoyed some form of outdoor recreation in 2013, an increase of 800,000 people (0.05%) from 2011 (Outdoor Foundation 2013). The report found that Americans took 12.4 billion outdoor excursions in 2012, up from 11.5 billion excursions in 2011. Complete transportation projects in these areas place preservation and conservation of natural resources first.

Examples of open spaces are shown in Figure 22.

Figure 22: Examples of open spaces

U.S. Forest Service recreation area on SR 89A.

US 89A along the Vermilion Cliffs provides access to the Grand Canyon National Park North Rim.

Open space along SR 179 includes trailheads, facilities for bicycles and pedestrians, and facilities designed to minimize impacts on the surrounding environment and views.

Cultural and Historic Sites

Cultural and historic sites are unique and require special treatment, including accommodating a wide range of transportation modes, high levels of foot traffic, and signing. Fundamental to these contexts are roadways designed to preserve these sites and conserve their resources. Cultural and historic sites can be located within a downtown, urban, suburban, or rural context. At a cultural or historic site, the transportation facility can enhance or provide access to the site while preserving the resource and providing opportunities that promote the local economy, community health, and environment. For example, providing trailheads and connections to adjoining trails, providing areas for vending, and protecting scenic views all contribute to achieving complete transportation goals.

Examples of cultural and historic sites are shown in Figure 23.

Figure 23: Examples of cultural and historic sites

SR 89A passes through the historic community of Jerome.

A roadside historical marker on US 93.

US 89 in Page serves tourists visiting Glen Canyon National Recreation Area.

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Chapter 4: Planning and Scoping

While statewide mobility needs are the core of ADOT's mission, decisions must also consider a broader spectrum of needs and solutions than those solely related to the highway infrastructure for which ADOT is responsible. Complete transportation considers the relationship between the transportation system and the communities it serves and recognizes how that relationship affects economic opportunity and quality of life. The planning and scoping phases of project development provide the best opportunity to effectively evaluate these broader considerations and to craft complete transportation solutions.

This chapter discusses integrating complete transportation concepts into planning and scoping. Established ADOT processes offer several opportunities to introduce and fully incorporate complete transportation during these early phases of project development.

Reasons to Incorporate Complete Transportation Early

Complete transportation considers solutions that reduce future needs for highway infrastructure through land use planning to manage travel demand or by enhancing opportunities for other modes of travel to distribute demand. Considering these alternatives early, during planning and scoping, allows time for thorough development and effective implementation.

Incorporating these alternatives early also presents the opportunity to build critical partnerships with local and regional agencies. These partnerships in turn create opportunities for ADOT to influence local land use or roadway network decisions.

Early consideration also yields solutions focused on people, not just vehicles. Such solutions may combine multiple strategies to reduce the need for infrastructure improvements, distribute demand or impacts, and provide safe and efficient choices for all users.

In the early stages of project development, the goal is to answer the following questions:

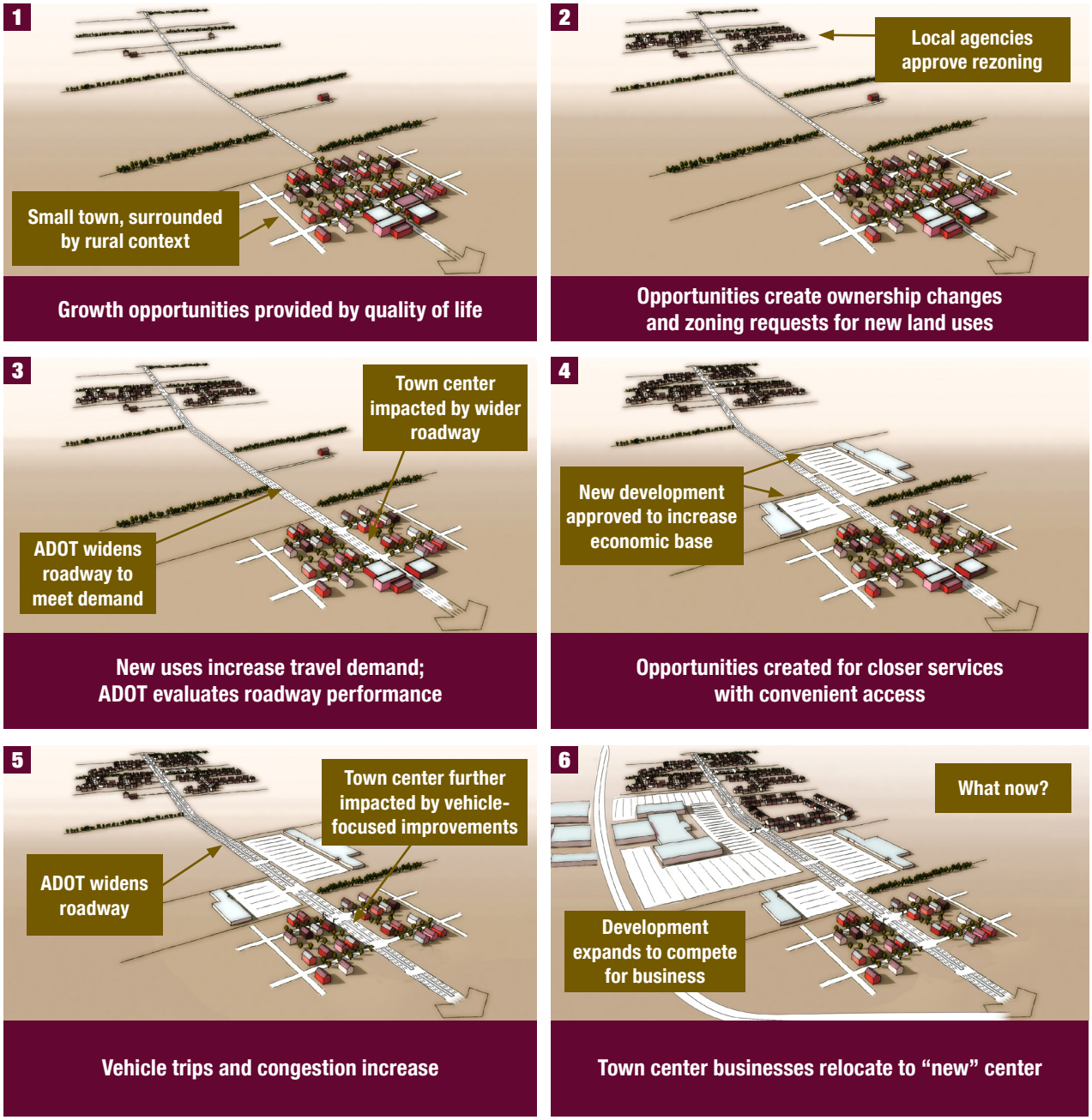
- Why is an investment needed?
- When is the optimum time to make this investment?
- What are the objectives, actions, features, and scale of the investment that will best meet the identified need?

Applying the seven strategies of complete transportation will result in more comprehensive answers to these questions that leverage the resources of ADOT and our partners to address larger goals. Through shared solutions that are efficient and sustainable, each investment helps ADOT achieve department, state, and community goals.

Example: When Complete Transportation Is Not Incorporated Early

Figure 24 illustrates the typical relationship between transportation and land use/local planning without complete transportation. The results show how a reactive approach with limited transportation choices overburdens roadways and creates disjointed communities.

Figure 24: When complete transportation is not incorporated early



Adapted from Smart Transportation Guidebook *(New Jersey DOT and Pennsylvania DOT 2008).*

What ADOT Can Do and What ADOT Can Influence

Complete transportation can neither solve every problem nor actively direct local decisions. However, it can help agencies overcome an approach of "theirs and ours" by encouraging them to seek partnerships, identify common goals to shape solutions that have broad-based support, and make transportation choices that consider land use and economic opportunity.

In a complete transportation approach, the planning and scoping processes consider solutions that ADOT can directly control (number of roadway lanes, design speed, alignment) as well as elements and resources that ADOT does not directly control (Figure 25).

For example, complete transportation leverages partnerships and strategies to constructively influence local planning and resource decisions. Of course, partnerships are two-way exchanges, and ADOT must remain open to input from partners regarding its decisions. Complete transportation presents ADOT with the opportunity to influence and be influenced in transportation decisions to create better solutions.

What does coordinating land use and transportation mean?

"At a minimum, the coordination of land use and transportation requires that those concerned with the well-being of a community (or region, state or nation) assess and evaluate how land use decisions affect the transportation system and can increase viable options for people to access opportunities, goods, services, and other resources to improve the quality of their lives. In turn, the transportation sector should be aware of the effects the existing and future transportation systems may have on land use development demand, choices, and patterns."

—FHWA's Planning Processes website (FHWA 2013c)

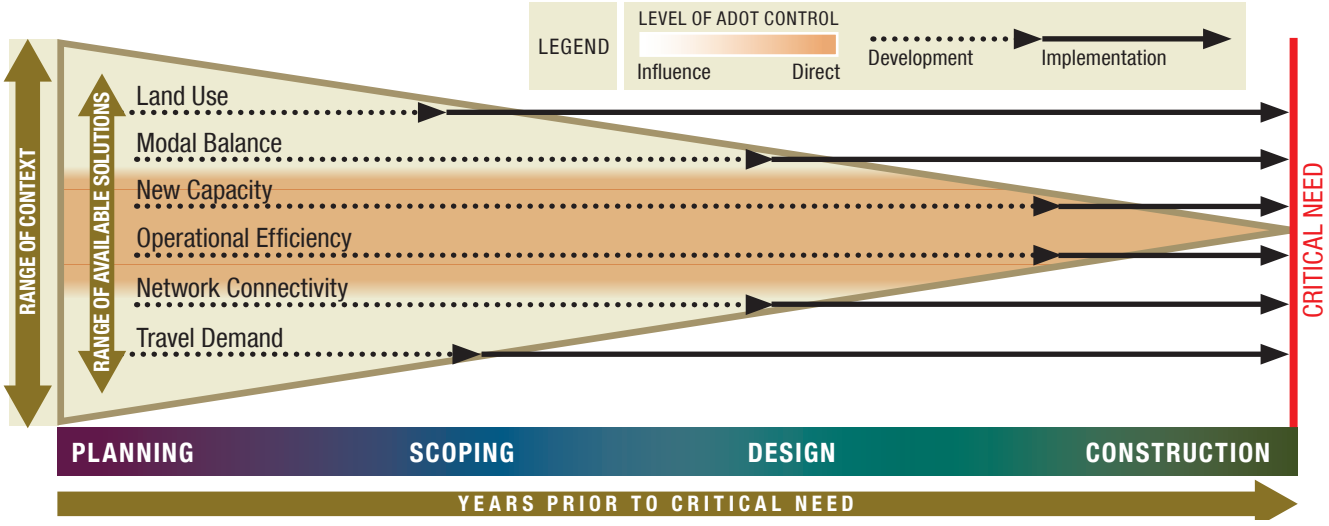
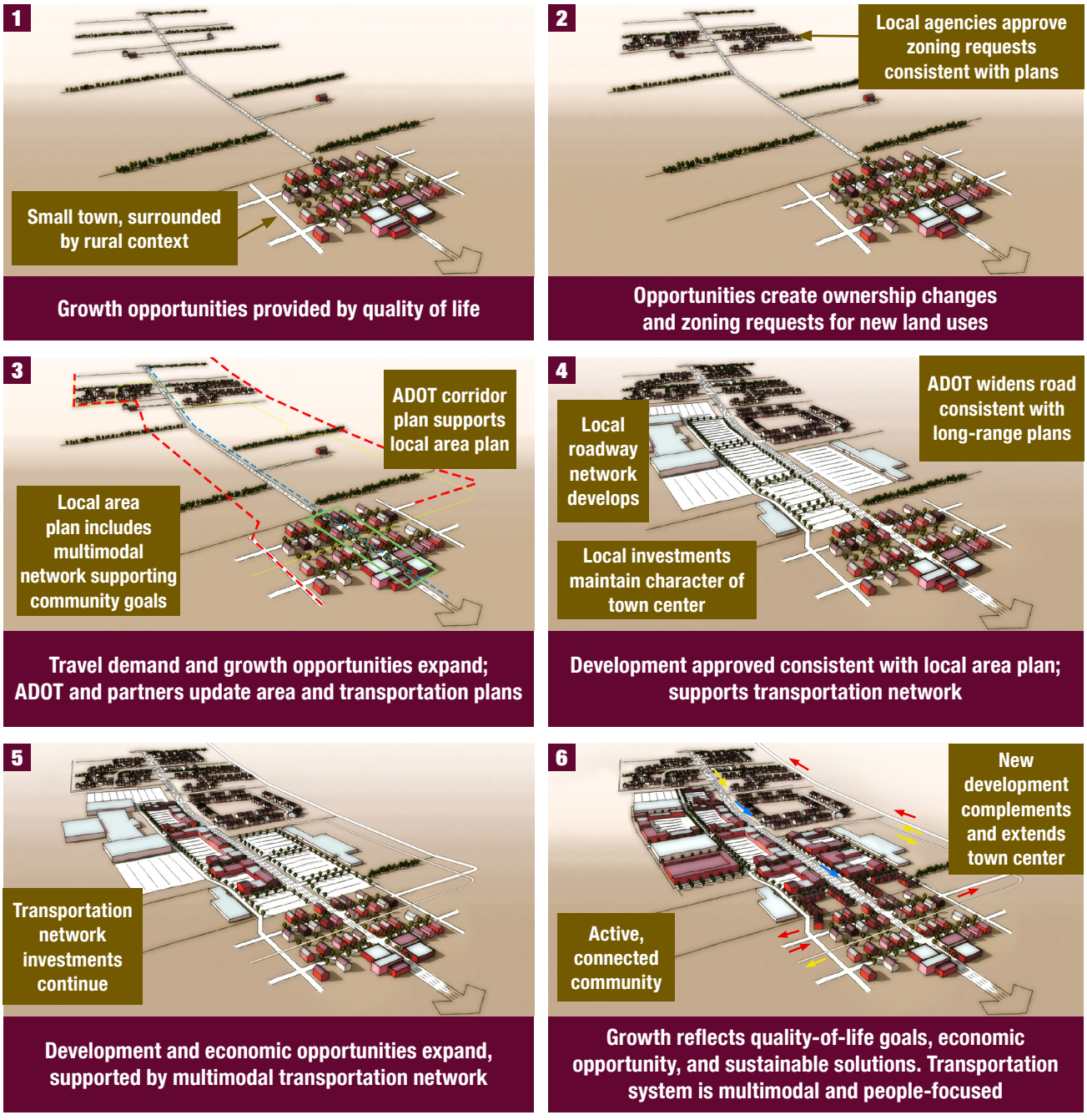


Figure 25: Solutions available during planning and scoping may include those requiring working partnerships

Example: A Complete Transportation Approach

Figure 26 illustrates a complete transportation approach that integrates transportation, community, the economy, and the environment. Established partnerships that jointly apply the seven strategies can work together to develop a complete transportation solution.

Figure 26: A complete transportation approach



Adapted from Smart Transportation Guidebook *(New Jersey DOT and Pennsylvania DOT 2008).*

Complete Transportation Considerations During Planning and Scoping

Figure 27 identifies considerations for applying the seven strategies during the early phases of project development.

Figure 27: Applying the seven strategies during planning and scoping

7 Strategies	Applying the Seven Strategies During Planning and Scoping
Understand the Context	◆ Recognize that context elements are temporal. Context changes over a 30-year horizon include changing land use, changing travel patterns, and emerging technology. ◆ Forecast and consider future conditions and how the project may shape or influence them. ◆ Consider current and long-term community goals and associated community economic and demographic changes.
Establish and Cultivate Partnerships	◆ Incorporate complete transportation into land use and transportation planning processes early in the process. This allows agencies to form partnerships and jointly investigate solutions that they may not have been able to realize alone. ◆ Engage partners by applying the seven strategies. This enhances effectiveness and strengthens working relationships. ◆ Remember that partnering with other agencies offers another "point of entry" where ADOT may be able to influence the plans and strategies of local communities and metropolitan planning organizations.
Define Wide-Ranging Measures of Success	◆ Choose benchmarks of success that reflect the goals set during planning processes. ◆ Ensure that ADOT measures include community and partner goals. ◆ Frame goals and measures of success so that they cascade from level to level as the project advances from inception through design and construction. Strategic, local, and project goals should inform performance measures.
Establish Full Spectrum of Needs and Objectives	◆ Identify overlapping needs and objectives. ◆ Verify that needs reflect deficiencies in performance, not assumed solutions. For example, a project need could be improving corridor travel time (a performance objective) as opposed to adding lanes (a presumed solution).
Consider a Full Set of Alternatives	◆ Consider alternatives that add capacity, reduce or distribute demand, and include alternative modes. ◆ Consider alternatives that address network capacity and connectivity. ◆ Consider otherwise viable alternatives that may require adjustments to policy.
Plan for All Users and Modes of Travel	◆ Focus not just on vehicles, but on people and how they travel. ◆ Enhance safety for all users. ◆ Understand that complete transportation is not about pitting transit or other modes against highways; instead, it aims to integrate solutions to provide an adaptive and sustainable mobility system.
Exercise Available Flexibility in Design	◆ Recognize that design choices are usually made during scoping. ◆ Include appropriate complete transportation strategies and document the results in the scoping process to inform design. ◆ Recognize the need for design exception/design variance process. ◆ Apply Highway Safety Manual methods to assess project design guidelines.

Additional Considerations for Planning and Scoping

Planning

Although early project development phases are referred to generally as planning and scoping, in practice these phases include multiple components. Planning also includes components at the state, regional, corridor, and project levels. Examples of statewide and mode-specific plans include:

- State Rail Plan
- State Freight Plan
- Asset Management Plan
- Strategic Highway Safety Plan
- Bicycle and Pedestrian Plan

These plans, along with other studies and plans, may provide additional insight into long-term project needs and context. These plans are most applicable, and should be consulted, during project planning and scoping.

The benefits of complete transportation can be fully realized when this Guidebook is utilized during the entire planning process. Applying the seven strategies to decisions made during the planning process ensures that the decisions are transparent and well supported by all parties. This builds trust among local agencies and other partners as the project development cycle moves forward.

Scoping

To fully realize the opportunities presented in the planning process, specific features of complete transportation must be incorporated into the design phase. While these choices are detailed in Chapter 5 as design options, many of the opportunities to include them in a project occur prior to design.

ADOT's scoping process is documented in the Project Scoping Document Guidelines (ADOT 2011a). The process is designed to document a design concept and cost for identified projects. Complete transportation strategies should be applied to the scoping process.

Complete transportation strategies encourage the inclusion of ADOT's partners in the scoping process and in developing wide-ranging measures of success that consider the needs of all users. The scoping process also requires identification of any intergovernmental agreements (IGAs) that have been made.

> "Major Project Scoping solutions are Context Sensitive Solutions (CSS). Multi-disciplinary teams work together to find solutions that meet the transportation needs within the project environment or context. CSS is a process that recognizes the need to consider highway projects as more than just transportation but as an integration with community values regarding the purpose and need of a project whereby the overall solution balances safety, mobility, and preservation of scenic, aesthetic, historic, and environmental resources."
>
> —Section 1.3, ADOT Project Scoping Document Guidelines (September 2011 revision)

Design elements that would require exceptions or variances to ADOT or other applicable guidelines, including the Roadway Design Guidelines, should be evaluated and documented during project scoping.

> "The discussions, criteria, and policies presented in [the RDG] are intended to guide the highway designer in exercising sound engineering judgment in the application of design parameters to the project development process. The goal is to provide a highway which increases transportation service and safety in a manner that is consistent with its setting and which is compatible with the community and State values and plans. The design data used for a given project should ordinarily equal or exceed the values given in [the RDG]. However, the philosophy presented above requires consideration of and permits use of lesser values when such action to meet the needs of a project is in the best interests of the public as a whole."
>
> —Section 3.1, ADOT Roadway Design Guidelines (2012 edition, revised April 2014)

The ADOT Design Exception and Design Variance Process Guide (ADOT 2009) should be referenced for current guidance. The exception and variance process requires approvals by ADOT and/or other agencies.

ADOT has been a leader in advancing the concepts of complete transportation. The 2012 Roadway Design Guidelines include many references and directions for incorporating these concepts. These references include:

- Sections 3.1 and 3.2 introduce the application of design guidelines and the process for design exceptions and design variances in scoping and design.
- Section 110 discusses the value of scenic and aesthetic characteristics in enhancing quality of life and providing economic benefits. Historical and scenic resources, landscaping and environmental design, and community values are discussed as elements that shape context-sensitive solutions.
- Section 110.4 specifically discusses the applicability of context-sensitive and flexible solutions, including an endorsement of the concept of context-sensitive solutions outlined in AASHTO's *A Guide for Achieving Flexibility in Highway Design* (AASHTO 2004a).

> "CSS or Context Sensitive Design are terms used interchangeably and describe a collaborative, inter-disciplinary approach in which citizens are part of the design team. Some design personnel perceive that the application of CSS may result in a conflict or compromise of established design criteria and guidelines and may result in a decrease in the level of safety provided with a corresponding increase in exposure to tort liability. This perception is not supported by the AASHTO CSS process espousing that flexible design solutions are accomplished within established design parameters and approaches."
>
> —Section 110.4, ADOT Roadway Design Guidelines (2012 edition, revised April 2014)

Chapter 5 discusses and details many of the design elements that shape a complete transportation solution. For many of these elements, a range of design values is presented to illustrate the flexibility available. The values presented are acceptable within current ADOT or federal design guidelines.

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Chapter 5: Complete Transportation Design Elements

This chapter describes complete transportation design elements for activity centers in different context types—downtowns and urban areas, suburban areas, and rural areas—and considerations for applying them. This is followed by specific design guidance for each context area based on ADOT, FHWA, and other references as listed within this Guidebook..

The design elements are grouped into the following categories, as presented in Table 6:

- Traveled roadway realm
- Pedestrian realm
- Intersections
- Transit

Table 6: Complete transportation categories and design elements

Complete Transportation Realm	Complete Transportation Elements
TRAVELED ROADWAY REALM	◆ Design speed, number and width of travel lanes, paved shoulders, medians, bicycle facilities, on-street parking, design for large vehicles, intersection vehicular capacity, urban design features
PEDESTRIAN REALM	◆ Sidewalks, pedestrian buffer areas, curb ramps, mid-block pedestrian crossings, mid-block treatments such as pedestrian hybrid beacons, pedestrian refuge islands, pedestrian lighting, wayfinding, landscaping, shared use paths
INTERSECTIONS	◆ Intersection spacing to facilitate pedestrian connectivity; curb extensions; marked crosswalks; signs, lighting, and accessibility features; pedestrian push-buttons; effective access management, use of roundabouts
TRANSIT	◆ Bus shelters, pullouts, bus-only lanes, park and ride lots

The design elements presented in this chapter are not limited to ADOT projects. Local government and regional agencies can also implement complete transportation within their communities by partnering with ADOT and initiating and managing their own projects, including locally funded projects and programs. The list of potential elements is also not intended to be exhaustive. For example, intelligent transportation systems (ITS) and other technology solutions provide benefits in managing travel demand that positively impact the triple bottom line.

Complete transportation design and implementation will vary in scale by context area. Elements in an activity center in an urban area will vary in size and scale compared with those needed in an activity center located along a state highway in a rural area. This chapter places increased focus on activity centers, and highlights design options for activity centers in urban, suburban, and rural areas.

To help determine the most appropriate elements within a given activity center, the complete transportation priority matrix (Figure 28) outlines design priorities for each context area, indicating the high-priority elements that should not be compromised during design.

Figure 28: Complete transportation design elements and applicability or level of focus matrix

	Design Element	Context Area		
		Urban	Suburban	Rural
Traveled Roadway Realm	Design Speed	H	M	L
	Number and Width of Travel Lanes	H	M	L
	Intersection Vehicular Capacity	M	H	L
	Interconnected Street System	H	M	L
	Design Vehicle Selection	H	M	M
	Medians	M	H	L
	Bicycle Facilities			
	» Bicycle lanes	H	H	L
	» Paved shoulders	-	-	H
	» Shared roadway	M	L	-
	On-Street Parking	H	L	L
Pedestrian Realm	Sidewalks			
	» Standard sidewalks	L	H	L
	» Wide sidewalks	H	M	L
	» Shared-use paths	L	H	H
	Pedestrian Buffer Areas	H	M	L
	Pedestrian Refuge Islands	H	H	L
	Pedestrian Hybrid Beacons	H	H	M
	Urban Design Features/Landscaping	H	M	L
Intersections	Intersection Spacing	H	M	L
	Access Management	H	H	H
	Intersection Crosswalks	H	H	L
	Curb Extensions	H	M	L
	Curb Return Radii	H	M	L
	Roundabouts	M	M	M
	Traffic Signal Coordination	H	H	L
Transit	Pedestrian Access to Transit Facilities	H	H	-
	Bus Shelters	H	H	-
	Bus Pullouts	M	M	-
	Park-and-Ride Lots	L	M	M

Legend: H = High M = Medium L = Low

TRAVELED ROADWAY REALM

Design Speed

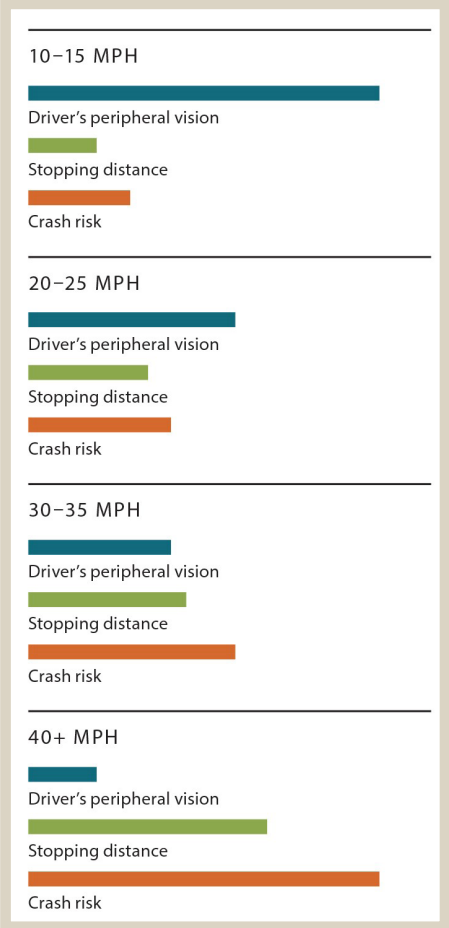
Design speed is one of the most important design criteria. Roadway geometry is dependent on the design speed and other criteria. The design elements are then assembled to develop the roadway cross section.

In many agencies, the selected design speed is often 5 to 10 mph greater than the anticipated posted speed limit, or the 85th percentile speed may be used. ADOT's Roadway Design Guidelines (RDG) identify a range of 30 to 60 mph for arterial streets and urban highways (ADOT 2014).

The Institute of Transportation Engineers' *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach* (ITE 2010) recommends replacing design speed with "target speed." The target speed, or desired operating speed, is the highest speed at which vehicles should operate on a roadway within the specific context area. This speed is consistent with the level of multimodal activity and reflects the roadway function and surrounding land use context. To improve safety for bicyclists, motorists, and pedestrians, the target speed is intended to be used as the posted speed limit.

Lower target speed is an essential characteristic of walkable, multimodal communities. Figure 29 illustrates how a driver's peripheral vision decreases as speed increases. The bar graphs also show that stopping distance increases with speed. These factors indicate that crash risk increases with speed.

Figure 29: Safety effects at different target speeds



Source: NACTO Urban Street Design Guide, page 140 (NACTO 2013).

Identification of the target speed allows the designer to select the design speed and appropriate roadway and roadside features, many of which can contribute to speed reduction. These include:

- Horizontal and vertical roadway geometry
- Narrower travel lanes
- Using on-street parking to create side friction
- Eliminating shoulders, except for bicycle lanes
- Using smaller curb radii
- Eliminating channelized right-turn lanes

Within a complete transportation design approach, the roadway engineer works collaboratively with stakeholders to look toward the future and consider land uses that represent a departure from existing patterns.

- Within urban activity centers, target (and design) speeds should generally range between 25 and 35 mph.
- In a suburban context, design speeds may be slightly higher, in the range of 35 to 45 mph.
- In rural areas, higher speeds may be appropriate.

Travel Lanes

The number of travel lanes should balance through capacity with the need to accommodate other street elements and minimize pedestrian crossing distances. This is particularly important in urban and suburban areas where there are higher pedestrian and bicycle volumes.

Travel Lane Width

Lane widths should be designed based on an understanding of the context, goals for traffic calming, and the need to accommodate larger vehicles such as trucks and buses. According to the AASHTO Green Book, lane widths may vary from 10 to 12 feet for rural and urban arterials.

Narrower lane widths are commonly used in urban areas, especially commercial districts or neighborhoods. Wider 12-foot lanes can be used on the outside lane of multilane facilities for transit or truck routes.

According to a study from the Midwest Research Institute (Potts et al. 2007), "A safety evaluation of lane widths for arterial roadway segments found no indication, except in limited cases, that the use of narrower lanes increases crash frequencies. The lane width effects in the analyses conducted were generally either not statistically significant or indicated that narrower lanes were associated with lower rather than higher crash frequencies. There were limited exceptions to this general finding."

Intersection Vehicular Capacity

A conventional design process utilizes traffic projections and strives to provide the highest practical traffic level of service (LOS). In a complete transportation approach, traffic projections and desired LOS are part of the process of balancing the needs of all roadway users. However, in an individual context area, emphasis may be placed on one user over another.

While capacity and vehicular LOS are important when selecting and sizing design features, they are only two of many factors considered in roadway design. In urban areas, traffic capacity may be secondary to community values or economic development. A complete highways approach emphasizes network capacity as opposed to the capacity of the individual thoroughfare (ITE 2010). A complete transportation approach shifts the focus away from adding vehicular capacity through street widening, instead emphasizing improving overall mobility, safety, and comfort for all roadway users.

The primary objective of activity centers is to improve multimodal mobility—walking, bicycling, and transit—with less emphasis placed on vehicular LOS. Within rural suburban and rural areas, there is more emphasis on vehicular users.

Interconnected Street System

In evaluating design choices for travel lanes and intersection capacity, the character and operation of connecting and parallel roadways should also be considered. Effective partnerships in developing complete transportation solutions may discover mutually beneficial design choices. Network solutions that distribute demand through an interconnected street system, rather than concentrating traffic on a single roadway, may provide community and transportation benefits.

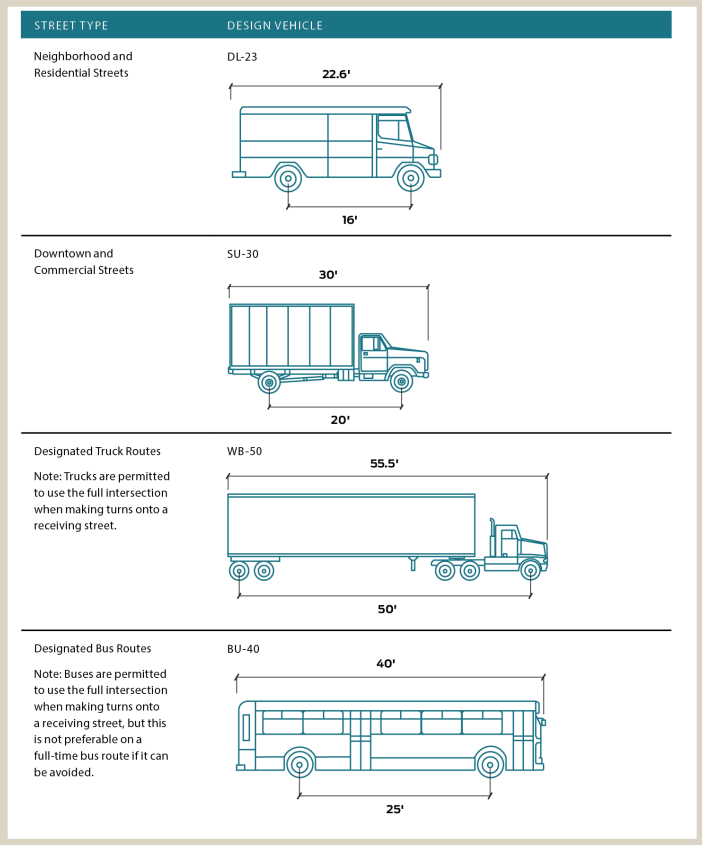
Design Vehicle Selection

As the ADOT RDG states, a design vehicle should be selected carefully, considering the appropriate uses of the intersection and the consequences of not providing for the largest vehicles anticipated. The types of roadways involved, the area where the intersection is located, and the types and volume of vehicles using the intersection determine the design vehicle.

Design vehicle selection also significantly impacts multimodal users. Large turning radii result in longer

pedestrian crossing distances. Design vehicle selection should consider the types of vehicles that will represent the majority of users. Very large trucks can be accommodated through intersections in urban areas, but with the understanding that they may occasionally encroach into adjacent travel lanes. Examples of design vehicles to consider in urban areas are shown in Figure 30.

Figure 30: Sample design vehicles for urban areas



Source: NACTO Urban Street Design Guide, page 145 (NACTO 2013).

Medians

The primary function of a median is to separate opposing traffic flows. However, medians can be used for landscaping, to provide room for left-turn lanes, or to provide a refuge for crossing pedestrians. Median widths vary depending on the purpose of the median.

Bicycle Facilities

In general, bicycle lanes or striped shoulders should be provided on roadways with speeds of 25 mph or greater.

Guidelines and warrants for bicycle facilities indicate that they should be considered in conjunction with projects located in areas with any of the following conditions:

- Within close proximity (3 miles) of a school, college, university, or major public institution (such as a hospital or major park).
- Where a project will provide connectivity between existing bikeways or connect to an existing bikeway.
- Where there is a history of bicycle crashes.
- Along a corridor where bicycle travel generators and destinations can be expected prior to the design year of the project.
- On identified recreation and transportation bicycle routes.
- In any location where engineering judgment, planning analysis, or the public involvement process indicates a need.

Determining the most appropriate type of bicycle facility to place in a specific location depends on many factors, including motor vehicle traffic speeds and volumes, density and type of land use, destinations and ridership, and physical space constraints.

Bicycle Lanes

A bicycle lane is located adjacent to motor vehicle travel lanes or parking lanes, and flows in the same direction as motor vehicle traffic. Bicycle lanes are designated by a white stripe, a bicycle symbol, and signage that alerts all road users that a portion of the roadway is for the exclusive use of bicyclists. Bicycle lanes enable bicyclists to travel at their preferred speed and facilitate predictable behavior and movements between bicyclists and motorists.

Bicycle lane width should be determined by context and anticipated use. The speed, volume, and type of vehicles in the adjacent lanes impact the bicyclists comfort and desire for lateral separation. Bike lanes are typically 4 to 6 feet wide. For roadways with no curb and gutter, and no on-street parking, the minimum width of a bicycle lane is 4 feet. For roadways where the bike lane is immediately adjacent to a curb, guardrail, or other vertical service, the minimum bike lane width is 5 feet (AASHTO 2012). Wider bike lanes (6 to 7 feet) and/or buffers provide additional operating space and lateral separation on roadways with higher speed and higher traffic volumes, thus increasing bicyclists' sense of comfort and perceived safety (Pedestrian and Bicycle Information Center 2014).

Designated and marked bicycle lane

Current ADOT policy requires local participation for installation and maintenance of bicycle lane pavement markings and signage. Refer to the ADOT Bicycle Policy (Policy MGT 02-1; ADOT 2007).

Striped Paved Shoulders

A striped paved shoulder can support bicycle traffic, and in low-volume rural areas, it can also serve pedestrian travel. Striped paved shoulders are not for the exclusive use of bicyclists and therefore do not include bicycle pavement markings.

Striped paved shoulder

Widths for paved shoulders vary from 4 to 10 feet (exclusive of the gutter pan). A narrower striped paved shoulder width is appropriate for a road with a lower traffic volume.

AASHTO's *Guide for the Development of Bicycle Facilities* (AASHTO 2012) provides recommendations for striped paved shoulder width.

Shared Roadway

In most instances, bicyclists and motorists share the same travel lanes. In situations where it is desirable to provide a higher level of guidance to bicyclists and motorists, shared lanes may be marked with a pavement marking symbol. The symbol, known as the shared-lane marking, is useful in locations where there is insufficient width to provide bike lanes. Additionally, neighborhood slow streets, or bicycle boulevards, are a form of shared roadways where a residential or low-volume street provides a comfortable space for bicyclists. Additional traffic calming measures such as mini-traffic circles may be installed along neighborhood slow streets to enhance comfort and connectivity for bicyclists.

Shared-use path

On-Street Parking

On-street parking promotes lower traffic speeds due to side friction between moving and passing vehicles. On-street parking is typically provided in activity centers located in urban or suburban contexts.

PEDESTRIAN REALM

Sidewalks

Sidewalks, provided on both sides of a street, are generally the preferred pedestrian facility. Pedestrian networks should provide direct routes between destinations. They are more densely distributed in urban areas due to a higher level of population and land uses.

An inviting public space for pedestrians at the Roosevelt Station in Phoenix

Pedestrian facilities should be provided on roadways with any of the following conditions:

- Within close proximity (1 mile) of a school, college, university, or major public institution (such as a hospital or major park).
- Within an urbanized area or an area projected to be urbanized by a metropolitan planning organization, council of governments, or local government prior to the design year of the project.
- Where there is a history of pedestrian crashes.
- Any location where engineering judgment, planning analysis, or the public involvement process indicates a need.

Exceptions to these guidelines are low-speed and low-volume roadways (under 400 vehicles per day) where pedestrians may use the paved or stabilized shoulder.

Standard and Wide Sidewalks

Current accessibility guidelines (Access Board, 2011) require a 4-foot minimum continuous and unobstructed clear width for sidewalks. However, the preferred minimum sidewalk width is 5 feet to allow two wheelchair users to pass each other. Higher pedestrian usage, particularly in urban areas, may warrant wider sidewalks to accommodate higher pedestrian flows. A 6-foot width allows for two people to walk comfortably side by side and provides sufficient space for pedestrians crossing in the opposite direction. Sidewalks with a width of eight to ten feet or more should be built where there is no sidewalk buffer along an arterial street and along roads and streets with a high number of pedestrians.

Shared-Use Paths

In addition to serving bicyclists, shared-use paths serve the transportation and recreational needs of pedestrians. Shared-use paths are wider than sidewalks and serve more types of users.

A shared-use path serves as part of the transportation circulation system. Where space allows, a 10- to 12-foot shared-use path may be provided parallel to a roadway as a side path or completely separate from the travel route of a roadway. Shared-use paths allow for travel by both pedestrians and bicyclists, and offer a high level of comfort for users due to their complete separation from motor vehicle traffic.

Pedestrian Buffer Areas

A pedestrian buffer area (often referred to as a buffer or landscaping strip) separates the sidewalk and the roadway. It is the physical area between the back of the curb and the roadside edge of the sidewalk. The buffer strip allows room to place utilities, bus stops, landscaping, street furniture, signs, and mailboxes without obstructing pedestrian travel, and allows pedestrians to pass safely and comfortably. Widths for buffer areas are generally in the range of 4 to 10 feet.

Pedestrian Refuge Islands

Median islands facilitate the crossing of multilane highways by allowing pedestrians to navigate only one direction of traffic at a time. The island provides a protected space for pedestrians to wait for an acceptable gap in traffic. Median islands can also help calm traffic by physically narrowing the roadway. By restricting left-turn movements, median islands have an access management benefit as well.

FHWA lists "Medians and Pedestrian Crossing Islands in Urban and Suburban Areas" among its Proven Safety Countermeasures **(http://safety.fhwa.dot.gov/provencountermeasures/fhwa_sa_12_011.cfm) (FHWA 2012c)**. FHWA suggests that raised medians, that are wide enough to serve as a pedestrian refuge area, should be considered in curbed sections of multilane roadways in urban and suburban areas, particularly in areas where there are mixtures of significant pedestrian and vehicle traffic (average daily traffic of more than 12,000 vehicles) and intermediate or high travel speeds. Medians/refuge islands should be at least 4 feet wide (preferably 8 feet wide for pedestrian comfort and safety) and of adequate length to allow the anticipated number of pedestrians to stand and wait for gaps in traffic before crossing the second half of the street. A length of 6-feet is required to allow for two, 2-foot detectible warning strips with a 2-foot separation.

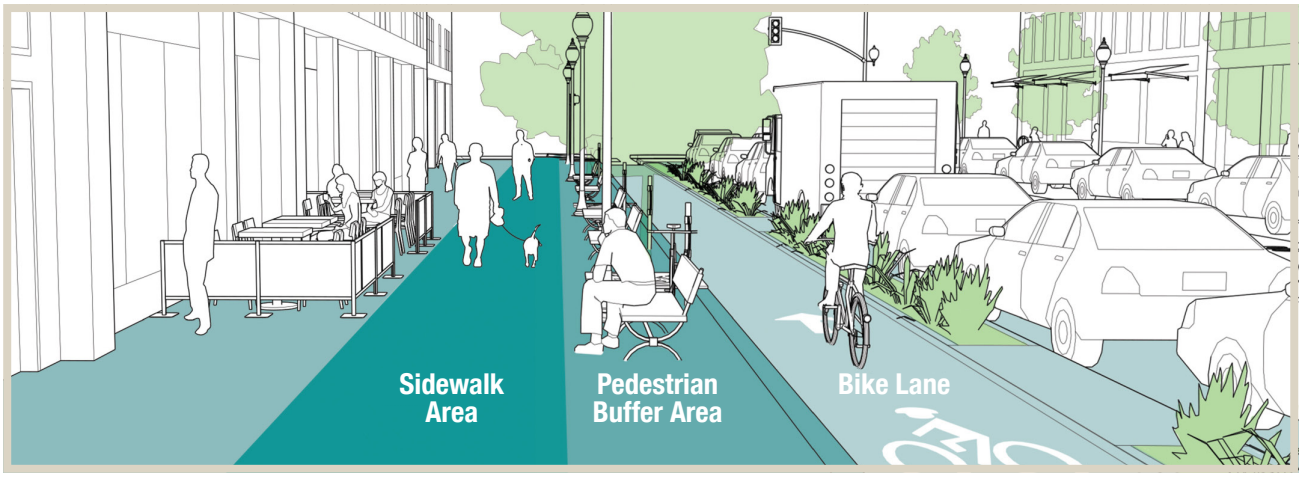
Pedestrian Hybrid Beacons

A pedestrian hybrid beacon (PHB) is a pedestrian-activated warning device located on the roadside or on a mast arm over a mid-block pedestrian crossing. It provides positive stop control in areas without the high pedestrian volumes that typically warrant installing a traffic signal. Design considerations are contained in FHWA's Manual on Uniform Traffic Control Devices (FHWA 2009) and warrants are established in the ADOT Traffic Engineering Guidelines and Processes (TGP) 640 Pedestrian Hybrid Beacons, "PHB Evaluation Guidelines" and Manual on Uniform Traffic Control Devices, Arizona Supplement (2009 edition).

Urban Design Features/Landscaping

Urban design features can improve comfort for pedestrians and other street users. Features include benches, landscaping, and street lighting. Landscaping provides shade for pedestrians and reduces ambient temperatures, particularly in an urban setting where there is a "heat island" effect. Lighting is designed for both pedestrian safety and the context appropriate aesthetics. Pedestrian real design should also consider pedestrian scale wayfinding signs. Pedestrian and bicycle amenities are illustrated in Figure 31.

Figure 31: Pedestrian and bicycle amenities in a downtown area



Adapted from the NACTO Urban Street Design Guide (NACTO 2013).

INTERSECTIONS

Intersection Spacing and Access Management

Managing access appropriate to the facility and context is a critical design choice. This includes the spacing of both intersections and other driveways or connections to balance accessibility and mobility. In general, a roadway primarily intended to serve traffic movement, such as a principal arterial, will have longer access spacing and fewer access connections. Urban areas focus on minimizing the distance between safe crossings to improve pedestrian connectivity as well as providing access to businesses and neighborhoods. As a result, intersection spacing is shorter. In rural areas, intersection and access spacing is typically longer.

Intersection Crosswalks

Crosswalks should be present on all legs of signalized intersections. Crosswalks provide protection to crossing pedestrians and should be striped as wide as or wider than the walkway to which they connect. Crosswalks may also be installed on the controlled legs of unsignalized intersections. Warrants must be met to install crosswalks at uncontrolled locations or on the uncontrolled leg of intersections. Pedestrian crosswalk warrants include gap time, pedestrian volume, approach speed, and other general conditions. Warrants are outlined in Section 910 of the AD*OT Traffic Engineering Guidelines and Processes* (ADOT 2015).

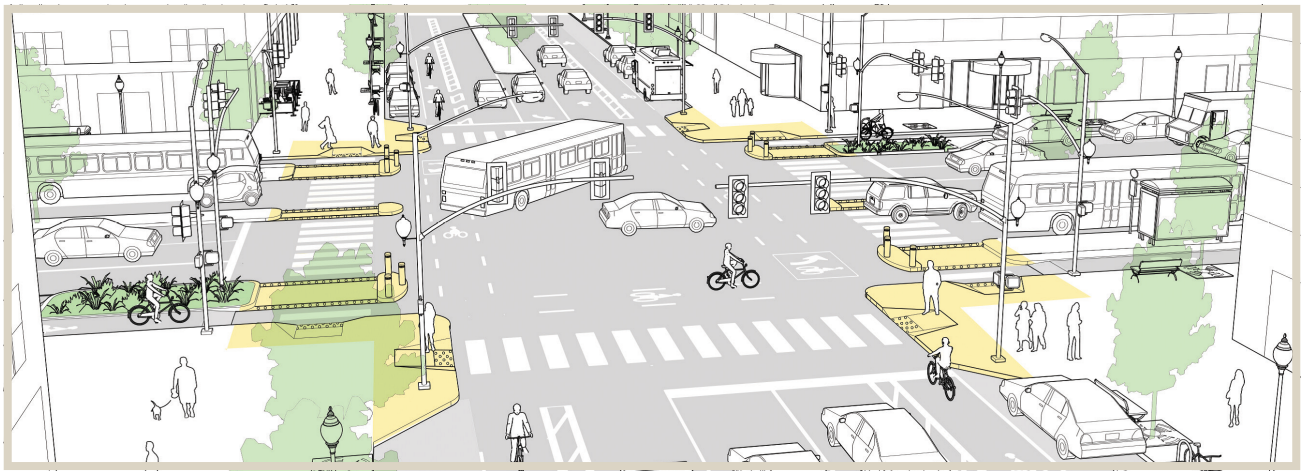
Curb Extensions

In urban and suburban context areas with parking, extending curbs into the parking lanes at intersections can calm traffic and reduce pedestrian crossing distances.

Curb Return Radii

Smaller curb radii and modifications of high-speed channelized right turns can reduce the speed of turning vehicles. Urban areas focus on keeping turning radii as tight as possible to calm traffic. However, wider turning radii may be necessary to accommodate trucks and transit vehicles. Figure 32 illustrates curb opportunities.

Figure 32: Curb extensions, crosswalks, and smaller curb radii



Adapted from the NACTO Urban Street Design Guide, page 95 (NACTO 2013).

Traffic Signal Coordination and Other Features

Traffic signal spacing has a direct effect on roadway efficiency. In general, long and uniform signal spacing reduces delays and better accommodates timing plans during peak and off-peak periods. In urban context areas, signal spacing is typically shorter than it is in rural areas, where distances between signalized intersections are longer. Other available features for traffic signal coordination should be evaluated for benefits in specific contexts. For example, traffic signal priority for buses or a leading pedestrian interval in the signal phasing may enhance safety and accessibility for transit users and pedestrians on specific routes.

Roundabouts

A roundabout is a channelized intersection with one-way traffic flow around a center island. An alternative to signalized intersections, roundabouts may reduce overall delays and congestion. They are typically considered at multileg and heavily skewed intersections. With fewer conflicts and lower speeds than are typical at four-legged intersections, roundabouts can reduce crashes and crash severity. Roundabouts have sidewalks around their perimeter and crosswalks with refuge islands to accommodate pedestrians. In a roundabout, a bicyclist may operate as either a motor vehicle or a pedestrian. Roundabouts may be single-lane or multilane. Multilane roundabouts present increased challenges for pedestrians and bicyclists.

TRANSIT

Pedestrian and Bicycle Access to Transit Facilities

Bicycle and pedestrian facilities should be considered on roadway improvement projects located in areas with any of the following conditions:

- Bicycle facilities: within the 3-mile bicycle catchment area of an existing fixed-route transit facility. A catchment area is defined by the radial distance from a transit facility per Federal Transit Administration (FTA) guidelines. This includes crossing and intersecting streets.
- Pedestrian facilities: within the ½-mile pedestrian catchment area of an existing fixed-route transit facility (such as a transit stop, station, or park-and-ride lot).
- Along identified or known transportation and recreation routes for pedestrians and bicyclists.
- Along any corridor programmed (and funded) to begin construction of high-capacity transit before the roadway project design year.
- Between transit stops or stations and local destinations.

The need for accommodations should be validated through coordination with the transit service provider (and MPO, regional planning commission, and/or local government, where applicable). This coordination is necessary for both existing and planned transit facilities.

Bus Shelters

Bus shelters at major bus stops provide protection from the elements and encourage transit use.

Pullouts

Bus pullouts can be used in suburban or rural contexts, if appropriate. Pullouts can also accommodate school bus stops on rural roads. They are not recommended in urban contexts.

Park-and-Ride Lots

By incorporating accessibility to public transportation, complete transportation projects recognize the value of managing demand by offering modal choices. This approach mitigates new highway needs and may provide community benefits including transit-oriented development or reduced highway demand. Partnerships with local agencies can often identify the need and location for such facilities.

Urban activity center in Flagstaff

COMPLETE TRANSPORTATION IN ACTIVITY CENTERS

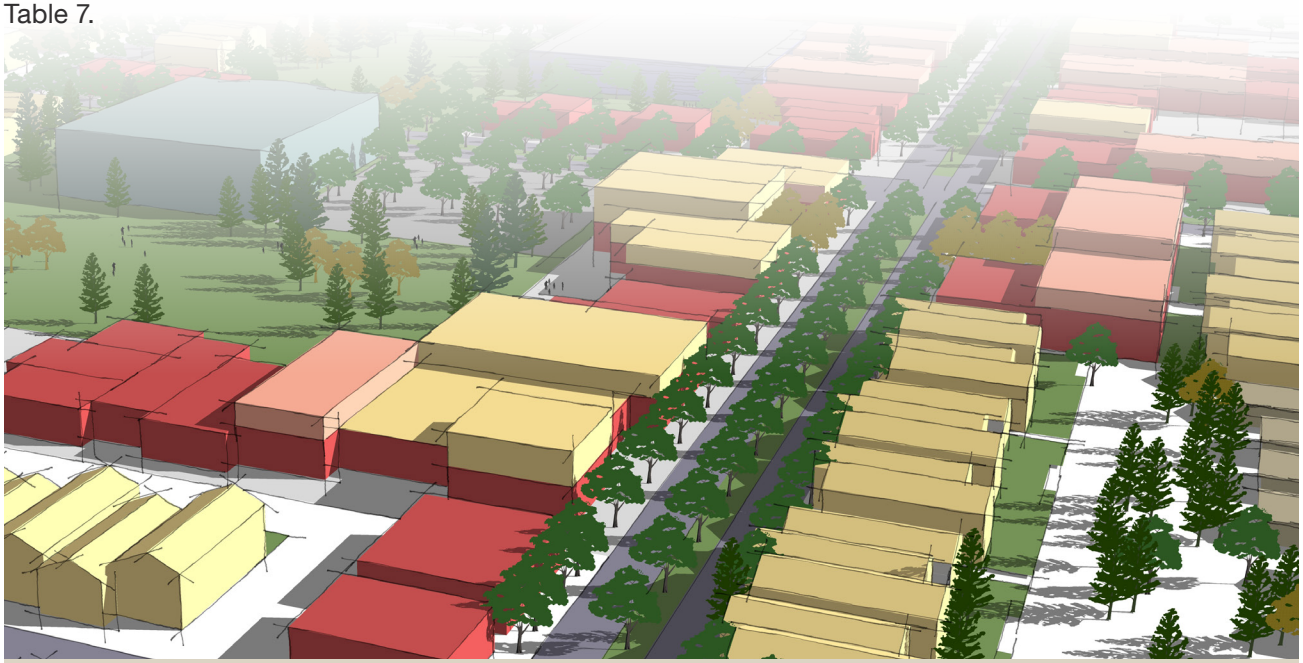
Activity centers vary in size and intensity. In Arizona, activity centers range from an urban downtown area to a commercial node located along a state highway in a rural area. This section describes design elements in activity centers located in three different context types: urban, suburban, and rural.

Activity Center — Urban Context

Characteristics of an activity center in an urban area include:

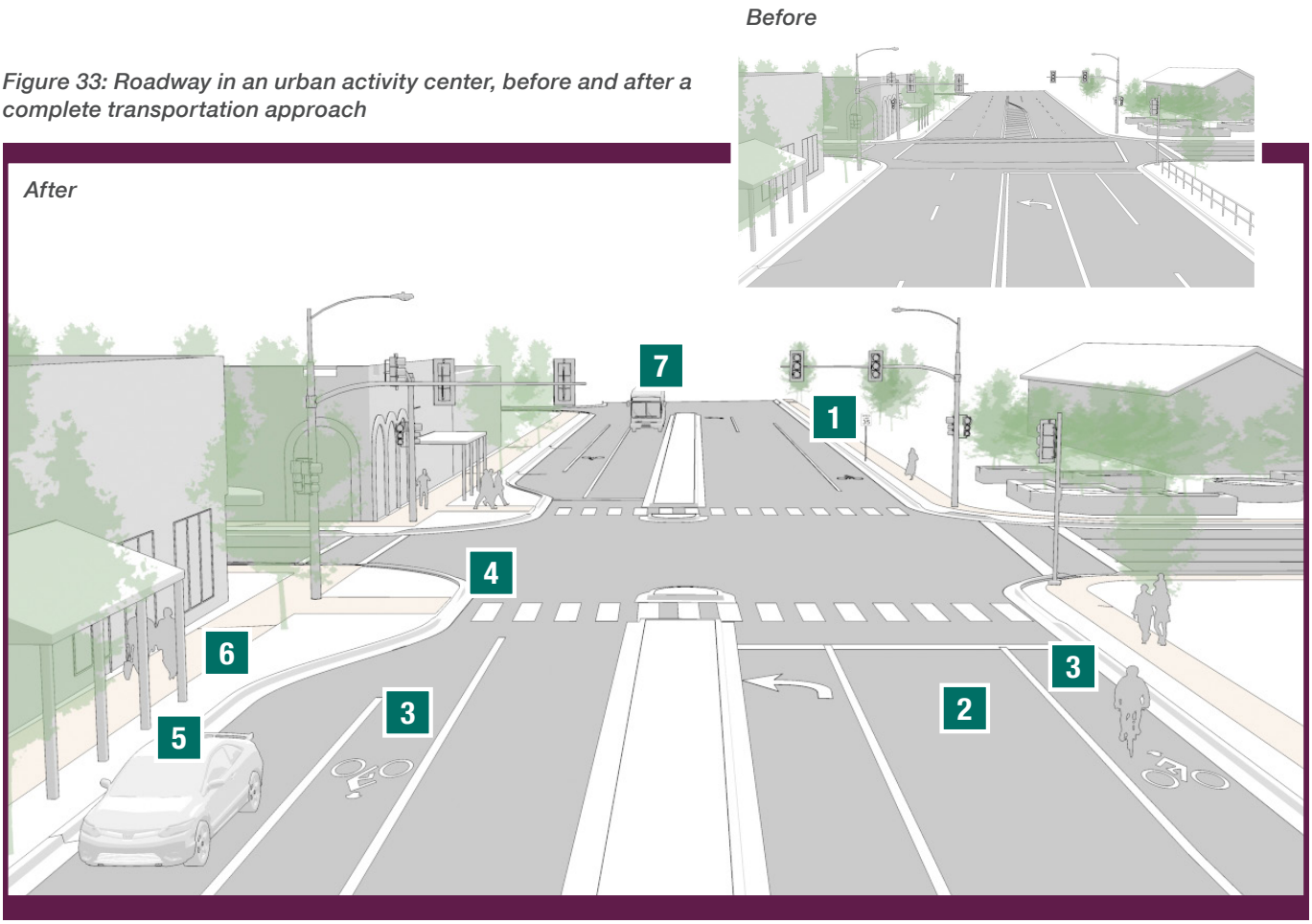
- A mix of economic and residential activities within ¼ mile of each other (or walking distance).
- Locations for a variety of activities, including public facilities and places to work, shop, and gather.
- Expectations for high levels of access to all transportation modes by visitors, residents, and businesses.
- Relatively high volumes of traffic and lower through-traffic speeds.

An example of how complete transportation elements can be applied to a roadway in an urban activity center is shown in Figure 33. An overview of design elements and design considerations is provided in Table 7.



3D visualization of an urban activity center

Figure 33: Roadway in an urban activity center, before and after a complete transportation approach



Recommendations – Urban Activity Centers

1. Design using a target speed of no more than 35 mph in an urban area.
2. Provide narrower travel lanes (10 or 11 feet) to encourage lower speeds and better accommodate bicycles, pedestrians, and transit.
3. Provide bicycle lanes or striped shoulders on all curbed urban areas. The width of the striped area should be 5 feet from the face of the curb.
4. Consider including curb extensions and pedestrian refuge islands to reduce the required crossing distance. Incorporate high-visibility crosswalk markings, which are more easily seen by motorists.
5. Provide on-street parking, which improves access to land uses and can also buffer pedestrians from traffic.
6. To accommodate pedestrians, provide wide sidewalks and a pedestrian buffer area in downtown areas.
7. Include transit facilities such as bus shelters with well-connected pedestrian facilities.
8. Consider a leading pedestrian interval to give pedestrians a head start in crossing a busy intersection.
9. Provide high-visibility crosswalks and refuge areas in medians, and provide accessible ramps at crossings.

This illustration depicts a constrained two-way street in downtown Flagstaff. This street is a main thoroughfare for multiple users, including bicyclists, buses, pedestrians, and vehicles. Parking is required to provide access to shopping and other land uses.

Table 7: Design elements in an activity center: urban context

Design Element	Design Goal	Recommended Dimensions and Considerations for Urban Activity Centers
TRAVELED ROADWAY REALM		
Design Speed	◆ Design for moderate travel speeds to reduce collision risk and severity and improve pedestrian comfort. Lower speeds are preferable.	◆ 25-35 mph ◆ Design speed should equal the target operating speed; serious injury and fatal pedestrian crashes are significantly reduced when speeds are 35 mph or less.
Travel Lanes	◆ Balance the need for through-capacity with need to accommodate other street elements and minimize crossing distances.	◆ 2-4 lanes ◆ 3 or more travel lanes in each direction result in higher-speed roadways; consider connectivity improvements to distribute traffic to other facilities.
Lane Widths	◆ Minimize lane widths in urban areas to moderate vehicle speeds and reduce crossing distances.	◆ 10'-12' (12' outside lanes preferred for transit and/or truck routes). ◆ Lane width decisions should be informed by an understanding of the goals for multimodal mobility as well as ensuring adequate space for larger vehicles such as trucks and buses.
Paved Shoulders	◆ Provide safe, comfortable access for pedestrians.	◆ Provide pedestrian buffer. ◆ 4'-6' wide if bicycle or parking lanes are not present.
Medians	◆ Medians can be used for landscaping, to provide room for left-turn lanes, or to provide a refuge for crossing pedestrians.	◆ 12'-18' wide for left-turn lane; 8'-10' for landscaping.
Bicycle Facilities	◆ Create facilities for safe, comfortable travel by bicycle. ◆ Consult the locality's bicycle plan and work to ensure connectivity.	◆ 5'-6' wide ◆ Bicycle lanes or striped shoulders should generally be provided on roadways with speeds of 25 mph or greater. ◆ Depending on context, consider wide curb lanes, bicycle lanes, or separated bicycle facilities in urban areas.
On-Street Parking	◆ Provide convenient access to local businesses. ◆ On-street parking can also serve as a buffer between pedestrian facilities and travel lanes.	◆ 7'-8' wide
PEDESTRIAN REALM		
Clear sidewalk width	◆ Provide sufficient through-space to accommodate demand and context. ◆ Wider sidewalks should be provided in downtown areas to accommodate higher pedestrian volume and pedestrian amenities.	◆ 5'-8' wide (Higher end of range preferred). ◆ At a minimum, two wheelchairs must be able to pass unobstructed. ◆ Commercial areas may require more sidewalk width. ◆ Sidewalks on both sides of the roadway preferred.
Sidewalk buffer area	◆ Use to provide access to adjacent land uses and to buffer pedestrians from traffic.	◆ 4'-6' wide
Pedestrian refuge island	◆ Raised medians and pedestrian refuge islands allow pedestrians to cross one direction of traffic at a time. This significantly reduces the complexity of the crossing.	◆ Minimum 6' wide for pedestrian refuge ◆ A refuge island can either be open pavement markings or raised medians. ◆ Refuge islands are especially important near transit stops along busy arterials at uncontrolled crossing locations.

Table 7: Design elements in an activity center: urban context (continued)

Design Element	Design Goal	Recommended Dimensions and Considerations for Urban Activity Centers
Mid-block or signalized pedestrian crossing	◆ Provide a safe crossing area at locations of high demand.	◆ Provide if warranted. ◆ Mid-block or signalized pedestrian crossings must be warranted; enhanced treatments (PHBs) should be considered on higher-speed, higher-volume roadways. At mid-block locations, where vehicle speeds are high, signalization may be the only practical means of helping pedestrians to cross.
Urban Design Features/ Landscaping	◆ Provide shade for walkers and reduce ambient temperatures/urban heat island effect.	◆ Consider shade landscaping, low-impact landscaping, pedestrian-scale lighting.
INTERSECTIONS		
Intersection spacing	◆ Minimize distance between safe crossings to improve pedestrian connectivity.	◆ 330' (divided) ◆ 660' (undivided), including alleys
Crosswalks	◆ Provide safe, comfortable access for all users.	◆ Provide marked crossings at all signalized intersections. ◆ Consider mid-block crossings, PHBs, and enhanced treatments where warranted. ◆ Provide ADA-accessible curb ramps.
Curb extensions	◆ Calm traffic and reduce pedestrian crossing distances.	◆ Extend curbs into parking lanes at intersections. ◆ Width of parking lane
Curb return radii	◆ Calm traffic.	◆ Keep turning radii as tight as possible. ◆ 15'-40' ◆ Allow for wider radii where necessary to accommodate trucks and/or transit vehicles.
Traffic signal features	◆ Design traffic signal coordination for all users.	◆ Provide pedestrian push-buttons at signalized intersections with crosswalks. ◆ Consider context-specific features including bus priority, bicycle detection, or leading pedestrian intervals.
TRANSIT		
Bus shelters	◆ Provide safe, comfortable access for all users.	◆ Provide bus shelters where transit is present. Locate at intersections with safe crossings.
Pullouts	◆ Not recommended in urban contexts.	◆ Not applicable
Bus-only lanes	◆ Consider bus-only lanes to speed the highest-frequency, highest-ridership transit routes.	◆ 12'-14' wide

Activity Center – Suburban Context

An activity center in a suburban area is typically located at the intersection of two arterial or collector streets, with a mix of uses serving the surrounding neighborhoods. Examples include smaller mixed-use centers at intersections and larger mixed-use centers along regional corridors. Characteristics of an activity center in a suburban area include:

- Single-use activities (residential, commercial, and employment) separated by parking, vacant land, and setbacks and not within convenient or easy walking distance of one another
- Retail and retail service centers separated by large parking areas
- Commercial centers isolated from other uses and not within walking distance of other commercial uses

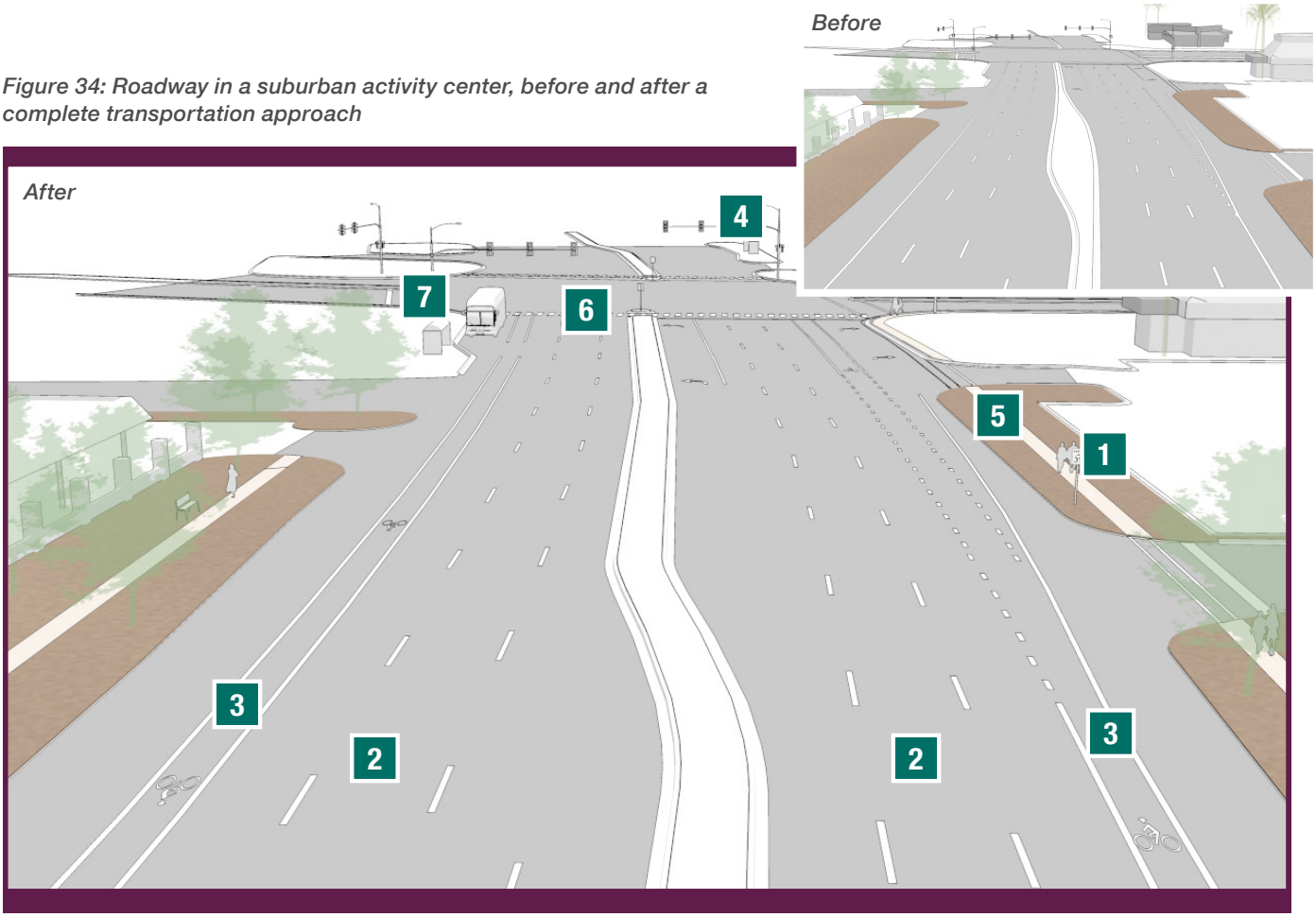
Typical transportation considerations include easy-to-access parking and multimodal access for transit, bicycle, and pedestrian facilities.

An example of how complete transportation elements can be applied to a roadway in a suburban activity center is shown in Figure 34. An overview of design elements and design considerations is provided in Table 8.

At this intersection on SR 77 in Tucson, businesses on both sides of the highway attract pedestrians from nearby housing developments.

3D visualization of a suburban activity center

Figure 34: Roadway in a suburban activity center, before and after a complete transportation approach



Recommendations – Suburban Activity Centers

1. Design speed should equal the target speed, which is the highest speed at which vehicles should operate within the context.
2. Minimize lane widths to moderate vehicle speeds while recognizing the need to accommodate truck traffic.
3. Provide a 4- to 6-foot striped paved shoulder to accommodate bicyclists. Consider a curb and gutter in this section.
4. Consider a leading pedestrian interval to give pedestrians a head start in crossing a busy intersection.
5. Provide a sidewalk and sidewalk buffer in locations with high pedestrian volume.
6. Provide high-visibility crosswalks and refuge areas in medians, and provide accessible ramps at crossings.
7. Provide transit pullouts; consider traffic signal priority for buses.

The illustration above depicts a busy suburban arterial. Suburban arterials serve both commercial and residential land uses.

Table 8: Design elements in an activity center: suburban context

Design Element	Design Goal	Recommended Dimensions and Considerations for Suburban Activity Centers
TRAVELED ROADWAY REALM		
Design Speed	◆ Design for moderate travel speeds to reduce collision risk and severity and improve pedestrian comfort. Lower speeds are preferable.	◆ 35-45 mph ◆ Design speed should equal the target operating speed; serious injury and fatal pedestrian crashes are significantly reduced when speeds are 35 mph or less.
Travel Lanes	◆ Balance the need for through-capacity with the need to accommodate other street elements and minimize crossing distances.	◆ 2 to 6 lanes (Preferred maximum is 4 lanes). ◆ 3 or more travel lanes in each direction result in higher-speed roadways; consider connectivity improvements to distribute traffic to other facilities.
Lane Widths	◆ Minimize lane widths in suburban areas to moderate vehicle speeds and reduce crossing distances.	◆ 10'-12' wide (12' outside lanes preferred for transit and/or truck routes) ◆ Lane width discussion should be informed by an understanding of the goals for multimodal mobility as well as the need to provide adequate space for larger vehicles, such as trucks and buses.
Paved Shoulders	◆ Provide safe, comfortable access for pedestrians.	◆ Provide pedestrian buffer. ◆ 4'-6' wide if bicycle or parking lanes not present.
Medians	◆ Medians can be used for landscaping, to provide room for left turn lanes, or to provide a refuge for crossing pedestrians.	◆ 12'-18' wide for left turn lane; 8'-10' for landscaping
Bicycle Lanes	◆ Create facilities for safe, comfortable travel by bicycle. ◆ Consult the locality's bicycle plan and work to ensure connectivity.	◆ 5'-6' wide ◆ Bicycle lanes or striped shoulders should generally be provided on roadways with speeds of 25 mph or greater. ◆ Depending on context, consider wide curb lanes, bicycle lanes, or separated bicycle facilities.
PEDESTRIAN REALM		
Standard Sidewalk	◆ Provide sufficient through-space to accommodate demand and context.	◆ 5'-6' wide ◆ At a minimum, two wheelchairs must be able to pass unobstructed. ◆ Commercial areas may require more sidewalk width. ◆ Sidewalks on both sides of the roadway preferred; preserve right of way for future sidewalks if not immediately provided.
Sidewalk Buffer	◆ Provide a landscape buffer in suburban/residential areas.	◆ 4'-6' wide ◆ Street trees can provide shade for pedestrians.
Pedestrian Refuge Island	◆ Raised medians and pedestrian refuge islands allow pedestrians to cross one direction of traffic at a time. This significantly reduces the complexity of the crossing.	◆ Minimum 6' wide for pedestrian refuge. ◆ A refuge island can either be open pavement markings or raised medians. ◆ Refuge islands are especially important near transit stops along busy arterials at uncontrolled crossing locations.
Mid-Block or Signalized Pedestrian Crossings	◆ Provide improved pedestrian connections to activity centers.	◆ Mid-block or signalized pedestrian crossings must be warranted; enhanced treatments (PHBs) should be considered on higher-speed, higher-volume roadways.
Urban Design Features/ Landscaping	◆ Provide shade for walkers and reduce ambient temperatures/urban heat island effect.	◆ Consider shade landscaping, pedestrian buffer, pedestrian scale lighting.

Table 8: Design elements in an activity center: suburban context (continued)

Design Element	Design Goal	Recommended Dimensions and Considerations for Suburban Activity Centers
INTERSECTIONS		
Intersection Spacing	◆ Minimize distance between safe crossings to improve pedestrian connectivity.	◆ 660' to 1,320' (Lower end of range preferred).
Crosswalks	◆ Provide safe, comfortable access for all users.	◆ Provide marked crossings at all signalized intersections. ◆ Consider mid-block crossings, PHBs, and enhanced treatments where warranted. ◆ Provide ADA-accessible curb ramps.
Curb Return Radii	◆ Calm traffic.	◆ Keep turning radii as tight as possible. ◆ 15'-40' ◆ Allow for wider radii where necessary to accommodate trucks and/or transit vehicles.
Round-abouts	◆ Simplify traffic movements. ◆ Reduce vehicle speeds to enhance safety for all users.	◆ Consider roundabouts in place of traffic signals. ◆ Consider at multi-leg and skewed intersections.
Traffic signal features	◆ Design traffic signal coordination for all users.	◆ Provide pedestrian push-buttons at signalized intersections with crosswalks. ◆ Consider context-specific features including bus priority, bicycle detection, or leading pedestrian intervals.
TRANSIT		
Bus Shelters	◆ Provide safe, comfortable access for all users.	◆ Provide bus shelters where transit is present. Locate at intersections with safe crossings.
Pullouts	◆ Enhance safety for all transit users and traffic mobility.	◆ Locate near intersection to allow pedestrian access.
Transit Centers	◆ Provide safe, comfortable access for all users.	◆ Consider access to existing or future transit centers.
Park-and-Ride Lots	◆ Provide mode choices. ◆ Reduce single-occupant vehicle trips.	◆ Consider incorporating park-and-ride lots if there is a connection to a bus, rail, or light rail system that will support a significant number of riders.

Activity Center – Rural Context

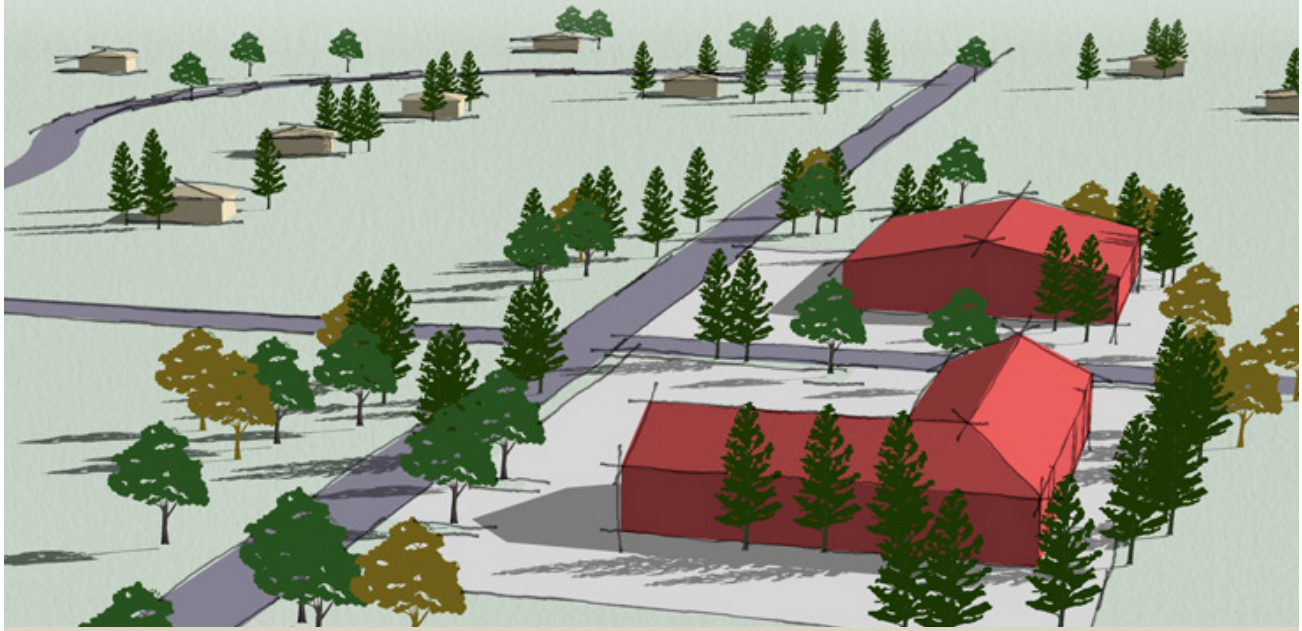
Activity centers in rural areas are typically located in unincorporated areas that are appropriate for local retail and service businesses. Types of land uses could include a wide range of uses to meet residents' needs locally, thus reducing the need to travel out of the area.

Transportation considerations include using rural street design standards, providing easy access to parking, and providing multimodal access, which could include pedestrian, bicycle, transit, and equestrian considerations.

An example of how complete transportation elements can be applied to a roadway in a rural activity center is shown in Figure 35. An overview of design elements and design considerations is provided in Table 9. Design elements are suggested based on criteria for arterial roads in rural areas.

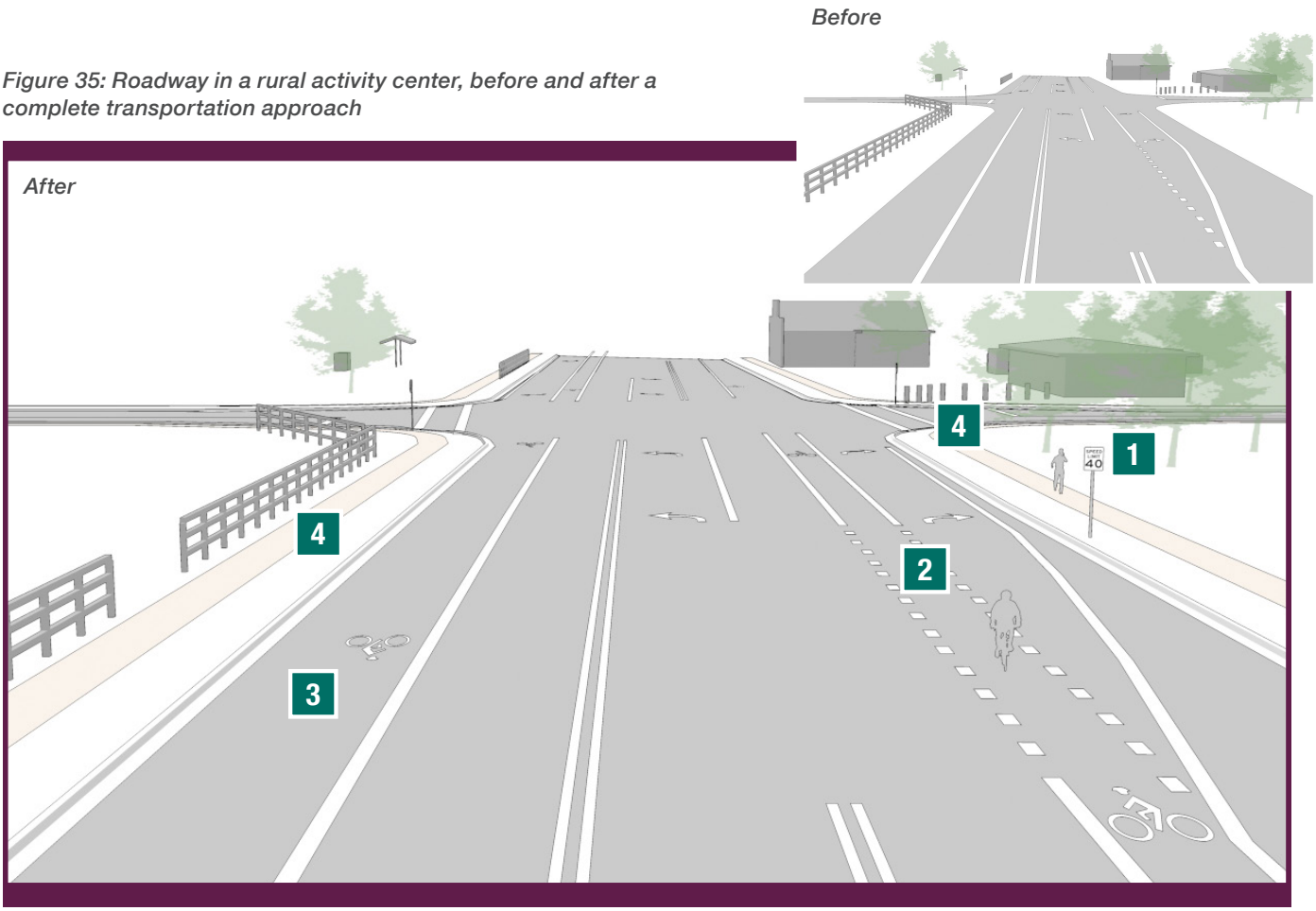
A rural activity center on US 89 within the Navajo Nation. The convenience markets located on opposite sides of the highway generate pedestrian traffic between them.

ADOT constructed sidewalks to accommodate pedestrians along US 89 near Cameron.



3D visualization of a rural activity center

Figure 35: Roadway in a rural activity center, before and after a complete transportation approach



Recommendations – Rural Activity Centers

1. As motorists enter a rural activity center, visual cues should be provided to encourage slower speeds.
2. While lane widths could be narrowed, truck traffic must still be accommodated. Striped shoulders may transition to a bicycle buffer at intersections and in turning lanes.
3. Provide a wide paved shoulder to accommodate bicyclists. Widths of 8 to 10 feet are appropriate. Typically a rural road will not have a curb and gutter.
4. Rural roads do not typically include sidewalks; however, at an activity center, it may be appropriate to include a shared-use path and crosswalks on the cross streets. Consider potential users of the path, such as pedestrians, bicyclists, and equestrians.

The illustration above depicts a two-way street in a rural community. Activity centers in rural areas require many of the same elements as in downtown centers, but on a smaller scale. This example shows a shared-use path.

Table 9: Design elements in an activity center: rural context

Design Element	Design Goal	Recommended Dimensions and Considerations for Rural Activity Centers
TRAVELED WAY		
Design Speed	◆ Design for moderate travel speeds to reduce collision risk and severity.	◆ 35-55 mph—desired operating speed for community arterial ◆ 45-55 mph—desired operating speed for regional arterial
Travel Lanes	◆ Balance the need for through-capacity with need to provide access to land uses along the regional travel route.	◆ 2 to 4—community arterial ◆ 2 to 6—regional arterial
Lane Widths	◆ Provide appropriate lane width for higher speeds of rural context	◆ 11'-12' wide
Paved Shoulders	◆ In rural areas, wide shoulders can be used by pedestrians and bicyclists.	◆ Provide a wide paved shoulder that can support bicycle and pedestrian travel. ◆ Match adjacent sections
Medians	◆ Medians can be used for landscaping, to provide room for left-turn lanes, or to provide a refuge for crossing pedestrians.	◆ Not typically provided except for pedestrian refuge
Bicycle Lanes	◆ Create facilities for safe, comfortable travel by bicycle. Typically the shoulder serves as the bike lane in rural areas. ◆ Connect destinations. ◆ If possible, connect to a larger regional system.	◆ 5' - 6' wide minimum (shoulder width should match adjacent sections)
PEDESTRIAN REALM		
Standard Sidewalk	◆ Sidewalks are typically not provided in rural settings; however, at activity centers, sidewalks should be considered commensurate with anticipated need.	◆ 5'-8' wide, depending on anticipated users
Shared-Use Path	◆ Provide access for multiple users.	◆ 12'-14' wide. ◆ Consider pedestrians, equestrians, and other users.
Pedestrian Refuge Island	◆ Provide a refuge for crossing pedestrians.	◆ Minimum 6' wide for pedestrian refuge
INTERSECTIONS		
Intersection Spacing	◆ Minimize distance between safe crossings to improve pedestrian connectivity; however, in rural areas, distances between intersections will typically be greater.	◆ 1,320' or more

Table 9: Design elements in an activity center: rural context (continued)

Design Element	Design Goal	Recommended Dimensions and Considerations for Rural Activity Centers
Round-abouts	◆ May reduce delay and congestion, increase capacity, and improve safety compared with signalized intersections.	◆ Compare to signal cost and operation.
Crosswalks	◆ Provide marked crossings at appropriate locations.	◆ At unsignalized locations, additional elements such as a PHB or pedestrian refuge islands should be considered. ◆ Minimum 6' wide
TRANSIT		
Bus Shelters	◆ Provide safe, convenient access where school or transit buses operate.	◆ Provide for transit or major school bus stops. ◆ Provide at intersections with safe crossing available, or at designated pullout areas.
Pullouts	◆ May be desirable if speeds are relatively high, boardings are high, and dwell times are long.	◆ Pullouts could accommodate major school bus stops on rural roads.

COMPLETE TRANSPORTATION IN SUBURBAN AREAS

Roads in suburban areas typically provide access to land uses such as walled or unwalled single-family subdivisions, master-planned communities, and large retail or commercial areas that are not within walking distance of other facilities or destinations.

Special design considerations in suburban areas include provision of access while optimizing provision of facilities for walking, biking, and using transit.

An overview of design elements and design considerations is provided in Table 10. Design elements are suggested based on criteria for arterial roads in suburban areas.

SR 347 in Maricopa is the primary arterial through this southernmost suburb of the Phoenix metropolitan area. Higher speeds and single-use land uses represent barriers to a complete transportation approach.

3D visualization of a suburban area

Table 10: Design elements in a suburban context

Design Element	Design Goal	Recommended Dimensions and Considerations for Suburban Areas
TRAVELED ROADWAY REALM		
Design Speed	◆ Design for moderate travel speeds to reduce collision risk and severity and improve pedestrian comfort.	◆ 35-45 mph
Travel Lanes	◆ Balance the need for through-capacity with the need to accommodate other street elements and minimize crossing distances.	◆ 2-4 lanes
Lane Widths	◆ Minimize lane widths in suburban areas to moderate vehicle speeds and reduce crossing distances.	◆ 10'-12' wide (12' wide outside lanes preferred for transit and/or truck routes).
Paved Shoulders	◆ Provide safe, comfortable access for pedestrians.	◆ Provide pedestrian buffer. ◆ 4'-6' wide if bicycle or parking lanes not present
Medians	◆ Medians can be used for landscaping, to provide room for left-turn lanes, or to provide a refuge for crossing pedestrians.	◆ 12'-18' wide for left-turn lane; 8'-10' for landscaping.
Bicycle Lanes	◆ Create facilities for safe, comfortable travel by bicycle. ◆ Consult the locality's bicycle plan and work to ensure connectivity.	◆ 5'-6' wide ◆ Consider wide curb lanes, bicycle lanes, or separated bicycle facilities depending on context.
PEDESTRIAN REALM		
Clear Sidewalk Width	◆ Provide sufficient through-space to accommodate demand and context.	◆ 5'-8' wide ◆ At a minimum, two wheelchairs must be able to pass unobstructed. ◆ Commercial areas may require more sidewalk width.
Sidewalk Buffer	◆ Provide a landscaped buffer to blend with adjacent land uses and separate pedestrians from traffic.	◆ 4'-6' wide ◆ Provide street furniture (lighting, benches, trash cans, bike racks) in suburban areas.
Pedestrian Refuge Island	◆ Provide a refuge for pedestrians.	◆ Minimum 6' wide for pedestrian refuge. ◆ A refuge island can either be open pavement markings or raised medians. ◆ Refuge islands are especially important near transit stops along busy arterials at uncontrolled crossing locations.
Mid-Block or Signalized Pedestrian Crossings	◆ Provide a safe crossing area at locations of high demand.	◆ Mid-block or signalized pedestrian crossings must be warranted; enhanced treatments (PHBs) should be considered on higher-speed, higher-volume roadways.
Urban Design Features/ Landscaping	◆ Provide shade for walkers and reduce ambient temperatures/urban heat island effect.	◆ Consider shade landscaping, pedestrian buffer, pedestrian scale lighting.

Table 10: Design elements in a suburban context (continued)

Design Element	Design Goal	Recommended Dimensions and Considerations for Suburban Areas
INTERSECTIONS		
Intersection Spacing	◆ Minimize distance between safe crossings to improve pedestrian connectivity.	◆ 1,320' to 2,640' (Lower end of range preferred).
Crosswalks	◆ Provide safe, comfortable access for all users.	◆ Consider mid-block crossings, PHB, and enhanced treatments. ◆ Provide ADA-accessible curb ramps.
Curb Return Radii	◆ Calm traffic.	◆ Keep turning radii as tight as possible ◆ 15'-40' ◆ Allow for wider radii where necessary to accommodate trucks and/or transit vehicles.
Round-abouts	◆ Simplify traffic movements. ◆ Reduce vehicle speeds to enhance safety for all users.	◆ Consider in place of traffic signals. ◆ Consider at multi-leg and skewed intersections.
TRANSIT		
Bus Shelters	◆ Provide bus shelters where transit is present. Locate at intersections with safe crossings.	◆ Varies
Pullouts	◆ Enhance safety for transit users and traffic mobility.	◆ Locate near intersections to allow pedestrian access. ◆ May be needed where boardings are high and dwell times are long.
Park-and-Ride Lots	◆ Provide mode choices. ◆ Reduce single-occupant vehicle trips.	◆ Consider incorporating park-and-ride lots if there is a connection to a bus, rail, or light rail system that will support a significant number of riders. ◆ Varies

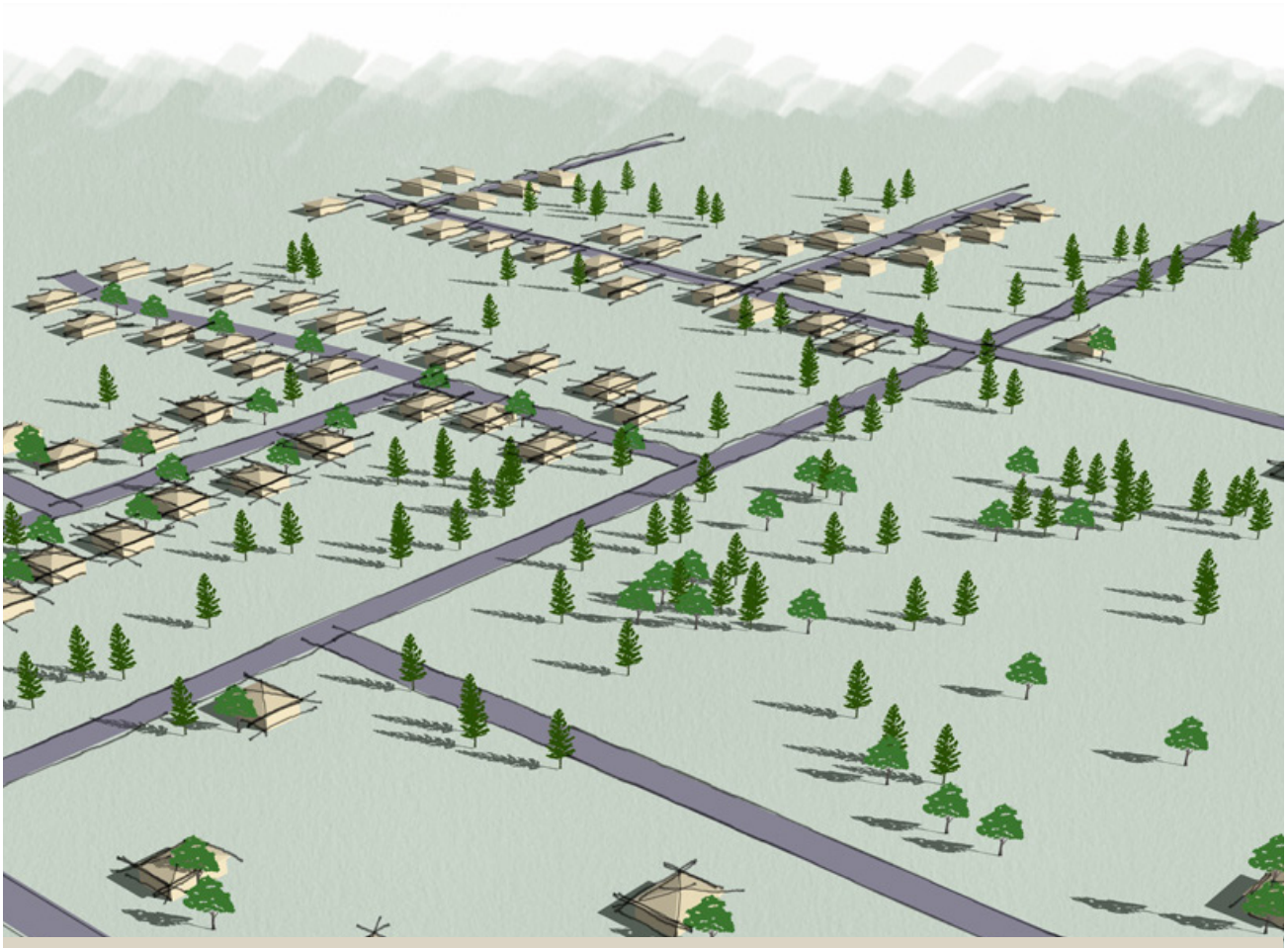
COMPLETE TRANSPORTATION IN RURAL AREAS

Roads in rural areas are generally characterized by open lands with sparse development and limited, generally minor side access requirements. Located away from populated areas, highways in these areas will have higher operating, posted, and design speeds. These roadways will generally be designed in accordance with the ADOT RDG.

On US 89 north of Cameron, a wide paved shoulder accommodates bicycles and pedestrians.

Special design considerations in rural areas include accommodating wildlife crossings, habitat connectivity, and minimizing potential vehicle-animal collisions. Striped paved shoulders can provide adequate bicycle accommodation, and can also accommodate occasional pedestrians.

An overview of design elements and design considerations is provided in Table 11. Design elements are suggested based on criteria for arterial roads in rural areas.



3D visualization of a rural area

Table 11: Design elements in a rural context

Design Element	Design Goal	Recommended Dimensions and Considerations for Rural Areas
TRAVELED ROADWAY REALM		
Design Speed	◆ Design for moderate travel speeds to reduce collision risk and severity.	◆ 45-65 mph
Travel Lanes	◆ Balance the need for through-capacity with the need to provide access to land uses along the regional travel route.	◆ 2-4 lanes (preferred maximum is 4 lanes)
Lane Widths	◆ Minimize lane widths to moderate vehicle speeds and reduce crossing distances.	◆ 12' wide
Paved Shoulders	◆ Provide a paved shoulder that can support bicycle and pedestrian travel.	◆ 5'-6' wide minimum (shoulder width should match adjacent sections).
SPECIAL DESIGN CONSIDERATIONS		
Wildlife Fences and Walls	◆ Reduce vehicle-animal crashes and guide animals to appropriate crossing points.	◆ Design is dependent on characteristics of wildlife crossing patterns.
Wildlife Crossings	◆ Provide wildlife crossings to minimize the potential for vehicle-animal collisions and support wildlife crossing patterns where needed. ◆ Reduce the barrier effect of roadways onto wildlife.	◆ Design is dependent on characteristics of wildlife crossing patterns as well as terrain and other conditions. ◆ Different species require different measures and design criteria.

COMPLETE TRANSPORTATION IN SPECIAL USE AREAS

Open Spaces

Design considerations for roads in open-space areas include providing access to recreational open space, accommodating wildlife movement and habitats, providing pullouts for features such as historical markers and scenic vistas, and coordinating with regional bicycle and trail networks.

Wildlife habitat connectivity is of particular concern along known wildlife corridors and on roads accessing Bureau of Land Management land and U.S. Forest Service land. Some design considerations, excerpted from ADOT's *Guidelines for Highways on Bureau of Land Management and U.S. Forest Service Lands* (ADOT 2008b, page 24), include:

- A roadway alignment that follows the natural terrain of the project area will typically present fewer obstacles to wildlife movement.
- When constructing a new roadway in areas of significant biological value, consider relaxing design standards without compromising safety. For example, in mountainous terrain, consider reducing the design speed to allow steeper grades and tighter turning radii, both of which can minimize disturbances to the adjoining landscape.
- Consider ways to increase wildlife permeability at every opportunity. Bridges are superior to embankments and culverts. Drainage culverts can accommodate both wildlife and water flows.
- Where possible, choose an alignment that screens vehicles from adjoining areas, thereby preventing light and noise pollution from spilling beyond the easement. A natural or artificial berm or vegetative screen can also be effective.
- Widening or improving existing roads should be viewed as an opportunity to increase habitat connectivity, particularly since upgrading typically increases the barrier effect of the corridor. While direct habitat loss is unavoidable with highway construction/upgrading, a mitigation plan that strives to moderate adjacent habitat effects and facilitate safe movement of wildlife across the highway (highway permeability) is a key step in softening these ecological effects. In particular, reducing the barrier effect by maximizing highway permeability is an important objective of the highway design process.
- Recognize that one of the ultimate goals is ecosystem health while implementing a roadway system.

US 93, the Joshua Forest Scenic Road

US 60 through the Salt River Canyon

- Recognize land management agency planning decisions for wildlife movement corridors that identify lands for retention or acquisition for this purpose.

Cultural and Historical Sites

As described in Chapter 3, cultural and historical sites can be located in urban, suburban, or rural settings. These sites can attract varying levels of traffic from tourists, school groups, and interested residents. Special considerations include pedestrian circulation to and within the site and parking needs to accommodate a mix of vehicle types (including tour buses, school buses, and recreational vehicles).

Scenic overlook in the Navajo Nation along US 89

Lake Powell is an example of a cultural site that is a significant tourist destination.

US 93 historical marker

SUMMARY

A summary of design elements for the context areas discussed in this chapter is provided in Table 12.

Table 12: Summary of design elements by context area

		ACTIVITY CENTERS		
	Design Option	**Urban**	**Suburban**	**Rural**
TRAVELED ROADWAY REALM	Design Speed (Lower Speeds Preferable)	25-35 mph	35-45 mph	35-55 mph
	Travel Lanes	2-4 lanes	2 to 6 lanes (preferred maximum is 4 lanes)	2 to 4 lanes (community arterial) 2 to 6 lanes (regional arterial)
	Lane Widths	10'-12' wide (outside lanes preferred for transit and/or truck routes)	10'-12' (outside lanes preferred for transit and/or truck routes)	12' wide
	Paved Shoulders	4'-6' wide (if bike lanes or parking not present)	4'-6' (if bike lanes or parking not present)	5'-6' wide minimum, match adjacent sections
	Medians	12'-18' wide for left turn lane, 8'-10' for landscaping	12'-18' for left turn lane, 8'-10' for landscaping	Not typically provided
	Bicycle Facilities/Lanes	5'-6' wide	5'-6' wide	Typically use paved shoulders
	On-Street Parking	7'-8' wide	Not typically provided	Not typically provided
PEDESTRIAN REALM	Standard Sidewalk	Wide sidewalk desirable	5'-6' wide	Not typically provided
	Wide Sidewalk	5'-8' wide (higher end of range preferred)	5'-8' wide (higher end of range preferred)	If provided, 5'-8' wide (higher end of range preferred)
	Shared-Use Path	Not typically provided	Not typically provided	If provided, 12'-14' wide
	Sidewalk Buffer Area	4'-6' wide	4'-6' wide	Provide if warranted
	Pedestrian Refuge Island	Minimum 6' wide for pedestrian refuge	Minimum 6' wide for pedestrian refuge	Minimum 6' wide for pedestrian refuge, if provided
	Mid-Block or Signalized Pedestrian Crossings (PHB)	Provide if warranted	Provide if warranted	Provide if warranted
	Landscaping	Shade, low-impact landscaping, pedestrian-scale lighting	Not typically provided	Not typically provided

	Design Option	Suburban	Rural	SPECIAL USE AREAS	
				Open Spaces	Cultural/ Historical Sites
TRAVELED ROADWAY REALM	Design Speed (Lower Speeds Preferable)	35-45 mph	45-65 mph	35-65 mph	35-55 mph
	Travel Lanes	2-4 lanes	2-4 lanes	2 to 6 lanes (preferred maximum is 4 lanes)	2 to 4 lanes
	Lane Widths	10'-12' wide (outside lanes preferred for transit and/or truck routes)	11'-12' wide	12' wide	11'-12' wide
	Paved Shoulders	4'-6' wide (if bike lanes or parking not present)	8'-10' wide	5'- 6' wide (shoulder width should match adjacent sections)	8'-10' wide
	Medians	12'-18' wide for left turn lane, 8'-10' for landscaping	Not typically provided	4'-6' wide for pedestrian refuge	12'-18' wide for left turn lane, 8'-10' wide for landscaping
	Bicycle Facilities/Lanes	5'-6' wide	Typically use paved shoulders	Typically use paved shoulders	Typically use paved shoulders
	On-Street Parking	Not typically provided	Not typically provided	Not typically provided	7'-8' wide
PEDESTRIAN REALM	Standard Sidewalk	5'-8' wide	Not typically provided	Not typically provided	5'-8' wide
	Wide Sidewalk	If provided, 5'-8' wide (higher end of range preferred)	Shared-use path desirable	Shared-use path desirable	Varies
	Shared-Use Path	Not typically provided	If provided, 12'-14' wide	If provided, 12'-14' wide	If provided, 12'-14' wide
	Sidewalk Buffer Area	4'-6' wide	Not typically provided	Not typically provided	4'-6' wide
	Pedestrian Refuge Island	Minimum 6' wide for pedestrian refuge	Minimum 6' wide for pedestrian refuge, if provided	Minimum 6' wide for pedestrian refuge, if provided	Minimum 6' wide for pedestrian refuge, if provided
	Mid-Block or Signalized Pedestrian Crossings (PHB)	Provide if warranted	Not typically provided	Not typically provided	Not typically provided
	Landscaping	Not typically provided	Not typically provided	Not typically provided	Not typically provided

Table 12: Summary of design elements by context area (continued)

		Area Type		
		ACTIVITY CENTERS		
	Design Option	Urban	Suburban	Rural
INTERSECTIONS	Intersection Spacing	330' (divided) to 660' (undivided), including alleys	660' to 1,320' (lower end of range preferred)	1,320' or more
	Crosswalks	Width of sidewalk, 6' wide (minimum)	Width of sidewalk, 6' wide (minimum)	6' wide (minimum)
	Curb Extensions	Width of parking lane	Not typically provided	Not typically provided
	Curb Return Radii	15'-40'	15'-40'	Not typically provided
	Roundabouts	Not typically provided	Consider roundabouts in place of traffic signals	Consider roundabouts in place of traffic signals
TRANSIT	Bus Shelters/ Bus Pullouts	Varies	Varies	Varies
	Bus-Only Lanes	12'-14' wide	Not typically provided	Not typically provided
	Transit Centers	Not typically provided	Varies	Not typically provided
	Park-and-Ride Lots	Not typically provided	Varies	Not typically provided
SPECIAL DESIGN CONSIDERATIONS				
Fences and Walls for Wildlife		Not typically provided	Not typically provided	Not typically provided
Wildlife Crossings		Not typically provided	Not typically provided	Not typically provided

		Area Type			
		Suburban	Rural	SPECIAL USE AREAS	
	Design Option			Open Spaces	Cultural/ Historical Sites
INTERSECTIONS	Intersection Spacing	1,320' to 2,640' (lower end of range preferred)	2,640' or more	Not applicable	Not applicable
	Crosswalks	Width of sidewalk, (6' wide, minimum)	Not typically provided	6' wide (minimum)	Width of sidewalk, (6' wide, minimum)
	Curb Extensions	Not typically provided	Not typically provided	Not typically provided	Not typically provided
	Curb Return Radii	15'-40'	Not typically provided	Not typically provided	Not typically provided
	Roundabouts	Consider roundabouts in place of traffic signals	Not typically provided	Not typically provided	Not typically provided
TRANSIT	Bus Shelters/ Bus Pullouts	Varies	Varies; provided along school routes where there is a safety concern with limited sight distances	Varies	Varies
	Bus-Only Lanes	Not typically provided	Not typically provided	Not typically provided	Not typically provided
	Transit Centers	Not typically provided	Not typically provided	Not typically provided	Not typically provided
	Park-and-Ride Lots	Varies	Not typically provided	Not typically provided	Not typically provided
SPECIAL DESIGN CONSIDERATIONS					
Fences and Walls for Wildlife		Not typically provided	Design dependent on type of wildlife	Design dependent on type of wildlife	Design dependent on type of wildlife
Wildlife Crossings		Not typically provided	Design dependent on type of wildlife	Design dependent on type of wildlife	Design dependent on type of wildlife

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