



WILDLIFE FRIENDLY GUIDELINES

COMMUNITY AND PROJECT PLANNING



Arizona Game and
Fish Department

Table of Contents

| | |
|--|----|
| Introduction | 3 |
| Purpose..... | 3 |
| The Future for Arizona’s Wildlife..... | 3 |
| \$\$\$ Economics and Wildlife..... | 3 |
| Planning at Different Scales: The Roles of Community and Project Planners..... | 3 |
| Community Scale - Planning for Wildlife | 5 |
| Wildlife Habitat Connectivity..... | 5 |
| Identifying Wildlife Resources in your Planning Area..... | 6 |
| Wildlife Species Identification..... | 6 |
| Crucial Habitat Identification..... | 6 |
| Wildland Block and Corridor Assessment for Your Planning Area..... | 9 |
| Incorporating Wildlife Conservation into Community Comprehensive or Regional Plans..... | 11 |
| Incorporating Wildlife Conservation into Community or Regional Transportation Plans..... | 15 |
| Maintaining Wildlife Travel Corridors & Minimizing Habitat Fragmentation across Roads and Through Development..... | 15 |
| Conservation Lands Systems / Open Space Programs..... | 19 |
| Considerations for Conservation Lands Systems..... | 19 |
| Habitat Conservation Plans (HCP)..... | 20 |
| Project Scale - Planning for Wildlife | 22 |
| Wildlife Habitat Connectivity..... | 22 |
| Identifying Wildlife Resources in your Project Area..... | 23 |
| Wildlife Species Identification..... | 23 |
| Commercial/Industrial Land Uses..... | 26 |
| Pollution Discharge Permitting & Stormwater Management..... | 26 |
| General Guidelines for Managing Stormwater Runoff for Wildlife Benefits..... | 26 |
| Water Resource Management – Grey Water Use, Conservation..... | 27 |
| General Guidelines for Using Recycled Water to Benefit Wildlife..... | 27 |
| Residential Land Uses..... | 29 |
| Integrated Conservation Design..... | 29 |
| Human/Wildlife Interface..... | 32 |
| Living with Urban Wildlife, Landscaping for Desert Wildlife..... | 32 |
| Fencing to Buffer Natural Areas from Urban Areas..... | 32 |
| Nature Hiking/Biking Trails within Development and Connection with Regional Trails.... | 34 |

Lighting..... 35

Glossary..... 37

Citations..... 39

Appendix I 42

Introduction

Purpose

These guidelines are intended to provide community and project planners the necessary information and tools to help protect wildlife and wildlife *habitat* in and around their planning area.

The Future for Arizona's Wildlife

The Arizona Game and Fish Department's (Department) vision of a 'wildlife friendly' Arizona includes interconnected networks of large *wildland blocks* supporting viable populations of all native species, while providing ample opportunity for people to enjoy and benefit from the presence of wildlife. The Department's vision for the future of Arizona also includes:

- Developing Arizona communities along transportation and infrastructure corridors that are *permeable* to wildlife movement.
- Incorporating wildlife passage structures into roadways to improve human safety.
- Planned communities where residents can enjoy positive wildlife viewing experiences from retained contiguous areas of open space along wildlife movement *corridors* and *riparian* areas that connect to larger wildland blocks.
- Within individual developments, limiting the proportion of disturbed area, utilizing native vegetation, and encouraging water conservation, ultimately allowing residents to enjoy and appreciate Arizona wildlife in their community while avoiding negative interactions.

\$\$\$ Economics and Wildlife

Arizona is a state rich in natural resources with wildlife being one of its most valuable assets. With more than 900 animal species and 50 million acres of public land, Arizona provides some of the best wildlife related recreational opportunities in the nation. The annual economic impact of fishing, hunting, and wildlife watching alone in Arizona is 2.1 billion. In 2006, 1.5 million Arizonans engaged in wildlife associated recreation, with a significant number (1.3 million) participating in wildlife watching activities (US Census Bureau, 2006). The economic return for investing in wildlife conservation is enormous. The promotion and incorporation of natural areas, wildlife, and native landscaping in community planning and development projects, can reap significant financial returns.

Planning at Different Scales: The Roles of Community and Project Planners

Community Planning

Planning for responsible development is done at two scales: the community scale and the project scale. Community planning occurs at the *landscape* level. Community planners are typically professional planners employed by counties, cities, or associations of local governments. The role of the community planner is to work with community leaders to develop comprehensive or regional plans, and to assist community leaders with decisions related to industrial, commercial, residential, recreational, and municipal land uses. Community planners work with state agencies to plan the transportation and infrastructure of an area, and with planners from other communities to foster coordination and cooperation in developing compatible plans. The role of the Department at the landscape scale is to delineate areas of conservation priority and the lands

that provide wildlife means of moving between these areas (*wildlife linkages*). **Community planners are encouraged work with the Department to identify the open spaces and wildland blocks to be maintained in their area, and the necessary connections between those blocks to be preserved or protected.** They are also encouraged to coordinate with developers to ensure new projects are compatible with the community comprehensive/regional plan and fit into the landscape-scale patchwork of existing projects so natural open spaces and wildlife corridors/habitats stitch together across developments and across land ownerships.

Project Planning

Project scale planning occurs at the level of the individual development. Project planners are typically comprised of a team of planners, engineers, and consultants hired by the developer to implement the design concept of a residential, commercial, or industrial development project. Project planners should work with community planners and the Department to ensure wildlife habitat *connectivity* and permeability are maintained across development projects. **The role of the community planner at the project scale should be to help developers understand the impacts their project may have at the landscape level and avoid, mitigate, or minimize those impacts. Project planners should also work with the Department to avoid impacts to wildlife, including threatened and endangered species in the project area and localized sensitive wildlife habitats.** It is at the project scale that community planners, project planners, and the Department can work together to design land use projects that maximize wildlife permeability and minimize human-wildlife conflicts.

Community Scale Planning

Community Scale - Planning for Wildlife

The goal of responsible planning for wildlife at the *landscape* or community scale is to balance the growth, diversity, and mobility of Arizona residents with the sustainability, diversity, and mobility of Arizona wildlife. Communities can achieve this goal by incorporating wildlife planning into their regional/comprehensive plans, their regional transportation plans, and their open space/conservation land system programs. An effective approach to wildlife planning begins with the identification of the wildlife resources in need of protection, an assessment of important *wildland blocks* and connective *corridors*, and the incorporation of these critical wildlife components into the community plans and programs.

Wildlife Habitat Connectivity

Arizona's natural environment is extremely diverse, ranging from tundra on the San Francisco Peaks to the Mojave Desert. Within this range of environments is an equally diverse assortment of habitats and wildlife. In fact, Arizona has the 3rd highest *biodiversity* in the United States (NatureServe 2002). Many species require different habitats in different seasons and need to be able to move long distances between habitats, hence the need for wildlife habitat connectivity. For a wildlife population to be *sustainable*, it must have adequate habitat resources in large, contiguous swaths of undisturbed natural areas (wildland blocks). Fragmentation of wildland blocks reduces wildlife's ability to survive and reproduce. Smaller blocks can often be useful, if provisions for movement between blocks (*connectivity*) are adequate.

As connectivity between wildland blocks is lost, isolation deprives species of their daily, seasonal, and lifetime needs. Loss of connectivity deprives animals of resources, reduces gene flow, and prevents animals from re-colonizing areas where *extirpations* have occurred, and ultimately prevents animals from contributing to *ecosystem* functions such as pollination, seed dispersal, control of prey numbers, and resistance to *invasive* species. Maintaining biodiversity and ecosystem functions requires habitat connectivity. Connectivity can be established through dedicated corridors of undisturbed lands or other forms of open spaces (parks/preserves/monuments) that support wildlife and allow wildlife to move between (*permeable*) wildland blocks. Disturbed areas (agriculture, flood control areas, low density residential areas) can also support wildlife and may act as corridors, especially if the disturbance is managed so as to minimize impacts to wildlife.

Both the wildland blocks and the corridors can also contribute to meeting the economic, recreational, social, and aesthetic needs of people. Smart planning is the key to retaining connectivity between large wildland blocks and increasing the value of disturbed areas to both wildlife and people. Striking the balance between the needs of people and the needs of wildlife is the essential element of responsible development.

Community Scale Planning

Identifying Wildlife Resources in your Planning Area

The first step in protecting wildlife resources is to determine which *species of conservation concern* are in the area and what *crucial habitats* are required to sustain them. There are several tools available to help planners identify species and habitats within their planning areas. In addition, the Arizona Game and Fish Department (Department) will work directly with community planners to identify resources and incorporate conservation concepts into planning documents and maps.

Wildlife Species Identification

Obtain a Species List:

- a. The U.S. Fish and Wildlife Service provides species information at a county level for all listed Threatened and Endangered Species. <http://www.fws.gov/southwest/es/arizona/>
- b. The Department also provides wildlife lists by county and by species. http://www.azgfd.gov/w_c/edits/hdms_species_lists.shtml.
- c. The Department also has a Geographic Information System (GIS) tool – The Online Environmental Review Tool (<http://www.azgfd.gov/hgis/>) from which you can obtain a *special status species list*. Keep in mind that this online tool generates lists primarily for smaller scale planning efforts.
- d. The Department is in the process of developing a Geospatial Planning Tool which will allow overlays of species, stressors, *biodiversity hot spots*, and infrastructure layers.

Crucial Habitat Identification

The Department can help determine where crucial habitats exist, and where they should be preserved. There are also many resources and identification books available to assist in your planning efforts to identify habitats within planning areas including Brown, D. E., and C. H. Lowe (1980).

Crucial Habitat Types:

1. Riparian Areas / Wetlands

Throughout Arizona, aquatic systems and associated *riparian* areas play a major role in maintaining biodiversity and often serve as movement corridors in the landscape context. Riparian communities and aquatic habitat provide migratory birds, pollinating insects, and bats with vital travel corridors for annual migrations. Scattered throughout the state, wetlands, springs, *cieneegas* (marshes), and seeps provide important habitat for a large number of species.

True wet meadows or wetlands with decisively moist organic soils are rare in Arizona, but include *cieneegas* in the eastern and southeastern parts of the state and wet meadows and boggy areas in the higher elevations. Wet mountain meadows and streams are highly productive and provide important habitat for *endemic* plants and wildlife such as the Arizona willow, Mogollon paintbrush, White Mountains clover, and Apache trout.

Community Scale Planning

Riparian areas in the Southwest are crucial habitats for wildlife sustainability. Even though riparian areas make up less than 2% of the total land area in the arid western United States, they are considered the most productive and *ecologically diverse* habitats in Arizona. The role of riparian areas is disproportionate to their size because of their many ecological functions, most importantly:

- Fish and wildlife habitat – 70% of all threatened and endangered vertebrate species in Arizona depend on riparian areas
- Increased water storage and recharge for aquifers
- Reduction of floodwater runoff
- Filtration and retention of upland sediment
- Reduction of chemical inputs from uplands by immobilizing, storing, and transforming
- Stabilization of stream banks and build up of new stream banks

Conservation Recommendations

- Preserve any existing self-sustaining riparian and aquatic ecosystem.
- Strive to protect ephemeral wetlands and ponds which provide important rearing, feeding, and life cycle opportunities for amphibians and other wildlife.
- Do not fragment wetlands with roads, trails, or buildings regardless of wetland size.
- Provide a buffer of upland vegetation of 100 feet or more around the wetland to protect it from sediment and chemical runoff and other degradation.
- Prevent pesticide, lawn, and farm chemicals including fertilizer and petroleum products from reaching the wetland.
- Expect and allow natural fluctuations in water levels. Minimize channelization and allow for natural movement of water over landscape during flood events.
- Minimize disturbance to your wetlands. Enjoy birds and other wildlife from afar.

2. Desert Habitat

Arizona contains portions of 4 different deserts, each with a distinctive biotic community: The Great Basin, Mojave, Chihuahuan, and Sonoran (Brown and Lowe, 1973). Of these, the Sonoran is the most imperiled by development. The flora of the Sonoran Desert is derived from subtropical elements, typically more intensively vegetated and composed of various vegetation communities whose biodiversity is among the highest of any desert in the world (Phillips and Comus 2000). Upland Sonoran desert scrub (Arizona has more than any other state), semi desert grassland, and *xeriparian* wash vegetation communities all provide important habitat to Arizona's diverse biotic community. The emblematic saguaro cactus is found in this community, as are numerous other succulent species including: chollas, pincushions, barrel cacti, organpipe, ocotillo, hedgehog, and prickly-pear. Saguaros provide important nesting habitat and food for a variety of desert wildlife, including gilded flickers, elf owls, and purple martins.

Conservation Recommendations

- Conserve forests of large, mature ironwood, mesquite, and palo verde. The cover and nutrition that mature desert trees provide is a critical resource for many desert wildlife species.

Community Scale Planning

- Conserve large stands of saguaro cacti. Saguaro provide critically important nesting and roosting cavities for a variety of wildlife, and their flowers and fruits are an important foraging resource, particularly for nectar-feeding bats and doves.
- Conserve upland Sonoran Desert scrub to capitalize on its unique biological and aesthetic value to provide high quality open space and passive recreational opportunities.
- Utilize underpass crossing structures for wildlife when planning highways and roads through desert habitats.

3. Hardwood Tree Forests

Hardwood trees, such as aspen and oak, provide food and shelter for a wide array of Arizona's wildlife, while also providing soil stability to minimize erosion. Aspen forests are important for biodiversity: over 130 bird species use aspens for cavity nesting as well as insect-foraging in the leafy canopy. Aspen are also important forage and thermal cover for small and large mammals (from the chipmunk to the elk). Gambel's oak is particularly important in ponderosa pine forests because it provides rare forest understory habitat. Large, mature oak trees with cavities are the most important roosting sites for bats in ponderosa pine forests and Mexican spotted owls use these large oaks for thermal protection and hunting. Oak acorns provide essential nutrition for many wildlife species including bears, squirrels, and deer.

Conservation Recommendations

- Preserve aspen and mature oak forests within the planning area.
- Limit grazing and over-browsing of aspen stands. Grazing and over-browsing can significantly reduce aspen regeneration, understory foliage volume, and the structural diversity important for numerous bird species. Encourage community construction projects to build and maintain fences around aspen stands. Fences should be a minimum of 8 feet tall.
- Discourage cutting of mature and standing dead oak. These large oaks provide a very significant and rare habitat resource for wildlife and should be preserved wherever possible.

4. Grasslands

Grassland systems have great social, economic, and ecological value. Historically, grasslands occurred across one-third of Arizona – over 24 million acres. They provide unique wildlife habitat and play an important role in water collection and percolation to help form the headwaters of rivers such as the Verde and San Pedro. There are many sensitive wildlife species that specialize in grassland habitats including: pronghorn, prairie dogs, burrowing owls, and ferruginous hawks.

Grasslands are recognized by many as the most imperiled ecosystem worldwide. Grasslands in Arizona have changed considerably over the last 130 years, due primarily to agricultural and urban conversion but also due to the invasion of woody shrubs such as mesquite and juniper. Only 31% of the state's former grasslands are in good condition, containing their native perennial grasses and low shrub cover.

Community Scale Planning

Conservation Recommendations

- The Department recommends preserving any native grassland in the planning area to ensure persistence of grassland birds and other grassland wildlife.
- Avoid planning highways across grasslands. Highways can cause significant fragmentation of habitat for grassland wildlife such as pronghorn. Because of their keen ability to detect movement from great distances, pronghorn will often avoid and refuse to cross high-traffic roadways.

Wildland Block and Corridor Assessment for Your Planning Area

The most effective way to ensure wildlife sustainability and habitat *connectivity* in your community is to delineate where the wildlife *wildland blocks* and *corridors* occur within your planning area. Once delineated, this information becomes a useful planning tool to help guide and inform growth, transportation, and conservation decisions that may impact wildlife and their habitats.

Delineating Wildland Blocks

Wildland blocks are large contiguous pieces of relatively undisturbed land dominated by natural vegetation that support habitat for a diverse array of native species, and have low levels of urbanization and agriculture. In general, wildland blocks should be large in size and have a relatively high area to perimeter ratio.

One approach to delineating wildland blocks in a planning area is to use distribution data for the suite of wildlife species potentially existing within a planning area. Species to include are typically identified by a scientific advisory committee assisting with plan development. Steps in the process are:

- a. Determine threatened, endangered, and sensitive species within the area
- b. Select a focal set of other species that represent the range of biodiversity for your area. Include species that have large-area requirements for survival (such as deer, bobcat, bear, or mountain lion).
- c. Determine the boundaries of suitable habitat for the suite of species.
- d. Establish a boundary around the relatively undisturbed area necessary to sustain populations of the species in the focal group.

Another approach is to use public land ownership boundaries within your planning area. Large areas of public ownership typically have a lower probability of habitat fragmentation relative to private and State Trust lands, and will encompass most of the primary habitats for wildlife in your planning area. Keep in mind, however, that wildland blocks can include State Trust or private lands if they are relatively unfragmented, dominated by natural vegetation that support habitat for a diverse array of native species, and have low to moderate levels of urbanization and agriculture. A combination of the approaches above should be assessed and utilized to appropriately identify wildland blocks within your planning area. For further assistance and available information contact the Department Regional office or the Phoenix Headquarters. Contact info can be found at: http://www.azgfd.gov/inside_azgfd/agency_directory.shtml.

Wildlife Corridors

Community Scale Planning

Wildlife corridors are the connections between wildland blocks that facilitate wildlife movement between areas. Corridors are critical for wildlife with large-area requirements, those species that migrate seasonally, and for all wildlife to maintain genetic diversity.

Corridor width requirements vary by the species that use them. For example, a flat-tailed horned lizard may not require a corridor as wide or as long as what might be needed for a black bear to pass safely from one habitat block to another. By planning corridors for those wildlife species with the largest width requirements, you can assume that you have provided the appropriate corridor width for most if not all of the wildlife species in your planning area.

So what makes a wildlife corridor? Streams, washes, canyons, and mountain ridges are some of the most frequently used landscape features for wildlife movement. Among these, *riparian* corridors are crucial because they house the highest wildlife diversity and yet are among the rarest landscape features in Arizona. When possible, planners should consult with the Department and local biology and wildlife experts to identify crucial wildlife movement corridors in their planning area. To identify wildlife corridors consider:

1. The Arizona Wildlife Linkages Assessment provides a broad framework of *wildlife linkages* and wildland blocks that exist around the state http://www.dot.state.az.us/Highways/OES/AZ_WildLife_Linkages/assessment.asp. The assessment document and map are the initial efforts to identify potential linkage zones that are important to Arizona's wildlife and natural *ecosystems*. While this is only the first step in a continuing process of defining crucial habitat connectivity areas, it provides an extremely valuable planning tool for community planners.
2. The Department is currently working to further define and identify wildlife corridors within each county of the State. Wildlife linkages identified in Maricopa County are nearly ready for public distribution, and the identification process is set to begin for Coconino County in the near future. Please contact your Department Regional Office or the Phoenix Headquarters for updates and further information. Contact information can be found at: http://www.azgfd.gov/inside_azgfd/agency_directory.shtml.
3. If wildlife corridors have not been defined, topographic features such as streams, washes, ridges, and canyons may be used in a GIS framework to determine potential corridors. For more information on approaches to wildlife corridor assessment, refer to the Corridor Design website <http://www.corridordesign.org/>.

Community Scale Planning

Incorporating Wildlife Conservation into Community Comprehensive or Regional Plans

Community planners have several tools they can use to incorporate wildlife conservation into local land use decision-making. Below is a list of examples of the types of planning tools that can guide responsible development for wildlife in your community.

1. Wildlife Conservation Policies

County and regional plans that identify conservation of wildlife and their *habitats* as a goal or policy are a powerful tool for responsible development. Wildlife protection policies give community planners the authority to recommend wildlife habitat mitigation measures as part of the approval process in land use planning and zoning cases. Mitigation measures can be important to ensure “no net loss” of wildlife habitat, allowing for ongoing development, but providing conservation in other areas.

Select Examples from Arizona Communities:

- Coconino County Comprehensive Plan, 2003 Natural Environment Goal: “Protect wildlife communities and their habitat.” See the Natural Environment section on pages 23-32.
- Pima County Comprehensive Plan, Updated 2007 Environmental Element, Natural Resources, Conservation Lands System: “Conservation actions are to be encouraged, and protection of biological resources is considered an essential component of land-use planning.” See Regional Plan Policies pages 39-47.
- Maricopa County Comprehensive Plan: 2020 Eye to the Future, 2002 Policy EE4.2: “Encourage protection of all endangered and threatened plants and wildlife designated on the Endangered Species List for Maricopa County.”, and Policy EE4.3: “Encourage the development of *corridors* linking established and proposed open space areas to allow migration of wildlife and encourage *biodiversity* of species.”
- City of Yuma, General Plan, 2002 Conservation and Environmental Element, Objective: “Promote the protection of the diverse wildlife in the Yuma area and the protection of natural habitats.”

2. Open Space Policies

Community open space is often composed of active recreation parks such as playgrounds, soccer fields, and golf courses. But when composed of undisturbed natural areas, community open space can serve as an important wildlife linkage between *wildland blocks* while also providing positive wildlife viewing experiences for community residents and visitors. Wildlife-based open space goals, policies, and objectives should be incorporated into county and regional plans, or within other departmental planning documents such as parks and recreation plans, regional open space and greenway plans, or natural resource management plans.

Community Scale Planning

Select examples from Arizona communities:

- Pima County Region Plan, Policy 6 Environmental Element, Natural Resources, Conservation Lands System (amended 2005): “Ensure the long-term survival of the full spectrum of plants and animals that are indigenous to Pima County through maintaining or improving the habitat conditions and ecosystem functions necessary for their survival”.
- Pinal County Open Spaces and Trails Master Plan 2007, Objective 1.1: “Preserve, protect, or conserve areas of critical habitat and high habitat value and wildlife movement corridors”.
- City of Tucson, 2001 General Plan Element 10: Parks, Recreation, Open Space, and Trails (PROST), “Promote the preservation and protection of remaining natural riparian habitats along all watercourses designated as trail corridors to recognize their multiple values for recreation, flood control, wildlife habitat, and open space”.
- City of Flagstaff 1998 Open Spaces and Greenways Plan: “Conserve natural ecosystems and wildlife habitats to be compatible with human needs for recreation functioning watersheds and community safety. Minimize the loss of critical wildlife habitat to keep wildlife in and around Flagstaff”.

3. Environmentally Sensitive Lands Policies and Ordinances

Policies in county/regional plans that emphasize conservation of environmentally sensitive lands are encouraged, and can be translated into ordinances that prevent development of those resources within a planning area. Environmentally sensitive lands are those with critical resources such as: floodplains, riparian zones, rivers and streams, wetlands, springs and seeps, steep slopes, and known crucial wildlife habitat and movement corridors.

4. Wildlife Reference Maps

Many county and regional plans will include maps of land use zoning and planned roads and trails, among other existing and future land uses within the planning area. Maps are useful tools in county and regional plans because they help guide specific types of development in appropriate locations, and they help users identify where issues may arise based on proposed changes in land use.

Wildlife species and habitat reference maps can be used alongside other planning maps. If community planners and project developers know ahead of time that a proposed land use has the potential to negatively impact a wildland block or corridor (see above), they can identify the steps necessary to avoid and mitigate their potential impact. County and regional plans can also authorize the use of these wildlife reference maps in the planning and zoning decision-making process to regulate those impacts to wildlife (see Conservation Lands System, below).

In addition to the steps listed above for identification of species and habitats within planning areas, planners should also contact Regional Arizona Game and Fish Department offices for additional area-specific information on wildlife, habitats, and corridors for incorporation into planning maps. Contact information can be found at:

http://www.azgfd.gov/inside_azgfd/agency_directory.shtml

Community Scale Planning

5. Zoning Designs to Conserve Wildland Blocks

The long-term viability of Arizona's wildlife depends on appropriate placement and planning of development. The Arizona Game and Fish Department (Department) encourages communities to guide development along available and planned infrastructure, utilities, and services, balanced with the available water supply.

- a. Design wildlife corridors through developing communities to maintain connectivity between wildland blocks. Wildlife reference maps that identify wildland blocks and corridors can assist with zoning decisions. Coordination with the Department will also help ensure that wildlife corridor design and placement will be beneficial to local wildlife.
- b. Avoid disconnected or spot development outside infrastructure corridors to avoid fragmentation of otherwise contiguous wildland blocks.
- c. Encourage infill development within already urbanized zones.
- d. Encourage a decreased intensity of land use as you move away from growth corridors, where low-density residential is the last development at the interface of wildlife wildland blocks. This zoning design creates a gradient or buffer effect between intensive human uses and wildlife. Development within growth corridors has the least impact to wildlife when it follows an integrated conservation design, described in #6 below.

6. Integrated Conservation Design

County and regional plans can also use policies to encourage creative planning and development that minimizes the loss of wildlife habitat and environmentally sensitive areas. These policies typically involve the incorporation of open space into development design. Ideally, these open space areas connect to larger wildlife corridor systems or protect environmentally sensitive lands such as wetlands, *riparian* areas, or steep slopes. Though implemented at the project scale, we encourage communities to recognize and describe these tools at the county/regional plan level to pave the way for their usage.

a. Clustering

This approach involves clustering development on a portion of the property that is less environmentally sensitive and allows the same net density that would be permitted with a conventional grid design under the existing zoning.

- i. Clustering can be implemented through zoning ordinances that specifically allow clustering, or
- ii. By amending existing zoning ordinances to allow clustering without a zone change.
- iii. When a cluster approach is combined with the specification of building envelopes (designated spaces where structures are permitted), the land surrounding each site plus all other undeveloped land can be held in common by all owners for wildlife conservation purposes.
 - For an Arizona community example, see Coconino County's Planned Residential Development Zoning Ordinance: http://www.coconino.az.gov/uploadedFiles/Community_Development/Section13.pdf.

Community Scale Planning

b. Transferring Development Rights (TDR)

This approach is another means of protecting highly sensitive wildlife wildland blocks and corridors in your planning area. It allows area sending property owners to realize an economic benefit from their property without having to develop the entire property. It also allows receiving area property owners to develop at densities greater than is permitted under the existing zoning. TDR programs can be implemented through direction provided in the county/regional plan, and then followed by development of a new ordinance.

- For an Arizona community example, see Pima County's Transfer of Development Rights (TDR) Program: <http://pimaxpress.com/planning/>

c. Density Bonus

An incentive-based approach where density of a developed area increases proportionately with every increase in area set aside for open space. Again, this type of approach is typically implemented via ordinance but is good to recognize at the county/regional plan level in order to ensure consistency in planning.

- For an Arizona community example, see Cochise County's Subdivision Regulation 603: Residential Conservation subdivision that awards a 30% density bonus to subdividers willing to dedicate 50% of their land for permanent open space

7. Conservation Acquisition and Easement

Perhaps one of the simplest and best ways to ensure wildlife habitat connectivity at the community scale is through purchasing lands in *fee simple* to set aside for conservation. Many Arizona communities have passed voter-approved bonds and initiatives that generate funds for the purpose of acquiring lands for public parks and natural open space. Recognition of this strategy in the county comprehensive plan or city/town general plan is an appropriate first step toward open space programs. Incorporating wildlife habitat connectivity objectives into those open space programs is one of the most effective methods you can use to ensure development does not occur in areas where wildlife will be most sensitive to habitat loss.

Rarely, however, do communities have the funds to purchase land in fee simple. One alternative to fee simple purchase is the purchase or donation of *conservation easements*. Conservation easements allow landowners to retain their property and associated tax benefits, while restricting development rights in perpetuity. Conservation easements are flexible and can be tailored to meet the needs of all parties involved. In most cases, they are purchased for a portion of the land's fair market value and a third party, such as a government agency or a nonprofit land trust, holds the easement. Conservation easements are very effective tools for wildlife conservation, particularly on large ranchlands or in areas where wildlife habitat corridors pass through urbanizing areas.

Community Scale Planning

Incorporating Wildlife Conservation into Community or Regional Transportation Plans

Transportation planning can have very direct impacts to wildlife (Panayides, 2006). As Arizona's urban and rural communities continue to expand, an increasing network of roadways are being planned and constructed to accommodate population growth. Where interstates are expanded and new highways are constructed, commercial and residential development is never far behind. As transportation systems are expanded outward, impacts to important wildlife *habitats* and *corridors* can be significant.

Roads act as barriers to wildlife, changing the physical *landscape* by altering hydrology and vegetation cover (1000 Friends of Florida, 2006-2007), and creating structures that some wildlife physically cannot cross over or under. **While road density may be a commonly used tool to measure impacts to wildlife, consideration should be given to the fact that road design and traffic volumes for any given area will have different impacts to different wildlife species** (Irwin, 2009).

To successfully design a transportation system that promotes human safety and minimizes impacts to wildlife, coordinate early and often with the Department and other wildlife stakeholders. There are generally two opportunities to reduce the impacts of roads on wildlife:

1. Modify current design and infrastructure of existing roads to accommodate wildlife passage (e.g. culverts, underpasses, overpasses, bridges)
2. Proactively plan, design, and engineer appropriate infrastructure through planned roads, highways, and other roadway networks to allow larger mammals to safely pass.

Efficient transportation planning can play a vital role in shaping where and how new growth occurs. Evaluating the overall landscape for *wildland blocks* and corridors, coordinating with state & federal wildlife management agencies, and understanding how transportation plans can facilitate future development are all essential to reducing or avoiding potential impacts to wildlife and their habitats.

Maintaining Wildlife Travel Corridors & Minimizing Habitat Fragmentation across Roads and Through Development

Fencing can act as a barrier to wildlife when construction is done without regard or knowledge of specific wildlife in the area. If fencing is necessary, it should be designed to allow for wildlife permeability, where appropriate and safe, and without compromising the intended use of the fence. Fencing design and roadway infrastructure engineering must be considered concurrently to allow for wildlife passage and to minimize vehicle – wildlife collisions.

One of the first steps a planner should take is to identify wildlife species, habitats, wildlife corridors and movement patterns of wildlife in the planning area.

Community Scale Planning

1. Available Maps and Tools to Identify Wildlife Corridors

- Arizona Wildlife Linkages Assessment at http://www.dot.state.az.us/Highways/OES/AZ_Wildlife_Linkages/index.asp
- The Maricopa County Wildlife Linkages Assessment will be available in 2009. Additional County wildlife linkage assessments will be forthcoming.
- Arizona Linkage Design Reports at <http://www.corridordesign.org/arizona/>
- The Department is developing a Geospatial Planning Tool which will allow overlays of species, stressors, *biodiversity hot spots*, and infrastructure layers.
- Road kill database – Arizona Game and Fish Department & Arizona Department of Transportation
- Also see the ‘Wildland Block and Corridor Assessment for Your Planning Area’ section, above.

2. Overarching Recommendations

These are general recommendations for planners to consider, but each planning area is unique and will require specific guidelines be developed to ensure successful conservation efforts.

- Fragmentation of wildland blocks or contiguous habitat should be avoided whenever possible. If these wildland blocks must be fragmented, mitigate through the appropriate wildlife crossing structure (see ‘Integrating Crossing Structure Engineering Guidelines’ below).
- Where multiple roads serve the same destination or population centers, consolidation of the roads should be considered to avoid further habitat fragmentation.
- If new roads are built, remove/obliterate parallel roads and revegetate with native vegetation.
- Proposed road designs within a community should be evaluated for both human safety and wildlife permeability.
- Large/wide road medians present both an opportunity and threat to wildlife. Wildlife (especially low flying birds and small mammals) attracted to habitat within the median may be at risk not only while crossing the roadway but also because of the possibility of becoming trapped between traffic lanes.
- Use native vegetation for median and sidewalk/curb landscaping whenever possible.
- When domestic livestock are not present, fences within the right-of-ways and/or within wildlife corridors should be removed.
- Fencing can also be effective in guiding wildlife to safe crossing structures (*funneling*) along roadways to prevent crossing in unwanted areas.

3. Roadway Fencing

Fence wire spacing and type of wire (smooth or barbed) should be evaluated depending on wildlife species present. Right-of-Way (ROW) fencing along roads should adhere to wildlife friendly fence design specifications which can be found at <http://www.azgfd.gov/hgis/pdfs/FencingGuidelines.pdf>.

4. Integrating Crossing Structures: Engineering Guidelines

Community Scale Planning

- Effective wildlife crossing structures can be designed to move wildlife over or under the road, based on the wildlife species affected, topography, linkage location, and habitat structure. The websites given below provide information on these structures:

<http://www.azgfd.gov/hgis/pdfs/BridgeGuidelines.pdf>

<http://www.azgfd.gov/hgis/pdfs/CulvertGuidelinesforWildlifeCrossings.pdf>

You can use road kill density information to establish appropriate crossing areas and types of crossing structure needed. Contact the Arizona Game and Fish Department or the Arizona Department of Transportation for information on road kill.

- Fencing can also be effective in guiding wildlife to safe crossing structures to prevent crossing in unwanted areas.
- More guidelines, Best Management Practices, and general information about wildlife and roads can be found in Foreman et al. (2003), Bissonette and Cramer (2008), Ruediger and DiGeorgio (2007), and Beier et al. (2008).

5. State and Regional Transportation Planning Information

Transportation planning in Arizona can be initiated from a number of sources including the Federal Highway Administration, Arizona Department of Transportation, Counties, Cities, or public organizations. **It is important for planners to identify adjacent planning efforts to ensure consistency and an integrated and holistic approach to transportation planning and wildlife conservation.** General information on planning efforts within the State can be found on the various web sites (Appendix I).

6. Regional Pedestrian/Bike Trail Systems

Hiking trails and bike routes are excellent alternatives for people to move within or across their community and can have less of an impact on wildlife than new road development. Numerous regional trails have the potential to be connected to community trail systems. Trail systems through natural areas also can be excellent wildlife-watching routes, providing recreational and educational opportunities for community residents while generating economic benefits from visiting tourists.

To minimize disturbance to wildlife, pedestrian/bike trail systems should be developed away from high quality or sensitive habitats (e.g. *riparian* areas, fawning/nesting sites, areas with special status species). Other suggestions for minimizing disturbance to wildlife can include utilizing natural barriers such as trees or shrubs and the existing topography (Colorado Division of Wildlife, Colorado State Parks “Planning Trails with Wildlife in Mind” 1998, <http://atfiles.org/files/pdf/Primer.PDF>).

The Arizona Department of Transportation’s Bicycle and Pedestrian Program website provides a wide variety of resources and information about biking and walking in Arizona. This website also contains 5-year plans for potential bike/pedestrian improvements. <http://www.azbikeped.org>

7. Alternative Transportation (Bus, Rail)

Alternative transportation allows commuters the ability to travel in and around rural and urban centers, and can provide an indirect benefit to wildlife by reducing the need for

Community Scale Planning

additional roads, thus decreasing future habitat fragmentation. A selection of alternative transportation plans and resources can be found at the websites below:

- 2007 MAG Human Services Coordination Transportation Plan
http://www.mag.maricopa.gov/pdf/cms.resource/HS_2007_Coordination-Transportation-Plan53747.pdf
- 2007 PAG Human Service Coordination Transportation Plan <http://www.azdot.gov>
- Rural and Small Urban Regional Transportation Coordination Plans
<http://www.azdot.gov>
- Valley Metro (Bus/Light Rail/Rideshare) <http://www.valleymetro.org/default.asp>

Community Scale Planning

Conservation Lands Systems / Open Space Programs

A conservation lands system (CLS) is, in its simplest form, a set of lands (including water resources) managed or set aside for conservation purposes. Some plans refer to this as an open space system or conservation reserve system. It is up to the planning agency (usually a county or municipality) to develop a conservation objective and determine what management focus and strategy will be implemented within the CLS to best meet this objective. A conservation objective could be as simple as preserving a viable population of a listed species or can be a complex and multipurpose conservation vision that applies to planning and zoning, open space acquisition, and regional transportation systems.

One example of a CLS in Arizona is within Pima County. To learn more about the Pima County CLS, visit <http://www.pimaxpress.com/Planning/>.

Pima County describes their CLS as “designed to protect the *biodiversity* and provide land use guidelines consistent with the conservation goals of the Sonoran Desert Conservation Plan (SDCP)”. The overarching purpose of the SDCP is to: “Ensure the long-term survival of the full spectrum of plants and animals that are indigenous to Pima County through maintaining or improving the *habitat* conditions and ecosystem functions necessary for their survival”. See www.pima.gov/sdcp for more information on the SDCP.

A CLS identifies those components of the regional *biogeography* which are most important for conservation. These lands may be in federal, state, or private ownership; therefore strategies for conserving these lands will vary. Conservation can be achieved through a variety of means including acquisition of real property, acquisition of *conservation easements*, purchase or transfer of development rights, conservation based ordinances and guidelines, and intergovernmental agreements. In most cases lands should be prioritized for their value to the conservation objective.

In many cases a CLS will identify important historic or cultural concerns as well as scenic landscapes and natural areas important for human uses. Pima County, for instance, recognizes working ranchlands as an important component of their CLS. Preserving other historic and natural aspects of a landscape will also benefit wildlife.

A CLS should be identified and implemented concurrent with the general or comprehensive planning process. It is important that all stakeholders and the public be involved in the process to ensure the best possible plan and to gain community support. This is especially true when the planning agency needs to gain public support for purchasing lands.

Considerations for Conservation Lands Systems

1. Arizona Game and Fish Department Planning Tools

The Arizona Game and Fish Department (Department) is in the process of developing various tools to help organizations plan for open space and conservation reserve systems.

Community Scale Planning

The Department's Areas of Conservation Priority model (ACP) is being developed using georeferenced datasets that reflect conservation planning priorities. Using Geographic Information System (GIS) software, the Department used spatial analysis to model and identify areas of conservation priority. The datasets developed in support of the ACP model can also be used in other models to address specific conservation questions as they arise. For more information about the ACP model and datasets, please contact the Department at 623-236-7734.

The Arizona Wildlife Linkages Assessment is a multi-agency report which identifies important landscape connections on a statewide scale using expert opinion and multi-agency input. The Arizona Wildlife Linkages Assessment provides a broad framework of *wildlife linkages* and wildland blocks that exist around the state. It can be accessed online at http://www.dot.state.az.us/Highways/OES/AZ_WildLife_Linkages/assessment.asp. The assessment document and map are the initial efforts to identify potential linkage zones that are important to Arizona's wildlife and natural *ecosystems*. While this is only the first step in a continuing process of defining *crucial habitat* connectivity areas, it provides an extremely valuable planning tool for community planners. These linkages are going to be further refined at the County level, and 16 linkages have been modeled at the species level to identify the most valuable corridor areas within the identified statewide linkage (<http://www.corridordesign.org/arizona/>). Please contact the Department's Habitat Branch for further information at 623-236-7600.

2. Prioritization Strategies

The planning agency's conservation objective will determine which strategies are best for the CLS. In most cases special status species will be a top consideration. These will include any species listed under the federal Endangered Species Act, and may include non-listed species.

When considering which species are most important to the conservation objective, the planner should consider the scope of the CLS and the scope of the plans to which it relates (e.g. the Pima County CLS relates to the Sonoran Desert Conservation Plan). It may be a good strategy to focus on the highest priority vulnerable species, while examining the biotic community as a whole. It is important to know how such focal species fit into the biotic community and how the local ecosystem functions. It is useful to employ species experts and professional modelers to model potential outcomes of various alternative Conservation Lands Systems.

In all cases it will be important to begin discussions with an interdisciplinary team of local experts. The Department strongly encourages participation by U.S. Fish and Wildlife Service and Department officials.

Habitat Conservation Plans (HCP)

A Habitat Conservation Plan (HCP) is a landscape level planning tool, administered through the U.S. Fish and Wildlife Service (USFWS) that helps communities balance growth with conservation. An incidental take permit is required when non-federal activities will result in *take* of threatened or endangered wildlife. An HCP must accompany an application for an incidental

Community Scale Planning

take permit. The purpose of the HCP is to ensure there is adequate minimization and mitigation of the effects of the authorized incidental take. The purpose of the incidental take permit is to authorize the incidental take of a listed species, not to authorize the activities that result in the take. The USFWS must comply with the National Environmental Policy Act (NEPA) before issuing an incidental take permit. Unless the proposed activities qualify for a categorical exclusion as a low-effect HCP, an Environmental Assessment (EA) or Environmental Impact Statement (EIS) must be prepared. Although preparation of NEPA documents is the responsibility of the USFWS, the applicant usually prepares the draft NEPA document to expedite the process.

More information can be obtained through the U.S. Fish and Wildlife Service at: http://www.fws.gov/Endangered/pdfs/HCP/HCP_Incidental_Take.pdf.

Typically, federally-listed wildlife species that are present or have habitat within the focal area are covered under an HCP. However, other sensitive wildlife species with the potential to be federally listed can also be covered. Although federally-listed plants receive protection under the Endangered Species Act (ESA), the ESA does not provide take prohibitions for listed plants on non-federal lands. However, the ESA requires that issuance of an HCP permit must not jeopardize any listed species; therefore, an HCP must address the effects of the permit on listed plants.

Project Scale Planning

Project Scale - Planning for Wildlife

Project leaders can achieve the goal of responsible planning for wildlife at the project scale by incorporating wildlife planning into their site-specific projects while tiering to community and regional comprehensive plans including transportation plans and open space/conservation land system programs (see information provided in the Community Scale section above). An effective approach to wildlife planning begins with the identification of the wildlife resources in need of protection, an assessment of important *wildland blocks* and connective *corridors*, and the incorporation of these critical wildlife components into the project plans.

Species have specific *habitat* needs that can be addressed at the project level including shelter from the elements and predators, food and water, and materials and locations for nesting or raising young. Some species require very specific conditions that exist in only a few localized sites, making it extremely important to identify species and associated habitat in your project area. Private lands make up 18% of Arizona's total area with concentrations near important resources for wildlife such as aquatic and *riparian* habitats, making private landowners key players in wildlife conservation.

Wildlife Habitat Connectivity

Knowing which wildlife species have *crucial habitats* and corridors in a project area is the first step in responsible development. However, knowing how your plans fit into the *landscape* context is equally important. Coordination between community planners and on-the-ground construction entities (e.g. developers, home builders, construction companies) is essential not only across roads, but also through human development to ultimately connect wildland blocks.

For example, if two developers design adequate open space within their developments to accommodate wildlife habitat, it is the responsibility of the community planners that oversee the developers' plans to make certain that the open space habitats "merge" if there is to be a true benefit to wildlife. This is crucial when a wildlife corridor has been identified in an area. Therefore, wildlife connectivity planning and coordination not only involves the roads, but also the developments between the wildland blocks.

Conservation of wildland blocks and corridors can contribute to meeting the economic, recreational, social, and aesthetic needs of people. Smart planning is the key to retaining connectivity between large wildland blocks and increasing the value of disturbed areas to both wildlife and people. Striking the balance between the needs of people and the needs of wildlife is the essential element of responsible development.

Project Scale Planning

Identifying Wildlife Resources in your Project Area

The first step in protecting wildlife resources is to determine which *species of conservation concern* are in the area and what *crucial habitats* are required to sustain them. There are several tools available to help project developers identify species and habitats within their project areas. In addition, the Arizona Game and Fish Department (Department) works directly with project planners to identify resources and incorporate conservation concepts into project documents and maps.

Wildlife Species Identification

Obtain a Species List:

- a. The U.S. Fish and Wildlife Service provides species information at a county level for all listed Threatened and Endangered Species <http://www.fws.gov/southwest/es/arizona/>.
- b. The Department also provides wildlife lists by county and by species. http://www.azgfd.gov/w_c/edits/hdms_species_lists.shtml.
- c. The Department also has a Geographic Information System (GIS) tool – The Online Environmental Review Tool (<http://www.azgfd.gov/hgis/>) from which you can obtain a *special status species list*. Keep in mind that this online tool generates lists primarily for smaller scale planning efforts.

Sensitive Wildlife: Special Status Species

Below are specific guidelines to be applied when a project may adversely impact the following species:

Sonoran desert tortoises

The Department has developed guidelines to reduce potential impacts to desert tortoises, and to promote the continued existence of tortoises throughout the state. Sonoran desert tortoises (which occur south and east of the Colorado River) encountered in a project site should be moved out of harm's way to adjacent appropriate habitat. Department guidelines for handling Sonoran desert tortoises can be found at <http://www.azgfd.gov/hgis/guidelines.aspx> Note: These guidelines do not apply to the Mojave population of desert tortoises (north and west of the Colorado River). Mojave desert tortoises are specifically protected under the Endangered Species Act, and any potential disturbance of Mojave desert tortoises or their habitat requires consultation with the U.S. Fish and Wildlife Service.

Western burrowing owl

Over the past 50 years, most burrowing owl populations have experienced declines throughout their range in North America. Burrowing owls are found in desert and grassland areas of Arizona where urbanization and other human activities are occurring. Burrowing owls are active during daylight hours, and use underground burrows for nesting and escape cover. The use of burrows makes them susceptible to impacts from ground disturbing activities, and their presence often goes undetected on a project site until ground disturbance is imminent. The Department has developed a set of guidelines for when burrowing owls are encountered in a project area. <http://www.azgfd.gov/hgis/guidelines.aspx>

Project Scale Planning

Measures should be taken to avoid, minimize, or mitigate impacts to all special status species occurring in or near your project site. We encourage you to work with the Department to identify those site-specific measures.

Crucial Habitat Identification

Project developers should work with biological consultants to identify crucial habitats within and adjacent to the project area. There are many resources and identification books available to assist in your planning efforts to identify habitats within planning areas including Brown, D. E., and C. H. Lowe (1980).

The *Crucial Habitat Types* and *Conservation Recommendations* are the same as for those listed in the Community Scale Planning Section above. There are, however, finer scale issues that arise in Project Planning.

- **Large Trees & Snags**

Standing dead trees (snags) are considered an integral habitat component of cavity-nesting birds and other wildlife (e.g., snag associated insects, bats) in the conifer forests of the southwestern United States. Some 85 species of North American birds construct nests in snags, or nest in natural cavities, or woodpecker-excavated holes in snags. Snags also serve as nesting and perching platforms for numerous raptor species. The tree species, size, bark retention, and condition influence the value of a snag as wildlife habitat. Removal of snags has been linked to declines in both diversity and density of cavity-nesting birds and tree roosting bats in southwestern forests.

Conservation Recommendation

- Preserve large trees and snags for wildlife.

Caves and Mine Shafts

Caves and mines provide stable conditions of temperature and humidity, making them ideal maternity and hibernation roosts for bats. Bats are an integral part of the natural environment. They undertake a range of important ecological functions which include the control of nocturnal insects (some of which are agricultural pests or annoying to people), and the pollination of agaves and other native plants.

Bat populations have been declining at an alarming rate in recent years. The causes of this decline are destruction of habitat, pesticides, and disturbance. Loss of roosting and foraging habitat has resulted from reservoir construction, watershed development, forest conversion, urbanization, and cave commercialization.

Conservation Recommendation

- Protect caves and mines in your planning area by avoiding development around these features and incorporating them into open space.
- The Department recommends surveying for the presence of bats in all caves and mines in the planning area where development will occur.
- Do not backfill any caves or mines where bats are present. The Department recommends installation of a bat gate to provide protection for the bats and reduce any hazards the

Project Scale Planning

mine or cave may have to the public. Examples of successful bat gate projects can be found at:

<http://www.batcon.org/index.php/conservation/topics/bats-a-mines/subcategory/89.html>

Canyons, Ridgelines, and Mountain Foothills

Large cliff areas and rocky hills are important nesting and roosting sites for a number of Arizona's bird species. The natural ledges and crevices found in cliff faces provide many raptors, such as peregrine falcons, with safe nest sites along with excellent vantage points for locating prey.

Arizona's deer populations, and therefore Arizona's large predators, are most common in canyons and mountain ranges throughout the state. Mountain lion and black bears use these steep areas for hunting, travel, and raising young. While mountain foothills and canyon rims provide scenic views that many desire for their own backyard, these are the places where dangerous interactions between people and predators are most common.

Conservation Recommendation

- Avoid development in canyons, mountain foothills, and along ridgelines to protect habitat for raptors and large predators and to reduce the potential for human-wildlife conflict.

Wildlife Corridors

Wildlife corridors are the connections between *wildland blocks* that facilitate wildlife movement between areas (see the "Wildland Block and Corridor Assessment" section, above). Corridors are critical for wildlife with large-area requirements, those species that migrate seasonally, and for all wildlife to maintain genetic diversity.

Corridor width requirements vary by the species that use them. For example, a flat-tailed horned lizard may not require a corridor as wide or as long as what might be needed for a black bear to pass safely between wildland blocks. By planning corridors for those wildlife species with the largest width requirements, you can assume that you have provided the appropriate corridor width for most if not all of the wildlife species in your project area.

Project developers should work with community planners and the Department to identify wildlife corridors in the vicinity of their project. Project developers and community planners should check with adjacent planned or existing developments to ensure open space designs "merge" well enough to provide wildlife habitat connectivity. If projects are located adjacent to a natural area already protected in public ownership, design your project's open space contiguous with the protected area.

So what makes a wildlife corridor? Streams, washes, canyons, and mountain ridges are some of the most frequently used landscape features for wildlife movement. Among these, *riparian* corridors are crucial because they house the highest wildlife diversity and yet are among the rarest landscape features in Arizona.

Project Scale Planning

Commercial/Industrial Land Uses

Pollution Discharge Permitting & Stormwater Management

NOTE: Pollution discharge and stormwater management is regulated by federal, state, county, municipal, and local governing bodies. Please ensure compliance with all laws and ordinances in your area.

“Stormwater has been identified as a major source of pollution for all water body types in the United States, and the impacts of stormwater pollution are not static; they usually increase with land development and urbanization” (US Environmental Protection Agency Publication 841-F-07-006, December 2007).

Typical pollution sources can include oils and gas from vehicles on roads, parking lots and driveways, fertilizers, pesticides, pet waste, soap/cleaning agents, and general soil erosion (US Environmental Protection Agency, 1995). If stormwater runoff and pollution is not controlled, it can have negative impacts to fish, wildlife, and other species dependant on *riparian*/wetland habitats.

General Guidelines for Managing Stormwater Runoff for Wildlife Benefits

- Planning stormwater runoff in a development should attempt to keep stormwater discharge at the same rate as it was prior to the development. (U.S. Environmental Protection Agency, 2008). Given the potential impacts to wildlife from untreated stormwater discharge, preventing excess runoff pollution could greatly benefit downstream wildlife and wildlife habitats.
- Typical stormwater conveyance includes hard infrastructure such as curbs, gutters, and pipes. Planners should consider the use of porous or semi-porous landscape materials (to the greatest extent possible), various topographic with vegetation, and infiltration/retention basins throughout the development to promote the infiltration of stormwater runoff back into the ground. This not only keeps pollutants from entering a natural waterway, but the ground also acts as a natural filter to enhance water quality for wildlife downstream.
- Water harvesting techniques not only reduce water needs for landscape irrigation, but also provide a temporary water source for wildlife and native vegetation.
- Avoid above-ground retention basins on properties adjacent to roads. Introducing standing water, and the increased vegetation production in the basins, can and will attract wildlife to the roadside. This is concern not only for wildlife, but also for human safety associated with vehicle/wildlife collisions.
- Design and vegetate stormwater retention basins with varied tree canopy cover, shrubs, and grasses to provide diverse habitat for local native wildlife. Keep the water depth relatively shallow and use gentle sloping shorelines. This will promote greater vegetation development on the shoreline and reduce erosion and sediment deposition into the basin. Another feature that enhances the area for wildlife is an irregular shoreline (Minnesota Pollution Control Agency 2002).

Project Scale Planning

Trash/Waste Containment

Wildlife, especially in an urban setting, can develop an affinity or dependence on human garbage or waste products. This can also alter the behavior of wildlife and eliminate the fear of humans in some species. When wildlife becomes accustomed to trash or garbage as a food source, this can lead to unwanted wildlife/human conflicts.

- Place trash in the appropriate receptacle and lock it to prevent wildlife from opening it.
- Keep trash receptacles in a fenced area, or in an enclosed location. To prevent birds and animals from getting to the area from above, install a roof structure or fencing.
- In bear country, use an approved bear proof trash receptacle.
http://www.azgfd.gov/w_c/urban_bear.shtml

Landscaping

Using native vegetation for landscaping in a developed area can provide many benefits to wildlife in the urban setting. Wildlife that have adapted to an urban environment quickly utilize any available habitat for food, cover, and shelter. Using native vegetation landscaping within your development not only provides a micro-habitat for wildlife, but if done consistently throughout the community, can provide “mini-*corridors*” that the animals can use to take care of daily needs. This would include areas between the sidewalk and the building and the medians in parking lots.

- Typically when an area is ready to be developed, the entire area is graded flat and constructed from the ground up. When possible, designate building envelopes where ground disturbance is allowed and otherwise leave the natural vegetation and topography intact in areas where development will not take place.
- While some city or county ordinances may require trimming and pruning landscape for aesthetic and safety purposes, try to keep vegetation as robust and natural as possible (especially in larger, undeveloped areas) to allow wildlife to use the vegetation available.
- For information on landscaping for desert wildlife please visit a Department office or visit the Department’s website: http://www.azgfd.gov/w_c/urban_wildlife.shtml.
- A general guide for the planning, design, and implementation of schoolyard habitats can be downloaded from http://www.azgfd.gov/i_e/ee/resources/books/schoolyard_habitat.pdf.
Concepts for using native landscaping in flood control areas can be found in “Landscape Design Themes Handbook: Guidelines for Identification and Selection of Landscape Design Themes for Applications to Flood Control Projects” – Flood Control District of Maricopa County, July 27, 2007.

Water Resource Management – Grey Water Use, Conservation

NOTE: All water resources and water quality issues are managed and/or administered by state, county, municipal, or local water authorities. If water resources are used in or for your development, please ensure compliance with all laws and ordinances in your area.

General Guidelines for Using Recycled Water to Benefit Wildlife

- Recycled water can be used to create riparian areas, wetlands, and aquatic habitat for wildlife on a development site. These areas provide water, food resources, and nesting habitat for waterfowl and other birds. These areas are also an excellent place for viewing wildlife.

Project Scale Planning

- Wastewater that is treated and discharged into a natural water course has the potential to benefit aquatic wildlife and riparian habitats downstream of the development. However, any water discharged must meet all Federal and State water quality standards.
- Water conservation throughout Arizona is important because of the arid nature of the State. Impacts from prolonged drought, climate change, and increased ground water and surface water use from expanding human populations place additional strains on the *ecosystem* and our available water resources. Increased and inefficient water use in rural and urban developments can also divert these resources from away from wildlife.

Recommendations

- Conserve water on your property by watering landscaping and vegetation directly via drip or soaker hose, rather than using a sprinkler system. This can help to reduce evaporation, and increase water infiltration and watering efficiency (National Wildlife Federation, 2006-2008).
- Use mulch in landscaped areas to retain soil moisture and maintain vegetation health.
- Utilize grass swales or porous walkways to increase water infiltration and reduce runoff (Goo, 1991).
- Avoid unnecessary water features such as fountains and waterfalls as they have high rates of evaporation.

Project Scale Planning

Residential Land Uses

Residential land uses can avoid and minimize their impacts to wildlife with good planning. Planning is best done with thorough coordination between the community planners and the project planners. Residential development can be *permeable* to wildlife with creative design that incorporates natural open space. A few of the tools that communities and developers can use are described below.

Integrated Conservation Design

Integrated Conservation Design typically involves a shift away from conventional grid development design, where developers can increase the intensity of land use on a portion of their property while conserving the remainder of the property as open space. Ideally, these open space areas within developments connect to a larger wildlife corridor system or protect environmentally sensitive lands. The best ways to ensure open spaces remain as undeveloped natural areas for wildlife is to donate a conservation easement on those lands to the county, city, or town in which your development resides. Otherwise, stipulate the allowable passive recreational uses of your open space within the Codes, Covenants, and Regulations (CC&Rs) for your development's Homeowners Association. The process for developing a property using an integrated conservation design method can vary, but some of the approaches are provided below and in the Community Scale Planning section above.

1. Clustering

This approach involves clustering development on a portion of the property that is not environmentally sensitive and allowing the same net density that would be permitted with a conventional grid design under the existing zoning.

When a cluster approach is combined with the specification of building envelopes (designated spaces where structures are permitted), the land surrounding each site plus all other undeveloped land can be held in common by all owners for wildlife conservation purposes. The ability to use clustering depends on the authority and flexibility within local land ordinances, so you will need to coordinate your project with your community planners.

2. Gradient Density

Similar to clustering, this approach allows the same net density that would be permitted with a conventional grid design under the existing zoning but allows for variation in lot size. This variation in lot size allows you to focus your highest residential densities toward the center of your development, and then create a gradient of decreasing densities out from the project center toward the open space. Low-density residential developments can be more permeable to wildlife use and movement, and provide a safer buffer between high-density residential development and the wildlife that respond negatively to urban land uses.

3. Transferring Development Rights (TDR)

This approach requires your county, city, or town to have passed a TDR ordinance. Check with your community planner to determine if this is an option for you. TDR allows sending

Project Scale Planning

area property owners to realize an economic benefit from their property without having to develop the entire property, while allowing receiving area property owners to develop at densities greater than is permitted under the existing zoning. To transfer development rights to or from your development property, you must have a willing sender or receiver and you must have concurrence from your local government through the planning and zoning process. This can be an effective tool to reduce wildlife impacts in sensitive areas while allowing more intensive land uses in areas with fewer wildlife issues.

4. Density Bonus

An incentive-based approach where density of a developed area increases proportionately with every increase in area set aside for open space. Again, this type of approach requires going through your community's planning and zoning process.

- Consider *landscape* context – public/private partnerships to stitch adjacent *habitats* together
- Conservation Based Design Ordinances (allowing higher density development on a portion of the project in exchange for open space easements on the other portion of the property)
- Environmentally Sensitive Lands Ordinances (protecting wetlands, caves, *riparian* areas, etc.)
- Open space easements. Better dedicated to the County/City, but ok if part of the Codes, Covenants, and Regulations (CC&Rs).
- Open space designs that agree with focal species priorities from Conservation Lands System/Open Space/HCP priorities

5. Stormwater Management

a. Designation of floodways

In areas of urban development, stormwater is typically directed to the street curb and then transferred to a retention basin or to the nearest natural drainage. When the development is being planned, take advantage of the natural topography, vegetation, and existing drainage areas for stormwater management. Designation of drainage areas on the property not only help retain water on site for wildlife and vegetation use, but they could also serve as the first step in preventing polluted stormwater runoff from entering natural drainages or streams. See the General Guidelines for Managing Stormwater Runoff for Wildlife Benefits section of 'Commercial/Industrial Land Uses' for more information.

b. Retention Basins

Planning stormwater runoff in a development should attempt to keep stormwater discharge on the property at the same rate as it was prior to the development. Given the potential impacts to wildlife from untreated stormwater discharge, preventing excess runoff pollution could greatly benefit downstream wildlife and wildlife habitats.

Typical stormwater conveyance includes hard infrastructure such as curbs, gutters, and pipes. Planners should consider the use of porous or semi-porous landscape materials, varied topography, and vegetation throughout the development to promote the infiltration of stormwater runoff back into the ground. This not only keeps pollutants from entering

Project Scale Planning

a waterway, but the ground also acts as a natural filter to clean the water as it reaches groundwater to enhance water quality for wildlife.

Water harvesting techniques not only reduce water needs for landscape irrigation, but also provide a temporary water source for wildlife and native vegetation.

Within developments, avoid above-ground retention basins adjacent to roads. Introducing standing water, and the increased vegetation production in the basins, can and will attract wildlife to the roadside. This is a concern not only for wildlife, but also for human safety associated with vehicle/wildlife collisions.

Design and vegetate stormwater retention basins with varied tree canopy cover, shrubs, and grasses to provide diverse habitat for local native wildlife.

Rain barrels are helpful in slowing runoff velocities off rooftops and can be enforced through Homeowner Association Codes, Covenants, and Regulations.

Project Scale Planning

Human/Wildlife Interface

Living with Urban Wildlife, Landscaping for Desert Wildlife

Wild animals venture into areas where people live in search of food and other resources they need to survive. With proper landscaping, people can enjoy wildlife watching in their own communities and prevent wildlife encounters that involve conflict. The Arizona Game and Fish Department (Department) provides information to the public and to landscape planners on living with wildlife and planning landscaping for desert wildlife at http://www.azgfd.gov/w_c/urban_wildlife.shtml.

The best way to prevent problem wildlife encounters is by keeping wildlife out of homes, buildings, and yards. Here are some tips:

- **Do not feed wildlife!**
Do not feed wildlife. Feeding songbirds is okay, but be aware that it may attract other animals. Keep bird food clean and dry, and place bird feeders where they are not accessible to other wildlife.
- **Close holes.**
Close holes around and under your home's foundation to discourage homesteading. Bury wire mesh 1 to 2 feet deep in places where animals might gain access.
- **Seal cracks.**
Seal all cracks and holes larger than a ¼-inch in diameter to keep out rats, mice, bats and snakes.
- **Keep garbage sealed.**
Store garbage in metal or plastic containers with tight-fitting lids. Keep cans in a garage or shed and put trash out only when it is scheduled to be picked up.
- **Keep pet food inside.**
If you have a pet door, keep your pet's food in the cupboard or refrigerator.
- **Mark windows.**
If birds fly into windows, mark them with strips of white tape or raptor silhouettes.
- **Fence gardens.**
Fence gardens and cover fruit trees with commercially available netting.
- **Screen chimneys and vents.**
Keep dampers closed to avoid 'drop-in' guests. Chimney tops should be screened from February to September to prevent nesting.
- **Keep cats indoors.**
Scientists estimate that free-roaming cats kill hundreds of millions of birds, small mammals, reptiles and amphibians each year. Keeping your cat indoors will also help your pet remain healthy and safe from disease, predation, and vehicle dangers.

Fencing to Buffer Natural Areas from Urban Areas

Fencing may be necessary in the natural-urban interface to accomplish the following functions:

- Control or restrict pet and human access (e.g. fencing, signage).
- Reduce the chance of nuisance wildlife from entering urban/residential areas.

Project Scale Planning

- Reduce attractions for pets and attractions for urban-tolerant wildlife species within the natural areas (e.g. cat feeding stations, open trash containers that attract nuisance wildlife).
- Allow limited and controlled recreational use in appropriate locations and restrict existing uncontrolled recreational uses (e.g., hiking, mountain biking, off-highway vehicle use, off-leash dog walking) that currently take place in sensitive *habitats*.
- Minimize disturbance (e.g. noise, glare) from adjacent land to wildlife species.
- Provide areas for public education and interpretation of the preserves' natural resources in order to generate local support.
- Provide an aesthetically appealing visual transition between development and open space, allowing people to see into the natural area, encouraging a sense of ownership and stewardship.

A fundamental objective of the urban-wildlife interface design should be reduction of the unwanted movement of animals and plants between the natural area and adjacent developed areas. The creation of a physical barrier between these two habitats is the most basic element of achieving this objective. Fencing should be designed to exclude undesired species from the preserve and prevent target species from leaving the preserve.

The design and installation of fencing are intimately connected with the design of proposed developments. For example, positioning dwelling units and infrastructure nearest the street, while leaving the rear portion of the lots undeveloped and using a sound, approved fence separating the development from the natural area, might be the most desirable design solution. While this approach reduces some of the risks of roadways immediately adjacent to the preserve and can reduce development-related disturbances (e.g., lighting, noise), it is dependent on long-term owner compliance with and maintenance of prescribed design features (e.g., drainage patterns, species selected for landscaping, upkeep of appropriate fencing design and materials).

The Department encourages management authority of natural areas within residential subdivisions be retained by the project developer or Homeowner's Association. This will ensure fences adjacent to natural areas are properly monitored and maintained; landscaping is monitored for usage of appropriate species; drainage infrastructure is monitored and maintained according to desired specifications.

Fencing Guidelines

Fencing is typically used around individual homes along property lines and along subdivision boundaries. While fencing can be useful to exclude certain nuisance wildlife species from entering subdivisions or individual properties, often times the result is loss of wildlife habitat, movement *corridors*, and entrapment/entanglement. The selection of fencing type and location is extremely important and will determine how it will affect wildlife.

Containment Fencing (inclusion) is designed to keep domestic animals in, and is used for cattle, horses, goats, sheep and other livestock, and for containment of pets or small children. This fence type can be particularly important for containing domestic dogs. Containment fencing is recommended around building envelopes of residential properties, but should be avoided on property perimeters of larger lots.

Project Scale Planning

Exclusion Fencing is designed to keep wildlife out. Each species may require different fencing designs and types, and many can be used for multiple species with similar habits and ability. The principle that should be followed for exclusion fencing on a property is to allow wild animals to use as much of your property as possible, and restrict them only from your designated building envelope or “living space”. This provides for broad wildlife corridors and large areas of connected habitat. For corridors, you want as large an area as you can supply, and many paths and smaller corridor units can add passage choice and reduce predation by those species that learn quickly where game trails, fencing, and other features are that will aid their feeding strategy. In order to keep wildlife out, most exclusion fences must be at least 8 feet tall. Be aware that this fence height is above most county/city standards and may require a zoning waiver.

The Department provides additional information on wildlife fencing guidelines on our website at <http://www.azgfd.gov/hgis/pdfs/FencingGuidelines.pdf>

Nature Hiking/Biking Trails within Development and Connection with Regional Trails

There are many benefits of trails and greenways. They make our communities more livable, replace greenhouse-gas emitting modes of transportation, improve the economy through tourism and civic improvement, preserve and restore open space, and provide opportunities for physical activity to improve fitness and mental health. They can also provide wildlife-viewing opportunities and reduce pressure on expanding vehicular transportation systems that have impacts to wildlife and their habitats.

Economic and Community Values

Trail systems help preserve a distinctive and slower paced or "rural" atmosphere. Trails and open spaces can offer developers and property owners higher property values. Some communities report that their trails attract recreational tourist dollars and become opportunities for business development such as outdoor stores, equestrian centers, and bed and breakfast places along extended routes. Around shopping areas or business parks, trails can enhance the way that space is used, integrating recreation and respite opportunities, inviting moments of pause and renewal amid the hectic pace of such urban places. Colorado State Parks provides a good reference at <http://atfiles.org/files/pdf/Primer.PDF>.

Recreational trails can be a useful feature incorporated into the urban-wildland interface. A recreational trail along an urban boundary provides public access to open space while minimizing the adverse effects of this access on sensitive biological resources that might occur nearby.

Recreational trails can easily be combined with other interface elements such as wildlife-exclusion fencing, drainage controls, and firebreaks. Interpretive signs placed along recreational trails can inform the public about the adjacent preserve or natural area and create a sense of ownership and stewardship among local residents. These residents can then serve as informal patrols for the project developer or Homeowner’s Association to help ensure that resources are

Project Scale Planning

protected. Trails through particularly sensitive areas can be designed to minimize impacts through the use of boardwalks, bridges, or raised platforms.

Buffering vegetation can be effectively used adjacent to trails to serve as a physical and visual barrier between the trail and the preserve or natural area. For example, native drought-tolerant and fire-resistant shrubs could be planted between a trail and a low barrier fence to discourage entry into sensitive areas alongside trails.

Trails provide convenient access for people to enjoy viewing wildlife, experience local wildlife habitats, and encourage stewardship for the local environment that might otherwise be lost. Good trails reduce environmental degradation, promoting care and appreciation instead. Urban trails are increasingly convenient and provide for a much larger base of community participation than trails located in wildlands. Through signage and educational interpretation, trails are a device for expanding awareness of environmental values, wildlife, and geologic features. Urban trails are linear parks - taking parks to people in ways that enhance a sense of community participation and real connection to nature.

This website is a great resource for development and management of trails:

<http://www.americantrails.org/resources/index.html>

Lighting

“Ecological light pollution” affects wildlife at the individual, community, and *ecosystem* level through “direct glare, chronically increased illumination, and temporary, unexpected fluctuations in lighting” (Longcore and Rich 2004). A form of this pollution is known as “sky glow,” and results from the accumulation of various artificial lighting sources, creating a glow that is reflected back to earth (Longcore and Rich 2004). The glow is naturally more pronounced near urban and other well-lit areas, but can also affect wildlife outside the city. Ecological light pollution stems from a wide variety of lighting systems, each of which is in use worldwide throughout the day and night.

Effects on Wildlife

The effects of ecological light pollution are widespread. They include disorientation from and attraction to artificial light, structural-related mortality due to disorientation, and effects on the light-sensitive cycles of many species.

Disorientation

Exposure to artificial light can create problems for species adapted to using light- or the absence of light- to aid in orientation. In these cases, ecological light pollution may interrupt natural behaviors, expose individuals to higher predation levels, or disrupt navigational abilities.

Nocturnal frogs are especially vulnerable to the effects of artificial lighting. A study conducted by Buchanan (1993) suggests that any exposure to artificial light impedes the ability of nocturnal frogs to locate and capture prey. This is probably due to their inability to adjust their eyes to new light levels quickly, a process that can take anywhere from minutes to hours (Cornell and Hailman 1984).

Project Scale Planning

Many predatory birds and reptiles, usually active only during the day, will forage at night under artificial lights (Longcore and Rich 2004). Prey species may suffer adverse affects as a result of this foraging shift over time.

Light-sensitive Cycles

Many species of wildlife operate specific internal cycles or rhythms that help them determine when to initiate foraging, migratory or reproductive behavior. The addition of artificial light to the nighttime environment disrupts the precision of these cycles, thus modifying behavior.

For example, American robins exposed to high levels of artificial light will initiate their morning songs significantly earlier (in relation to the onset of dawn) than those exposed to less light, sometimes up to 100 minutes earlier (Miller 2006). Prolonged singing could result in higher energy demands, greater predation risk, or disruption of normal feeding cycles.

Recommendations

Alternatives to the current lighting systems are often surprisingly simple.

- Eliminate all bare bulbs and any lighting pointing upward. This is especially true for decorative lighting, and would reduce contributions to overall light pollution.
- Use only the minimum amount of light needed for safety.
- Use narrow spectrum bulbs as often as possible to lower the range of species affected by lighting.
- Shield, canter or cut lighting to ensure that light reaches only areas needing illumination. This will significantly reduce sky glow.
- Light only high-risk stretches of roads, such as crossings and merges, allowing headlights to illuminate other areas. Where possible, use embedded road lights to illuminate the roadway.
- In Flagstaff and Coconino County, the desire to maintain dark skies for the Flagstaff Naval Observatory and Lowell Observatory has led to city and county ordinances protecting dark skies. These ordinances have coincidentally offered wildlife relief from the negative impacts of light pollution. For more information visit <http://flagstaffdarkskies.org/>.
- All new developments should use the latest management technologies so that continued growth and expansion leads to no increase in the impact of light pollution (Salmon 2003).

Glossary

Biodiversity – The variety of species found in an area

Biodiversity hot spots – Areas where the number of species is high

Biogeography – The combination of physical features and animal and plant distributions in an area

Cienegas – Areas where the soil is moist year round

Connectivity – The absence of barriers to wildlife movement between wildland blocks.

Conservation Easements – Legal agreements that restrict uses of land to those compatible with preservation of the existing natural community

Corridors – Pathways with no or few barriers to a focal group of wildlife species, connecting one or more wildland blocks

Crucial Habitats – Places whose preservation has been judged by wildlife professionals as necessary to prevent unacceptable declines, or facilitate future recovery of important wildlife populations

Ecologically Diverse – A measure of the variety of ecosystems in a given area

Ecosystem – The complex of organisms and environment that function as an ongoing unit

Endemic – Native to an area

Extirpations – Loss of a species from a location

Fee simple – Absolute title to land

Funneling – Restrictions that cause animals to move through a given area

Habitat – A place where an animal has the resources necessary to survive and reproduce

Invasive – Non native species that displace native species in an ecosystem

Landscape (Scale or level) – A heterogeneous geographic area characterized by diverse interacting patches or ecosystems

Permeable – A measure of the likelihood an animal will move through an area

Riparian – The interface between land and a flowing body of water. A riparian area is generally defined as the area from the water's edge to the point where vegetation is no longer influenced by the availability of water from the body of water

Sustainable – The ability of a system to persist through time without human input

Special status species list – A report generated from AGFD's HDMS system for a given location identifying the proximity of species accorded some level of protection by either state or federal agencies

Species of Conservation Concern – Species whose persistence or abundance in an area is threatened by development

Take – Removal of an individual from a population

Wildland blocks – Large sections of contiguous pieces of relatively undisturbed land

Wildlife Linkages – Areas of connectivity identified as necessary to maintain the long-term sustainability of targeted wildlife populations

Xeriparian – an area (generally a desert wash) that is normally without flowing or standing water, but supports a distinctive biotic community due to the occurrence of periodic or seasonal flows

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Appendix I

STATE AND REGIONAL TRANSPORTATION PLANNING INFORMATION

Arizona Department of Transportation

Arizona Department of Transportation Planning

<http://tpd.azdot.gov/>

State & Regional Transportation Planning Areas

<http://tpd.azdot.gov/planning/>

Staff Contact Information

<http://tpd.azdot.gov/planning/areas.php>

Arizona Department of Transportation 5-year Construction Plan

<http://tpd.azdot.gov/pps/introduction.asp>

Flagstaff District - <http://www.azdot.gov/Highways/districts/Flagstaff/index.asp>

Globe District - <http://www.azdot.gov/Highways/districts/Globe/index.asp>

Holbrook District - <http://www.azdot.gov/Highways/districts/Holbrook/index.asp>

Kingman District - <http://www.azdot.gov/Highways/districts/Kingman/index.asp>

Phoenix Construction District -

http://www.azdot.gov/Highways/districts/Phx_Construction/index.asp

Phoenix Maintenance -

http://www.azdot.gov/Highways/districts/Phx_Maintenance/index.asp

Prescott District - <http://www.azdot.gov/Highways/districts/Prescott/index.asp>

Safford District - <http://www.azdot.gov/Highways/districts/Safford/index.asp>

Tucson District - <http://www.azdot.gov/Highways/districts/Tucson/index.asp>

Yuma District - <http://www.azdot.gov/Highways/districts/Yuma/index.asp>

County Departments of Transportation

Maricopa County Department of Transportation - <http://www.mcdot.maricopa.gov/home.htm>

Pima County Department of Transportation - <http://www.dot.pima.gov/>

Existing Regional Transportation Plans:

Maricopa Association of Governments (MAG) – Regional Transportation Plan 2007 Update – July 2007 - <http://www.mag.maricopa.gov/project.cms?item=411>
(generally updated annually)

Pima Association of Governments (PAG) – 2030 Regional Transportation Plan – June 2006 - <http://www.pagnet.org/Default.aspx?tabid=379>
(generally updated every 3-4 years)

Central Arizona Association of Governments – 5-year Transportation Improvement Plan FY2008-FY2012 - <http://www.caagcentral.org/trans/tip.html>

Regional Framework Studies:

“Building a Quality Arizona” bqAZ– Statewide Transportation Planning Framework
<http://www.bqaz.gov/>

Northern Arizona

Western Arizona

Central Arizona

Eastern Arizona

I-10 Hassayampa Valley Study

I-8 and I-10 Hidden Valley Study