

## 4. Access and Travel Patterns

This section examines historic and current factors affecting access patterns and transportation infrastructure within the three counties surrounding Coconino National Forest (COF). The information gathered is intended to outline current and future trends in forest access as well as potential barriers to access encountered by various user groups. Primary sources of data on access and travel patterns for the state's national forests include the Arizona Department of Transportation (ADOT), the Arizona Department of Commerce (ADOC), and the circulation elements of individual county comprehensive plans. Indicators used to assess access and travel patterns include existing road networks and planned improvements, trends in vehicle miles traveled (VMT) on major roadways, seasonal traffic flows, and county transportation planning priorities. Additional input on internal access issues has been sought directly from forest planning staff.

Various sources of information for the area surrounding COF cite the difficulty of transportation planning in the region given its vast geographic scale, population growth, pace of development, and constrained transportation funding. In an effort to respond effectively to such challenges, local and regional planning authorities stress the importance of linking transportation planning with preferred land uses. Data show that the area surrounding the Coconino saw relatively large increases in VMT between 1990 and 2000, mirroring the region's relatively strong population growth over the same period. Information gathered from the ADOT and county comprehensive plans suggest that considerable improvements are currently scheduled for the region's transportation network, particularly when compared to the areas surrounding Arizona's other national forests.

### 4.1 Historical context and current access issues

Transportation infrastructure throughout the state of Arizona was initially developed to serve the needs of a predominantly rural population while supporting expansion of the state's largely agricultural economy. State, county, and city comprehensive plans reviewed for this assessment specifically mention economic influences such as logging, ranching, tourism, and recreation as having played a role in developing the region's circulation system (Coconino County 2003, ADOT 2004a).

Today, many regions of the state, including the area surrounding COF, are struggling to provide much-needed improvements to transportation networks in order to accommodate growing populations and changing local economies. Circulation planning throughout the area of assessment is challenging given the geographic scale of the area, the presence of private lands and development within the national forest boundaries, and the competing needs of rural and urban residents of the counties. Each of the comprehensive plans further admits that current transportation networks have been developed as needs have arisen and are therefore inadequate for handling projected long-term growth (Coconino County 2003, Gila County 2003, Yavapai County 2003).

Despite a diverse array of transportation planning issues at the county and municipal level, planning agencies throughout the state express a common concern for the linkages between transportation and land use planning. In its current long range plan, ADOT includes an appendix which analyzes broad transportation trends and issues as well as potentially significant implications for future transportation planning. In summary, ADOT identifies five large-scale issues that are most likely to influence transportation planning in the coming years: 1) Population growth and demographic change, 2) Economic growth and change, 3) Security concerns, 4) Energy supply and efficiency, and 5) Technological change and opportunities (ADOT 2004b). While the latter three issues are discussed in largely hypothetical terms and are at best indirectly linked to forest management, the first two identified issues are immediately relevant and pertain directly to other factors presented in this assessment.

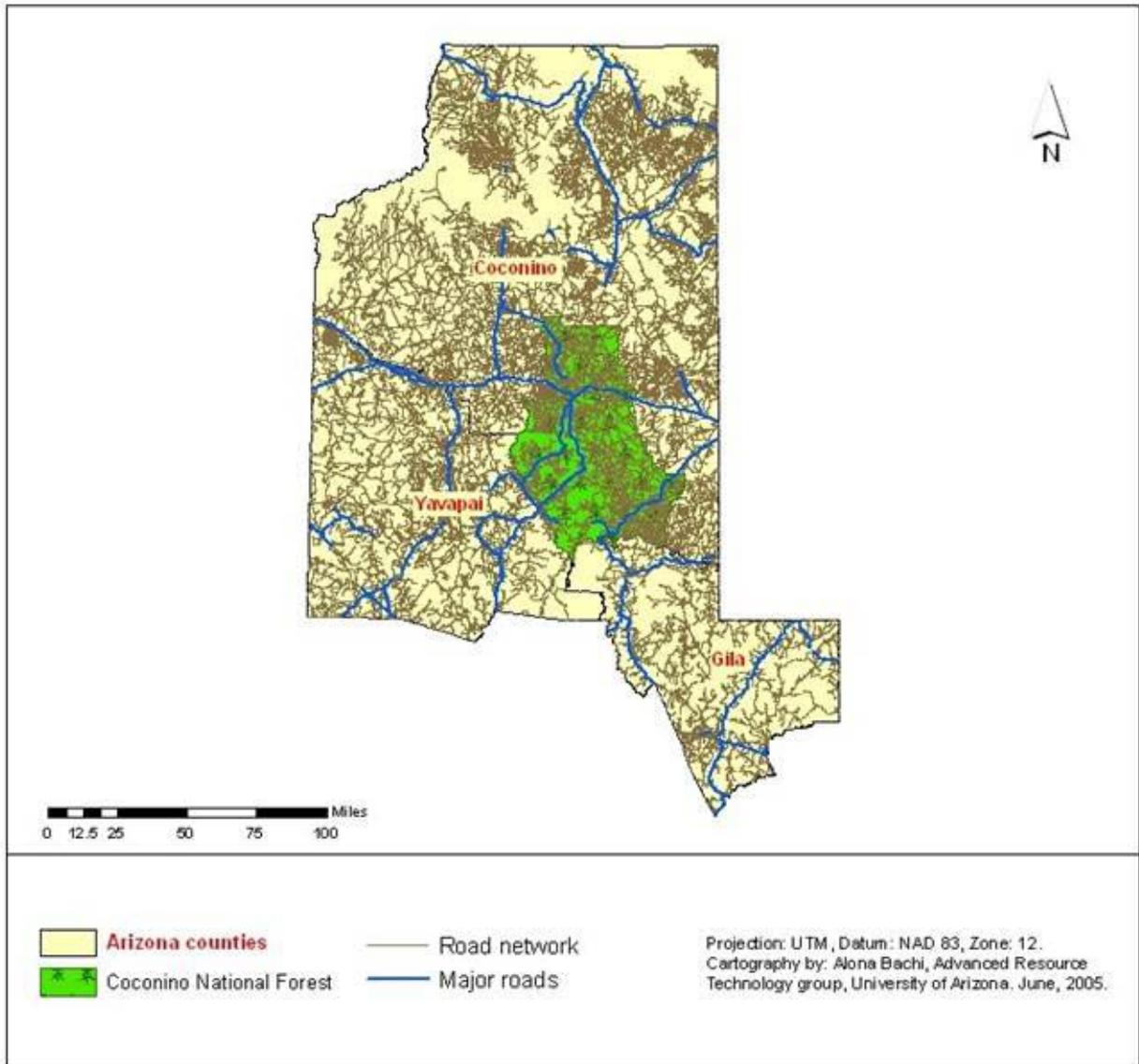
Stressing the importance of demographic change for the future of transportation planning in the state, ADOT notes that Arizona's population is projected to double over the next forty years, growing from 5 to 10 million residents. In the agency's estimation, such changes will require "major expansions of roadway capacity and the development of transportation options and alternatives to provide acceptable levels of service on Arizona's roadways and maintain circulation" (ADOT 2004b). Specific concerns regarding the impact of population growth on state transportation planning include the cost of infrastructure surrounding sprawling metropolitan areas, traffic congestion and greater commuting distances within developed areas, and access to the state highway system for areas outside of major metropolitan centers.

In order to adequately prepare for future transportation needs, ADOT calls for greater coordination between state, regional, and local agencies on transportation and land use planning statewide. Strategies for doing so include the provision of education and technical assistance to local partners, enforcement of legal land use requirements, and the exercise of direct land use controls through state agencies such as the Arizona State Land Department (AZSLD). Through such efforts, ADOT hopes to play an important role in shaping the location of future development to ensure maintenance of existing infrastructure while meeting the transportation needs of millions of new residents (ADOT 2004b).

Citing Arizona's transition from an agricultural- and extraction-based economy toward one where sales and services are increasingly important, ADOT stresses the consequent changes to transportation needs throughout the state. As a case in point, small parcel shipments and an increase in commuting, both of which stem from growing information- and service-based industries, result in different travel patterns and different types of vehicles on the road. ADOT suggests that increases in highway and freight rail capacity, development of intelligent traffic systems (ITS), expansion of intermodal facilities, and other related investments could help sustain Arizona's current industries and provide opportunities for new industries (ADOT 2004b).

#### **4.2 Predominant transportation modes and seasonal flow patterns**

A map of the roadway network within the area of assessment is presented in Figure 14. Interstates, U.S. and State highways, and Indian Routes within the area of assessment are presented in Table 23. Figure 14 shows that the area clearly has a substantial amount of roads with a particularly dense road network in the northwest and southeast areas of the forest. Additionally, most of the major roadways follow a north-south orientation, the lone exception being Interstate 40 which is oriented east to west.



**Figure 14. Road Network within the Area of Assessment**

**Table 23. U.S., State, and Indian Routes by County**

	Interstates / U.S. Highways	State Highways	Indian Routes
<b>Coconino County</b>	Interstate 40 Interstate 17 U.S. 89 U.S. 160 U.S. 180	State Highway 64 State Highway 66 State Highway 67 State Highway 87 State Highway 89 State Highway 89A State Highway 98 State Highway 99 State Highway 260 State Highway 264	Indian Route 2 Indian Route 15 Indian Route 18
<b>Gila County</b>	U.S. 60	State Highway 73 State Highway 77 State Highway 87 State Highway 88 State Highway 170 State Highway 188 State Highway 260	
<b>Yavapai County</b>	Interstate 17 Interstate 40 U.S. 93	State Highway 69 State Highway 71 State Highway 89A State Highway 96 State Highway 97 State Highway 169 State Highway 260	

Source: Arizona Department of Commerce: County Profiles

The vast majority of circulation corridors throughout the area of assessment provide infrastructure for a single transportation mode: travel by motorized vehicle. Currently, over ninety percent of daily person trips in the Flagstaff area utilize private motor vehicles whereas less than ten percent of mobility in the winter is accomplished via public transit, i.e. walking and bicycling. Given the expense of developing infrastructure for alternative modes of transportation and the patterns of development throughout rural areas of the state, the predominance of motorized vehicles is likely to continue for the foreseeable future. Nonetheless, counties and cities throughout the region express a desire to reduce dependency on automobiles by supporting alternative modes—transit, walking, bicycling—thereby reducing the demand for expanded roadways (Coconino County 2003, Gila County 2003, Yavapai County 2003, FMPO 2001).

The Arizona highway system consists of over 58,000 miles of roadway, of which two percent are interstates, three percent are U.S. routes, and nearly six percent are state routes. Although only twelve percent of the total highway network are state facilities, over fifty-seven percent of the daily vehicle miles traveled (VMT) occurs on these roads. The Interstate System carries twenty-eight percent of all daily VMT (ADOT 2004c). Much of the Arizona state highway system passes through lands owned by federal agencies and federally recognized tribes. Federal agencies and federally recognized tribes own seventy percent of the land in Arizona. Federal lands agencies, including the USFS, the BLM, and others, own forty-two percent of the land in Arizona, with over 2,000 miles of state highway passing through these

lands. Arizona’s twenty-one federally recognized tribal nations own twenty-eight percent of Arizona land. An additional 1,200 miles of state highway pass through these lands, with over one-half of these road-miles in the Navajo Nation (ADOT 2004c).

Table 24 presents data on daily VMT for the years 1990 and 2000 as well as the percentage change. ADOT reported a dramatic increase in travel on non-state roads within Yavapai County over the ten-year period. Similar, though less substantial, increases were seen for traffic counts on all roads within the county over the same period. In light of the significant increases in population and housing in Yavapai County between 1990 and 2000, the increase in travel on non-state roads likely points to significant increases in travel on county and private road networks. Coconino and Gila Counties also experienced increases in VMT on non-state roads that were much higher than those for the state over the same period.

**Table 24. Daily Vehicle-Miles of Travel (VMT) by County, 1990-2000 and % Change**

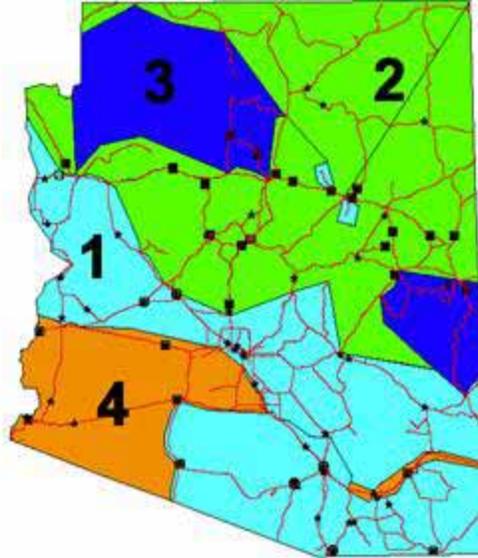
Area	Total VMT all roads (000s)			Total VMT state system (000s)			Total VMT non state (000s)		
	1990	2000	% Change	1990	2000	% Change	1990	2000	% Change
<b>Coconino County</b>	4,783	6,796	42.09%	3,646	5,211	42.92%	1,137	1,585	39.40%
<b>Gila County</b>	1,312	1,948	48.48%	1,005	1,470	46.27%	307	478	55.70%
<b>Yavapai County</b>	3,439	6,803	97.82%	3,182	4,776	50.09%	257	2,027	688.72%
<b>Arizona</b>	97,139	134,345	38.30%	40,252	66,671	65.63%	56,887	67,674	18.96%

Source: Arizona Department of Transportation, Transportation Planning Division

HPMS Data for the Calendar years 1990 and 2000

### Seasonal Flow Patterns

The Data Section of ADOT’s Transportation Planning Division has delineated four distinct “cluster areas” of traffic patterns throughout the state of Arizona. The clusters represent areas that are similar in terms of their variation with respect to Average Annual Daily Traffic (AADT) for the given area. Cluster areas are arranged hierarchically such that Area 1 demonstrates the least amount of monthly variation from the AADT whereas Area 4 experiences the greatest variation. Figure 15 shows the four cluster areas within the state of Arizona as well as the various Automatic Traffic Recorder (ATR) positions.



Source: Arizona Department of Transportation, Transportation Planning Division, Data Section

**Figure 15. Traffic Pattern Cluster Areas**

Table 25 provides daily and monthly factors for each of the four cluster areas collected during 2003. The factors below are presented as an inverse ratio of AADT to collected traffic counts. A factor of *greater than one* shows that traffic was *less* than average for the specific time period; *less than one* shows traffic as being *greater* than the AADT during the period.

Points of access to Coconino National Forest extend into the portions of the state designated as Areas 1, 2 and 3 by ADOT's Transportation Planning Department. Data in Table 25 show that peak traffic flow for areas 2 and 3 occurs between June and August while traffic is lowest from November to February. The area immediately surrounding Flagstaff is designated as being in Area 1. Along with the larger urban metropolitan areas surrounding Phoenix and Tucson, the daily and monthly traffic counts in Flagstaff, as of 2003, fluctuated less than those in other regions of the state. It cannot be assumed, however, that seasonal traffic flow in the Flagstaff area parallels that for the rest of Area 1. Data in Table 25 show that traffic counts were highest in Area 1 during the months of March and April and lowest during June and July. In this sense, seasonal traffic flow within the Flagstaff area would be expected to more closely resemble that of neighboring regions in Area 2 and 3. This would confirm the logical notion that traffic in the region fluctuates primarily according to weather conditions and patterns of visitors from outside the region.

**Table 25. Daily and Monthly Traffic Variation by Cluster Area, 2003**

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
<b>Area 1</b>	1.011	0.940	0.930	0.959	0.999	1.033	1.050	1.049	1.075	0.983	0.998	1.022
<b>Sunday</b>	1.109	1.076	1.067	1.109	1.104	1.066	1.043	1.111	1.086	1.062	1.116	1.095
<b>Monday</b>	1.029	1.016	1.045	1.021	1.011	1.019	1.032	1.039	1.034	1.024	1.012	0.981
<b>Tuesday</b>	1.041	1.040	1.049	1.056	1.044	1.044	1.054	1.040	1.047	1.068	1.046	0.978
<b>Wednesday</b>	1.074	1.058	1.031	1.049	1.062	1.050	1.033	1.027	1.047	1.056	0.952	1.003
<b>Thursday</b>	0.981	1.009	0.995	0.962	0.984	0.998	0.947	0.988	0.991	0.983	1.033	1.100
<b>Friday</b>	0.879	0.883	0.893	0.884	0.873	0.878	0.911	0.863	0.865	0.872	0.901	0.915
<b>Saturday</b>	0.958	1.000	0.996	1.055	1.046	1.038	1.058	1.040	1.047	1.069	1.047	1.012
<b>Area 2</b>	1.176	1.133	1.053	1.038	0.978	0.925	0.902	0.926	0.979	0.965	1.016	1.068
<b>Sunday</b>	1.008	0.972	1.029	1.039	1.065	1.001	1.005	1.055	1.058	1.021	1.043	1.061
<b>Monday</b>	1.066	0.996	1.086	1.039	1.027	1.059	1.052	1.061	1.024	1.064	1.073	1.009
<b>Tuesday</b>	1.163	1.123	1.12	1.083	1.084	1.114	1.099	1.083	1.087	1.102	1.052	1.008
<b>Wednesday</b>	1.098	1.138	1.067	1.05	1.067	1.088	1.063	1.051	1.062	1.062	0.962	1.01
<b>Thursday</b>	1.026	1.064	0.991	0.977	0.997	1.003	0.964	1.012	0.997	0.998	1.05	1.076
<b>Friday</b>	0.861	0.876	0.86	0.869	0.865	0.864	0.925	0.866	0.866	0.883	0.915	0.935
<b>Saturday</b>	0.914	0.971	0.981	1.047	0.998	1.012	0.991	0.974	1.015	0.996	0.993	0.983
<b>Area 3</b>	1.566	1.534	1.175	1.034	0.921	0.783	0.737	0.801	0.911	0.906	1.186	1.525
<b>Sunday</b>	1.05	0.966	1.164	1.079	0.944	1.048	1.019	0.931	1.02	0.943	1.091	1.051
<b>Monday</b>	1.099	0.907	1.073	1.049	1.026	1.046	1.04	1.089	1.008	1.067	1.058	1.037
<b>Tuesday</b>	1.119	1.071	1.005	1.088	1.065	1.04	1.052	1.118	1.105	1.1	1.047	1.007
<b>Wednesday</b>	1.158	1.159	0.929	1.052	1.087	1.056	1.04	1.105	1.091	1.112	1.069	1.049
<b>Thursday</b>	1.069	1.19	0.962	0.937	1.069	0.999	1.055	1.081	1.041	1.057	1.084	1.093
<b>Friday</b>	0.889	1.006	0.93	0.908	0.964	0.952	0.999	0.941	0.925	0.961	0.856	1.029
<b>Saturday</b>	0.823	0.897	0.992	0.939	0.897	0.892	0.839	0.844	0.876	0.845	0.889	0.851
<b>Area 4</b>	0.952	0.932	0.922	1.067	1.086	1.05	0.961	1.07	1.19	1.087	0.945	0.859
<b>Sunday</b>	0.962	1.026	0.971	0.948	1.032	0.964	0.886	0.985	0.985	0.938	0.927	0.981
<b>Monday</b>	1.111	1.021	1.091	1.054	0.982	1.058	1.077	1.079	0.961	1.043	1.129	1.052
<b>Tuesday</b>	1.131	1.074	1.079	1.115	1.114	1.108	1.133	1.108	1.083	1.104	1.108	1.017
<b>Wednesday</b>	1.095	1.049	1.057	1.082	1.096	1.075	1.083	1.063	1.089	1.077	0.942	1.041
<b>Thursday</b>	0.991	0.98	0.997	0.968	0.996	1.002	0.931	1.013	1.028	1.014	1.034	1.186
<b>Friday</b>	0.878	0.874	0.86	0.848	0.824	0.867	0.927	0.847	0.87	0.866	0.937	0.915
<b>Saturday</b>	0.905	1.027	1.01	1.059	1.032	0.983	1.046	0.966	1.05	1.027	0.993	0.889

N.B.: Factors listed represent a ratio of recorded traffic counts to the Annual Average Daily Traffic (AADT)

Source: Arizona Department of Transportation, Transportation Planning Division, Data Section

### 4.3 Regional transportation plans and roadway improvements

Each of the counties within the area of assessment shares common issues regarding transportation infrastructure. Nonetheless, various constraints and opportunities are discussed for individual areas in available ADOT documents as well as county and city comprehensive and transportation plans. This section examines both barriers to access and planned improvements for the state and county transportation networks surrounding the COF.

Planned improvements to the state highway system surrounding COF are presented in Table 26. Although the data may not account for all ADOT projects within the area of assessment, they present a useful guide to the timing, nature, and extent of highway projects that are likely to influence travel to and from the forest.

**Table 26. ADOT Current 5-Year Transportation Facilities Construction Program, Coconino National Forest**

Year	Route	Milepost	County	Funding Source	Location	Length (miles)	Type Of Work	Cost (\$1000)
2007	17	293	Yavapai	Interstate Maintenance	McGuireville Traffic Interchange	1	Reconstruct Traffic Interchange	\$13,100
2005	17	293	Yavapai	STATE	McGuireville Traffic Interchange	0	Right-of-Way Acquisition	\$900
2006	17	298	Yavapai	Interstate Maintenance	JCT SR 179 - Yavapai County(SB)	12.74	Resurface	\$3,561
2006	17	322	Coconino	STATE	Munds Park Traffic Interchange		Design Traffic Interchange	\$600
2006	17	323	Coconino	STATE	Christensen Rest Area	0.1	Construct (Rest Area Closure)	\$150
2005	40	201	Coconino	Interstate Maintenance	MP 201 to Walnut Canyon Traffic Interchange	4.2	Resurface	\$4,617
2008	40	205	Coconino	Interstate Maintenance	Walnut Canyon (WB)	3	Reconstruct Roadway	\$4,400
2005	40	205	Coconino	STATE	Walnut Canyon (WB)	3	Design Roadway	\$350
2006	179	304.5	Yavapai	Surface Transportation	Village of Oak Creek - North Forest Boundary	2.6	Construct roadway	\$9,635
2005	179	304.5	Yavapai	STATE	Village of Oak Creek - North Forest Boundary	2	R/W Acquisition	\$350
2005	179	304.5	Yavapai	STATE	Village of Oak Creek - North Forest Boundary	6.3	Utility relocation	\$400
2007	179	307	Yavapai	Surface Transportation	Coconino National Forest	2.95	Construct roadway. Construct Restroom	\$10,865
2007	179	308	Yavapai	STATE	Village of Oak Creek - North Forest Boundary	0.1	Building (Forest Service IGA) Design Restroom Building (Forest Service IGA)	\$160
2005	179	308	Yavapai	STATE	Forest Boundary-Sedona, Unit I	0.1		\$40
2005	179	310	Coconino	STATE	North Forest Boundary - Sedona	3.3	Utility relocation	\$1,100
2005	179	310	Coconino	STATE	North Forest Boundary - Sedona	n/a	Acquire Right of Way	\$6,770
2007	179	310	Coconino	Surface Transportation	City of Sedona	2.52	Construct roadway.	\$7,335

Source : Arizona Department of Transportation  
<http://tpd.azdot.gov/pps/searchprogram.asp>

In an effort to facilitate coordination among the various planning authorities throughout the state, ADOT has charged various regional planning bodies with responsibility for distributing federal transportation planning and construction funds to local agencies in their respective areas. Within the area of assessment for the COF, the Northern Arizona Council of Government (NACOG), the Flagstaff Municipal Planning Organization (FMPO), the Central Arizona Association of Governments (CAAG), and the Central Yavapai Municipal Planning Organization (CYMPO) share transportation planning responsibilities within their respective areas. Policy decisions regarding circulation infrastructure development and improvement within the regional planning area are influenced by both city and county provisions (Coconino County 2003, Gila County 2003, Yavapai County 2003). A brief description of access issues and planned improvements as discussed in regional, county, and city comprehensive plans is included below. It must be kept in mind, however, that the timing and implementation of these projects is subject to considerable funding constraints and an uncertain pace of future development.

### *Coconino County*

Similar to other comprehensive plans, the circulation element of the *Coconino County Comprehensive Plan* claims that limited funding requires a continuing emphasis on maintaining existing systems rather than pursuing new roadway construction and other improvements. As with other elements in the comprehensive plan, the circulation framework for the county is grounded within an overall conservation framework. The plan explicitly states that circulation throughout the county will be planned in order to limit fragmentation or damage to habitat, disruption of wildlife movement, or introduction of pollutants and invasive species as a result of road construction (Coconino County 2003).

Two major highways serve crucial circulation roles for Coconino County—Interstate 17, which heads south to Phoenix, and Interstate 40, the only east-west roadway extending across the county. U.S. highways in Coconino County primarily serve north-south traffic. Coconino County is responsible for maintaining the roads it owns as well as those managed through cooperative agreements with ADOT, the FS, and the Navajo Nation. The most pressing access issues occur on private, unpaved roads throughout the county. The county encourages the formation of improvement districts in order to ensure maintenance of private roads in previously developed areas. The Public Works Department is responsible for all roadway improvements. Projects are evaluated according to safety and efficiency and are prioritized in the county's Capital Improvement Plan (CIP). The most recently available CIP describes no major roadway improvements affecting forest access in Coconino County (Coconino County 2003).

### *Gila County*

The primary routes within Gila County consist of State Routes, including US 60, US 70, SR 87, SR 188, SR 288, and SR 260. Most of the secondary routes are FS roads that provide access to pockets of private lands located within the Tonto National Forest boundaries. Most roadways directly under the jurisdiction of Gila County are located in rural areas and consist of two-lane collector and local roadways. The urban roadways under Gila County's jurisdiction include those within the communities of Claypool, Central Heights, Strawberry, and Pine.

Among the primary transportation-related issues identified in the *Gila County Comprehensive Master Plan* are adequacy of emergency access, all weather property accessibility, lack of alternative transportation mode facilities, and deficiencies in roadway construction and maintenance funding. In an effort to address these issues, the county has recently developed the *Gila County Roadway Design Standards Manual* to standardize the construction of all new roadways and improvement for existing roadways under its jurisdiction as well as to establish policies regarding roadway issues such as all-weather access standards, emergency access standards, etc. (Gila County 2003). As of 2003, the county

was in the process of developing a CIP to identify and prioritize all transportation improvement projects for county roads; however, a copy of the plan was not available at the time of this assessment.

### *Yavapai County*

As with Coconino County, the transportation element of the *Yavapai County General Plan* calls for transportation planning that complements the overall vision for the county. As such, the transportation element calls for improved efficiency of limited transportation corridors, maintenance of scenic routes and the exercise of restraint in the construction of new routes in order to preserve the rural character and natural habitat of the county. Although Yavapai County measures over 100 miles in width and length at its extremes, there are a limited number of major transportation corridors within the county's large geographic area. Two major highway corridors running north/northeasterly through the county, SR 89 and I-17, serve the majority of Yavapai County communities, cities, and towns. Five other state highways, SR 179, SR 260, SR 89A, SR 69, and SR 169, provide connecting corridors for the Verde Valley area and the central Yavapai region (Yavapai County 2003).

Several large residential developments in Chino Valley and north of the Paulden community have been proposed and are expected to have a significant impact on SR 89 North, necessitating improvements. In the short term, ADOT proposes to complete the widening of SR 89 to a five-lane section from the Prescott Lakes Parkway intersection to just north of the Willow Lake Road intersection. Following an inter-governmental agreement with the City of Prescott, ADOT planned to begin construction of the widening in 2004. Other improvements for North SR 89 and for the intersection area of SR 89 and SR 69, such as traffic roundabouts, are in long-range planning. In addition to these scheduled road improvements, the *Yavapai County General Plan* describes ongoing efforts by the towns of Prescott, Prescott Valley, and Sedona to develop alternative transportation networks in support of pedestrians and bicyclists (Yavapai County 2003).

#### **4.4 Internal modes, barriers, and access issues**

With respect to internal access issues, a common concern regarding barriers to access for COF is the development of private land adjacent to forest boundaries. This issue has been primarily limited to areas near the cities of Flagstaff and Sedona. In certain cases, developers and home owners have responded to perceived congestion by seeking to limit access to established forest trails and roads. FMPO addresses this issue in its *Regional Land Use and Transportation Plan*. Through the Flagstaff Area Open Spaces and Greenway Plan, the FMPO plan strongly encourages future land development plans to work closely with COF to manage access to established trails and roads (Farr, pers. comm.).

Another concern common among various user groups is that of OHV access to both FS and user-created roads. While virtually all user groups claim to support limiting damage to FS lands stemming from OHV use, opinions differ on how to do so. Organized OHV-user groups have voiced general support for limiting cross-country travel between FS and user-created roads but would like to see both remain open in the future. Various environmental groups, on the other hand, believe that access to user-created roads should be curtailed until the completion of a forest-wide Roads Analysis Process (RAP). Finally, a third perspective is offered from individuals typically unaffiliated with organized user-groups. Many of these individuals are retired, physically limited, and/or long-time users of backcountry areas. They rely on OHV access to remote areas and do not believe that their intermittent use causes damage to non-roaded areas. They are therefore opposed to limitations on cross-country travel (Farr, pers. comm.).

Currently, there are no explicit differences in the general access afforded to various user groups on the Coconino NF. Businesses, individuals, or groups intending to use COF lands for a variety of special purposes ranging from commercial recreation to infrastructure must apply for a Special Use

Authorization. In certain areas, the forest restricts motorized travel in “quiet areas” during fall hunting seasons. In the future, access for various user groups is likely to be affected by the revised Environmental Impact Statement (EIS) to be issued for the Apache-Sitgreaves, Coconino, Kaibab, Prescott, and Tonto National Forests in late 2005. The joint plan is likely to limit cross-country access to OHV users, including those previously allowed access for the purposes of camping, gathering fuelwood, and retrieval of big game (Farr, pers. comm.).

#### **4.5 Key issues for forest planning and management**

The Forest Service has long been aware of the considerable impact internal roads have on forest management. Increasingly, however, the short- and long-term effects of such roads have become highly controversial given the wider public’s concern for roadless areas and the perceived detrimental affects on wilderness due to resource extraction. Previous research on the impact of roads in forested environments tended to focus on broadly defined positive and negative impacts of road networks. Positive impacts are generally considered to include improved access to forest areas for the purpose of timber harvesting and the collection of special forest products, livestock grazing, mining, fire control, research and monitoring, access to private inholdings, and the cultural value of the roads themselves. Potentially negative impacts of forest roads include adverse effects on hydrology and geomorphic features; habitat fragmentation; predation; roadkill; invasion by exotic species; degraded water quality and chemical contamination; degraded aquatic habitat; use conflicts; destructive human actions such as fire ignition, trash dumping, and illegal hunting; lost solitude; loss of soil productivity; and a decline in biodiversity (Gucinski et al. 2001).

Although much of the existing research on forest roads focuses on their physical and ecological impact, considerable attention has also been given to the direct and indirect socioeconomic consequences of road networks within the national forests. For example, the fact that the FS is required by law to permit access to private inholdings is increasingly important to the COF given current access issues involving private property abutting forest boundaries.

The indirect economic consequences of forest roads (or the lack thereof) are also considerable for forest managers and surrounding communities. For instance, the extent and quality of forest roads are known to have a substantial impact on the economic costs and benefits associated with various user groups such as timber harvesters, energy and mining interests, fuels managers, and recreational users (Gucinski et al. 2001, Duffus 1992). Likewise, land managers in Arizona are increasingly aware of the potential economic and environmental impacts of OHV use, an issue discussed in more detail later in this assessment.

This assessment, however, is primarily concerned with the socioeconomic status and trends among communities outside of the forest, many of which are likely to directly affect future forest management alternatives. The quantity and quality of road networks to and from the COF are no exception. A recent report to the United States Congress noted that while the condition of our national interstate highway system has improved considerably over the last fifty years, traffic congestion has also increased. Daily VMT—the principle measure of traffic density—increased 31% on the national highway system between 1990 and 2000. By comparison, the state of Arizona reported a 38% increase in VMT over the same period. Each county within the area of assessment for the COF reported even greater increases, the highest of which was in Yavapai County (97.82%). The same study also found that while “the density of traffic on urban interstate highways is higher than on rural interstates, traffic on rural interstate highways is increasing at a faster rate than on any other class of road.” Additionally, the Federal Highway Administration (FHWA) expects to see significant increases in both passenger and freight traffic on the interstate highway system between 2001 and 2010 (17% and 28% respectively) (Siggerud 2002). Given population projections for counties within the area of assessment, the COF is likely to be affected by increased traffic flow, congestion, and longer commute times.

Finally, current and projected trends in vehicular traffic are particularly relevant in that they are instrumental in determining local and regional land use patterns. Each of the county comprehensive plans reviewed for this assessment makes specific mention of the link between transportation networks and land use. Some acknowledge that regional approaches to transportation development and financing likely offer the best chances of accommodating expected growth without compromising residents' quality of life. Indeed, research has shown that adequate highway systems and access to regional urban centers have a direct impact on population density, reflecting the importance of transportation on the location decisions for individual residents. Furthermore, studies have shown that transportation infrastructure is directly related to economic stability in that economic diversity, and therefore stability of local and regional economies, is dependent on an efficient highway system (Booth 2002, Case and Alward 1997).

## 5. Land Use

In this section, land ownership and use within the three counties surrounding the Coconino National Forest (COF) are examined. Land ownership and use are both variables which can significantly influence the interaction of forests and surrounding communities. Regional patterns of major land uses vary from county to county, reflecting differences in soil, climate, topography, ownership, development patterns, and other cultural, social, and economic trends. Individual counties must manage a range of land use issues including, but not limited to, water quality and availability, logging and mining activity, agricultural and recreational lands, access to state and federal land, transition of rangelands, open space preservation, and residential sprawl (Northern Economics 2002).

Collected land use and ownership data reveal that the area of assessment for the COF contains a relatively high percentage of Native American and Forest Service (FS) land, both of which stand to have a considerable impact on future forest planning. Yavapai County is particularly notable for its relatively high amounts of private and State Trust land. Each of these factors contributes to a land use policy environment that is increasingly focused on the economic and environmental sustainability of urban development in the face of continuing calls for the preservation open space. The proximity of private parcels and forest lands has also contributed to a number of significant land exchanges involving the COF over the last several years.

### 5.1 Historical context and land use patterns

Since the federal government first began designating public-trust land in the late nineteenth century, the amount of national forest land in Arizona has remained remarkably steady. The concept of shared land has had a long history in the Southwest, mirroring Native American and Mexican-American sensibilities (Baker et al. 1988). This, in part, may explain the relative stability of the use of these lands since their inception. The amount of land under public domain stood at 75% in Arizona in 1891, and by 1977, that number remained at over 70%. Today, the National Forest System itself accounts for about 15% of the land in Arizona. This small segment of the state's land represents a substantial portion of Arizona's natural resources, including 40% of the watersheds and nearly 60% of the timber. For this reason, maintaining the integrity of the forest boundaries by acquisition of land to form contiguous borders has historically been an essential objective of the USFS. Recently, trends have reflected the increasing importance of national forests as a resource for recreational use. The primary purpose of national forest land is for "multiple use" although certain elements of its subsidiary functions, like maintaining wilderness and species habitats, can limit this practice (Baker et al. 1988).

The majority of land in the National Forest System is grassland, with only about 20% being forested (Alig et al. 2003). In the latter areas, logging remains an integral and controversial element of national forest land use despite the fact that private owners contribute 90% of the timber harvest in the U.S. and control 60-70% of the timberland (Haynes 2003a, Alig and Butler 2004). Five years ago, Arizona national forests produced 13 million cubic feet of saw-timber, but over the past two decades, the amount of land devoted to timber uses has declined, and these lower levels are expected to remain stable for at least the next fifty years (Mills and Zhou 2003, Alig and Butler 2004, Johnson 2000). Logging does remain a central issue for planning in the COF as it has been highlighted under the current Washington administration's new forest policy and is subject to both traditional and experimental logging activities. Mining also has a long history on Coconino lands. According to the U.S. Code Sec. 482n, numerous areas within the forest remain open for mining development with restrictions on lumber clearing in the mining area. A more detailed history of land use on the Coconino National Forest is provided in section 2.1.

Although the total amount of land covered has remained consistent, the specific lands contained within the national forests have occasionally been juggled about. FS and BLM lands can be traded or sold under

a process that has been in place for over fifty years. These exchanges can attempt to redirect growth away from areas deemed environmentally sensitive and keep it near communities with compatible infrastructures. The process begins when private interests wish to acquire or use federal lands. Following an environmental analysis, trades may be made at fair market value. In the 1990s, such trades occurred for private interests in Blue Ridge, for water treatment and ranger station resituating in Sedona. Permitted land uses include telescope near the Happy Jack ranger station (COF 2001b, USFS 2004b, USFS 2004c). Additionally, the new wave of wireless telecommunications has led the government to install network communication towers within the boundaries of federally protected lands. One such project took place in the Coconino and Prescott National Forests, the towers being planted along I-17. Investigations are underway regarding the possible environmental effects of the installation procedures on the land and how the low-grade radiation emanating from such towers might affect nearby flora (COF 2001a).

On the other side of this issue are those lands, protected as environmentally sensitive sites, on which development is strictly prohibited. Recently, ninety acres of the Sedona Red Rock area were acquired by the Coconino National Forest through Land and Water Conservation Act funding (O'Leary 2004). These lands have been acquired for recreation and other purposes and incorporated into the National Forest instead of the possibility of being developed in the future by private land owners (Farr, pers. comm.). The forests have added or released land regularly in an attempt to consolidate territory within the outer boundaries of the national forests (Baker et al. 1988). Several House and Senate initiatives have mandated land transfers around the COF, specifically PL 108-190, which proposed that 222 acres of federal land near the Payson Municipal Airport be exchanged for 157 acres of private land near the Montezuma Castle National Monument and a private parcel of land of 108 acres within the boundaries of the COF. The bill was passed in December, 2003. In 2002, about 250 acres from inside the Dry Lake crater was purchased and added to the COF (Wotkyns 2002).

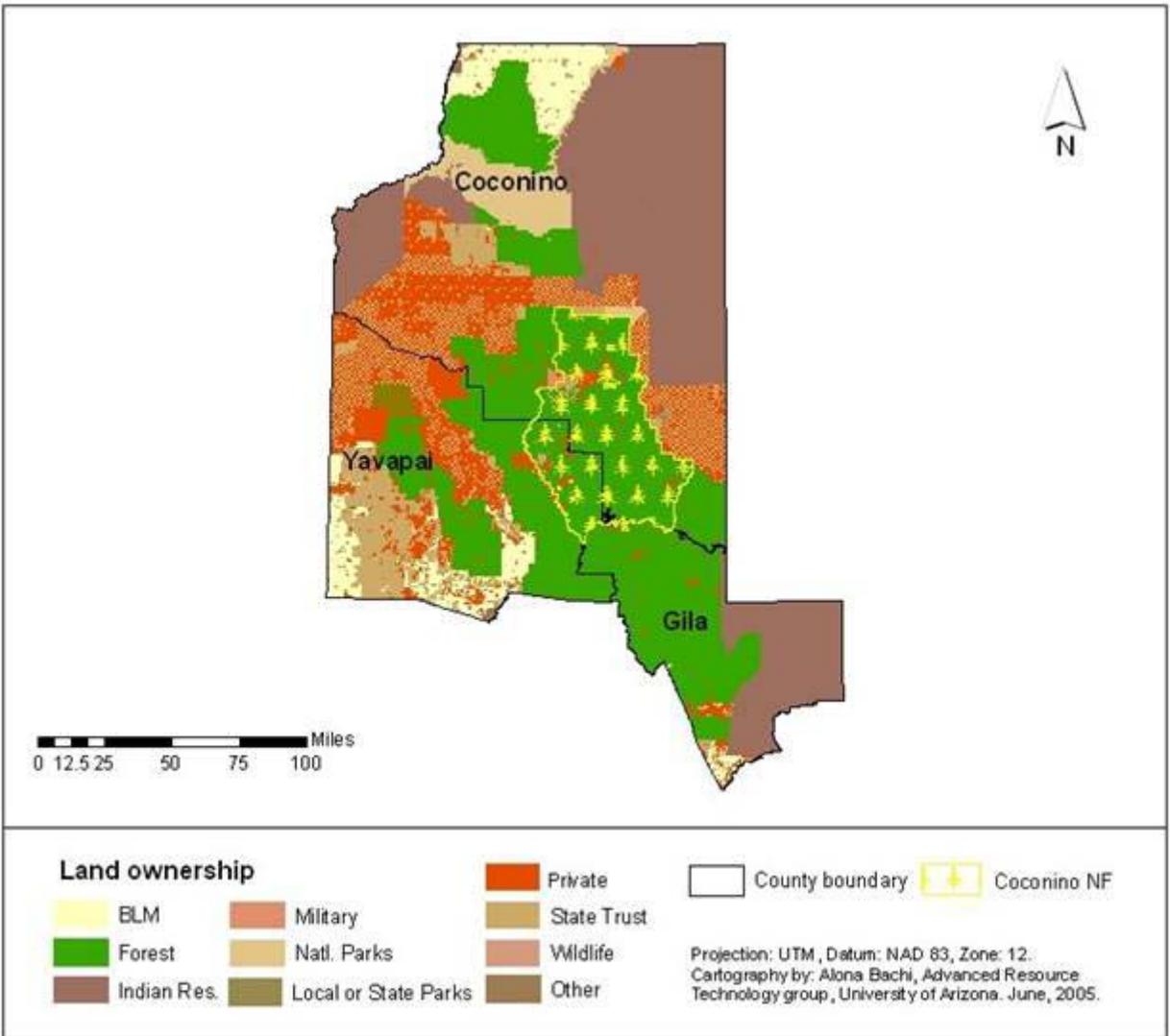
Naturally, the private citizens who live on the outskirts of the forest represent a formidable influence on the forests themselves. Originally, grazers and lumbermen expanded their own privately-held lands into those earmarked for the national forests although this was eventually suppressed. Nonetheless, the communities that build and grow on the edges of these public lands frequently apply for exchanges and purchases involving these lands to allow towns to grow—applications which may either be accepted or rejected by the USFS depending upon how such trades threaten to impact the specific forests.

## **5.2 Land ownership and land use**

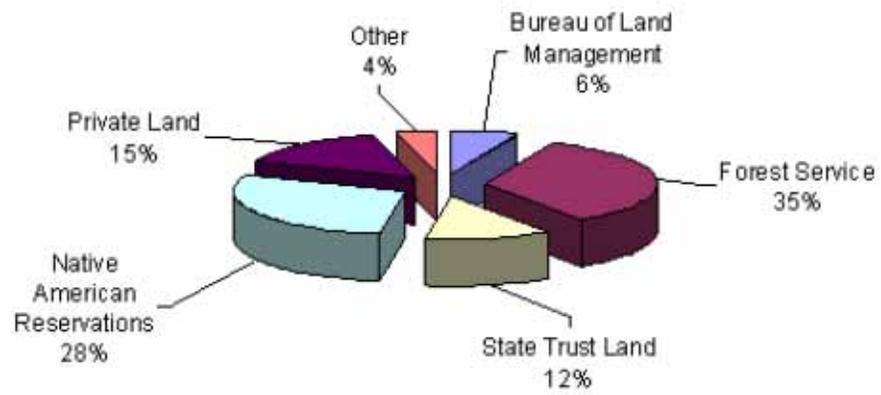
There are over 20 million acres of land in the three-county area of assessment for COF. Within this expanse, there are distinct patterns of land ownership and use, each of which carries important implications for current and future forest management. Figures 16 and 17 provide information on land ownership for the entire area of assessment while Table 27 provides more detailed land ownership data on a county-by-county basis. Figure 16 displays a relatively large amount of Forest Service land in close proximity to private land as well as considerable Native American holdings within the area of assessment. Data in Figure 17 suggest that, as a whole, the area of assessment for the COF closely resembles overall ownership patterns for the state of Arizona. For example, approximately 15% of the land within the area of assessment is under private ownership while 12% is State Trust land. Both of these factors exercise a great deal of influence on regional development patterns as is discussed later in this section (AZSLD 2004).

The more detailed data provided in Table 27 indicate important differences in ownership among the three individual counties within the area of assessment. Here again, Yavapai County is notable for its relatively substantial amount of private and State Trust land. Coconino and Gila Counties show the highest percentage of land owned by Native American entities (38.13% and 37.89% respectively) while Gila County reports the greatest amount of land held by the FS (55.44%). Meanwhile, Gila County also reports

very limited amounts of private (3.43%) and State Trust land (1.02%) when compared to neighboring counties and the state as a whole.



**Figure 16. Land Ownership within Area of Assessment**



Source: Arizona State Land Department

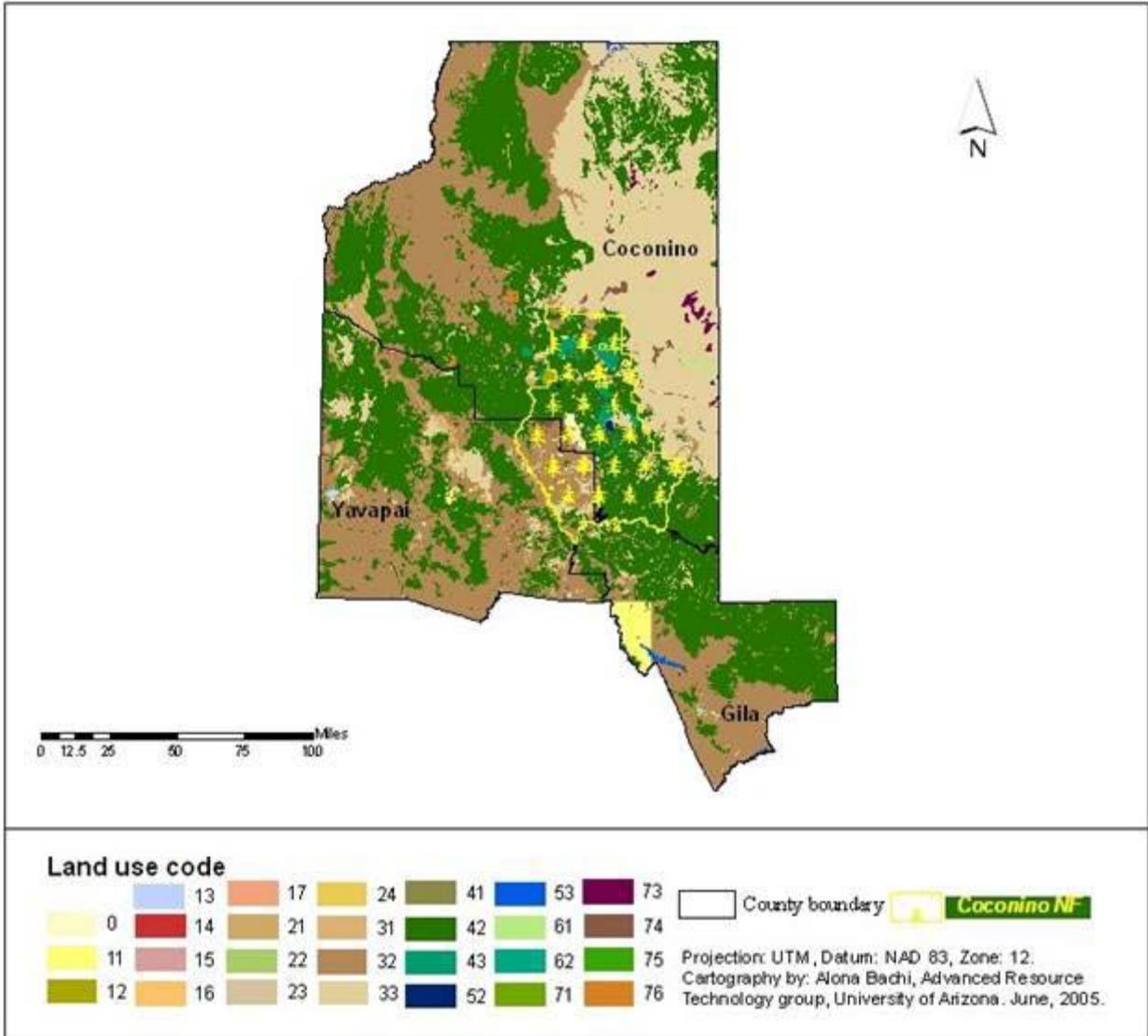
**Figure 17. Percent Ownership of Major Land Owners in Three-County Area of Assessment**

**Table 27. Land Ownership by County, 2005**

Land Ownership	Acres	Percent	Land Ownership	Acres	Percent
<b>Coconino County</b>			<b>Yavapai County</b>		
Apache-Sitgreaves NF	288,821.10	2.42%	BLM	605,411.62	11.64%
BLM	605,491.35	5.08%	Bureau of Reclamation	8,682.85	0.17%
Coconino NF	1,399,784.27	11.73%	Coconino NF	425,932.99	8.19%
Game and Fish	10,073.02	0.08%	County Land	5,784.83	0.11%
Glen Canyon NRA	40,657.72	0.34%	Game and Fish	1,033.74	0.02%
Grand Canyon NP	681,829.36	5.72%	Hualapai Indian Res.	851.14	0.02%
Havasupai Indian Res.	171,918.92	1.44%	Indian Allotments	254.12	0.00%
Hopi Indian Res.	493,566.28	4.14%	Kaibab NF	25,380.40	0.49%
Hualapai Indian Res.	579,476.99	4.86%	Military Res.	257.75	0.00%
Indian Allotments	4,625.05	0.04%	Montezuma Castle	534.34	0.01%
Kaibab Indian Res.	13,170.00	0.11%	Montezuma Well	270.16	0.01%
Kaibab NF	1,510,895.79	12.66%	Other	8.24	0.00%
Marble Canyon NM	14,600.29	0.12%	Parks and Recreation	403.81	0.01%
Navajo Army Depot	25,752.93	0.22%	Prescott NF	1,211,345.57	23.30%
Navajo Indian Res.	3,166,147.29	26.54%	Private Land	1,324,643.23	25.47%
Navajo NM	39.18	0.00%	State Trust Land	1,265,474.56	24.34%
Navajo-Hopi Joint Use	123,966.85	1.04%	Tonto NF	321,677.16	6.19%
Prescott NF	43,592.26	0.37%	Tuzigoot NM	43.24	0.00%
Private Land	1,587,305.56	13.31%	Yavapai Apache Ind. Res.	617.61	0.01%
State Trust Land	1,125,427.03	9.43%	Yavapai Prescott Ind. Res.	1,378.16	0.03%
Sunset Crater NM	3,035.99	0.03%	TOTAL	5,199,985.52	100.00%
Walnut Canyon NM	3,049.74	0.03%			
Wupatki NM	36,478.85	0.31%			
TOTAL	11,929,705.82	100.00%			
<b>Gila County</b>					
BLM	66,386.65	2.16%			
Bureau of Reclamation	204.36	0.01%			
Game and Fish	105.56	0.00%			
Private Land	105,218.18	3.43%			
San Carlos Indian Res.	633,998.74	20.67%			
State Trust Land	31,220.90	1.02%			
Tonto NF	1,700,171.68	55.44%			
Tonto NM	1,107.14	0.04%			
White Mtn. Apache Res.	528,141.70	17.22%			
Yavapai Tonto Apache	81.74	0.00%			
TOTAL	3,066,636.65	100.00%			

Source: Arizona Land Resource Information Service

Figure 18 depicts land cover within the entire area of assessment while Table 28 provides detailed data on land cover within each of the three counties. As a point of clarification, cells with no data for a given category indicate that the land cover type does not exist within the county whereas a figure of 0.00% indicates that the cover type constitutes less than one-tenth of one percent of the county's total land area. Gila County reported the greatest amount of residential cover at 5.79% compared to 1.08% for the assessment area as a whole. Gila County also reported the greatest amount of industrial land cover while Coconino had the greatest amount of land dedicated to commercial and services uses. Evergreen forest was the predominant land cover in both Gila and Coconino Counties (57.07% and 43.19% respectively) while shrub, brush, and mixed range constituted the predominant land cover in Yavapai County (49.30%).



**Figure 18. Land Cover within the Area of Assessment**

**Table 28. Land Cover by County and Assessment Area, 1990**

Land Use code	Coverage Type	Coconino County		Gila County		Yavapai County		Assessment Area	
		Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
0	Unknown / Background	26,569	0.22%	1,397	0.05%	2,549	0.05%	30,516	0.15%
11	Residential	13,388	0.11%	177,606	5.79%	28,107	0.54%	219,102	1.08%
12	Commercial and services	20,442	0.17%	635	0.02%	3,431	0.07%	24,509	0.12%
13	Industrial	2,572	0.02%	3,771	0.12%	10,397	0.20%	16,741	0.08%
14	Transportation, communication, utilities	14,942	0.13%	112	0.00%	13,348	0.26%	28,403	0.14%
16	Mixed urban or built-up land	4,100	0.03%	139	0.00%	1,610	0.03%	5,849	0.03%
17	Other urban or built-up land	1,442	0.01%	516	0.02%	851	0.02%	2,810	0.01%
21	Cropland and pasture	130,213	1.09%	3,296	0.11%	94,142	1.81%	227,651	1.13%
22	Orchards, groves, vineyards, nurseries, and ornamental horticultural areas	0	0.00%	0	0.00%	86	0.00%	86	0.00%
23	Confined feeding operations	79	0.00%	11	0.00%	90	0.00%	180	0.00%
24	Other agricultural land	335	0.00%	23	0.00%	1,412	0.03%	1,770	0.01%
31	Herbaceous rangeland	9,559	0.08%	7,350	0.24%	54,394	1.05%	71,302	0.35%
32	Shrub and brush rangeland	2,384,941	19.99%	1,051,802	34.30%	2,563,774	49.30%	6,000,518	29.71%
33	Mixed rangeland	3,831,908	32.12%	37,833	1.23%	343,004	6.60%	4,212,745	20.86%
41	Deciduous forest land	740	0.01%	0	0.00%	315	0.01%	1,055	0.01%
42	Evergreen forest land	5,152,147	43.19%	1,750,257	57.07%	2,033,524	39.11%	8,935,928	44.25%
43	Mixed forest land	147,202	1.23%	286	0.01%	1,214	0.02%	148,701	0.74%
51	Streams and canals	1,252	0.01%	0	0.00%	0	0.00%	1,252	0.01%
52	Lakes	11,380	0.10%	0	0.00%	216	0.00%	11,596	0.06%
53	Reservoirs	17,868	0.15%	23,153	0.75%	4,441	0.09%	45,462	0.23%
61	Forested wetland	17,097	0.14%	206	0.01%	0	0.00%	17,304	0.09%
62	Non-forested wetland	602	0.01%	31	0.00%	0	0.00%	634	0.00%
73	Sandy areas not beaches	55,941	0.47%	2,424	0.08%	1,585	0.03%	59,950	0.30%
74	Bare exposed rock	56,324	0.47%	274	0.01%	13,536	0.26%	70,134	0.35%
75	Strip mines, quarries, gravel pits	6,094	0.05%	5,145	0.17%	13,387	0.26%	24,626	0.12%
76	Transitional areas	21,834	0.18%	368	0.01%	14,571	0.28%	36,773	0.18%
77	Mixed Barren Land	364	0.00%	0	0.00%	0	0.00%	364	0.00%
85	Mixed tundra	369	0.00%	0	0.00%	0	0.00%	369	0.00%
	<b>Total</b>	<b>11,929,706</b>	<b>100.00%</b>	<b>3,066,637</b>	<b>100.00%</b>	<b>5,199,986</b>	<b>100.00%</b>	<b>20,196,328</b>	<b>100.00%</b>

Source: U.S. Geological Survey, 1990

Land use/ land cover digital data collected by USGS and converted to ARC/INFO by the EPA. Each quadrangle of land use data has a different representative date; however, dates ranging from mid-1970s to early 1980s are common.

Metadata can be found at <http://www.epa.gov/nqispgm3/spdata/EPAGIRAS/meta/general-metadata.text>

### 5.3 County land use plans and local policy environment

For the purpose of this assessment, county comprehensive plans have been used as a primary source of information on the history of land use within a region, the patterns of development, desired conditions, and current county land use policies. It must be noted, however, that county governments hold no legal authority over independent jurisdictions such as federal and state lands, incorporated cities and towns, or Native American tribal reservations. Additionally, the comprehensive plans reviewed for this assessment vary widely with respect to the date of their adoption, the nature of land use data provided, and the overall format of the documents. While some offer a broad, descriptive analysis of land use patterns and desired conditions, others present more detailed, prescriptive policies and guidelines for county land use. As such, information from the various comprehensive plans is discussed in terms of its potential for influencing land use patterns adjacent to the national forest.

#### *Coconino County Comprehensive Plan*

The *Coconino County Comprehensive Plan* estimates that nearly 60% of the county's population—an estimated 75,000 people—lives within the Flagstaff Regional Planning Area. All other residents of the county, approximately 40,000 individuals, live in unincorporated areas (Coconino County 2003). As noted earlier, Coconino County is the largest county in Arizona and the second largest in the United States, but it remains one of the most sparsely populated. Native American reservations (Navajo, Hopi, Kaibab-Paiute, Havasupai, and Hualapai) cover 38.1% of the land area. Federal and state agencies manage a combined 49% of the county's lands—the Forest Service (28.3%), the BLM (5%), the State Trust lands (9.4%), and the Park Service (6.8%). Only 13% of the land in Coconino County is under private ownership (Coconino County 2003).

The *Coconino County Comprehensive Plan*, adopted in September 2003, is based in large part on a conservation framework that seeks to accommodate growth in existing communities while retaining their historic, natural, and cultural character (Coconino County 2003). The plan also claims that “conservation-based planning provides an equitable way to consider the varied interests of residents, developers, and conservationists in a cooperative manner” (Coconino County 2003). In order to facilitate implementation of the framework, the plan incorporates specific conservation guidelines into each of its elements.

The plan describes a rapidly decreasing private land base, limited water sources, and public concern over the impact of high-density development on the area's rural character as the primary planning challenges faced by the county. The majority of private land in the county is owned by ranchers and others with large holdings. Platted subdivisions are almost completely built out and development of inholdings is constrained by political pressure as a result of preference for open space. Although some growth has been facilitated through lot splits, the county's authority for reviewing such development does not extend to issues of drainage, utilities, and other infrastructure, often resulting in uncoordinated wildcat development in unincorporated areas (Coconino County 2003).

Water for residential use is either unavailable or difficult to obtain in unincorporated areas of Coconino County. The plan claims that groundwater depth typically exceeds 1,000 feet prompting residents to depend on shared wells, small public water supply systems, or the hauling of water from municipal standpipes. While the county does have the authority to require developers to reveal sources of water for planned subdivisions, it does not have the legal authority to evaluate the impact of proposed wells on neighboring water sources or the environment. The plan also alludes to the planning challenges posed by the reverence for the “rural” character of the county held by many residents in unincorporated areas. It explicitly states that the ultimate success of the conservation framework will depend on planners' success in redefining “rural character” from that of two- to five-acre lots with no protected open space to land use patterns that incorporate smaller individual lots and large areas of conserved open space (Coconino County 2003).

Land use patterns in Coconino County have historically been influenced by land ownership, topography, tourist attractions, Native American reservations, and railroad infrastructure. In the foreseeable future, demographic trends, employment growth, and availability of water are likely to play increasingly important roles in determining patterns of development. In an effort to respond to these and other factors, the *Coconino County Comprehensive Plan* promotes mixed-use, infill development as the surest way of supporting a stable county economy while preserving healthy landscapes. The plan specifically mentions the acquisition of conservation easements and the use of Transfers of Development Rights (TDRs) as effective methods of preserving county open space. The plan cites the transfer of 40,000 acres of Cataract Ranch from Babbitt Ranches to The Nature Conservancy and Coconino County as a successful example of conservation easements (Coconino County 2003).

The plan also cites the importance of ranchlands in ensuring sustainable management of county land use, estimating that nine ranch owners with private land holdings each exceeding 10,000 acres collectively own 1.13 million acres—71% of the county’s private land (Coconino County 2003). One means of doing so is by allowing ranchers to petition the Board of Supervisors for the formation of “rural planning areas” which provide incentives for large, private landholders to set aside portions of ranchland for purposes of conservation. The use of rural planning areas was specifically provided for under the state of Arizona’s Growing Smarter legislation (Coconino County 2003).

- Residential land use

Residential areas in unincorporated Coconino County fall into various categories with most areas surrounding the cities of Flagstaff and Williams characterized as, and zoned for, agricultural-residential land uses. Exceptions include the Parks and Mormon Lake areas, several platted subdivisions, and rural ranchlands. The *Coconino County Comprehensive Plan* distinguishes between three residential development patterns: rural communities; remote subdivisions; and rural, large-parcel agricultural-residential lands. Rural communities, which may include some small-scale commercial development, include areas such as Doney Park, Parks, Pinewood, Kachina Village, Mountaineer, and Mormon Lake. Rural subdivisions in the area include Forest Lakes, Clear Creek Pines, Starlight Pines, Mogollon Ranch, Blue Ridge Estates, and Tamarron Pines. Many of the residential units in these areas are developed on lots ranging from two-and-a-half to ten acres and serve as second homes, a trend county planners expect will continue (Coconino County 2003).

The pace of residential development and the scarcity of available land have made the affordability of housing a growing issue in Coconino County. The *Coconino County Comprehensive Plan* asserts that median home prices in the county doubled between 1987 and 2000. Given a median household income of \$38,256 in 2000, over one-half of residents in the Flagstaff area could not afford a median-priced home. In unincorporated areas of the county, higher development costs and land prices are due in part to large lot zoning and the fact that more accessible lands with existing infrastructure have already been developed. Attempts by the county to address the issue of housing affordability have included the amendment of the county subdivision ordinance to simplify the subdivision process, the encouragement of higher densities, the clustering of subdivisions, and the selection of locations for manufactured homes. A related trend in residential housing involves the proliferation of seasonal homes in Coconino County. Census data reveal that in 2000, 17% of all homes in Coconino County were used for seasonal occupancy. At issue is the fact that the costs to the county of providing second-home communities with services, such as police protection, solid waste disposal, road maintenance, and snow removal, typically exceed tax revenues from seasonal populations (Coconino County 2003).

Residential development in unincorporated Coconino County is also complicated by the common use of lot splits. State law allows owners to divide land into parcels of thirty-six acres or more with no county oversight. Similarly, subsequent owners can split property up to five ways without subdivision review until the resulting parcels reach the minimum zoned size. The *Coconino County Comprehensive Plan*

claims that, as of 2002, these types of developments contained approximately 3,200 forty-acre lots that covered 200 square miles (8%) of private land in the county.

Current land regulations also permit ranchers to sell their land for development as forty-acre “ranchettes,” an increasingly attractive option for agricultural interests, particularly in light of the ongoing drought and diminishing grazing rights on state and federal land. The checkerboard pattern of development that results from this practice has the potential to affect state and federal lands by increasing pressure for consolidation of available sections. While residents and developers benefit from these practices in terms of lower density, lower initial land costs, and shorter times for approval, the county seeks greater control over lot splits and the purchase of “ranchettes” in order to mitigate some of the negative consequences. These include conflict over easements, substandard roads, inadequate drainage, and fragmentation of wildlife habitat (Coconino County 2003).

- Commercial and industrial land use

Commercial uses in unincorporated Coconino County are typically located on or near state highways and are characterized as neighborhood commercial or tourist/highway commercial uses. Common commercial land uses in the county include general retail and office facilities, grocery stores, gas stations, restaurants, post offices, and feed stores. Tourist/highway commercial uses typically include hotels, motels, campgrounds, RV parks, gift shops, and recreational facilities. Both county and municipal planners have attempted to maintain the rural character of low-density residential areas by encouraging the location of commercial development near major intersections and existing communities. The county has taken the further steps of amending the zoning ordinance to prohibit establishments of over 70,000 ft<sup>2</sup> in rural areas as well as adopting design guidelines from commercial and industrial uses through the Area Plan process in the communities of Tusayan, Doney Park, Oak Creek Canyon, Kachina Village, and Mountaineer (Coconino County 2003).

Due to the fact that most industrial facilities require municipal water, fire protection, and other services, relatively few are located outside of cities and towns in unincorporated areas of the county. As of 2002, the primary areas of heavy industrial zoning and development were located near Winona (seventy-two acres) and on Leupp Road (242 acres) in the Doney Park area. An additional 140 acres are industrially zoned in Bellemont and considerable additional development is possible at both Bellemont and Flagstaff Ranch Road. The *Coconino County Comprehensive Plan* states a preference for future industrial uses in the area that do not require large amounts of water such as warehouse, distributing, and light manufacturing (Coconino County 2003).

### *Yavapai County General Plan*

Like that of Coconino County, Yavapai County’s general plan of 2003 states the overall objective of promoting development that maintains the region’s traditionally rural character while adequately planning for expected growth. The challenge of doing so is heightened given the fact that Yavapai County’s population growth over the last two decades has more than doubled that of Coconino County and has been nearly 20% greater than overall population growth for the state of Arizona over the same period. This substantial growth in the county’s population has coincided with a decline in traditional land uses such as ranching, agriculture, and mining and has led to significant expansions of existing municipalities (Yavapai County 2003).

The majority of land in Yavapai County is publicly owned and managed by federal and state agencies. 38% of total county land is under the jurisdiction of the USFS, 24% is managed by the AZSLD, and 11.6% is controlled by the BLM. Approximately 25% of land in Yavapai County is privately owned. USFS lands are concentrated in the eastern and southern portions of the county, and BLM lands are

primarily located in the southwestern and south-central areas of the county. AZSLD holdings are also concentrated in the southern areas but are additionally present in checkerboard sections throughout northern Yavapai County.

In addition to Federal and State agencies, twelve other jurisdictions control limited portions of land within the county. Nine of these jurisdictions are incorporated cities and towns, and three are Tribal Reservations (Yavapai-Prescott Indian Reservation, Yavapai-Apache Reservation, and Hualapai Indian Reservation). As of 2002, these twelve jurisdictions held approximately 236 square miles of land, comprising 2.9% of the county's total land base (Yavapai County 2003).

Many of the county's current planning efforts are directed toward the designated "major growth areas." According to the *Yavapai County General Plan*, 2000 Census data suggest that 50% of the total county population lives in the Central Yavapai Region and another 32% lives in the Verde Valley area. The areas surrounding Prescott and Prescott Valley have grown dramatically since the 1970s, largely as a result of the sale and conversion of former Fain family ranch holdings. Additionally, planned area developments such as Yavapai Hills, Hidden Valley Ranches, and Sandretto Hills have been annexed into the City of Prescott. Similar conversions of ranch and farm properties have led to substantial residential development in the Verde Villages, Chino Valley, and along the State Highway 69 and Williamson Valley Road corridors. This trend is expected to continue as other large ranches in Yavapai County are currently being proposed as sites for future development (Yavapai County 2003).

- Residential land use

The *Yavapai County General Plan* states that approximately 96% of the land in unincorporated Yavapai County is zoned for residential land use. This land is subject to two-acre minimum zoning and comprises 3.7 million acres of government-owned property and over 1 million acres of private property. Land use referred to as Rural Residential is primarily located in the southern and western portions of unincorporated Yavapai County. Rapid growth has also been experienced in areas referred to in the plan as "municipal influence areas." These areas are primarily residential developments adjacent to, but outside, the boundaries of existing municipalities.

As is the case in Coconino County, effective planning is made more difficult by the prevalent practice of lot-splitting. The plan states that between April 2000 and April 2001, 1,760 parcel splits were recorded in Yavapai County, accounting for 90% of home sites developed during the period. The result is that many large, private holdings have been continuously split into numerous two-acre parcels. Under current state law, the county has little authority to require infrastructure or dedication of open space for split parcels, nor does it review split properties for suitable access, water, sanitation, drainage, or available utilities. Importantly, state law also permits installation of "exempt wells." Wells qualify as exempt if they have less than a thirty-five gallons per minute pumping capacity. This includes the vast majority of wells for residential consumption as wells with three- to ten-gallon-per-minute capacity are deemed sufficient for typical households. As a result of parcel splits and well exemption, the plan claims that a large percentage of current land development in unincorporated Yavapai County is "unplanned" (Yavapai County 2003).

- Commercial and industrial land use

The *Yavapai County General Plan* states a preference for general commercial and tourist-related businesses to be located along the major intersections found on State Highways 69, 89, 89A, 179, 260 and Interstate 17. Although the mining industry has declined throughout the county, this land use continues in the community of Bagdad as well as various small mining entities in other parts of the county.

### *Gila County Comprehensive Master Plan*

Like many areas throughout the Mountain West, current patterns of existing land use in Gila County are rooted in the history of settlement by miners, ranchers, and loggers. The influence of mining activity on patterns of development is still seen in communities such as Hayden, Winkelman, Miami, and Globe, compact towns characterized by platted grid street networks and historic downtown cores. By comparison, the rural patterns of development that have been maintained in the northern communities of Young, Pine, and Strawberry reflect a past rooted in logging and ranching. While mining and ranching continue to make significant contributions to the county's overall economy, industries supported by recreation and tourism are becoming increasingly important and are likely to influence development patterns in the future (Gila County 2003).

Gila County covers an area of approximately 3,052,096 acres, just 4% of which (124,000 acres) is private property. 18,500 acres of private property in the county lie within incorporated municipalities such as Payson, Globe, and Miami. The remaining 105,000 acres of private property are held in parcels scattered around unincorporated communities such as Pine, Strawberry, Star Valley, Gisela, and Young as well as within larger land areas managed by the USFS and the BLM. In the southern part of Gila County, large parcels of private land are owned by ranching and mining interests north and west of Miami. Over ninety-five percent of the county's land area is collectively managed by the Fort Apache and San Carlos Apache Indian Reservations (38%), Tonto National Forest (55%), BLM and National Park Service (1.7%), and other local and state government agencies (Gila County 2003).

The limited amount of private land combined with moderate population growth in Gila County has resulted in a continuation of historical development patterns in unincorporated areas of the county. Recent development has been concentrated in northern portions of the county in the towns of Payson and Globe as well as the unincorporated areas surrounding Pine, Strawberry, Tonto Basin, and Star Valley. This concentrated growth has been due in part to the practices of developing pockets of residential use on vacant parcels as well as subdividing and lot splitting of scattered private properties (Gila County 2003).

The *Gila County Comprehensive Master Plan* was adopted by the Board of Supervisors on November 4, 2003. In addition to a discussion of existing conditions and land use preferences for the remote and sparsely inhabited areas of the county, the plan also includes five distinct "Area Land Use Plans" (one each for the northwest, northeast, west central, east central, and southern portions of the county) as well as individual "Community Land Use Plans" for the unincorporated communities of Pine, Strawberry, Star Valley, Tonto Basin, Young, Gisela, and Claypool. Rather than an exhaustive discussion of these more detailed plans, this assessment is limited to the more generally applicable policies and land use designations contained in the land use element of the *Gila County Comprehensive Master Plan*. Area and community land use plans can be reviewed at <http://co.gila.az.us/default.aspx>.

- Residential land use

The *Gila County Comprehensive Master Plan* provides for eight distinct residential designations based on the density of dwelling units. These designations range from very low-density rural detached residential development (one dwelling unit per ten-or-more acres) to high-density suburban residential detached or attached development (more than ten dwelling units per acre). Much of the residential development outside of unincorporated communities has been the result of lot splitting on large parcels and historic land grants and purchases. Many of these areas are located within the TNF, are accessed by unimproved forest roads, and have little, if any, developed infrastructure. Potable water is either hauled or provided by private wells, and waste water is disposed of in individual septic tanks.

In rural areas of northern and eastern Gila County, residential development is characterized by a mixture of seasonal, secondary, and full-time site-built and manufactured homes. Meanwhile residential development in southern portions of the county is concentrated in the Tonto Basin, Lake Roosevelt, and

Dripping Springs area. The plan states that the southern areas of the county have a significantly lower number of seasonal and part-time residences (Gila County 2003).

- Commercial and industrial land use

The plan designates two distinct types of commercial land use: neighborhood commercial and community commercial. Neighborhood commercial areas are to be no larger than five acres and located at intersections of local roads. They are intentionally limited to serving the needs of residents in the immediately surrounding unincorporated areas. Community commercial land uses, such as grocery stores and supporting commercial services, are intended to provide for both community and regional commercial needs.

Similarly, industrial land uses are divided into two categories: light industrial and heavy industrial. Light industrial uses include low-intensity employment, manufacturing, and fabrication activities buffered from residential uses and are generally not served by heavy truck or delivery traffic. Heavy industrial uses include heavy manufacturing, smelting, mining, and other tasks that involve significant noise, dust, odor or other emissions. Historically, significant portions of southern Gila County have been designated as heavy industrial areas due to the substantial impact of the mining industry in the region (Gila County 2003).

Regarding the impact of land use on forest management, the plan notes that the *Gila County Land Use and Resource Policy Plan for Public Lands* was adopted by the Board of Supervisors in February 1997. It is described as a “tool to assist county, state, and federal decision makers in protecting, evaluating and enhancing Gila County’s customs, culture, social sustainability, economy, tax base and overall public lands ecosystem health” (Gila County 2003). Copies of this plan were not available at the time of this assessment.

#### *Local land use policy issues*

The primary land use issues facing county residents within the area of assessment are the result of a transition from an area defined by its rural character to one facing increasing pressure for urban development. While residents and planners prefer to maintain a rural character throughout unincorporated county lands, rapidly increasing populations and expanding city boundaries represent some of the challenges for doing so.

Preservation of open space is a particularly important land use issue among planners and property owners within the area of assessment. Adequate open space is seen as a critical step toward protecting important watersheds, preventing fragmentation of wildlife habitat, and creating buffers between low-density rural development and higher-density uses within incorporated cities. Policies aimed at preserving open space have been mentioned in each of the county comprehensive plans. These methods include the encouragement of “clustered development,” the purchase of development rights, and the dedication of land such as conservation easements. Although no such measures have been adopted, the *Flagstaff Area Regional Land Use and Transportation Plan* mentions the possibility of adopting rural and urban growth boundaries, outside of which future development would be discouraged or prohibited (Coconino County 2003, Yavapai County 2003, Gila County 2003).

In addition to the provision of open space, county land use planners also emphasize the need to ensure efficient and effective land use in areas suitable for development. A commonly mentioned policy for ensuring efficient land use is the encouragement of infill development. Infill development not only limits urban sprawl, it maximizes the efficiency of infrastructure and minimizes traffic congestion, thereby lowering the overall cost of development. Policies aimed at encouraging infill include the provision of

density transfers and zoning changes that allow for mixed uses in low-density areas (Coconino County 2003, Gila County 2003, Yavapai County 2003, FMPO 2001).

Another factor certain to influence the pattern of future development is the relative scarcity of private land within the area surrounding COF. In an effort to capitalize on the current land market and accommodate the need for residential and commercial development resulting from population growth, large property owners commonly engage in the practice of “lot splitting.” Currently, county governments exercise little or no authority over this practice, resulting in developments that circumvent established density guidelines as well as avoiding the costs of installing critical infrastructure such as sewers, water, improved roads, and emergency access. In addition to advocating state legislation that would grant counties the power to regulate lot splitting, county planners propose sharing the cost of development with private interests through tools such as impact fees (Coconino County 2003, Gila County 2003, Yavapai County 2003). Proponents of development also advocate the consolidation and conversion of the current patchwork of State Trust lands currently managed by the AZSLD. They argue that the exchange and/or sale of these State Trust lands will alleviate land scarcity, provide much needed funds for the state educational system, and allow for protection of environmentally sensitive landscapes. A further discussion of the impact of State Trust Lands on Arizona’s national forests is presented in the next section (Coconino County 2003, Yavapai County 2003, Gila County 2003).

Undoubtedly, the availability of sufficient water supplies is a growing concern for Arizona communities, particularly those experiencing relatively high rates of population growth. Recently, Governor Napolitano cited the “one-two punch of record drought and record growth” as the greatest threat to the state’s water supply and a serious concern for Arizona’s future development (Napolitano 2004). One of the statewide policies enacted through the Arizona Department of Water Resources (ADWR) is to require developers in AMAs to identify a 100-year assured water supply, participate in banking water, expand use of effluent water, and convert homes and building to low-water-use fixtures. Currently, the Prescott Active Management Area in central Yavapai County is the only one within the area of assessment and measures 485 square miles (ADWR 2005). Additionally, the 1998 Growing Smarter legislation passed by the State Congress requires the inclusion of a Water Resources element in the comprehensive plans of all counties with a 2000 population of 125,000 or greater. The current versions of the Yavapai and Coconino County comprehensive plans both contain Water Resources elements which support making water availability a key consideration for all major developments and subdivision applications filed in conjunction with a rezoning for higher density. Policies for effectively managing future development with respect to projected water supplies include county support for the formation of water districts, incentives for low-water plumbing devices, drought-tolerant landscaping, and the identification and reuse of non-potable sources such as gray water (Coconino County 2003, Yavapai County 2003).

Finally, the proximity of many rural communities to large parcels of public land have prompted calls for greater collaboration on land use planning between county and municipal governments and their federal and state counterparts. In addition to the aforementioned issues, county residents are particularly interested in coordinating efforts on land acquisition and exchange as well as fire management and forest restoration (Coconino County 2003, Yavapai County 2003, Gila County 2003).

#### **5.4 Changes in land ownership affecting the Coconino National Forest**

A number of land acquisitions and land exchanges proposed in recent years have either directly or indirectly involved lands managed by the COF. A brief description of information available on these land transactions follows:

- Camp Verde Townsite Act (2005)

In May 2005, SWCA Environmental Consultants released a draft environmental assessment of the proposed sale of a 223-acre parcel approximately one-and-a-half miles southeast from the center of Camp Verde, referred to as the airstrip site. The town of Camp Verde intends to use the site to provide community parkland and recreational opportunities for a growing number of town residents. The airstrip site was deemed preferable to others initially considered for town acquisition in that it would be made more affordable through the Townsite Authority Act (SWCA 2005).

- Camp Verde Sanitary District Site Acquisition (2004)

In April 2004, the Director of Lands and Minerals for the Southwest Region of the Forest Service issued a Decision Notice (DN) to allow the purchase of 161 acres of Forest Service land by the Camp Verde Sanitary District (CVSD). Fifty-seven acres of the purchase was enabled under the authority of the Sisk Act and 104 acres under the authority of the Townsite Act. The purchase is expected to allow the CVSD to meet community development needs for the next twenty to thirty years by providing land necessary for constructing improvements to the existing sewage and water treatment facilities. The lands involved in the sale are located in the eastern portion of Camp Verde near State Route 260 in the Coconino National Forest, Yavapai County (USFS 2004).

- Red Rock District Office (2004)

The Arizona National Forest Improvement Act of November 2000 gives the Forest Service the authority to exchange or sell these parcels to acquire, construct, or improve administrative facilities. The Red Rock Ranger Station twenty-one-acre parcel is located on Brewer Road in Sedona. The property was scheduled to be sold through a competitive prospectus process in March 2005. Future use of these locations will be determined by the local community jurisdiction; however, it is expected that both sites will continue to have similar use as neighboring parcels (COF 2005).

- Mule Park Land Exchange (2004)

In March 2004, the Coconino National Forest issued a Decision Notice (DN) approving the exchange of forest for private lands with Lawrence W. Knipp and Beverly A. Knipp, through their designated representative, Federal Land Exchange, Inc. (FLEX). The transaction involved the exchange of approximately 270 acres of private land in three parcels within the Mogollon Rim District of the Coconino National Forest for approximately 197 acres of federal land in one parcel located within the Mogollon Rim Ranger District of the Coconino National Forest approximately thirty to forty miles southeast of Flagstaff. The exchange was intended to facilitate the consolidation of public lands, thus improving overall management, benefiting specific resources and increasing management efficiencies. In exchange, FLEX offered generally unimproved private land parcels containing a significant amount of meadow. The opinion expressed in the DN stated that the acquisition of such lands was important for various wildlife species as well as providing additional dispersed recreation opportunities. It also explained that ownership consolidation of these lands would reduce complexity of land ownership patterns, reduce the potential for development of private lands in an inconsistent manner with adjacent national forest lands, and reduce the potential for encroachments, trespass, and related impacts to the forest (COF 2004).

- Sedona Land Exchange (2004)

In September 2001, the Director of Minerals and Lands for the Southwest Region of the Forest Service issued a Decision Notice (DN) approving the sale of 266 acres of Forest Service land to the city of Sedona for the purpose of resolving land needs for the treatment of effluent. Approximately 198 acres of the purchase were authorized under the Arizona National Forest Improvement Act, and the remaining sixty-eight acres were authorized under the Townsite Act. With the proceeds from the sale of federal land, the Coconino National Forest purchased a priority 100-acre non-federal parcel on the Woo Ranch (COF 2001b).

- **Bellefont Land Exchange (2003)**

In February 2003, the Director of Lands and Minerals for the Southwest Region of the Forest Service issued a Decision Memo approving the exchange of approximately 754 acres of Federal Land on the Coconino National Forest for approximately 1,160 acres of non-Federal land located within the Coconino, Coronado, Kaibab, Prescott, Sitgreaves, and Tonto National Forests. The land exchange was processed by the State of Arizona through the Arizona Game and Fish Department. The transfer of the federal parcel into state ownership was intended to allow the Arizona Game and Fish Department to directly develop and operate a permanent shooting facility in a safe and efficient manner. The memo explained that all development and uses of this shooting facility, including safety zones, would be encompassed in these 754 acres. It also stated that the exchange would allow the forest to better control unregulated and indiscriminate shooting on national forest land in unsafe and uncontrolled cinder pits around the Flagstaff area (USFS 2003g).

- **Montezuma Castle Land Exchange (2003)**

In July 2003, a Senate report from Committee on Energy and Natural Resources directed the Secretary of Agriculture to implement house bill H.R. 622. The bill approves the Montezuma Land Exchange which calls for the transfer of otherwise known as the Tonto and Coconino National Forests Land Exchange Act. The bill calls for two individual land exchanges. The Montezuma Castle Land Exchange involves transfer of 222 acres of National Forest System land in the Tonto National Forest adjacent to the town of Payson and near the municipal airport for approximately 157 acres of private land adjacent to Montezuma Castle National Monument and nearly 108 acres of private land known as the Double Cabin Park Lands. Both private parcels involved in the exchange were located within the Coconino National Forest (Domenici 2003).

- **Diamond Point/Q Ranch Land Exchange (2003)**

The same bill, H.R. 622, called for the transfer of 108 acres of National Forest System land to the Diamond Point Summer Home Association in exchange for 495 acres of private land. The federal land was located approximately eight miles northeast of the city of Payson and was specifically identified for exchange in the TNF Management Plan. The private land, previously the Q Ranch, was the third and final parcel of a major private inholding conveyed to the TNF. The land was initially purchased by the Conservation Fund and optioned to the association for use in the land exchange. There was reportedly broad public support and no opposition throughout the exchange process (Domenici 2003, WLG 2005)

## 5.5 Key issues for forest planning and management

“A critical element in understanding the regional significance of national forest lands and resources in the Southwest is understanding the development and relationships of public and private land ownership and control.”

- Timeless Heritage: A History of the Forest Service in the Southwest

Few, if any, of the topics included in this assessment have as direct an impact on forest management as land use planning. Although land ownership and use remained remarkably stable in the century following the founding of the Arizona Territory in 1863, recent shifts in the state’s population and economic base have brought about dramatic trends in land use that are likely to influence forest management for decades to come.

Arizona has long maintained a relatively large percentage of lands under federal jurisdiction. In 1891, land held under the public domain accounted for approximately 75% of Arizona’s total land base. By 1977, the proportion of federally controlled land had decreased but was still substantial at 71%. By comparison, federally controlled land accounted for 34% of New Mexico’s land base in the same year. Alternatively, only 16% of land in Arizona was under private ownership in 1977 while private land constituted 45% of all land in New Mexico in the same year (Baker et al. 1988). When combined with demographic and economic trends discussed previously in this assessment, these ownership characteristics have placed increasing pressure on what has likely become one of Arizona’s most valuable natural resources: land.

The current policy debate regarding transition of public and private lands in Arizona is rooted in a historic context that reflects significant economic change. Traditionally, sectors such as mining, ranching, and logging have been mainstays of the state’s predominantly rural economy. In addition to owning substantial portions of Arizona’s limited private land base, these interests have exerted considerable influence over the management and use of adjoining public lands. For example, private owners of scattered parcels on which springs and wells are located have typically enjoyed a certain amount of control over activities on surrounding dry areas. Likewise, large private landowners, such as railroads and mining companies, have also sought to influence access to the state’s vast public lands. Although many of the industries associated with Arizona’s early history have declined in recent decades, controversy between public and private land interests has steadily increased under the pressure for continued urban development. According to the *Land and Water Law Review*, “The proper allocation of rights to private landowners and federal land conservation interests has become one of the most contentious and emotional issues in public land law” (Stuebner 1998).

The area surrounding the COF exemplifies many of the trends and controversial issues involving the economic stability and effective management of public lands. Within the area of assessment, Yavapai County serves as a particularly poignant example of an area engaged in vigorous debate over land management practices. Collected data show that over 87% of land within the county is controlled by the FS, the AZSLD, and private owners. Meanwhile, Yavapai County has seen considerable population and housing growth in recent decades, much of which is attributable to the area’s wealth of natural resource amenities.

At issue is how, and whether, private owners and public land managers can come to an agreement on how to best manage the competing priorities of resource conservation and economic development. As seen in the county comprehensive plans reviewed for this assessment, planners are struggling to cope with growing demands for housing and recreation while ensuring preservation of a shrinking natural resource base that contributes to Arizona’s highly valued “rural character.”

Much of the current controversy involving land management is encapsulated in the debate over open space. Research shows that the rate of conversion of private parcels from farming, ranching, and forestry to more urban land uses has outpaced population growth over the last several decades (USFS 2005f). This trend has led to increasingly pointed exchanges between ranchers, farmers, seasonal residents, conservation interests, and home builders over the immediate and long-term value of open space. Meanwhile, all sides of the debate over management of public lands have become aware of the increasingly important role of Arizona's State Trust lands in conserving natural resources and sustaining urban growth. As such, proposed reforms of the current State Trust land system are likely to be highly relevant to future management plans of the COF in light of the amount of State Trust lands within the area of assessment (c.f. Section 9.2).

Finally, all of the national forests in Arizona are likely to find themselves in the center of a growing debate over the management of the state's water resources. This is due to the fact that the forests share primary responsibility for the management of watersheds critical to environmental sustainability as well as residential and industrial growth. Studies have shown that approximately forty percent of surface and subsurface water in Arizona originates on lands administered by the Forest Service (USFS 1983). The role of the COF in protecting the integrity of area watersheds is likely to become increasingly important given the rates of projected growth in Yavapai and Coconino Counties.

In order to facilitate resolution of current and future land use issues, the COF should continue working in partnership with affected communities and landowners adjacent to forest boundaries and promote the efforts of county and city land use planners in the institution of sustainable regional approaches to urban development and resource conservation. In particular, the FS can use its technical and organizational strengths to help stakeholders make informed decisions about land ownership and use that will undoubtedly affect their future environmental and economic well-being (USFS 2005f).