GROWTH ON THE COCONINO PLATEAU

Potential Impacts of a Water Pipeline for the Region

March 2001

Morrison Institute for Public Policy

Arizona State University

On the Cover: **FLAGSTAFF'S "NEW TOWN" CIRCA 1881**

When the railroad bypassed Flagstaff's original town site, a new business district was constructed along the tracks.

GROWTH ON THE COCONINO PLATEAU

Potential Impacts of a Water Pipeline for the Region

March 2001

Rick Heffernon
Principal Investigator and Senior Research Analyst
Morrison Institute for Public Policy

Mark Muro
Senior Research Analyst
Morrison Institute for Public Policy

with Assistance from
Rob Melnick, *Director,* Morrison Institute for Public Policy
Christina Kinnear, *Graduate Research Associate,* Morrison Institute for Public Policy

Special Contribution by
John Kent Hill
Timothy D. Hogan
Tom R. Rex
Center for Business Research, Arizona State University

Morrison Institute for Public Policy

Copyright ©2001 by the Arizona Board of Regents for and on behalf of Arizona State University and its Morrison Institute for Public Policy.

BITTER SPRINGS OVERLOOK *The Navajo community of Bitter Springs, located at the base of Echo Cliffs, would be one of the beneficiaries of a regional pipeline proposed for north-central Arizona.*

TABLE OF CONTENTS

Executive Summary . . . 7

Introduction . . . 11

- Purpose of Study . . . 11
- Study Area . . . 11
- Role of Research in Regional Water Planning . . . 11
- Features of the Pipeline Proposal . . . 12

Research Methods and Activities . . . 12

Resources and Expectations: Views of Stakeholders . . . 15

- Key Observations . . . 16
- Water Resources and Needs . . . 16
- Population Effects of Pipeline . . . 18
- Land Uses and Development . . . 18
- Regional Infrastructure . . . 19
- Policies Regarding Growth, Infrastructure, and Water Management . . . 20

A Development Wildcard: State Trust Lands . . . 21

- Critical Issues . . . 21
- History . . . 21
- Dynamics . . . 22
- Impacts . . . 22
- Protection . . . 22
- Bottom Line . . . 23

Water and Growth in Western States: Four Case Studies . . . 25

- Lessons Learned . . . 25
- Selection of Case Study Projects . . . 25
- Selection Criteria . . . 25
- Projects . . . 25
- Canadian River Project . . . 26
  - Background and Development . . . 26
  - Growth-Related Impacts . . . 26
  - Summary of Canadian River Effects . . . 27
- Gillette-Madison Water Project . . . 28
  - Background and Development . . . 28
  - Growth-Related Impacts . . . 28
  - Summary of Gillette-Madison Effects . . . 29
- Quail Creek Reservoir and Pipeline . . . 30
  - Background and Development . . . 30
  - Growth-Related Impacts . . . 30
  - Summary of Quail Creek Effects . . . 31
- Lower Gunnison Basin Unit Winter Stock Water Replacement Program . . . 32
  - Background and Development . . . 32
  - Growth-Related Impacts . . . 32
  - Summary of Lower Gunnison Effects . . . 33

Population on the Coconino Plateau: A Demographic Analysis 35
Key Points 35
Demographic Profile of Coconino County 35
Subregions of the Coconino Plateau Study Area 36
Growth Determinants 36
Conclusions 38

Growth Management: How the Region Plans 39
Key Characteristics and Analysis 39
Analysis of Growth Management Criteria 39
Conclusions 42

A Statewide Approach: Growing Smarter Legislation 43
Main Impacts 43
Compliance with Growing Smarter Acts 43

Conclusions and Policy Choices: The Water-Growth Equation 45
Policy Choices: Moving the Growth Debate Forward 46

References 47
Sources 48

Appendices
Appendix A: Stakeholders Interviewed 49
Appendix B: Growth on the Coconino Plateau: A Demographic Analysis 50
Appendix C: Growth-Related Plans Analyzed 66
Appendix D: An Arizona Growth Management Time Line 67
Appendix E: Highlights of the Growing Smarter Acts 68

Maps
1: Study Area: Coconino Plateau Watershed 10
2: Study Area: Proposed Pipeline Routes 13
3: Study Area: State and Private Land Ownership 21
4: Case Study Sites 24
5: Study Area: Subregion Boundaries 34

Tables
1: Entities and Organizations Represented 15
2: Population Change in Coconino County 35
3: Age Distribution in Coconino County, 1990 36
4: Baseline Population Projections for Coconino Plateau Study Area 37
5: Population Projections by Scenario, Coconino Plateau Study Area 38
6: Analysis of Growth Related Plans 40
7: Compliance with Growing Smarter and Growing Smarter Plus General/Comprehensive Plan Requirements 43

EXECUTIVE SUMMARY

Purpose of Study

Morrison Institute for Public Policy was asked by the Arizona Department of Water Resources to study potential growth impacts of a proposed new water pipeline for the Coconino Plateau Watershed in north-central Arizona, an area that is projected to nearly double in population over the next 50 years. The area of study extends from Page and Grand Canyon in the north, to Flagstaff and Williams in the south. (See Map 1, page 10.) It includes three cities, portions of two Indian reservations, one national park, two nationals forests, and roughly 1.5 million acres of mixed private and state lands primarily arranged in an alternating, one-square mile checkerboard pattern. The great majority of residents in the region currently rely on groundwater to meet their water needs.

Pipeline Proposal

In 1999, a water pipeline from Lake Powell was proposed to meet regional water demand up to the year 2050. This proposal grew out of regional efforts to plan future water resources, a water demand and resource analysis published by Arizona Department of Water Resources, and concerns over the effects of increased groundwater pumping on seeps and springs at Grand Canyon, the Havasupai Reservation, and elsewhere. The pipeline as proposed would draw water from Lake Powell and deliver it to a number of communities and entities across the region. From north to south, they are:

- City of Page
- Six western Navajo communities
  - LeChee
  - Coppermine
  - Bitter Springs
  - Cedar Ridge
  - Bodaway/Gap
  - Cameron
- Grand Canyon National Park
- Tusayan
- Valle
- Red Lake
- Kaibab National Forest (Kaibab Lake)
- City of Williams
- City of Flagstaff

The proposed pipeline would be designed to supply some or all of the anticipated new water demand for these areas until 2050, a volume that currently ranges from less than 10,000 acre-feet per year if new groundwater development is allowed in the future, to over 20,000 acre-feet per year if it is not.

To determine the growth effects of a potential regional pipeline, both quantitative and qualitative data sets were gathered. Research included interviews with key stakeholders in the region, field trips, consultation with experts, case studies, demographic analysis, appraisal of growth-related plans of governing bodies and agencies in the region, and evaluation of statewide growth management laws and their effects on regional planning.

Summary of Results

Key observations of stakeholders:

- **Groundwater is the most relied-upon source of water in the study area, but resources and needs vary tremendously.** While Flagstaff and Page have enough water to meet near-term demand, Williams and most Navajo communities in the study area face critical water shortages. Most areas could see their water sources or systems affected by acts of nature, policy decisions, or legal action.
- **Expectations differ regarding local impacts of a water pipeline.** Flagstaff is expected to grow regardless of new water sources, while Navajo communities hope pipeline water will stimulate economic development. Growth prospects in the western portion of the study area are widely debated.
- **Substandard rural development is feared in the western portion of the study area.** Stakeholders worry that new water could accelerate "wildcat" and strip-type development along the gateway to Grand Canyon National Park. While some development there is inevitable, they want to preserve the sense of open space.
- **Regional infrastructure has limited capacity to accommodate growth.** Highways, streets, schools, and phones need upgrades to keep pace with regional growth, though some stakeholders want to preserve the highway approach to Grand Canyon as it is. Some also noted the need for water distribution lines to serve low density areas, and increased sewage treatment capacity.
- **A water pipeline could be used to manage growth in conjunction with other measures.** Among the collateral measures: 1) state legislation prohibiting any new groundwater uses in the study area, 2) legislation providing counties with greater power to regulate subdivisions, and 3) some type of management authority that could limit access to pipeline water in unincorporated areas.
- **Strong water conservation efforts could enhance existing water supplies.** Some believe that water conservation has been discouraged, rather than encouraged, by outdated county and local ordinances. Nevertheless, Tusayan currently reclaims a substantial portion of its water.

Critical issues regarding state land dynamics:

- **State trust lands in the region could be developed in the future, with the market deciding where.** Current law requires that state trust lands be managed for maximum public benefit, therefore, the real estate market

will effectively determine which lands are reclassified for development.

- **Development "hot spots" will be along the north-south highways.** Commercial development of state land in the region has been historically slow. But if conditions change, the action will likely follow major road corridors along which the proposed water pipeline might run – particularly State Highway 64 north from Williams, and U.S. Highway 89 north of Flagstaff.
- **Conservation efforts could preserve key state lands.** Existing and pending land preservation efforts could limit development in sensitive areas, but they will require substantial funding. Potential changes in state law may also alter Land Department mandates and allow no-cost conservation set-asides.

Lessons learned from other regions with water supply projects:

- **Water tends to flow toward economic growth, but does not, alone, create growth.** Where economic performance has led to population growth that strains water resources, an augmented water supply tends to facilitate further growth. But water has little growth effect in economically depressed areas unless combined with some other factor that triggers economic improvement.
- **Infrastructure and the decision on who gets water affects where and how a region grows.** If water access is tightly controlled by, or restricted to, urban areas, the region will tend to grow through urban infill or contiguous development on the fringe. If water is readily available across a region, development may leapfrog to more remote and unincorporated areas where land and development fees are less expensive.
- **Water projects can produce long-term economic benefits, and they can protect regional aquifers.** Reservoirs and other uses of project water can attract a recreation industry that contributes to the region's overall economy. Projects that use renewable water sources to meet demand can also reduce pressure on local groundwater sources, at least in the short term.
- **Surface water projects can damage downstream resources and undercut water conservation efforts.** Projects that divert streams or reduce stream flows can substantially alter natural resources. New water supplies also tend to reduce immediate resource concerns so that conservation efforts lose their impetus.

Key points regarding the region's growth prospects:

- **Coconino County has experienced high growth rates – and this is expected to continue.** Arizona Department of Economic Security (DES) projections rely on historical patterns to forecast future results, therefore population growth is projected to persist into the future, albeit at a somewhat reduced rate.
- **Coconino County has an unusually youthful profile.** With a high proportion of residents less than 25 years old and a low proportion over 50, the area is not considered a retirement haven.
- **Growth projections assume that current economic and demographic forces will continue.** But if growth drivers change, the regional growth trajectory will follow.
- **Tourism is the most important economic factor affecting growth in the region.** Because tourism leads all economic activity in north-central Arizona, it is likely to create the most jobs – and growth – in the future.
- **Pipeline water will have little impact on total projected population growth for the region.** DES projections tacitly assume that the region's ability to meet water demand in the future will not differ substantially from its ability to meet demand now, so overall growth figures should not be affected by the source of water.
- **Pipeline water and tourism expansion will have greatest effect in the western portion of the study area.** The western portion of the study area currently faces economic constraints that are influenced by a lack of available water. An improvement in either tourism visitation or water supply would stimulate growth in the area; an improvement in both would produce substantial gains.

Key characteristics of the region's growth-related plans:

- **Many plans are getting old.** Almost half were adopted more than 10 years ago, but some are scheduled for update. Analysis of the Flagstaff update-in-progress suggests a future trend toward greater specificity regarding growth management.
- **Water availability, adequacy of infrastructure, and transportation are addressed in nearly every plan, while other growth management tools appear in only a few.** Among the plans, Flagstaff, Page, Grand Canyon, and two county areas – Tusayan and Valle – tend to contain the most detailed growth management policies.
- **The verdict is out on the region's readiness to manage growth.** Due to the conflicting missions of some planning entities, and the age of some plans, it is difficult to predict how the region will collectively manage future growth. Moves toward cooperative planning efforts, the wide-spread use of county area plans, and anticipated updates to county and municipal plans promise reasonable preparation for the future.

Main impacts of the Growing Smarter acts:

- **City and county governments must update their general/comprehensive plans every 10 years, and then they must conform to them.** New plans must be ratified by voters, and changes can be made only with approval of a supermajority of the governing body.
- **The cities of Flagstaff and Page must address new elements in their future general plans, while Williams and Coconino County probably don't.** Based on population and growth rate factors, future Flagstaff plans must include five new growth-related elements (open space, growth areas, environmental planning, cost of development, and water resources), while Page plans must include just the first four. Williams and Coconino County appear to be exempt from the five elements at this time, but the county may have to add a water element if its Census 2000 population exceeds 125,000.

- **Some state and private lands regarded as "open space" may be preserved for conservation purposes.** New state funding sources will be able to grant monies to governments and other organizations to help them obtain development rights from state and private lands.

Conclusions: The Water-Growth Equation

The Coconino Plateau region is projected to nearly double in population over the next 50 years, and water demand will increase accordingly. Because population projections assume that additional water supplies will be available to meet that demand, a water pipeline designed to accommodate projected growth should have little effect on what is projected. The fact is, economic and demographic factors, not water per se, are the most significant drivers of population.

But the water-growth equation is not simple. State population projections do not consider potential changes in economic or demographic growth factors that might be supported by an assured water supply, nor do they consider any effects that might accrue if the region is unable to develop water unconditionally. Either could affect actual growth. Moreover, while growth number may hit projections, the pattern of growth could vary depending on the water's source and distribution.

Increased development of groundwater would favor growth in established communities. These places tend to have more growth management tools at their disposal and better, more comprehensive infrastructure to accommodate that growth – positive circumstances from a regional planning perspective. But future groundwater supplies are not assured due to uncertainties regarding the nature of local aquifers and the complexity of groundwater rights in the region. Already, national parks, Indian tribes, and even downstream water users are questioning whether deep wells on the Coconino Plateau impinge on their surface water rights, and well permits on national forest land are being scrutinized more carefully to determine their impacts on other water resources.

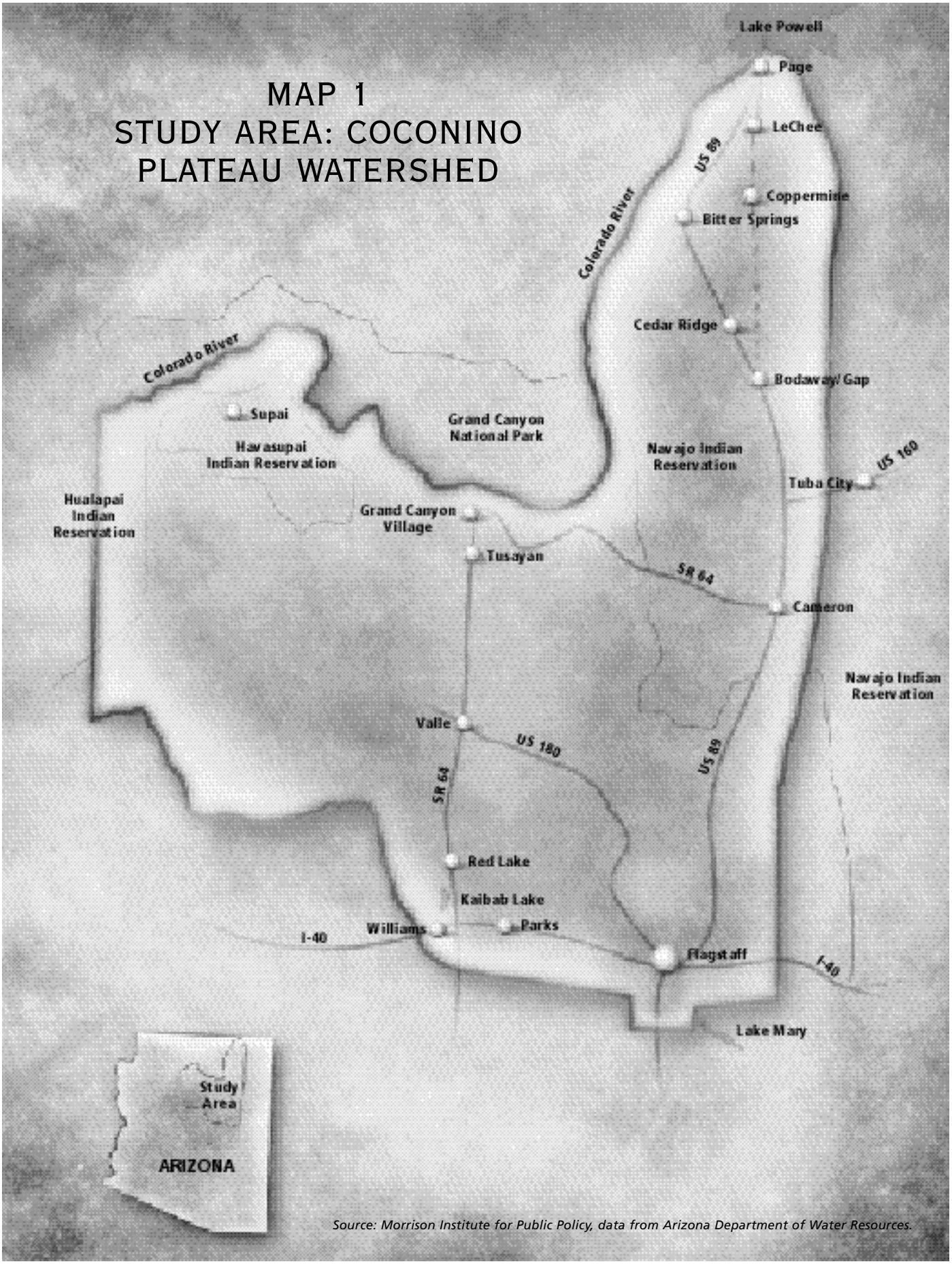
The beauty of a water pipeline is that it might sidestep most of the difficult groundwater issues. It would also be welcomed in parts of the region where water is especially short. But a regional pipeline could alter ***how*** growth occurs – and where. One area likely to grow with a pipeline is the western portion of the Coconino Plateau between Williams and Grand Canyon. This is a landscape of wide open spaces, but it is comprised of a mix of private land and state trust land, both of which are potentially developable. Weak economic factors combined with a lack of available water in this area have constrained growth in the area, but that could change dramatically with a rebound in tourism and an assured pipeline supply of water. Those who want to preserve a scenic approach corridor to the Grand Canyon, may demand some type of protective action for this area.

Policy Choices: Moving the Growth Debate Forward

Throughout Arizona, growth and its impact on natural resources has become the centerpiece of public policy debate. While much of the discussion has focused on the state's major metropolises, rural areas such as the Coconino Plateau region face many of the same policy choices. Most prominent among these choices is how best to balance the perceived value of development against its impact on the environment. As the only regional governing body in a regionwide decision-making process, Coconino County is in the best position to lead consensus building on a number of growth-related matters.

Among the most critical growth-related issues that must be decided regarding a regional pipeline:

- **Who will get pipeline water and how will it be treated and distributed?** The time to determine access to pipeline water, as well as its distribution and treatment, is before construction begins. That decision will strongly affect future growth patterns in the region. A more restrictive policy will channel growth toward places where infrastructure and growth management tools are at their most robust, thereby discouraging sprawl.
- **How much protection will the aquifer receive?** One major selling point for an outside water source for the region is the potential protection it affords regional aquifers. But if groundwater production increases regardless of the pipeline, political support for the proposal could be undermined. To keep all stakeholders on board, some type of restriction on groundwater use or development may be necessary as a corollary to pipeline construction.
- **How big should the pipe be?** The diameter of the pipe will determine the maximum number of people that can be served, therefore decision-makers need to decide early on how much growth they want to accommodate.
- **What growth management powers will the county wield?** Counties currently possess relatively few tools to manage growth in their unincorporated areas, particularly when it comes to regulating small and/or low density wildcat subdivisions. Because timing could be critical when it comes to protecting lands considered sensitive to development in the study area, concerned stakeholders may want to push for faster action in the state capitol, and/or develop a regional plan for protecting sensitive lands through purchase, lease, or regulation.
- **Who will manage the pipeline?** The legal and management structure for administering the water pipeline will play a significant role in determining how water is allocated. Whoever controls those allocations – particularly for any unencumbered water – will have power to regulate new subdivisions in unincorporated areas of the county, thereby influencing how much population growth can occur there.



Source: Morrison Institute for Public Policy, data from Arizona Department of Water Resources.

INTRODUCTION

Purpose of Study

Morrison Institute for Public Policy was asked by the Arizona Department of Water Resources to study potential growth impacts of a proposed new water pipeline for the Coconino Plateau Watershed in north-central Arizona. This is a rapidly growing region that expects to need additional sources of water to meet anticipated growth over the next 50 years. Currently, the main source of water in the region is groundwater, primarily from deep wells. Reliance on groundwater would likely increase if the region continues to grow and if an outside source is not available.

Concerns have been raised that pumping of groundwater in some parts of the region could lead to the decline of seeps and springs elsewhere, such as at Grand Canyon and the Havasupai Reservation. In response, a regional water pipeline was proposed in 1999 that would run from Lake Powell to several communities across the region. The pipeline would likely resolve most concerns about seeps and springs (only complete cessation of groundwater pumping would resolve all concerns), but it has raised two new concerns: 1) that it might stimulate population growth beyond what the region was already expecting to accommodate, thereby increasing water demand beyond what the pipeline was designed to carry, and 2) that it might stimulate growth in areas where it is not wanted. Consequently, Morrison Institute was commissioned to examine the potential population growth impacts of the water pipeline, as well as the readiness of regional and local governments and service agencies to manage such growth.

Study Area

The area of study for this report is defined as the Coconino Plateau Watershed (formerly called the North Central Arizona Regional Watershed). This region, which is located in north-central Arizona, is wholly contained within Coconino County, extending roughly from Page and Grand Canyon in the north, to Flagstaff and Williams in the south. (See Map 1, page 10.) The study area includes three cities of greatly varying size, and encompasses portions of two Indian reservations, one national park, and two nationals forests. Overall, the region is largely composed of open space, including a wide swath of private and state lands that are arranged in a checkerboard pattern across the mid-section of the study area.

Role of Research in Regional Water Planning

Morrison Institute's research is one part of a comprehensive research and planning project referred to as the Coconino Plateau Regional Water Study. This project is an effort to prepare for the region's water resource needs over the next 50 years. Other research aspects of the project include analysis of regional water demand and sources, technical study of pipeline routes and costs, and regional groundwater study. Related independent studies, such as ongoing monitoring of wells and springs in the region, will also be incorporated into the planning effort.

The planning process for the Coconino Plateau region grew out of Arizona's Rural Watershed Initiative. This is a statewide program in which the Arizona Department of Water Resources (ADWR) works with rural communities to help them develop locally-driven solutions to their water needs. Under the Rural Watershed Initiative, planning areas are identified by their watersheds, not by geopolitical boundaries.

Two planning groups currently operate in the Coconino Plateau Watershed. One is the Coconino Plateau Water Advisory Council, which was formed by the Coconino County Board of Supervisors in late 2000 as an oversight and policy-making group. The Water Advisory Council is composed of elected and executive-level representatives of various entities and interest groups throughout the region, including Coconino County, the cities of Flagstaff, Page, Sedona, and Williams; the Havasupai, Hopi, and Navajo tribes; the Kaibab and Coconino national forests; Grand Canyon National Park; Arizona State Land Department; Arizona Department of Water Resources (ADWR); Northern Arizona University; Grand Canyon Trust; Coconino Bar Association; Coconino Natural Resources Conservation District; Northern Arizona Home Builders; and a private water and drilling company.

Meanwhile, a "technical committee" for the watershed has engaged in discussion and research dating back more than two years. Among those who have participated in this group are representatives of a number of stakeholders and interested parties. Several of the entities represented on the technical committee – including ADWR, Havasupai Tribe, Navajo Nation, City of Flagstaff, City of Williams, Hydro Resources of Tusayan, Coconino County, City of Page, and U.S. Bureau of Reclamation – signed a memorandum of understanding (MOU) to "cooperatively develop regional water plans and/or cooperative programs that identify future water supplies and water development scenarios that best serve public needs and protect nationally and locally significant resources" (Memorandum of Understanding Among the Participants of the North Central Arizona Regional Water Study, 2000). The Water Advisory Council, however, is expected to replace this MOU with a new agreement reflecting the more comprehensive role and mission of the policy-making group.

As a basis for a cooperative regional water study, ADWR prepared a report in 1999 titled "Phase 1: North Central Arizona Regional Water Study." This report calculated future water demand in the Coconino Plateau region, analyzed possible water sources to serve those demands, and outlined future research tasks. Among the conclusions of the Phase 1 report was that a water pipeline from Lake Powell "may be a cost and environmentally effective alternative that would provide the region a firm, reliable water supply to meet future demands and deserves further study" (Arizona Department of

Water Resources, 1999). The report included in its appendix a technical memorandum from the Navajo Nation Department of Water Resources that presented route options for a regional pipeline as well as preliminary cost estimates.

Features of the Pipeline Proposal

The proposed pipeline as it was envisioned in the Phase 1 report would draw water from Lake Powell near Glen Canyon Dam and deliver it to a number of communities and entities across the region. Based on updated information provided by a more recent review of pipeline routes and costs by the U.S. Bureau of Reclamation (September 2000), the current potential beneficiaries of this water are, from north to south:

- City of Page
- Six western Navajo communities
  - LeChee
  - Coppermine
  - Bitter Springs
  - Cedar Ridge
  - Bodaway/Gap
  - Cameron
- Grand Canyon National Park
- Tusayan
- Valle
- Red Lake
- Kaibab National Forest (Kaibab Lake)
- City of Williams
- City of Flagstaff

Several different routes have been considered by preliminary engineering studies, but most are variations on the one presented in Map 2, page 13.

The volume of water that the proposed pipeline would carry was estimated in the Phase 1 Report based on Department of Economic Security and Navajo Nation population projections. By 2050, the region's total water demand was forecast to reach 26,350 acre-feet per year. Of this amount, 16,900 acre-feet per year were expected to be met by existing and future development of groundwater sources. The remaining 9,450 acre-feet would be delivered by the pipeline.

Since publication of the Phase 1 Report, the pipeline demand figure has been adjusted to reflect desired increases for some beneficiaries and reductions for others (U.S. Bureau of Reclamation, 2000). Demand could rise higher, however. Under one scenario suggested by a number of stakeholders in the region, new groundwater pumping would be restricted upon completion of the pipeline. In such a case, estimated demand for pipeline water would likely double.

RESEARCH METHODS AND ACTIVITIES

Both quantitative and qualitative data sets were gathered and analyzed for this study. Among the research activities that were conducted are the following:

Stakeholder interviews were individually conducted with 58 representatives from a range of Coconino Plateau interests including governments, businesses, utilities, community groups, and state and federal agencies. (See Appendix A for a complete list.) The interview content was then analyzed to determine the views of stakeholders regarding the availability of water resources, potential effects of the proposed pipeline, and measures that should be taken to manage the pipeline's water supply and any growth impacts it might produce.

Field trips throughout the study area were carried out to familiarize researchers with the study area, observe locales of particular concern, meet with stakeholders difficult to interview by telephone, and make a photographic record of the study area.

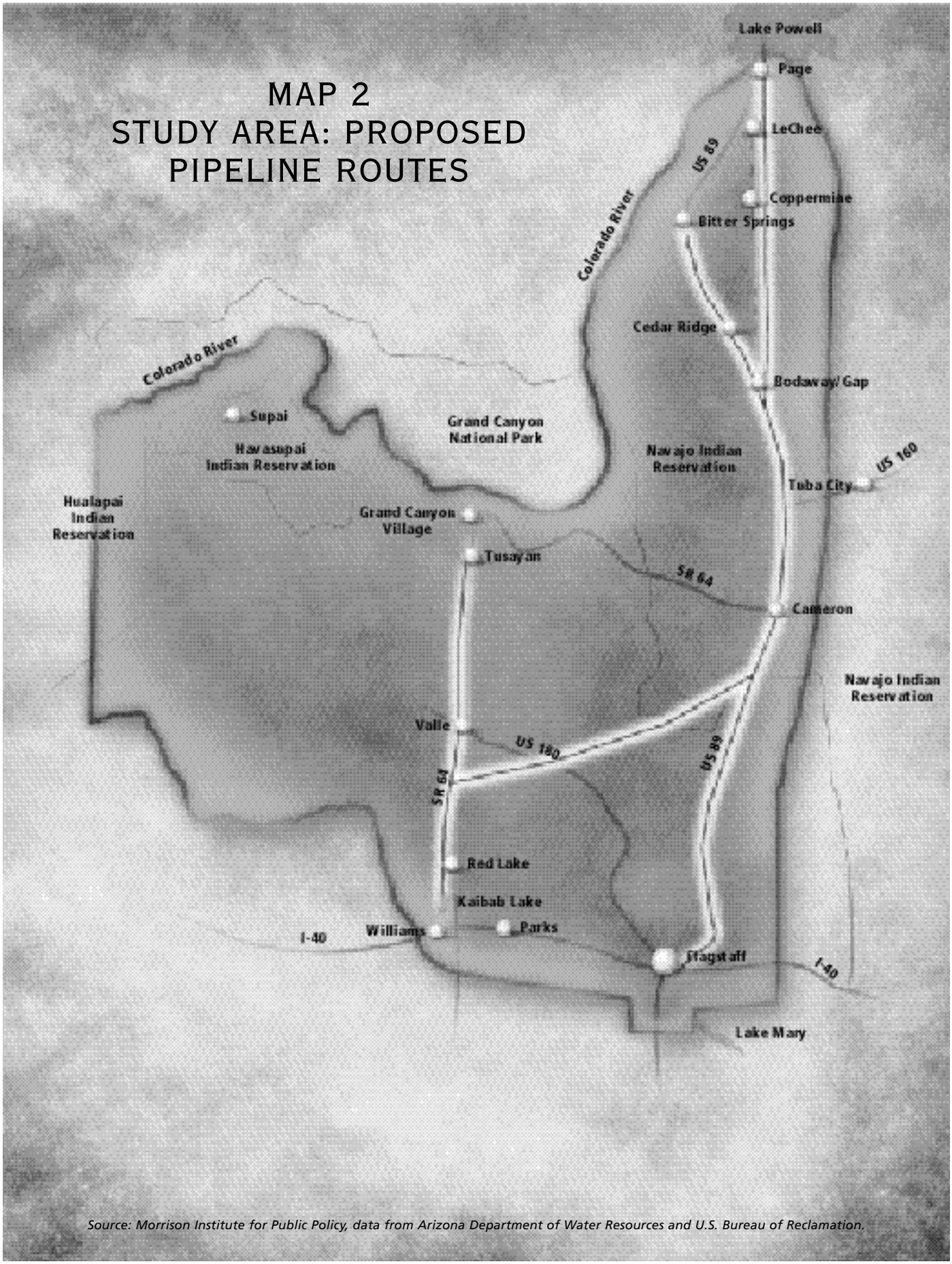
Research and consultation with experts was conducted regarding topics of special interest, including planning issues, growth management, master-planned communities, the effects of water on population growth, and the dynamics of state and private grazing lands. These data provided further background and analysis of issues raised during previous phases of the research.

Case studies were conducted to understand the growth experiences of similar regions with regional water projects already in place. The case study sites were selected based on their similarity to the Coconino Plateau study area and their length of operation.

A demographic study was commissioned to review population projections for the region and analyze their assumptions and weaknesses. The demographic study also assessed the potential growth impacts of various reasonable economic and growth scenarios and their possible interaction with the introduction of a new, assured water source through a pipeline.

General plans and/or related planning documents (e.g., economic development plans, water resource strategies) were acquired from city and county governments, unincorporated planning areas, the Navajo Nation, and federal agencies such as the National Park Service and U.S. Forest Service. (See Appendix C for a complete list.) These planning documents were then analyzed to determine the region's readiness to manage or accommodate any changing growth patterns associated with a pipeline.

Results of these research activities are presented in following sections.



Source: Morrison Institute for Public Policy, data from Arizona Department of Water Resources and U.S. Bureau of Reclamation.

THE RESERVOIR *Under a proposed pipeline, Colorado River water backed up by Glen Canyon Dam would be diverted to several north-central Arizona communities, including Page (on horizon, upper right).*

RESOURCES AND EXPECTATIONS: VIEWS OF STAKEHOLDERS

Stakeholders, by definition, are those who have some interest or share in the well-being of an enterprise. In the Coconino Plateau region they hold an interest in the future growth and development of the area. In order to identify key issues surrounding the possible construction of a water supply pipeline across the Coconino Plateau, interviews were conducted with 58 individual stakeholders from a cross-section of community, government, and business interests. These individuals were selected on the basis of their involvement with water or growth issues in the study area, management of lands potentially affected by the proposed water pipeline, government or community positions, business interests, or their role as infrastructure providers. Table 1 shows the entities and communities represented. A full list of all stakeholders interviewed appears in Appendix A.

Stakeholders were interviewed primarily by telephone or in person, but also by E-mail when necessary or for follow-up questions. The interview format varied depending on the type of entity or community represented by the stakeholder. Questions generally addressed their views on the status of current water resources in the region; the need for a water pipeline; the effects of a new water supply on population growth and land uses; the parts of the study area most likely to be affected by water-related growth; the type of management needed in conjunction with a new water supply; and the ability of the region's infrastructure to accommodate growth.

TABLE 1: ENTITIES AND ORGANIZATIONS REPRESENTED

Entity	Elected Official or Chief Administrator	Private Sector Executive	Planning or Water Resources Specialist	Other Professional Staff[1]	Community Representative
Government/Community					
Arizona Department of Water Resources			●		
Arizona Governor's Office				●	
Canyon Forest Village			●	●	
Coconino County	●		●		
Flagstaff, City of	●				
Page, City of	●		●		
Parks Area					●
Tusayan Area		●	●		
Valle Area					●
Williams, City of	●		●		
Land Managers					
Arizona State Land Department			●	●	
Babbitt Ranches		●			
Coconino National Forest				●	
Grand Canyon National Park			●	●	
Kaibab National Forest				●	
Indian Tribes					
Bureau of Indian Affairs			●		
Havasupai Tribe			●	●	
Navajo Nation	●		●	●	●
Conservation Organizations					
Grand Canyon Trust				●	
The Nature Conservancy				●	
Infrastructure Providers					
Arizona Department of Transportation				●	
APS				●	
Bellemont Water Co.				●	
Citizens Utilities Co.				●	
Coconino County Superintendent of Schools					
Doney Park Water Co.		●			
Maine School District	●				
Qwest Communications				●	
Williams School District	●				

[1] *Includes land management, intergovernmental relations, forestry, public relations, grazing, engineering, natural resources, program management, and other areas.*

Source: Morrison Institute for Public Policy.

Key Observations

- **Groundwater is the most relied-upon source of water in the study area.** Little usable surface water exists, and in many cases it has proven unreliable.
- **Water resources and needs vary tremendously across the region.** While Flagstaff and Page possess adequate water resources to meet near-term demand, Williams and most of the Navajo communities in the study area face critical water shortages. Other areas could see their water sources or systems threatened by acts of nature, policy decisions, or legal action.
- **Expectations differ regarding local impacts of a water pipeline.** For example, Flagstaff-area stakeholders anticipate little growth impact of a water pipeline on Flagstaff, since they expect the city to grow regardless of new water sources. Navajo stakeholders, by contrast, hope pipeline water would stimulate economic development. Opinions vary regarding the likelihood or amount of pipeline-related growth in the western portion of the study area.
- **The western portion of the study area is feared most vulnerable to substandard rural development.** Stakeholders worry that new water could accelerate "wildcat" and strip-type development along the gateway to their crown jewel, Grand Canyon National Park. While some development is inevitable there, they want to preserve the sense of open space.
- **Concerns exist over the capacity of regional infrastructure to accommodate substantial growth.** Highways, streets, schools, and phones led the list of infrastructure items needing upgrade to keep pace with regional growth, though some stakeholders want to preserve the highway approach to Grand Canyon as it is. With additional water flowing to the region, stakeholders also mentioned the need for water distribution lines in low density areas, and increased sewage treatment capacity.

WATER UNDER THE BRIDGE *The Transcanyon Pipeline, suspended beneath this bridge over Bright Angel Creek, carries drinking water to the South Rim of Grand Canyon National Park.*

KAIBAB LAKE IN DROUGHT *Extremely low water levels in Kaibab Lake, a water source for Williams, exposed most of the water intake structure (upper left) and stranded a floating dock (lower left).*

- **A water pipeline could be used as a growth management tool in conjunction with other measures.** Among the collateral measures mentioned were: 1) state legislation prohibiting any new groundwater uses in the study area, 2) legislation providing counties with greater power to regulate subdivisions, and 3) some type of management authority that could limit access to pipeline water in unincorporated areas.
- **Strong water conservation efforts could enhance existing water supplies.** Several stakeholders argued that water conservation has been discouraged, rather than encouraged, by outdated county and local ordinances. Nevertheless, Tusayan currently reclaims a substantial portion of its water.

Water Resources and Needs

Stakeholders identified groundwater as the most significant source of water supplies for the great majority of the study area. It provides most of the water supply for Flagstaff, the majority of the water supply for Navajo residents in the study area, a substantial portion of the Williams water supply, all of the water supply for the Valle area, the majority of water for the Tusayan area, and a small portion of the water consumption of the Parks area. In addition, many residents in unincorporated areas of the county haul groundwater from wells in Valle, Bellemont, the Flagstaff area, or the Navajo Reservation.

Other sources play a lesser role in regional water supplies. Surface water is the sole source for Page, LeChee, and Grand Canyon National Park[1], and it has been the sole source of water for Williams until recently. In late 2000, however, a

[1] *Water sources for this study are classified based on their legal definitions under water rights law. These classifications may vary when using different standards. Using criteria established for water quality standards, for example, Grand Canyon's water source is considered to be groundwater.*

new large-production well was drilled and incorporated into the Williams water system, and in 2001 another new large-production well is expected to come online. Nevertheless, surface water will likely remain a significant source for the future. Other users of surface water include Tusayan, which augments its supply from the Grand Canyon water system; and Flagstaff, which has a seasonal source of water (Lake Mary) that is primarily used to meet peak summer demand. In addition, many residents in unincorporated areas of the county haul water from Williams that originated as stored surface water. And captured surface water – usually in stock ponds – is widely used for livestock watering and other purposes across the study area when available. Tusayan also uses a significant amount of reclaimed water for non-potable domestic purposes.

Water supply needs and reliability vary tremendously across the region. In the sparsely populated western portion of the study area, population tends to cluster around a number of small, defined communities, therefore, most water needs are currently addressed within those communities. Grand Canyon Village has sufficient supply for its near-term demand, but relies entirely on the Transcanyon Pipeline from below the North Rim. This pipeline has some significant drawbacks: it has been proven vulnerable to flood and rockslide, it would be difficult to expand or replace, and it alters natural ecosystems on both sides of the Colorado River. Immediately to the south of the national park, Tusayan receives some of Grand Canyon's pipeline water, but relies primarily on very deep groundwater wells, as does Valle. The Tusayan and Valle wells tend to be drought resistant and of fairly good quality, but they are risky to drill, expensive to develop and operate, and of unknown sustainability. In addition, a number of hydrologists familiar with the area believe that wells in this area could affect spring flows in Grand Canyon and on the Havasupai Reservation.

WINDMILL NEAR COPPERMINE *In drought conditions, this windmill represents one of the few potential water sources for livestock on the Coppermine Chapter of the western Navajo Reservation.*

Williams has historically relied entirely on surface water that collects in five small reservoirs, mostly outside the city on national forest land. After a recent period of drought, however, Williams faced a serious shortage of stored water in 2000. A new deep well drilled by the city on national forest land southwest of town gave some relief by meeting about 40 percent of the city's summertime consumption needs, and another high volume well located within the city limits is expected to add at least as much water to the city system in 2001. Other subdivisions outside of Williams, such as in the Parks area, tend to rely primarily on hauled water, though some residents possess wells that are characterized as relatively shallow and drought-sensitive.

The eastern portion of the study area is almost as sparsely populated as the west but – outside of Page – has fewer well-defined communities. Water for Page and nearby LeChee is drawn from Lake Powell and handled at Page's treatment facility prior to distribution by local water utilities. This source is relatively secure and adequately meets current demand. However, both recipients would like an additional source to meet future growth and provide a backup in case of failure to the current system. In outlying areas of the LeChee Chapter, residents haul treated Lake Powell water from pay-for-service public hydrants.

Other Navajo chapters in the study area have less reliable water service. For example, many Bodaway/Gap residents haul water from Tuba City due to a lack of reliable local wells, while residents in Cameron fear their wells are contaminated by uranium tailings. (Only one well in a uranium-bearing formation has been shut down, according to Navajo Nation Department of Water Resources). Even when water is available in the Navajo chapters in the study area, relatively little of it is distributed directly to homes. A large portion of the residents live at least part of the time in remote areas where utility pipelines are unlikely to reach them anytime in the near future. They must haul their drinking water over miles of poor roads, and in times of drought, must also haul water for livestock and agricultural fields.

In the Flagstaff area, groundwater resources vary in depth, with the deeper wells generally providing the most drought resistance. Current capacity meets demands without any significant strain, but near-term growth is expected to be met through expansion of well fields, most of which are on Forest Service land. While

Lake Mary provides a backup source of water for the city of Flagstaff, this source is drought sensitive and, therefore, unreliable in time of greatest need. One potential variable for Flagstaff, Williams, and others reliant on wells on public lands is the status of their well use permits. The Forest Service has announced it will scrutinize well permits more closely in the future to consider their impact on surface water and other wells in the area.

Population Effects of Pipeline

Nearly every stakeholder indicated that a new water pipeline would provide a stimulus to population growth in the region. The greatest potential impacts, according to most stakeholders, would be felt in the western part of the study area, between Williams and Grand Canyon. This area has been historically water-short, contains a vast amount of private land, contains an almost equal amount of state trust land that could be converted to private land, and has some potential to grow along with any economic expansion of Grand Canyon National Park, Williams, or Flagstaff. Listed as the most likely centers of growth associated with a pipeline were Williams, Valle, and Tusayan. The Parks area was also considered a likely growth area if pipeline water ever reached it; but there was much doubt about this occurring because of the distance of its subdivisions from the proposed pipeline routes. Little effect from a pipeline was anticipated in Flagstaff.

LECHEE GROWTH *With a reliable water source and economic growth occurring in nearby Page, LeChee has grown more than other Navajo chapters in the study area.*

A few stakeholders, however, questioned whether the pipeline would actually alter growth in the western portion of the study area. They argued that the cheapest water option for a developer would be to drill a well and create a private water company to serve a subdivision. Few have done so, leading these stakeholders to believe that other factors – such as jobs, services, and infrastructure – have not been in place to support area growth.

On the Navajo Reservation, most said that an increased water supply from a pipeline would support a few needed basic retail services such as laundromats, gas stations, and stores in some of the chapters, and possibly support some manufacturing. These businesses would provide jobs to keep some residents from having to migrate elsewhere. The water would also encourage retiring, better educated Navajos to return home. Many have left the reservation to find jobs and have come to expect basic services, such as running water in their homes, according to stakeholders. An assured water supply would also allow more gardening or limited farming to take place, according to some stakeholders, providing a better standard of living for those in remote locations.

Land Uses and Development

Stakeholders' greatest land use concerns focused on subdivision and development of the western portion of the study area. Because much of that area is considered the gateway to Grand Canyon National Park, and most of it currently exists as open space, many expressed alarm that a pipeline might accelerate growth there. These stakeholders said they did not want to see strip development along State Route 64, nor did they wish to see existing undeveloped private and state trust lands in the area carved up into ranchette developments – particularly wildcat subdivisions with no electricity, sewer, fire protection, schools, or other basic services. Most conceded the need for some growth in the Tusayan and Valle areas, but only if it were well planned and managed. As one stakeholder put it: "We don't want Gatlinburg-type development outside the park entrance," – referring to the widely disdained "tourist trap" ambience of Gatlinburg, Tennessee, a prominent gateway to Great Smoky Mountains National Park.

Little concern was expressed over the proposed pipeline's impact on land uses in the Flagstaff area. As the region's largest city, Flagstaff is expected to grow regardless of new water sources. Quite the opposite is true on the Navajo reservation. There, most stakeholders said they hoped the pipeline water would stimulate economic development, which is sorely lacking, and lead to increased retail opportunities and services. The only land use concern was over a recent trend toward conversion of agricultural land to home sites on the reservation. If the pipeline made farming more attractive, loss of fields and pastures could become an issue.

GOOD VIEWS, FEW AMENITIES *Many low-density subdivisions in the study area, such as this Government Prairie community, provide few basic services or supporting infrastructure, such as paved roads, fire protection, drinking water, or sewage treatment facilities.*

Regional Infrastructure

A number of concerns were raised regarding the capacity of regional infrastructure to accommodate substantial growth in the future. Stakeholders pointed out that main highways and some city streets were already crowded during peak tourist season, phone service was spotty or nonexistent in many areas, and that school space was short in at least one district. They further noted that some proposed projects requiring large amounts of electrical power or natural gas fuel have had to be tabled due to lack of capacity.

Regional highways were considered to be in need of substantial upgrades, according to most stakeholders. U.S. Highway 89, a main north-south artery running across the western Navajo Reservation and connecting to Utah and other western states, was depicted as overcrowded and dangerous, particularly during peak summer season. But not all of its traffic is due to tourism. "The reservation is growing faster than most people realize," said one stakeholder. Similarly, State Route 64 and U.S. Highway 180, the two main routes to the Grand Canyon, were also deemed inadequate. Said one, "If we're going to call this 'the Grand Canyon State' on our license plates, we should have a better road as gateway." Some, however, said they prefer to keep a two-lane approach to Grand Canyon for scenic and environmental reasons. While a project is underway to widen U.S. Highway 89 to four lanes for about eight miles north of Flagstaff, and add some passing lanes elsewhere, five-year plans by the Arizona Department of Transportation project no other major highway upgrades in the region.

Considered more of a quality-of-life issue than a safety concern was congestion on Flagstaff city streets, particularly near the downtown area. Officials have worked on many transportation plans over the years, said stakeholders, but traffic growth has outpaced mitigation efforts. Said one stakeholder, "It doesn't matter what we do, we will always have a traffic problem in this city."

Lack of phone and internet service in rural areas was a big concern of residents and businesses there. The main service provider, Qwest Communications (formerly U.S. West), was characterized by stakeholders as indifferent to rural needs and uncooperative about expanding coverage. Most hoped that wireless phone service would eventually provide a cost-effective substitute.

The area's main electricity provider, APS, was perceived as keeping up with growing demand for the most part. Upgrades were said to have been made recently in Valle and Red Lake to meet anticipated needs for the next several years, and new lines had also been installed in Howard Mesa and elsewhere. A proposal to run an electric rail service from Tusayan to Grand Canyon, however, was scrapped because of the cost of providing such a large increase in electrical capacity to the area. On the Navajo Reservation, a problem for its main utility NTUA (Navajo Tribal Utility Authority) was that most residences were so widely separated that it was often cost-prohibitive to install the infrastructure needed to provide service to individual homes.

Schools also face a difficult task when it comes to expanding capacity, according to stakeholders, but their problem is their funding stream. Because they are funded primarily on the basis of enrollment, and because they receive no impact fees from developers, they must wait until they are overcrowded before they can build new facilities. The Grand Canyon School District currently has more student applicants than space, said stakeholders, and the school system is unlikely to expand inside the park. Consequently, some parents who live and work in the area currently have to send their children many extra miles to Williams. Some of these parents were

counting on a new school facility to be built in the Tusayan area as part of the proposed Canyon Forest Village, but since voters rejected the zoning change necessary for that development, many Tusayan and Valle area students will continue to travel to Williams.

Policies Regarding Growth, Infrastructure, and Water Management

Several stakeholders suggested that a pipeline could be used to manage growth and development in the study area if it were accompanied by other management tools. The three tools most often mentioned include: 1) state legislation prohibiting any new groundwater uses in the study area, 2) state legislation providing counties with city-like power when dealing with subdivision proposals, and 3) some type of management authority over the pipeline that could limit access to pipeline water in unincorporated areas.

A combination of these tools would be expected to provide three main growth management benefits, according to stakeholders. First, it would protect the aquifer from increased pumping, thereby ensuring relatively natural flows of seeps and springs in Grand Canyon and the Havasuapai Reservation. Second, it would allow the county to regulate wildcat subdivisions and thereby reduce the number of new subdivisions without services. And third, it would restrict water delivery to existing communities – thereby channeling new growth toward those places while, at the same time, reducing pressure to have development sprawl onto lands that are now open spaces.

One of the most frequent concerns from stakeholders in low-density areas such as Parks or the Navajo Reservation was how water might be distributed from a regional pipeline to individual homes. Residents of non-Indian rural lands fell on two sides of the issue – some preferred to continue hauling water and thereby keep population growth low; others hoped to someday see "city-style" running water in their subdivision. Similarly, these residents fell on both sides of the funding issue: some favored a water district that could issue bonds to finance new water lines to their subdivisions; others strongly opposed any tax increase to pay for infrastructure. On the Navajo Reservation, few believed that water pipelines would ever reach seasonal "sheep camps" or other remote residences. Most, however, felt that pipeline water could be trucked to stock ponds or holding tanks in outlying areas, particularly in times of drought.

Some stakeholders also raised the question of how a large volume of new water would be treated, both before and after use. Unlike most ground water, the pipeline water would require purification to become potable. But while the region's cities have water treatment plants, other areas do not. Moreover, an increase in water consumption in the region would lead to increased disposal of waste water. Several feared that existing septic systems would prove inadequate, especially in more densely populated subdivisions or commercial areas.

Water conservation issues were also raised by a number of stakeholders. They recommended measures be enacted to reduce water needs in the future. While Tusayan reportedly utilizes reclaimed water for more than one-fourth of its domestic supply, no water conservation measures were required in most parts of Coconino County, according to stakeholders, and certain measures – such as gray water reuse – were actually discouraged at the county level, a situation they would like to see changed. A study has been proposed to assess the degree to which water conservation and reuse could improve the region's water supplies.

A DEVELOPMENT WILDCARD: STATE TRUST LANDS

Coconino County encompasses state trust lands totaling more than 1 million acres, an area larger than the state of Rhode Island. Approximately three quarters of these lands lie within the Coconino Plateau study area, the majority in the western subregion. (See Map 3, below.) Most occur in one-mile-square sections interspersed with comparable sections of private land in a vast "checkerboard" pattern. Because these state lands can be purchased or leased for commercial development, they represent a potential wildcard in the future of the Coconino Plateau. And because they are checkerboarded with private land, they have the potential to multiply the amount of private land available for development in many areas.

The amount and nature of state land that is sold or leased for development purposes is a largely uncontrollable variable that may affect future growth of the region. This suggests several critical issues for consideration.

Critical Issues

- **State trust lands in the region could be developed.** State law currently requires that these lands be managed for maximum public benefit. That means the Arizona State Land Department can lease or sell parcels whenever the market is "right."
- **The market will decide which trust parcels are developed.** The land commissioner's discretion is strongly conditioned by the mandate to maximize each parcel's economic yield. That means that the real estate market will effectively determine which lands are reclassified.
- **Development "hot spots" will be along the north-south highways.** Commercial development of state land in the region has been slow to date. But if conditions change, the action will likely follow major road corridors along which the proposed water pipeline might run – particularly State Highway 64 north from Williams, and U.S. Highway 89 north of Flagstaff.
- **Conservation efforts could preserve key state lands.** Existing and pending land preservation efforts could limit development in sensitive areas, but they will require substantial funding. Potential changes in state law may also alter Land Department mandates and allow no-cost conservation set asides.

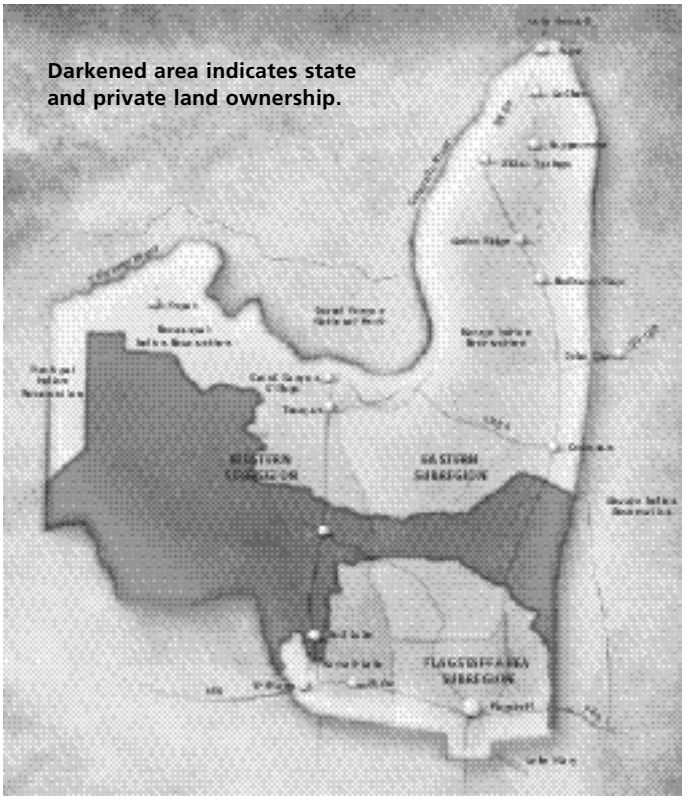
History

The state's trust lands are a legacy of land grants made to Arizona by the federal government. These grants took place on two occasions: first upon Arizona's establishment as a territory in 1863, and later just prior to statehood in 1912. Altogether, Arizona received more than 9.4 million acres (13,500 square miles) to be held in trust for specified beneficiaries, principally the state's public schools.

At the onset, provisions regarding trust lands were written into the Arizona Enabling Act and the Arizona Constitution. These provisions mandated quite specifically how the lands should be administered for the benefit of the trust. Additional direction was later furnished by the U.S. Supreme Court which, in 1967, ruled that lands granted to the state should "provide the most substantial support possible to the beneficiaries." Consequently, the Arizona State Land Department sees its mission as producing the maximum financial yield from state lands.

Most often the Land Department chooses one of three options for generating income from its lands: leasing land for grazing purposes, collecting fees for public access, or selling mineral resources on state lands. When it is fiscally advantageous, however, the department also may lease or sell land for development projects. Revenues derived from these transactions are then deposited in the Permanent Fund, and the interest earned is made available to the trust beneficiaries. While the option of converting state lands into large-scale developments currently affects only a small minority of state lands, it is the possibility of conversion that makes them a potential source of new development in areas currently thought of as open space.

Map 3: Study Area: State and Private Land Ownership



Source: Morrison Institute for Public Policy, data from Arizona Department of Water Resources and Arizona State Land Department.

Dynamics

The vast majority of state holdings are currently classified as grazing land. Other classifications include urban, commercial, mineral, and agricultural. But the classifications are not static. At any time, changes can be made in response to local conditions. For example, grazing or agricultural land may be reclassified as commercial land – and made available for lease or purchase – if the land's market value comes to exceed the value of its current use.

Sometimes reclassifications are initiated by the Land Department, but typically they occur at the behest of local applicants who anticipate a development opportunity near a growing urban area. The actual decision to reclassify is a discretionary call made by the land commissioner after staff study, appraisal, consideration of department conceptual plans in urban areas, and consultation with local jurisdictions.

Nothing in the decision-making process bars the state from reclassifying actively-used grazing land. The guiding concept for the Land Department is that the reclassification provide a "higher" use, economically speaking, for the parcel. The applicants for a reclassification must, therefore, demonstrate that their proposal to lease or buy state land promises a greater revenue stream for the trust. While an existing lease holder can appeal a proposed reclassification, the lessee has little likelihood of blocking this conversion in a robust local real estate market. In this way the real estate market largely determines where land will be reclassified and, thus, where development will spread.

LAND FOR SALE *Much of the scenic open space between Williams and Grand Canyon consists of private and state land that is potentially developable in the future.*

Impacts

In Coconino County, the Land Department has completed few reclassifications of grazing land as commercial land. This is due, in part, to the fact that the approximately 1,000 acres of state land already reclassified as commercial have generated little interest from buyers.

In the Flagstaff vicinity, for example, only a handful of commercial developments have been pursued, though 23,000 acres of attractive state lands lie checkerboarded with national forest or private lands within a few miles of city limits. In fact, just one project outside city limits has been undertaken recently within the 525 square mile Flagstaff Area Regional Plan boundaries, a city-county joint planning area that encircles much of the populated area in the Flagstaff vicinity. That project is Forest Highlands, a gated golf community southwest of the city. County and city officials suspect that Flagstaff's urban service boundary, which bars city water service connections outside the city limits, has dampened developer enthusiasm for more such projects.

Outside the Flagstaff Area Regional Plan boundaries, service constraints have also limited development. While thousands of sections of state trust land – checkerboarded with private sections – arc across the county's midriff, relatively few of them possess significant development potential at this time. Most of these tracts remain primitive, distant from improved roads, and without easy access to water. Furthermore, Coconino County actively discourages wildcat subdivision with its permit fee schedule, and the Land Department won't break up its properties for homestead purposes because that leads to piecemeal development, which complicates subsequent disposition of trust property and the delivery of infrastructure.

Nevertheless, nothing precludes new circumstances – such as continued population growth, or new sources of water – from stimulating development of these more remote state lands in the study area. Most likely to gain value in such circumstances would be parcels located near major road corridors along which the proposed water pipeline might run, particularly in two broad reaches: first, the 25 mile stretch of State Highway 64 that runs from Cataract Creek near Williams through Valle to Red Butte; and second, the 12 miles of U.S. Highway 89 that run north from Wupatki National Monument to Gray Mountain.

Already along Highway 64, a total of 19 sections of checkerboarded private land known as the Howard Mesa Ranch have been purchased by Arizona Land and Ranches, Inc, a Prescott development company. This area is zoned for very low density use, thus the subdivision is being developed for the second-home and "ranchette" market, with limited infrastructure and no water. But county officials wonder if the addition of water to this area might not stimulate a major developer to buy up both private and state parcels for a large-scale master-planned development.

Protection

A number of options for protecting state land from future commercial development have emerged in recent years. Some subdivision developers have set aside scenic parcels they pur-

RANCHETTE ACREAGE *The private holdings of Howard Mesa Ranch along State Route 64 south of Grand Canyon are being converted to minimum 10-acre subdivisions. Some fear the same outcome for state trust lands in the area.*

chased from the state in a deal with municipalities to relax open space requirements for their subdivision. Proposition 303, passed by Arizona voters in November 1998 as part of Governor Jane Hull's Growing Smarter program, provides municipalities and others with $20 million a year in matching funds for the purchase or lease of state lands for conservation purposes. (No lands in the study area have been formally reclassified for this purpose, but they could be in the future.) And a legislative initiative on the November 2000 ballot offered to protect up to 3 percent of state lands from any development as open space. While this measure was defeated by voters, it was widely agreed that the primary reason was that voters saw it as not protecting enough land.

Efforts are also underway to shield from development some of the private lands that are checkerboarded with state lands. For example, The Nature Conservancy is actively soliciting conservation easements on private ranch lands in order to protect wildlife corridors and significant habitat. These easements typically forbid any subdivision, commercial development, or mining on the affected property, while allowing the continuation of grazing and other activities, as well as the sale of the property. The land owner is usually compensated by direct payment for loss of the development right, or by tax benefits for the charitable donation of those rights. However, any state trust lands leased by the ranches for grazing are not covered by the conservation easement.

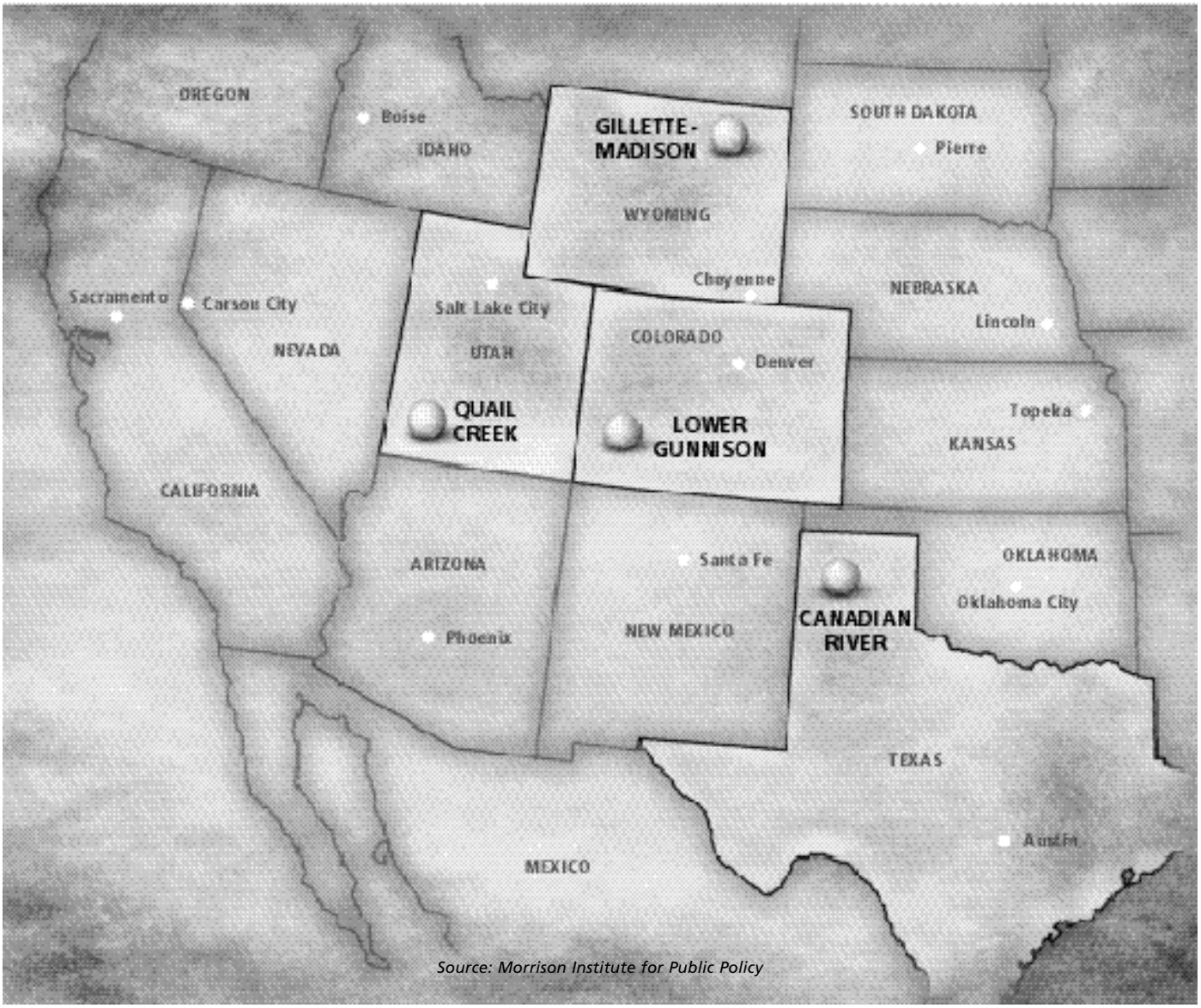
An example of the use of easements came in January 2001, when The Nature Conservancy announced that Babbitt Ranches had donated a conservation easement covering 35,000 acres of private land operated as part of Cataract Ranch in the northern portion of the study area near the Grand Canyon. It is unclear, though, whether many more easements will be forthcoming. Most ranches in the area probably do not generate the kind of revenue that makes tax write-offs attractive enough to motivate a donation. Conservation organizations, therefore, would require substantial funding to purchase these easements. And while further acquisitions of conservation easements could forestall development of substantial tracts of private land in the study area, state grazing lands would still be available for conversion if the real estate market demands.

Bottom Line

The dynamic nature of state trust lands opens the possibility of substantial conversions of open space to development in Coconino County, especially along the county's major north-south highways. While little state land in the area has been sold in the past decade, water pipelines installed near state parcels could increase their value in the future. Because of the state's fiduciary duty to manage trust lands for the highest economic benefit, this could significantly alter the region's growth map over the 50 year time horizon of this study.

STREET SIGN, NO STREETS *Developers of this 1960s-era "Grand Canyon" subdivision near Valle sold thousands of unimproved, one-acre lots, but provided no basic amenities, such as streets or utilities. Most lots remain vacant today.*

MAP 4: CASE STUDY SITES



Source: Morrison Institute for Public Policy

WATER AND GROWTH IN WESTERN STATES: FOUR CASE STUDIES

Regional water supply projects are nothing new in the West. Many have been in place for decades, often supplying the water that western cities needed to grow. In order to extract lessons from existing water projects in regions similar to the Coconino Plateau, four case studies were conducted to examine the effects these regions experienced after the introduction of "new" water.

Looking across the experiences of all four case studies, a number of lessons emerge.

Lessons Learned

- **Water tends to flow toward economic growth.** Where regional job growth has led to population growth – putting a strain on available water resources – an augmented water supply tends to facilitate further growth by maintaining or improving the quality of life.
- **Water, alone, does not create growth.** When water flows to economically depressed areas, it has little effect on population growth unless some other factor triggers an increase in economic performance. Sometimes this factor is new business location to the region, job expansion, or increased attractiveness of the region as a retirement destination.
- **New growth tends to follow available infrastructure.** In areas where growth pressures already exist, new development will tend to follow the lines of least resistance – such as already installed water lines.
- **The decision on who gets water affects where and how a region grows.** Water management decisions – usually made early on – can determine where new subdivision and industrial development will occur. If water access is tightly controlled by, or restricted to, urban areas, the region will tend to grow through urban infill or a fringe build-out that is contiguous with older subdivisions. If water is readily available anywhere in the region, development may leapfrog into more remote and unincorporated areas where land and development fees are less expensive.
- **Water projects can produce long-term economic and quality-of-life benefits.** Water projects that involve reservoirs or other uses of the water for recreational purposes (e.g., ponds, golf courses, wetlands), can attract a recreation industry that contributes to the region's overall economy.
- **Renewable water projects can protect local aquifers.** Water projects that capture surface flows reduce pressure on groundwater sources in local areas, at least in the short term.
- **Surface water projects can damage downstream resources.** The diversion of streams or the reduction of stream flows can substantially alter natural resources. This can lead to negative downstream impacts.
- **New water undercuts water conservation efforts.** Water conservation is often a strategy of last resort for water-short areas. When new projects reduce immediate water supply concerns, conservation loses its impetus.

Selection of Case Study Projects

Water projects had to qualify on a number of factors to be considered as candidates for the case study. First, they had to have sufficient history in order to provide usable lessons – ideally 15-20 years of operation or more. Second, the projects needed to supply primarily municipal and industrial water. In addition, the projects and their service areas had to match the study area in a number of important ways. For example, no projects were selected that primarily served large metropolitan areas because the majority of the study area is sparsely populated. Based on interviews and field research, a list of potential comparison points was constructed to determine which water projects would be most appropriate for case study.

Selection Criteria

Case Study Projects should have…

- Sufficient history (ideally 15-20 years)
- Primarily municipal water use
- A mainly rural service area
- One or more small urban hubs
- Low density population outside incorporated towns
- Projections of rapid population growth
- Indian reservations in service area
- Scarce/expensive/uncertain alternate water sources
- Development perceived limited by lack of water
- Abundant open spaces available for development
- Environmental or aquifer concerns related to growth
- Concerns over infrastructure and management of new water

Projects

No project or region perfectly matched all points of comparison. In fact, no projects serving Indian communities were found that had sufficient history of providing municipal water. Four projects, however, were selected for case study because, together, they encompassed a significant number of the selection criteria. These are:

Canadian River Project – the largest water project in the case study, serving 11 cities and towns in north Texas including Amarillo and Lubbock.

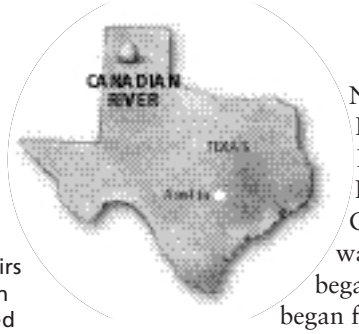
Gillette-Madison Water Project – the smallest water project in the case study, serving Gillette, Wyoming, and two small communities.

Quail Creek Reservoir and Pipeline – a complex project serving southwest Utah's Washington County, a scenic and rural area much like the Coconino Plateau, and one that has been experiencing sustained rapid growth.

Lower Gunnison Basin Unit, Winter Stock Water Replacement Program – a federally funded water infrastructure project in southwestern Colorado that replaced agricultural water ditches with municipal-style water lines, inadvertently making agricultural lands more attractive for residential subdivision.

Descriptions and results of each case study follow.

CANADIAN RIVER PROJECT



Location: Texas Panhandle

Purpose: Municipal and industrial water for 11 cities and towns, including Amarillo and Lubbock

Management/Delivery Model: An authority-operated system of 323 miles of pipelines, 10 pumping stations, and 3 regulating reservoirs to transport water from Lake Meredith, an impoundment of the Canadian River formed by Sanford Dam, to 11 cities.

Date of Service: 1968

Pipeline Capacity: 126,000 acre-feet per year

Cost of Construction

- **Projected:** $96 million
- **Actual:** $83 million

Cost of Maintenance and Operation

- **Projected:** $33 per acre-foot (10 cents per 1,000 gallons), including debt service
- **Actual:** $46 per acre-foot (14 cents per 1,000 gallons), including debt service

Population in Service Area

- **Initial (1968):** 350,000
- **Projected 2000:** N/A
- **Actual 2000:** 489,033

Volume of Water Delivered Annually

- **Projected:** 103,000 acre-feet
- **Actual:** 73,400 acre-feet (10-year average)

Points of Comparison to North Central Arizona Pipeline

- **Population Centers:** scattered and small, with relatively small urban hubs
- **Population Density:** low-density development outside incorporated cities/towns
- **Growth Profile:** more growth occurring in urban hubs
- **Land Availability:** large amount of undeveloped land
- **Land Uses:** livestock grazing
- **Project Design:** municipal and industrial use
- **Other Water Sources:** uncertain groundwater
- **Development:** perceived to be limited by lack of water

Background and Development

The Canadian River Project supplies municipal and industrial water to 11 towns and cities located in the semiarid high plains of the Texas panhandle. Beneficiaries of the project include Amarillo, Borger, Brownfield, Lamesa, Levelland, Lubbock, O'Donnell, Pampa, Plainview, Slaton, and Tahoka – all members of the Canadian River Municipal Water Authority (CRMWA). Until the late 1960s, these municipalities relied entirely on groundwater pumped from the huge Ogallala aquifer. Concerns over a declining water table, however, led local and state officials to look for renewable sources of water beginning as early as the 1940s. The result was a U.S. Bureau of Reclamation plan to impound the Canadian River behind Sanford Dam north of Amarillo and divert its waters southward via more than 300 miles of pipeline.

Nearly 20 years were required to develop the plan. In 1950, Congress authorized the Canadian River Project as a federal reclamation project. In 1953 the Texas Legislature created the CRMWA to distribute water from the project. It wasn't until 1962, however, that construction began on Sanford Dam, and by early 1968 water began flowing to the 11 member cities and towns with 29,000 acre-feet delivered that year. Annual water delivery has increased in subsequent years, reaching a peak of 80,606 acre-feet in 1999.

Originally viewed as the long-term solution to the municipal water supply needs of high plains cities, the Canadian River Project has not been problem-free. Lower-than-anticipated inflow into Lake Meredith has at times caused allocations to member cities to be reduced to 80 or 90 percent of full allotment. In addition, the salinity of Canadian River water has become increasingly severe, in large part due to heavy upstream infusions into the river from a shallow brine aquifer under artesian pressure. This has reduced water quality overall.

CRMWA has been working to address both issues. Early in 2001 the authority expects to complete an $80 million system to transfer up to 40,000 acre-feet of supplementary groundwater into its grid, the water to be extracted from well fields 30 miles east of Lake Meredith that are not considered appropriate for agricultural pumping. The intent is to blend this water with lake water for delivery to 10 of the CRMWA cities (Borger will receive its well water directly at its posttreatment storage point) to increase both the quantity and quality of the system's water. Meanwhile, CRMWA hopes to directly address the salinity issue with a $10 million project that will involve drilling into the upstream brine aquifer and then pumping the aquifer to reduce its pressure. This project is also slated for completion in 2001.

Growth-Related Impacts

Population

The Canadian River Project has effectively removed water as a constraint on municipal growth in the region, allowing several member towns and cities to modestly increase their population. Absent Canadian River water, most members would have been forced to develop additional well capacity, a situation that in a declining aquifer could have led to serious water shortages and a reduction or reversal of growth rates.

Among the fastest growing members since Canadian River Project water began flowing are Amarillo and Lubbock, the two largest cities in the area with populations of 177,644 and 192,732 respectively. Since 1970, Amarillo increased its population by 40 percent and Lubbock by 37 percent. In these cities, water likely enabled, but did not itself drive the growth. More powerful drivers, according to local economic devel-

opment officials, are the cities' locations as transportation hubs, and a region-wide migration from farm to city. Amarillo further benefited from an aggressive economic development effort, while Lubbock profited from the presence of Texas Tech University and the city's status as a major processing center for regionally grown crops.

Not all CRMWA members, however, have experienced substantial growth. Three of the project's largely agricultural towns (Brownfield, Tahoka, and O'Donnell) grew less than 10 percent over 30 years, while three others (Pampa, Slaton, and Lamesa) actually lost population. Local observers believe that agriculture sector problems such as low commodity prices, drought, and depletion of irrigation water supplies drove small operator farmers off the land and into the region's cities.

Also not experiencing major growth have been unincorporated areas that receive project water. Of the 24,000 CRMWA water users estimated by officials to reside outside member towns, a little over 4,000 live in four older, slow-growing communities that in the last 20 years began to experience groundwater problems and arranged to buy water from Lubbock. One nonmember town, however, has experienced growth. This is Canyon, an older community about 17 miles south of Amarillo that has been buying its water from Amarillo for 15 years. Between 1990 and 2000 Canyon grew from 11,365 to 13,000 residents as it evolved into a bedroom community for Amarillo. The area between Canyon and Amarillo is also gradually evolving from an agricultural area into an exurban residential area.

Sprawl

The project's impact on development patterns has been mixed. Large industrial taps on the pipeline have allowed four major commercial installations to be established in unincorporated areas along the aqueduct. These include a feedlot north of Plainview, a fertilizer plant near Borger, and a copper refinery and a generating plant, both north of Amarillo. Given local groundwater constraints, none of these operations could have obtained adequate water to locate in the area without the pipeline.

In terms of residential sprawl, however, several planners and utility officials suggest that most dispersed residential development in unincorporated areas has been discouraged by the terms under which Amarillo and Lubbock make Canadian River Project water available. As a rule, project cities refuse to serve domestic water outside their borders unless they first annex the land. Thus, the Canadian River Project may well be promoting contiguous urban development because of the risks involved in developing alternative water sources for new subdivisions outside city boundaries.

Water Resources

Since water began flowing through the pipeline, CRMWA member cities and towns have shifted from 100 percent reliance on groundwater resources to nearly 70 percent reliance on the Canadian River Project, thus reducing drawdown of the Ogallala aquifer. While most members continue to use some groundwater to augment their supply, particularly during peak seasons, the deteriorating quality of some groundwater supplies has forced a few to stop this practice altogether.

At the same time, concerns have grown about the quality of the water delivered from Lake Meredith. While it was realized early that the lake's water would be somewhat mineralized, the switch from groundwater has been extremely objectionable to some citizens. Chloride (salt) content has been generally increasing during the life of the project, and drought cycles now produce chloride contents as high as 475 milligrams per liter. That exceeds both the federally recommended salinity standard of 250 mg/L and the state benchmark of 300 mg/L. Corrosiveness and mineral deposition problems accompany a noticeably salty taste.

To mitigate this problem, some member cities with locally available, high quality groundwater have chosen to blend their groundwater with lake water to achieve a better product, but a number of cities do not have good groundwater available for such mixing. At the regional level, however, the authority is currently working to complete its $10 million salinity control project upstream of the lake. Since this project will address the source of 70 percent of the chlorides reaching Lake Meredith, it holds out the possibility of significant water quality improvement. The expectation is it will reduce or eliminate the need for groundwater blending in the future.

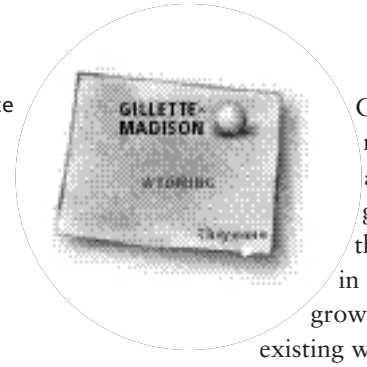
Recreation

Along with drinking water, Lake Meredith also provides a major recreational asset to residents of Texas, Oklahoma, and New Mexico. Over 1.4 million visits are recorded yearly to the National Park Service-administered lake, which provides over 100 miles of shoreline and 16,000 acres of water surface. The lake, which is surrounded by 200-foot canyons and grasslands, is open year-round for fishing. Also popular are water sports, picnicking, birding, and horseback riding. Facilities include access roads, parking areas, picnic tables and shelters, drinking water, boat launching ramps, boat docks, a swimming area, and public restrooms.

Summary of Canadian River Effects

- The water pipeline has facilitated growth in larger cities, but not in most small towns, some of which lost population. Economic factors likely play a more powerful role in stimulating growth.
- The water pipeline has allowed some industrial development to occur in areas that would have not otherwise been likely to develop.
- Control over the distribution of pipeline water has allowed cities to effectively discourage sprawl outside their boundaries.
- The water pipeline has provided some measure of protection for the underlying aquifer by reducing pumping.
- Lake Meredith offers the region a major recreational asset.

GILLETTE-MADISON WATER PROJECT



Location: Northeast Wyoming, vicinity of Gillette
Purpose: Municipal and industrial water for Gillette and environs
Management/Delivery Model: A city-operated, 43-mile long, 30-inch diameter water pipeline transporting groundwater from a well-field in the Black Hills
Date of Service: 1981
Pipeline Capacity: 16,000 acre-feet per year
Cost of Construction
- **Projected:** $22.5 million (master plan)
- **Actual:** $28 million

Cost of Maintenance and Operation
- **Projected:** $114 per acre-foot (35 cents per 1,000 gallons)
- **Actual:** $521 per acre-foot ($1.60 per 1,000 gallons)

Population in Service Area
- **Initial (1981):** 14,381
- **Projected 2000:** 42,270
- **Actual 2000:** 22,000

Volume of Water Delivered Annually
- **Projected:** 11,300 acre-feet per year
- **Actual:** 12,500 acre-feet per year

Points of Comparison to North Central Arizona Pipeline
- **Population Centers:** scattered and small, with relatively small urban hubs
- **Population Density:** low-density development outside incorporated cities/towns
- **Growth Profile:** rapid growth possible
- **Land Availability:** large amount of undeveloped land
- **Land Uses:** livestock grazing, resource extraction
- **Project Design:** municipal and industrial use
- **Other Water Sources:** uncertain groundwater
- **Development:** perceived to be limited by lack of water

Background and Development

The Gillette-Madison Water Project grew out of a water quality and quantity crisis facing the city of Gillette, Wyoming, in the 1970s. Located on the high plains in the northeast portion of the state, Gillette's economy at the time revolved around large-scale extraction of oil from beds near the city. Today the city remains an important "energy capital," with 30 percent of the nation's coal supply and much of its coal-bed methane coming from mines in surrounding Campbell County.

In contrast to its mineral wealth, Gillette had meager water resources in the 1970s. Surface water was extremely limited, annual rainfall in the region averaged only about eight inches per year, and the main source of municipal water – groundwater from three aquifers located beneath the city – showed alarming signs of stress. With a total annual yield of 4,300 acre-feet, the city's 28 wells were not projected to meet the maximum water demands of the city after 1984. Moreover, declining productivity and a history of variable quality water at many wells had already led to watering restrictions in the summertime.

Gillette's water concerns emerged during a regional boom in domestic oil exploration activity related to a worldwide oil crisis. Rapid growth ensued, with the city's population more than doubling in two years, from 5,400 residents in 1975 to 12,317 in 1977. Recognizing that future growth could be constrained by the city's unreliable existing water supplies, officials began a search for alternative sources. The most promising source appeared to be in the Madison formation's artesian limestone aquifer, which underlies much of northeast Wyoming. A test well drilled into the formation suggested the availability of significant quantities of water.

The solution that emerged was the Gillette-Madison Water Project, a plan to drill wells into the Madison Formation, approximately 40 miles east of Gillette in the Black Hills, and transport the water to Gillette via pipeline. In December 1977, the state of Wyoming concluded in a report that it was appropriate for the state to install the well field and pipeline that would serve Gillette. The Wyoming Legislature subsequently established a finance package for the Gillette-Madison Water Project consisting of a combination of direct grants and loans from the State Farm Loan Board. In 1980, construction began on an eight-well extraction field and a 43-mile-long, 30-inch diameter transmission main to the city. Water delivery began in summer, 1981.

Growth-Related Impacts

Population

The Gillette-Madison Water Project resolved Gillette's anticipated water shortages, allowing the city to grow substantially. During the five-year period following completion of the project, Gillette's population increased 34 percent, from 14,381 residents in 1981 to 19,295 in 1986. The new water, however, was not the most important factor driving this growth. Far more significant was the energy industry, which employs more than a fifth of all Campbell County residents, and which was already enjoying an economic boom in the area. But this industry can crash as well as boom, and beginning in 1987 it did. In the next three years, Gillette's population slid to 17,502 residents, a drop of more than 9 percent. Since then, the city has resumed its growth, but at a much more moderate 3 percent annual rate that, according to city officials, reflects increased activity in the region's extensive low-sulfur coal and coal-bed methane sectors. The result of whipsawing economic cycles is that the Gillette area's current population of 22,000 has fallen far short of the more than 42,000 forecast during the project's planning phase.

Sprawl

The pipeline and its water have provided little impetus for growth beyond the city limits of Gillette. Local observers attribute this restraining effect to regulations that tightly restrict access to the pipeline. Only two small communities along the pipeline route are allowed to tap directly into the system. Moorcroft, 30 miles from Gillette, is provided a supplemental entitlement of about 1,100 acre-feet per year as mandated in the project's enabling legislation. And Rozet, an unincorporated hamlet eight miles from Gillette, gained a tap that initially served unlimited water to a single elementary school, and now also serves a county cemetery, a fire station, several trailer parks, and an industrial truck-fill installation.

Others who want to obtain project water cannot simply tap into the water pipeline, but in most cases must buy water from Gillette, which the state of Wyoming considers a regional water purveyor. This arrangement has, in many cases, discouraged new development in unincorporated areas distant from the city – partly due to Gillette's hesitation to supply remote customers, and partly due to the cost of infrastructure to transport water long distances. Adding to these restraining effects are the increasingly regionalized policies of the Wyoming Water Development Commission. Since the late 1980s, the commission has resisted developing expensive new remote water systems and encouraged smaller communities to link to "regional" providers like Gillette.

Closer to Gillette, unincorporated areas have seen modest population growth, mostly associated with the development of ranchettes and small subdivisions. In total, some 700 connections for new service have been made to homes or small water companies in these areas, adding an estimated total of less than 3000 people overall. State and local officials expect more of these connections to be made in the future, given continuing groundwater problems in the area and Gillette's role as a regional water purveyor. Still, most new tie-ins are expected to remain close to Gillette, thereby avoiding any substantial amount of dispersed development.

Water Resources

Since a series of technical problems were solved in the 1980s, the Gillette-Madison Project has provided a stable source of drinking water for Gillette and other recipients. This water is quite hard, with its total dissolved solids and hardness both rated at about 500 milligrams per liter, but it needs little treatment prior to delivery beyond chlorination. The supply has also proven plentiful. Initially the system delivered a baseline 3 acre-feet per day of project water – peaking at 21.5 acre-feet per day in summer – which was blended with 3 acre-feet per day from existing "soft water" wells. More recently, Madison production has been boosted to a base of 13.8 acre-feet per day – peaking at 33.8 acre-feet per day in summer – through an upgrade to larger pumps on the original Madison wells and the addition of three pumps at the pipeline's two pumping stations. Given the pipeline's size, the system's maximum capacity is now rated at about 35 acre-feet per day – a figure that puts the system near its peaking capacity. In short, the project has greatly improved water quality in Gillette, averted shortages, and made it possible for the town to grow.

Along with a plentiful supply, however, has come a certain extravagance. As the city's public works director, Bill Carson, observes: "We now use too much water." Where records from the 1970s pegged consumption in the city at 125 gallons per capita per day, it now exceeds 200 gallons a day on average, and as much as 600 gallons per capita on peak days. A good deal of this increased use, moreover, has not been on the part of individuals, but on the part of the city. The new water supplies have allowed Gillette to embark on a concerted beautification program that has included the installation of new landscaping in its numerous parks and greenbelts, and the planting of 500 large trees in the city every year since 1987. Overall, according to city utilities director Jon Young, the city of Gillette now dedicates an estimated 10 to 15 percent of its daily water production to "greening up the desert" – an undertaking that would have been unimaginable before the completion of the Gillette-Madison pipeline. Add in the county's parks, local schools, and homeowners, and perhaps half of all the city's water goes to support landscaping.

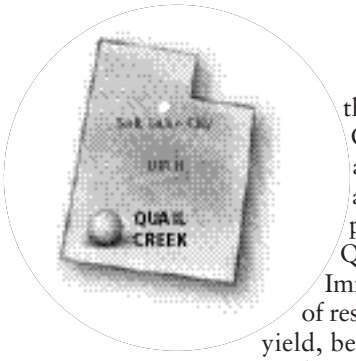
Recreation and Environment

Gillette's enthusiastic use of water to beautify its parks and plantings has not been the Madison Project's only environmental impact. In recent years, the pipeline has also allowed the city to pump raw water from one of its in-town wells into Burlington Lake in McManaman Park as part of a city effort to maintain a local wetland to support waterfowl, migratory geese, and shorebirds. Last year, for example, the city poured 46 acre-feet into the lake to keep the area wet. Over the years the town has enhanced the park with paths, tree plantings, interpretive signs, and viewing blinds, developing it into a popular bird-watching and education center.

Summary of Gillette-Madison Effects

- The water pipeline has allowed Gillette to grow modestly, but the pace of growth has been dictated primarily by trends in the energy industry, the area's dominant employer.
- Sprawl into remote unincorporated areas has been constrained by the uncertainty of groundwater supplies there and restricted access to pipeline water, with the result that most development in unincorporated areas has been confined to areas near Gillette.
- Project water has coincided with an increase in consumption in Gillette that has seen the city use significant amounts of water on several nonessential but popular quality-of-life projects, including a city-wide beautification program and a bird-supporting wetland.

QUAIL CREEK RESERVOIR AND PIPELINE



Location: Southwestern Utah
Purpose: Municipal, industrial, and agricultural water supply for Washington County, Utah
Management/Delivery Model: A 9.5-mile pipeline diverting flows from the Virgin River to Quail Creek Reservoir, a 40,000 acre-foot off-stream storage facility
Date of Service: 1985
Pipeline Capacity: 109,000 acre-feet per year
Cost of Construction
- **Projected:** $20 million
- **Actual:** $23.5 million

Cost of Maintenance and Operation
- **Projected:** N/A
- **Actual:** $40 per acre-foot (12 cents per 1,000 gallons)

Population in Service Area
- **Initial:** 25,300
- **Projected 2000:** 55,000
- **Actual 2000:** 86,000

Volume of Water Delivered Annually
- **Projected:** 20,000 acre-feet
- **Actual:** 24,165 acre-feet total; 11,512 acre-feet M&I

Points of Comparison to North Central Arizona Pipeline
- **Population Centers:** scattered and small with a relatively small urban hub
- **Population Density:** low density developments outside of cities/towns
- **Growth Profile:** fast-growing cities and towns
- **Land Availability:** large amount of undeveloped private land
- **Land Uses:** livestock, agriculture
- **Project Design:** municipal and industrial use as a major component (also agriculture)
- **Other Water Sources:** uncertain groundwater, springs
- **Development:** fast growth perceived to be limited by available resources

Background and Development

The Quail Creek Reservoir and Pipeline project was prompted by fast growth in southwestern Utah's Washington County and the perception that available water resources would soon prove inadequate. Before the project, Washington County towns depended primarily on local springs and wells for their drinking and "secondary" (landscape) water. While these sources provided a fairly reliable flow, their ability to support projected growth in this area, considered gateway to Zion National Park, was deemed questionable by the late 1970s. Spring water production was nearly fully exploited, and the expense for increasing groundwater production appeared formidable.

The Washington County Water Conservancy District, therefore, conceived the Quail Creek project. The district proposed to build a pipeline to divert a portion of the flow of the Virgin River, and a 40,000 acre-foot reservoir in the Quail Creek drainage that would hold the diverted water for distribution and use in Washington County. In 1985, construction was completed on both endeavors, with the new reservoir situated 15 miles northeast of St. George, the county seat.

At first, none of the new water was treated for public consumption, so only agricultural customers received flow from the system. By late 1989, however, Washington County's largest city, St. George, had constructed a new water treatment facility at the reservoir, and a 14-mile-long pipeline from the treatment plant to the city, so it could begin using treated Quail Creek water for municipal consumption. Immediately afterward, St. George's consumption of reservoir water, and its share of the overall project's yield, began to climb. By 1999, Quail Creek Reservoir was supplying 8,874 acre-feet of water annually to the city, or 55 percent of its total use. This amount represented more than three-quarters of all the water drawn from the Quail Creek project for municipal and industrial purposes, and more than one-third of the project's peak annual yield. St. George currently remains the only city in the region with a means of treating Quail Creek water.

Even without a treatment plant for Quail Creek water, however, the towns of Hurricane and Washington have found a way to use the water to augment their municipal supplies. Since 1993, Hurricane has been drawing 800 to 1,000 acre-feet per year of untreated Quail Creek water and applying it to outdoor watering – in effect, saving the town from using potable water for such purposes. The town of Washington has also begun taking an estimated 700 acre-feet per year for similar uses. But these towns each hold 2,000 acre-feet per year allotments, so Washington is considering construction of a micro-filtration plant to treat the rest of its share for domestic use. Another proposal calls for building a pipeline to deliver treated water from Quail Creek Reservoir to the town of Ivins and others. These and other plans to distribute Quail Creek project water in Washington County will likely consume the fully allocated 22,000 acre-feet per year firm yield of the system.

The probability of full consumption of Quail Creek project water, along with expectations of continued fast growth, has spurred the county to pursue two new water development projects. The first of these, scheduled for 2001, will link the Quail Creek Reservoir via a 4-mile, 60-inch pipeline to a new 50,000 acre-foot storage reservoir south of the original one. The second project, with a longer time horizon, proposes construction of a 120-mile-long pipeline from Lake Powell to the new reservoir. This plan would deliver 60,000 acre-feet per year of Colorado River water to meet the county-projected near tripling of water demand by 2050.

Growth-Related Impacts

Population

Water from the Quail Creek Reservoir and Pipeline enabled a major population growth trend in Washington County to continue. Much of this growth resulted from a strong influx of retirees and others who were drawn to the area by its mild winters and proximity to Zion National Park and other natural attractions.

Without the Quail Creek project, however, water supply problems might have dampened this growth trajectory significantly. In St. George, for example, population grew from 28,572 in 1990 to about 50,000 in 2000. At its peak in 2000, the city's

water consumption hit 116.6 acre-feet per day, but its well and spring water resources produced only 64.4 acre-feet per day. This suggests that without the pipeline's supply of water, the city would have had difficulty handling this growth.

The same applies to Washington County as a whole. The county grew from 48,580 people in 1990 to 82,115 in 1998. As of 1998, the county estimated its total, reliable, potable water supply at 32,550 acre-feet per year, of which 7,000 acre-feet were delivered from the Quail Creek Project. Meanwhile, total consumption of potable water was estimated at 29,553 acre-feet per year. Thus, the county may have seen a shortfall of as much as 4,000 acre-feet without Quail Creek water.

Impacts of the water on smaller municipalities underscore the system's importance in supporting population growth. Both Hurricane and Washington receive raw water for irrigation from the system, which has allowed them to save an equal amount of potable water from being used in yard and golf course service. Assuming that a family of four normally consumes about 0.5 acre-feet per year, this savings of about 1,500 acre-feet per year of potable water in the two towns would allow approximately 12,000 additional residents to settle there. Ivins has also benefited. Years ago this small town arranged with St. George to receive 270 acre-feet per year of treated water, but because of the Quail Creek project, St. George was actually able to sell Ivins 1,715 acre-feet in 2000. Without that additional 1,445 acre-feet of potable water, Ivins would have had a hard time servicing its rapid population growth from 1,163 in 1990 to an estimated 5,814 in 2000. Consequently, most observers of the region agree with Bob Nicholson, community development director of St. George. "The reservoir and pipeline have definitely facilitated population growth here," says Nicholson. "They've not stimulated it, but they've allowed it."

But much of Washington County's growth in the last decade might have occurred even if the Quail Creek project had not been built. Today the system delivers only about a quarter of the region's total municipal and industrial water budget of around 52,000 acre-feet per year. Absent the project's construction, alternative water sources could have been tapped. For example, agricultural consumption runs up to 87,800 acre-feet per year, and substantial flows of this water might have been converted to residential uses. In addition, the county's very high per capita municipal and industrial consumption rate of 335 gallons per day (445 gpd including secondary water) is much larger than that of the state (284 gpd) or cities such as Denver (217 gpd) or Phoenix (175 gpd), so gains through conservation measures could also have made water available for new development. Furthermore, some moderation of the region's high peak demand for water through storage or other means could have accommodated substantial growth as well.

Sprawl

The Quail Creek project has also had a modest, but mixed, influence on where growth has occurred. Urban compactness has been promoted by the fact that only one municipality – St. George – has a facility to treat Quail Creek water. For that reason, St. George receives most of the system's M&I deliveries. Concludes community development director Nicholson: "Since only St. George can serve drinking water [from the system] and you can't just go out and drill a well, developers need to be in St. George to get water. That may promote concentration a bit."

Nevertheless, the project has facilitated dispersed development in several instances – and could do so more broadly if other towns follow through on plans to build treatment plants or delivery pipelines. The town of Ivins, for example, was able to exceed its spring and groundwater budget because of water purchase arrangements with St. George, which is tied to the project. And the town of Washington's new master-planned golf community, Coral Canyon City, which will double the size of the town, would not have been possible without the 700 acre-feet per year of Quail Creek water the town recently began drawing from the pipeline, according to the town's public works director, Michael Shaw.

Water Resources

In terms of water resources, the Quail Creek project has had two major impacts. First, it has likely delayed regional water conservation efforts. The project provides an abundance of "raw" water for the irrigation of parks, golf courses, and lawns, and that has undercut any impetus for utilizing water-efficient landscaping. Consequently, the county's high per capita water consumption has declined little over the last decade.

The project has also impacted flows in the Virgin River. By removing almost all of the river's flow from a 14-mile reach of the streambed, the project has sparked considerable controversy over the fate of several sensitive native fish populations in the river. Growing concerns over these species have led to negotiations over how much water may be diverted, and how much should be left in the river. Both the Utah Division of Wildlife Resources and the State Water Plan have called for minimum flows to be maintained, even at the diversion point.

Recreational Impacts

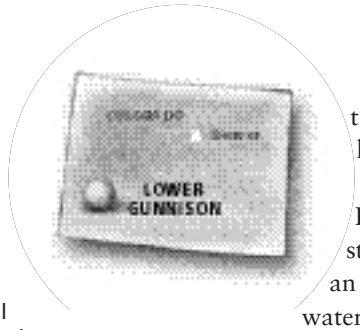
A final impact of the project is its creation of a regional attraction that also produces substantial economic benefit. With a surface area of 650 acres, Quail Creek Reservoir has emerged as a popular water recreation area, drawing more than a half million visitors a year to its Quail Lake State Park. These visitors enjoy the reservoir and its shoreline for boating, water skiing, fishing, swimming, and RV camping. Demand for this type of recreation remains so high that reservoir managers recently had to place a cap on the number of boats allowed on the water per day. According to county estimates, the reservoir generates approximately $20 million a year in local economic activity.

Summary of Quail Creek Effects

- The reservoir and pipeline have helped facilitate rapid population growth by making water available not only for treatment and drinking, but also for outdoor uses that free up potable supplies for domestic consumption.
- The project has channeled development toward the region's largest city, but also supported some dispersed development near smaller towns.
- The reservoir created by the project has become a major economic and recreational asset in the region.
- The project has forestalled water conservation efforts in the region and allowed per capita water consumption to remain very high.
- The project has diminished Virgin River flows below its diversion point, with possible negative impacts on native species.

LOWER GUNNISON BASIN UNIT WINTER STOCK WATER REPLACEMENT PROGRAM

COLORADO RIVER WATER QUALITY IMPROVEMENT PROGRAM



Location: west-central Colorado, near Montrose

Purpose: reduction of salt loading to the Colorado River system

Management/Delivery Model: 161 miles of rural water pipelines and 9 storage tanks added to the infrastructure of three rural water districts to deliver treated municipal and industrial water from Project 7 (the regional water treatment authority) to unincorporated agricultural areas of Montrose and Delta counties

Date of Service: Staged, between 1990 and 1995

Cost of Construction

- **Projected:** $27.6 million
- **Actual:** $22 million

Cost of Maintenance and Operation

- **Projected:** $1,101 per acre-foot ($3.38 per 1,000 gallons) for Tri-County and Chipeta water districts; $909 per acre-foot ($2.79 per 1,000 gallons) for Menoken Water District
- **Actual:** N/A

Population in Service Area

- **Initial:** 24,576
- **2000:** 29,404

Volume of Water Delivered Annually

- **Projected:** 825 acre-feet
- **Actual:** N/A

Points of Comparison to North Central Arizona Pipeline

- **Population Centers:** scattered and small, with a relatively small urban hub
- **Population Density:** low-density development outside incorporated cities/towns
- **Growth Profile:** rapid growth possible
- **Land Availability:** large amount of undeveloped land
- **Land Uses:** livestock grazing, outdoor recreation
- **Other Water Sources:** uncertain groundwater
- **Development:** perceived to be limited by lack of water

BACKGROUND AND DEVELOPMENT

The Lower Gunnison Basin Unit Winter Stock Water Replacement Program was not intended to expand the domestic water supply infrastructure in rural Colorado when it was undertaken in the early 1990s. Instead, as part of the federal Colorado River Water Quality Improvement Program, it was designed to reduce salt-loading of the Colorado River system by providing a replacement winter water supply for livestock operators. These operators had been watering their livestock each winter by diverting the Uncompahgre River into unlined canals that leached salts into the system. By providing an alternative water supply through a network of new enclosed water lines, the Stock Water Replacement Program ended winter canal flows across 86,000 acres of agricultural land in two counties, thereby eliminating the salt-loading of an estimated 74,000 tons annually.

But the $22 million salt-reduction project constructed by the U.S. Bureau of Reclamation had an unintended impact. By introducing a huge new water delivery infrastructure into rural Delta and Montrose counties, it greatly enlarged the supply of potable water to areas that had not previously been served. This occurred because of the way the program was structured.

Under the program, more than 900 users of the canal system became eligible to receive replacement water from Project 7, the regional water treatment authority. This water was to be delivered to the users' historic point of use – stock tanks – by extending the water lines of three existing domestic water systems: Chipeta Water District, Menoken Water District, and Tri-County Water Conservancy District. These federally funded extensions, completed between 1990 and 1995, ultimately saw the construction of 161 miles of new delivery pipeline, several pumps, and 9 storage tanks within the water companies' service areas.

This new water infrastructure substantially increased the ability of the three rural utilities to deliver treated water suitable for domestic consumption. During the construction phase, low capacity 2-inch trunk lines were replaced with much larger capacity 6-inch lines; new service lines were installed where previously there had been none; and numerous undeveloped agricultural areas were connected to "city" water service for the first time. A case in point is the Menoken district's 80-mile-long web of pipeline serving about 40 square miles north of Montrose. This system gained some 20 new miles of service line, allowing water to flow for the first time to unserved areas of three rural roads.

GROWTH-RELATED IMPACTS

Population

The Lower Gunnison Basin Unit Winter Stock Water Replacement Program facilitated population growth in unincorporated areas of Delta and Montrose counties during the 1990s. Growth pressures in the region had been building in the early 1990s due to a combination of factors related to the region's western appeal: scenic mountains, relatively mild climate, proximity to national monuments, access to ski areas, and relatively affordable housing. But many unincorporated

areas of the two counties had seen their development potential constrained by such problems as a lack of water service, the variable quality of local groundwater wells, and in some cases, inadequate water pressure for rural fire coverage. The Stock Water Replacement Program provided many of these areas with convenient, high-pressure potable water deliveries for the first time. And since no rules precluded the use of these "winter watering" taps for year-round domestic hookups, the program is widely agreed to have spurred rural subdivision and homebuilding.

Exactly how much new development occurred in the areas affected by the Stock Water Replacement Program is not easy to assess. Overall growth in all unincorporated areas of the two counties in the early 1990s exceeded 3 percent per year, according to state and county figures, but has since settled down to about 1.5 percent per year. Regarding the specific water districts in which the Stock Water Replacement Program operated, Taggie Aultman, general manager of the Chipeta Water District, says the program "definitely allowed more housing to go in all over the area" in her district. Mike Berry, general manager of Tri-County Water Conservancy District, allows that "many" of the 535 taps the program installed in his district (an increase of 10 percent) now serve homes or subdivisions. And Menoken Water District officials note that "about 98 percent" of the 127 taps originally installed by the program in Menoken's service area were converted to year-round residential use within a few years.

Many additional taps were also installed in the new water lines by the water companies. Menoken officials report that in the 1980s, prior to the program's extension of lines, only 153 new taps had been sold by their water district, while in the 1990s, after the program's extensions, 478 new taps were sold – a better than threefold increase. Menoken officials also point out a sharp increase in the number of subdivisions planned for areas served by the new lines. Before the 1990s, almost no subdivisions were begun in those areas because adequate drinking water and fire capacity was nonexistent. Since 1990 about "10 or 15" projects have gone in, each with 15 to 20 lots typically ranging from one to three acres. In this fashion a federally funded program intended to help livestock operators reduce salt leaching unexpectedly made the new land being served much more attractive for residential development.

Sprawl

The Stock Water Replacement Program's role in promoting dispersed development has been pronounced. With the addition of 161 miles of new water infrastructure in rural Colorado, sizable areas of two counties have been effectively opened up to low-density housing outside major town boundaries. Residential settlement patterns have clearly been affected.

According to Tri-County Water District officials, new residential development basically "followed the water lines" in the district's service area into new regions of Delta County; development also followed new water lines 10 miles south from Montrose past the Colona reservoir into Ouray County. Similar results have been reported by officials of other water districts. Concludes Frank Mesaric, city engineer for the city of Montrose, which is the region's main urban hub: "The program has definitely favored development in the outlying areas. It's opened up many areas that weren't conducive to it before."

Moreover, in conjunction with a regional real estate boom, the program helped increase rural land prices more than four-fold. According to Lynn Johnson, a broker associate for the ReMAX real estate corporation in Montrose, scenic agricultural land that fetched $1,500-an-acre 10 years ago now costs from $5,000 to $7,000-an-acre.

Water Resources

Ongoing trend studies by the U.S. Geological Survey confirm that the Lower Gunnison Basin Unit Winter Stock Water Replacement Program has begun to reduce salt loading into the Colorado River system. Over the long term, that reduction will help maintain water quality for downstream water users. Closer to home, the program's infrastructure improvements have provided some rural residents a high-quality, reliable water alternative, freeing them from reliance on highly mineralized groundwater wells.

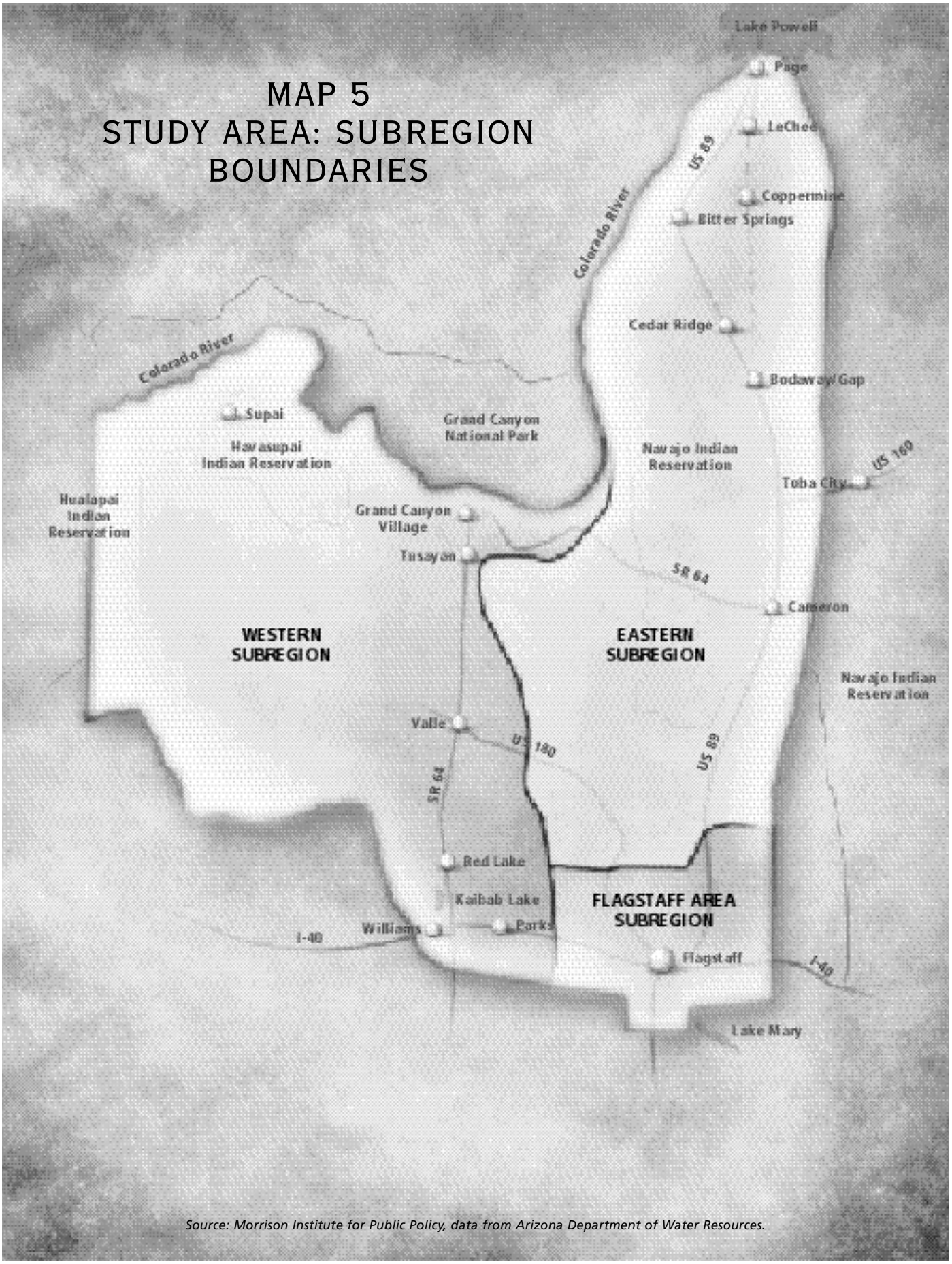
Economic Benefits

All three of the rural water districts cite the importance of the Winter Stock Water Replacement Program over the last decade in helping them expand and upgrade their systems to serve a growing region. Because the federal program defrayed all design and construction costs, it essentially provided $22 million of system improvements and 160 miles of new pipeline at no cost to struggling rural water companies. In that regard, the program can be viewed as a major infrastructure investment with significant economic impacts on the two counties.

Summary of Lower Gunnison Effects

- The program's construction of new pipelines has helped drive rural development and population growth by providing access to treated water in agricultural areas where it did not previously exist.
- The program's role in installing new water infrastructure in two rural counties has accelerated sprawl by expediting development in areas that would otherwise have been difficult to open up.
- The program's replacement of canals with pipelines for winter livestock watering in the region has reduced salt loading of the Colorado River Basin by reducing the seepage of Basin water through the region's highly mineralized soils.

MAP 5
STUDY AREA: SUBREGION BOUNDARIES



Source: Morrison Institute for Public Policy, data from Arizona Department of Water Resources.

POPULATION ON THE COCONINO PLATEAU: A DEMOGRAPHIC ANALYSIS

The Coconino Plateau Region has grown rapidly over the last 50 years. The next 50 years may offer much of the same. According to projections supplied by the Arizona Department of Economic Security (DES) and the Navajo Nation as part of the Phase 1 Report of the Coconino Plateau Regional Water Study, the study area is projected to double by 2050.

In order to assess the impact of a regional water pipeline on these projections, the Morrison Institute asked the Arizona State University Center for Business Research to analyze the Phase 1 Report population projections, as well as a number of population variables. (See Appendix B for the full text of the Center's demographic analysis.) Among the variables that were considered were high-growth/low-growth economic scenarios, pipeline/no pipeline alternatives, and a variety of growth factors influencing three subsets of the region: the Western, the Eastern, and the Flagstaff Area subregions.

A number of key points emerged from the demographic analysis.

Key Points

- **Coconino County has experienced high growth rates – and this is expected to continue.** DES projections rely on historical patterns to forecast future results, therefore population growth is projected to persist into the future, albeit at a somewhat reduced rate.
- **Coconino County contains a high proportion of residents less than 25, and a low proportion over 50.** The region's unusually youthful profile is due in part to Northern Arizona University and a high Navajo birth rate. The deficit in older residents indicates that, unlike much of Arizona, the area has not become a retirement haven.
- **Population projections show a near doubling in population over 50 years.** While DES population projections are reasonable estimates for the region as a whole, they are less likely to be accurate for specific cities and communities. However, DES projections do not consider trends that break with the past.
- **Growth projections assume that current economic and demographic forces will continue to spur growth.** Continued expansion of tourism, second home construction, and other growth factors are implicit in the projections. If these growth drivers were to change, the actual growth trajectory would change.
- **Tourism is the most important economic factor affecting growth in the region.** Tourism leads all economic activity in north-central Arizona. It is, therefore, likely to create the most jobs – and growth – in the future.
- **Pipeline water will have little impact on projected population growth.** DES projections do not consider changes in the availability of natural resources or other potential constraints or facilitators to future growths. Therefore, the projections tacitly assume that the region's ability to meet water demand in the future will not differ substantially from its ability to meet demand now.
- **Pipeline water and tourism expansion will have greatest effect in the Western subregion.** The Western subregion currently faces economic constraints due to two factors: lack of available water, and flat visitation at Grand Canyon, the region's biggest visitor attraction. An improvement in either factor would stimulate growth in the subregion; an improvement in both would produce substantial gains.

Demographic Profile of Coconino County

Coconino County has experienced a high rate of growth over the past 50 years, with population increasing an average of 40 percent each decade – from 18,800 in 1940 to 96,600 in 1990. Relatively fast growth is expected to continue from 2000 to 2050. Because the study area contains more than three-quarters of the county's total population, it is expected to grow accordingly.

Table 2: Population Change in Coconino County

Year	Population	Numeric Change	Percent Change
1940	18,800	-	-
1940-50	23,900	5,100	27%
1950-60	41,800	17,900	75%
1960-70	48,300	6,500	15%
1970-80	75,000	26,700	55%
1980-90	96,600	21,600	29%
Projected			
1990-2000	123,300	26,700	28%
2000-10	147,400	24,100	20%
2010-20	169,300	21,900	15%
2020-30	189,900	20,600	12%
2030-40	211,600	21,700	11%
2040-50	235,700	24,100	11%

Source: Morrison Institute for Public Policy, data from ASU Center for Business Research using information from U.S. Department of Commerce, Bureau of the Census, and Arizona Department of Economic Security.

Coconino County is a relatively youthful place. Compared to the rest of the state and the nation, the county has shown a substantially higher percentage of residents under the age of 25, and a substantially lower percentage of residents over the age of 50. Student enrollment at Northern Arizona University and the young average age on the Navajo Reservation are factors in this unusual distribution. The below average incidence of older age groups, and the small net in-migration of those over 60 (between 1985 and 1990; see Appendix B, Table 2) suggest that the county has not been attracting a significant retirement community.

Table 3: Age Distribution in Coconino County, 1990

Age	Coconino County[1]	Difference from U.S.[1]
Less than 5	8.9%	+1.5%
5 to 17	22.1%	+3.9%
18 to 19	5.5%	+2.4%
20 to 21	5.7%	+2.6%
22 to 24	5.9%	+1.4%
50 to 59	6.7%	-2.1%
60 to 69	4.9%	-3.4%
70 to 79	2.5%	-3.2%
80 or older	1.0%	-1.8%

[1]Age group population is shown as a percentage of total population.

Source: Morrison Institute for Public Policy, data from ASU Center for Business Research using information from U.S. Department of Commerce, Bureau of the Census.

Subregions of the Coconino Plateau Study Area

For purposes of demographic and economic analysis, the study area was broken into three subregions: Flagstaff Area, Western, and Eastern. Each subregion encompasses some unifying characteristics not evidenced in the study area as a whole.

The Flagstaff Area subregion is about four times the size of the city of Flagstaff, extending out in all directions. It is the smallest subregion in area with 268 square miles – less than 10 percent of each of the other two subregions. But it is the most populous and urbanized subregion with an estimated 74,000 residents in 2000 – three times that of the other two subregions combined. Besides Flagstaff, the subregion includes the unincorporated communities of Doney Park/Black Bill, Fort Valley, Timberline/Fernwood, Kachina Village, and Mountainaire. The Coconino National Forest manages most of the non-private land in this subregion.

The Western subregion extends from Grand Canyon to Williams, and from the western boundary of the study area to a north-south line running east of State Route 64. This is the largest subregion in area with 3,953 square miles, but the smallest in population with a projected 7,350 residents in 2000. More than two-thirds of the population is concentrated in two widely spaced centers, Williams and the Grand Canyon/Tusayan area. The vast majority of open lands are a mix of private and state trust lands used primarily for grazing. In the southernmost portion of the subregion, Kaibab National Forest manages most of the non-private lands, while in the northernmost portion Grand Canyon National Park and the Havasupai Tribe are the primary land managers.

The Eastern subregion extends from Page to the Flagstaff Area, and from the boundary of the Western subregion to a line running east of U.S. Highway 89. This area is slightly smaller than the Western subregion with 3,557 square miles, but contains almost twice the population with a projected 14,550 residents in 2000. Most of the population is in Page, with a projected 9,050 residents in 2000. The great majority of the subregion is made up of Navajo Reservation lands, including the small, dispersed Navajo communities of LeChee, Coppermine, Bitter Springs, Cedar Ridge, Bodaway/Gap, and Cameron. The southwestern edge of the region contains a mix of private, state, and national forest lands.

Growth Determinants

Population growth is driven both by demographic and economic factors. Demographic drivers include the demands for goods and services that are stimulated by those who have migrated into the area, such as tourists, college students, retirees, and weekend or summer home owners. Economic drivers include the businesses that create new jobs in export-based sectors, such as manufacturing or natural resource extraction. Tourism produces both demographic and economic driven growth.

Among demographic drivers, tourism leads the region, attracting numerous visitors with high daily expenditures. College students also have major impacts, but these occur primarily in the Flagstaff Area subregion. Seasonal residents tend to influence job growth in the construction industry, but their influence wanes afterward; moreover, seasonal residents are not counted by the census. Retirement migration has had no overall impact on growth in the region.

Among economic drivers, tourism is the dominant activity, accounting for a total of 14,000 jobs – one-third of all private sector employment in 1997. The manufacturing sector, meanwhile, has contributed little to growth in recent years, and federal government employment, a large sector of the economy, has been in decline.

Baseline Projections

DES produces two types of population figures between decennial census periods: estimates and projections. Population estimates are made for prior years after the last census and are updated annually, while population projections are made for future years and are updated every five years. Accuracy of both estimates and projections tend to decrease as the time elapsed from the last census increases. For projections, the county population is calculated first, and that total is then divided up among the various cities and communities within the county. The state projection is a simple total of the county projections.

The DES projections for the study area show a 92 percent increase in population over the 50 year period, 2000 to 2050. Most of the population increase is expected to take place in the Flagstaff Area subregion with the addition of more than 88,000 people, but the highest percent change is anticipated in the Eastern subregion, and particularly in Page, which is projected to more than double in size. The lowest percent change is anticipated in the Western subregion, most notably in Williams.

Table 4: Baseline Population Projections for Coconino Plateau Study Area

Location	2000	2050	Numeric Change	Percent Change
Study Area	96,125	184,650	88,525	92%
Western Subregion	7,350	13,375	6,025	82%
City of Williams	2,925	4,825	1,900	65%
Eastern Subregion	14,550	29,475	14,925	103%
City of Page	9,050	18,775	9,725	107%
Flagstaff Area Subregion	74,225	141,800	67,575	91%
City of Flagstaff	60,700	113,700	53,000	87%

Source: Morrison Institute for Public Policy, data from ASU Center for Business Research using information from Arizona Department of Economic Security.

It is important to note that DES projections are based almost entirely on historic patterns of growth, with no effort made to identify conditions that might change that pattern. For example, they do not consider a condition in which water resources might become more restricted than they are now. DES projections assume that water circumstances will continue as they have in the past. Therefore, a significant break with historic conditions could cause actual population figures to diverge from projections.

For Coconino County and the study area, the DES projections imply that the tourism industry will continue to grow, as will NAU enrollment and second home development. Migration rates, however, will vary according to national age distribution statistics – those age 20-25 have a greater tendency to relocate in another region than do older persons.

Updated DES estimates for 2000 were released in December 2000 showing the county population 1 percent higher than previously estimated. ***Updated figures, however, were not used in this study because they were not available for all places within the study area.*** Census 2000 figures, meanwhile, are due to be released in March 2001, and they are expected to show somewhat higher figures than the projections.

Growth Scenarios

DES projections anticipate substantial growth for the region. Several factors, however, could produce growth faster or slower than projected. Among the factors considered by this study were tourism, enrollment at NAU, second home development, retirement development, export industries, changes in energy costs, changes in economic cycles, and changes in growth rates of Arizona's major metropolitan areas.

The factors most likely to increase growth are gains in tourism and the attraction of export industries, such as manufacturing, to the area. Each of these could potentially accelerate new job creation that attracts in-migration. The likelihood of other factors exceeding their implicit growth rates under the baseline scenario is small.

The factors judged likely to slow growth are increases in energy costs, declining economic cycles, and slowing growth in the state's metropolises. Each of these could diminish tourism, second home development, and enrollment at NAU.

Using likely growth factors and DES projections, four scenarios were developed:

- **Baseline scenario** – growth follows DES projections over the next 50 years.
- **Tourism high growth scenario** – growth is accelerated due to a rebound in regional tourism activity and increased tourism development, particularly in the Grand Canyon and Lake Powell areas.
- **Manufacturing high growth scenario** – growth is accelerated due to Flagstaff attracting new manufacturing firms that use relatively little water and pay high wages.
- **Low growth scenario** – growth is constrained to a slower pace than evidenced recently due to a combination of declining foreign economies, high energy costs, and a correction in the domestic economy.

Of the four scenarios, the baseline projection has the greatest likelihood of occurring because historical trends have a tendency to continue. Next most probable is the tourism high growth scenario, because tourism counts were relatively weak in the 1990s and construction of a water pipeline would allow expansion of facilities. The manufacturing high growth scenario and the low growth scenario are somewhat less probable – each with about the same likelihood of occurring. The odds are small that both of the high growth scenarios would occur together.

HOTEL ROW, TUSAYAN *Tourism is the leading economic and demographic driver of growth in the region. This is particularly true for key spots such as Tusayan, located close to the Grand Canyon's south entrance.*

Table 5: Population Projections by Scenario, Coconino Plateau Study Area

Location	Water	Baseline	Population Projection of 2050		
			Low Growth	Tourism High Growth	Manufacturing High Growth
Entire Study Area	No Pipeline	184,650	168,200	200,400	210,25
	Pipeline	186,300	170,100	210,675	211,900
Western Subregion	No Pipeline	13,375	12,375	19,275	14,675
	Pipeline	17,425	15,45	31,025	22,500
Eastern Subregion	No Pipeline	29,475	27,125	35,400	30,775
	Pipeline	29,475	27,125	36,976	31,800
Flagstaff Area Subregion	No Pipeline	141,800	128,700	145,725	164,800
	Pipeline	139,400	127,525	142,675	157,600

Source: Morrison Institute for Public Policy, data from ASU Center for Business Research using information from Arizona Department of Economic Security.

Projections and Impacts

All four scenarios were analyzed for their population impacts, first under baseline conditions (i.e., "no pipeline," but with an assumption that water will be as available in the future as it has been in the past), and second, under conditions of a regional water pipeline. Results are shown in Table 5 above.

In the *baseline scenario,* the water pipeline produces little overall effect on the study area, primarily because the baseline scenario assumes that water will not be a limiting factor in the future any more than it has been in the recent past. The main impact of the pipeline would be seen in the distribution of population – it would favor the Western subregion, where water has been much more of a constraining factor. The pipeline would expedite expansion of tourism facilities close to Grand Canyon National Park, creating more jobs, and it would make the subregion's relatively low land and housing prices more attractive compared to Flagstaff. The result would be an increase in the Western subregion's growth rate under a pipeline alternative, due in part to a shift of growth away from Flagstaff. This pipeline-related growth effect occurs for Flagstaff in the following scenarios as well.

The *low growth scenario* creates a gradual slowing of population growth over the next 50 years, reflecting the modest pace of growth in the 1960s in Arizona. This is in keeping with a typical growth cycle that produces a slowing trend following a period of high growth, thus it has a reasonable chance of happening. The low growth scenario without a pipeline decreases the population change in the study area by about one-third by 2050, with the impact fairly evenly distributed. With a pipeline supply of water, growth is not reduced as much; in the Western subregion, in particular, growth is expected to actually increase over the no-pipeline baseline scenario due to the subregion's release from water constraints.

The *tourism high growth scenario* without a pipeline adds 25,600 residents to the total study area population by 2050, an additional 14 percent. This scenario produces proportionally more impact on the Western and Eastern subregions than on the Flagstaff Area subregion because they are closer to the main points of interest for visitors. When tourism high growth is combined with a water pipeline, the Western subregion grows substantially more, reaching a population of more than 31,000 residents in 2050 compared to 19,275 with the no-pipeline tourism high growth scenario, and 13,375 with the no-pipeline baseline scenario.

The *manufacturing high growth scenario* generates a similar overall effect as the tourism high growth scenario with a pipeline, except that the manufacturing scenario is only mildly influenced by the pipeline alternative. The Flagstaff Area subregion would feel the most significant impact with manufacturing, growing up to an additional 23,000 in population – a 16 percent increase over the baseline scenario with no pipeline. If a pipeline were added under the manufacturing scenario, the Western subregion would also grow due to employees finding less expensive housing in Parks or Williams. This would occur at the expense of some growth in Flagstaff. Growth in the Western subregion, however, would not match that found under the tourism high growth scenario.

Conclusions

Population growth results from both demographic and economic factors, but DES population projections are based primarily on historic trends. They do not take into consideration potential reversals of trends, nor do they consider other factors such as regionwide water shortages. Therefore, a water pipeline by itself – in the absence of any change in demographic, economic, or natural resource factors – is not likely to increase population growth substantially beyond current DES projections. With tourism the overall leading growth driver in north-central Arizona, the greatest impact of a regional water pipeline would be in the western portion of the study area where tourism is dominant, economic conditions may improve, and where water has been a constraining factor for many years.

GROWTH MANAGEMENT: HOW THE REGION PLANS

The term, "growth management," is often used to carry on discussions about government policies and programs that affect how a place expands and develops. While it has no precise definition, growth management usually refers to tools and efforts to channel and accommodate growth through such means as laws, incentives, agreements, easements, and long-term planning.

To assess the readiness of the Coconino Plateau region to manage future growth, planning documents were collected and analyzed from 14 different governmental entities in the study area responsible for planning on the vast majority of lands in the region. The planning documents include city general plans, a county comprehensive plan, county area plans, Navajo economic development and water resources plans, a national park general management plan, and national forest land management plans.

The plans vary considerably in their scope and purpose, a reflection of the differing missions and characteristics of the entities from which they came.

Key Characteristics and Analysis

- **Many plans are getting old.** Almost half were adopted more than 10 years ago. Some, however, are scheduled for update in the near future. The Flagstaff update, which was far enough along to be evaluated for this analysis, suggests a future trend toward greater specificity in growth management.
- **Water availability is addressed in every plan.** Many policies are general in nature, but some plans require evidence of sufficient water before building approval is granted.
- **Adequacy of infrastructure and transportation are addressed in nearly every plan.** All plans require that certain basic infrastructure be planned and funded before development, but the Flagstaff draft plan requires that infrastructure actually be in place. Regarding transportation analysis and policy, Page, Flagstaff, Doney Park, and Grand Canyon plans provide the greatest detail.
- **Population limits are not discussed in any plans.** Page planners, however, recognize a de facto population limit based on the city's relatively small land base and slim prospects for expansion.
- **Urban limits appear in three plans.** Flagstaff, Grand Canyon, and Page each have some form of urban limit, but only Flagstaff draws a conventional urban growth boundary.
- **Development impact fee policies appear in four plans.** Flagstaff, Page, Tusayan, and Valle plans each discuss impact fees, but no plan includes an impact fee schedule.
- **Infill incentives are a feature of one plan.** The Flagstaff draft plan specifies that the city adopt regulatory and financial incentives for infill in the city's core. It also addresses the development of partnerships and financing mechanisms to support infill.
- **The verdict is out on the region's readiness to manage growth.** Due to the conflicting missions of some planning entities, and the age of some plans, it is difficult to predict how the region will collectively manage future growth. Moves toward cooperative planning efforts, the wide-spread use of county area plans, and anticipated updates to county and municipal plans promise reasonable preparation for the future.

UPSCALE DEVELOPMENT, PAGE *Because Page is in the enviable position of owning all developable land within its boundaries, the city can control when, where, and what kind of development residents will see in the future.*

Analysis of Growth Management Criteria

Growth-related plans were collected from 14 entities in the study area. These include the city of Flagstaff, city of Page, city of Williams, Coconino County, Tusayan, Valle, Bellemont, Red Lake, Fort Valley, Doney Park, the Navajo Nation, Grand Canyon National Park, Coconino National Forest, and Kaibab National Forest.

Each plan was analyzed to determine the degree to which it contained seven growth management tools: water as a component of development, adequate infrastructure requirements, transportation planning, limits on population growth, urban limit line, impact fees, and infill incentives. Table 6 shows the results. Four descriptors were used to rate the manner in which the plans addressed each specific tool:

- *Detailed* indicates that the plan includes this tool as a separate element, or contains a specific description of a problem in this area as well as numerous policies and implementation strategies, a time line and, in some cases, funding sources.

- *Moderate* indicates that the plan defines the tool and includes multiple goals, policies, and implementation strategies.
- *Limited* indicates that the plan defines the tool but contains few related goals or policies.
- *None* indicates that the plan contains no reference to the tool.

Some potential conflicts in purpose occur among the planning documents. For example, city and county plans lean toward providing basic services for their residents, while national park and national forest plans lean toward sustaining natural resources. Nevertheless, the development process for plans reveals a high deal of cooperation and communication among entities, as well as with the public at large. Representatives of various governmental bodies often serve on each other's planning committees or participate in the review of each other's plans prior to adoption.

One unusual planning characteristic of the study area deserves mention – Coconino County's pursuit of localized "small area" plans in unincorporated communities. These plans feature a county-facilitated grass roots process that helps local people set goals and policies to address future land use and development in their communities. Upon completion, the small area plans are adopted by the county board of supervisors as amendments to the county's comprehensive plan so they can guide the decision-making process of the board and the planning and zoning commission. The area plans of six unincorporated communities were evaluated for this analysis: Tusayan, Valle, Bellemont, Red Lake, Fort Valley, and Doney Park.

The county has also participated with the city of Flagstaff in creation of a Flagstaff Area Regional Land Use and Transportation Plan. This plan, currently in published draft form, will replace the city's 1987 general plan when it is completed and adopted. It differs considerably from the 1987 plan in that it includes a substantial portion of unincorporated county lands for cooperative planning purposes. The 1999 draft of the Flagstaff area plan was used in the analysis for this report.

Plan Approval Date

For smaller cities and counties, as well as cash-strapped agencies, the cost of preparing detailed plans may be a burden, limiting the frequency of updates. Six of the 14 plans were adopted more than 10 years ago. Two of those already have updates in progress, and another plan is also scheduled for revision. All three were municipal or county governments that had waited until potential conflicts among statewide growth management efforts were resolved at the conclusion of 2000.

Table 6: Analysis of Growth Related Plans

Jurisdiction	Recent Plan Approval	Type of Plan	Water Component of Development	Adequate Infrastructure Requirements	Transportation Planning	Limits on Population Growth	Urban Limit Line	Impact Fees	Infill Incentives
Flagstaff	1987[1] (Update 2001)	General Plan	Detailed	Detailed	Detailed	None	Detailed	Limited	Moderate
Page	1996 (Update 2001)	General Plan	Limited	Moderate	Detailed	None	Moderate	Limited	None
Williams	1995	General Plan	Limited	Limited	Moderate	None	None	None	None
Coconino County	1990 (Update 2001)	Comprehensive Plan	Moderate	Limited	Moderate	None	None	None	None
Tusayan	1997	County Area Plan	Moderate	Moderate	Moderate	None	None	Limited	None
Valle	1999	County Area Plan	Moderate	Detailed	Moderate	None	None	Limited	None
Bellemont	1985	County Area Plan	Moderate	Limited	Limited	None	None	None	None
Red Lake	1992	County Area Plan	Limited	Limited	Moderate	None	None	None	None
Fort Valley	1990	County Area Plan	Moderate	Limited	Moderate	None	None	None	None
Doney Park	1988	County Area Plan	Limited	Limited	Detailed	None	None	None	None
Navajo Nation	2000 & 1999	Water Resource Development Strategy; Economic Development Program	Moderate	Limited	None	None	None	None	None
Grand Canyon National Park	1995	General Management Plan	Moderate	Limited	Detailed	None	Detailed	None	None
Coconino National Forest	1988	Land and Resource Management Plan	Limited	Limited	Limited	NA	NA	NA	NA
Kaibab National Forest	1999	Land Management Plan	Limited	Limited	Limited	NA	NA	NA	NA

[1] 1999 published draft update analyzed.

Detailed = Topic found as a separate element of plan or with a specific description of problem with many policies, implementation strategies, timeline and in some cases, funding sources.

Moderate = Topic found within plan with multiple goals, policies and implementation strategies.

Limited = Topic found within plan, but few goals or policies.

None = No section within general/comprehensive/area plan regarding this topic.

NA = Not Applicable.

Source: Morrison Institute for Public Policy.

CAMERON, CIRCA 1938 *The facilities of the trading post at Cameron have been upgraded substantially in the last 60 years to accommodate tourism growth. Navajo officials currently see the Cameron area as a potential source of future economic growth for the reservation.*

Water Component of Development

Every plan addresses the issue of water availability as a component of development. Some plans require developers to provide evidence that water is available before final building approval is given. Flagstaff's draft plan contains a detailed water element that analyzes ground water usage, current sources, possible future sources, and projected need. The Flagstaff plan also includes a breakdown of water providers and quantities produced. In contrast, Coconino County's plan provides only a limited analysis of water's effect on development. The county's small area plans sometimes go further. For example, the Tusayan plan requires adequacy of water supply and waste water treatment be reviewed for all major developments requiring planning and zoning commission or county board of supervisor approval. Fort Valley has a similar policy. Meanwhile, the Navajo Nation development strategy proposes to establish a water resource development task force to coordinate technical and fiscal services of the Navajo Nation and federal agencies. The water development strategy also recommends preparation of a reservation-wide needs assessment, and development and rehabilitation of local water supply and distribution systems.

Adequate Infrastructure Requirements

Every plan contains some requirement that adequate infrastructure – such as roads, schools, water service, and parks – be planned and funded prior to development. Most plans provide some language regarding the importance of infrastructure. The Flagstaff draft plan, however, requires that public facilities be in place prior to development and also seeks legislation to require adequate public facilities in surrounding Coconino County. Currently, the county only asks that developers submit a report on the impact of development on waste water systems and surface and ground water. Some county small area plans, however, are more restrictive. The Valle plan, for example, requires that new developments seeking approval provide adequate basic utility services. The area plan for Tusayan also requires that major new developments construct their fair share of facilities for a reclaimed water storage and distribution system.

Transportation Planning

Nearly every plan includes some form of transportation planning. Page's plan outlines a coordinated effort with state and federal agencies to upgrade roadways through the city, and also sets goals for improving circulation. Likewise, the Doney Park area plan contains a detailed transportation element that quantifies traffic usage data, provides evaluations of past road projects, and provides 19 detailed transportation policies. In addition, the Grand Canyon general management plan focuses attention on access to the park, and details major changes in circulation patterns in order to limit traffic congestion.

Limits on Population Growth

Entities in the region have different perspectives on accommodating population growth. While no plan mentions any specific methods for limiting population growth per se, the city of Page tacitly recognizes some limits. With an expected build-out for the city in about 20-25 years, a limit on population growth can be inferred.

Urban Limit Line

Urban limit lines, also called urban growth boundaries, draw a line between areas where development is wanted and where it is not. Three jurisdictions within the region employ some form of urban limit lines. Since 1982, Flagstaff has employed an urban service boundary to identify areas suitable for urban development based on where facilities and services can most efficiently be provided by the city. The Grand Canyon plan does not use the term "urban limit line," but nevertheless has policies that set urban limits through the concept of "devel-

opment zones." These are small areas of land designated to contain all facilities that serve park managers and visitors. The Page plan does not mention urban limits either, but city planners recognize a de facto urban line due to the unusual circumstance that the city owns all developable land inside the city limits. If Page's land use plan is followed, developers will be constrained from purchasing real estate outside the areas designated for residential or commercial use, effectively removing open and public spaces from future development.

Impact Fees

Impact fees are a means of making development pay for itself by allowing a city or other entity to recoup the cost of infrastructure and public amenities. Four plans address the subject of impact fees, but only the Flagstaff draft plan includes a statement that development "pay its fair share." None of the plans spell out a schedule of fees.

Infill Incentives

Infill incentives are used to promote development in the urban cores of a city or county. Examples are tax breaks or the easing of zoning ordinances for businesses that build in designated areas. Only the Flagstaff draft plan includes a discussion of infill incentives. The plan contains no specific incentives, but proposes the city adopt regulatory and financial incentives as well as development partnerships.

Conclusions

The verdict is out on the region's readiness to manage growth. Due to some differences in plan missions, conflicts in goals, and the age of some of the planning documents, it is difficult to draw broad generalizations about the adequacy of regional planning. Most entities appear to address growth in the areas of water and transportation issues, and to a lesser degree, infrastructure requirements. But other areas of growth management are mentioned less frequently and in less detail.

Some encouraging trends are evident. The county has effectively overlaid many of its unincorporated residential areas with planning amendments that function much like municipal general plans, lending some degree of order and voice to loosely-knit communities. In addition, some city and county plans are scheduled for updates mandated by the state's Growing Smarter laws that govern how plans must be constructed, adopted, and followed. If currently scheduled updates follow the example of the draft Flagstaff area plan, future planning documents will address growth management issues much more specifically than they have in the past.

A STATEWIDE APPROACH: GROWING SMARTER LEGISLATION

In 1998, the Arizona legislature passed the first of two related acts intended to help manage growth in the state. This legislation, called the Growing Smarter Act, was based in large part on a concept known as "smart growth," which has been defined as a set of growth management tools that attempt to strike a balance among issues of economics, environment, and quality of life.

The Growing Smarter Act of 1998 and its follow-up, the Growing Smarter Plus Act of 2000, were not the first or only growth management actions taken in Arizona. (See Appendix D: An Arizona Growth Management Time Line.) They were, however, the most comprehensive, making significant changes in the way city and county governments do their planning, how lands are regulated under local governments, the role of citizens in land use issues, and the management of state trust lands. Many of these changes will have long-term effects on city and county governments in the Coconino Plateau study area.

Main Impacts

- **City and county governments must update their general/comprehensive plans every 10 years.** These plans must be ratified by voters before they are adopted.
- **City and county governments must conform to their general/comprehensive plans.** Changes can be made only with approval of a supermajority of the governing body.
- **The cities of Flagstaff and Page must include new elements in their general plans.** Flagstaff must include all five new elements – open space, growth areas, environmental planning, cost of development, and water resources. Page must include only the first four elements – it is exempt from the water resources element because of a population under 10,000.
- **Williams and Coconino County probably won't need to add new plan elements.** Both should be exempt from all five elements if their current population projections are accurate. But if Census 2000 results show Coconino County with more than 125,000 residents, the county would be required to add the water resources element, a task that could be difficult and expensive to accomplish.
- **Some state and private "open space" lands may be preserved for conservation purposes.** New state funding sources will be able to grant monies to governments and other organizations to help them obtain development rights from state and private lands.

Compliance with Growing Smarter Acts

Growing Smarter and Growing Smarter Plus established several requirements that explicitly address municipal and county plans. (For a summary of relevant Growing Smarter provisions, see Appendix E: Highlights of the Growing Smarter Acts.) Among these new requirements are five additional elements that nearly every plan must contain. Only places with low population and/or a slow growth rate are exempt from these requirements. Table 7 shows how the new required components will affect currently operational plans of the study area's three cities, as well as Coconino County.

It should be noted that some of the entities shown in the table already have plan updates in progress, but have delayed completion of these updates until November 2000 election results determined exactly which requirements they would have to meet. Also bearing on plan requirements in some cases are Census 2000 results, due to be released in March 2001. It

Table 7: Compliance with Growing Smarter and Growing Smarter Plus General/Comprehensive Plan Requirements

Jurisdiction	General Plan Adoption	Population 2000 (Estimate)	Annual Growth Rate 1990-2000	Open Space[1]	Growth Areas[1]	Environmental Planning[1]	Cost of Development[1]	Water Resources[1]	Ability to Comply with GS/GSP[2]
Flagstaff	1987	60,700	>2%	NO	NO	NO	NO	NO	Update will comply
Page	1996	9,050	>2%	NO	NO	NO	NO	NO	Update will comply
Williams	1995	2,925	<2%	NR	NR	NR	NR	NR	NR
Coconino County	1990	123,300	>2%	NR	NR	NR	NR	NR[3]	Update will comply

[1] Ratings: YES = does comply; NO = does not comply; NR = not required to comply.

[2] Based on information supplied by local staff/officials.

[3] Element will be required if Census 2000 population exceeds 125,000.

Source: Morrison Institute for Public Policy; data from Arizona Department of Economic Security.

should also be noted that, while city and county plans may not presently contain required elements as specified by the Growing Smarter acts, it does not mean that the city or county failed to address these issues in other ways, such as through ordinances or regulations. Therefore, Table 7 should be viewed only in light of how the Growing Smarter acts will affect the way new general and comprehensive plans must be written.

Among the three cities in the study area, only Flagstaff has sufficient population to be required to include all five new elements in its general plan. A general plan update scheduled to be complete in 2001 is expected to comply without major difficulty. The city of Page will be required to include four of the growth-related elements in its next general plan. Because its 2000 population projected is expected to be under 10,000, the city should be exempt from the water resources element at this time. Williams expects to be exempt from all five elements. With a projected population of 2,925 and a growth rate estimated at less than 1 percent, the city falls within the parameters for exemption set by the 2000 legislation.

Coconino County may also be exempt from the five new elements, pending results of Census 2000. While the county is sure to stay below the 200,000 population threshold for adding the first four new elements, it is estimated to be very close to the 125,000 threshold for the water resources element. If the Census 2000 count for the county exceeds that number, planning staff expect it will be costly and difficult to include a water resources element in the county's next comprehensive plan.

FLAGSTAFF INFRASTRUCTURE, THEN AND NOW *In 1905, the corner of Aspen and San Francisco featured horse-drawn wagons, dirt streets, and a utility pole in the middle of the road. Nearly a century later, the same area has automobiles, paved streets, and underground utilities, and it even sports a microwave communications tower.*

CONCLUSIONS AND POLICY CHOICES: THE WATER-GROWTH EQUATION

The Coconino Plateau region is projected to nearly double in population over the next 50 years. If it does, water demand will increase accordingly, and it is assumed that additional water supplies will be available to meet that demand. While it seems remarkable in a desert state that official population growth projections simply assume that water will be available to meet the burden of growth, the truth is that Arizona has nearly always managed to provide water to its growing communities.

The consequence of Arizona's historic success in finding water is that growth in the Coconino Plateau region is expected to occur regardless of where that additional water comes from – whether it is pumped from underground aquifers, hauled by railroad cars, harvested from rainfall on rooftops, captured through conservation and recycling, or piped in from Lake Powell. Therefore, a water pipeline designed to accommodate the type of growth that is anticipated by population projections should have little effect on those figures. The fact of growth is that economic and demographic factors, not water per se, are the most significant drivers of population.

But the water-growth equation is not simple. State population projections do not consider potential changes in economic or demographic growth factors that might be supported by an assured water supply. They also ignore any effects that might accrue if the region is unable to develop water unconditionally. Either could affect actual growth. Even assuming that additional water sources are always available and total growth occurs as projected, the patterns and effects of that growth could vary depending on where the water comes from and how it is distributed.

Increased development of current water resources – which are primarily groundwater – would favor established communities that have the funding and delivery infrastructure to make additional supplies of water available to a growing population. These communities tend to have more growth management tools at their disposal than do dispersed communities, and also they tend to have better, more comprehensive infrastructure to accommodate an influx of residents. Both of these are positive circumstances from a regional planning perspective.

However, unrestricted use of groundwater is not assured for the future. Not only do many unknowns exist regarding the size and nature of local aquifers, but also the future of groundwater rights in the region is unclear. Several stakeholders in the region could find themselves at odds over the effects of groundwater pumping. Already, national parks, Indian tribes, and even downstream water users are questioning whether wells on the Coconino Plateau impinge on their water rights. In addition, Forest Service officials have begun to carefully scrutinize well permits on national forest lands to determine their impacts on other water resources. The outcome of groundwater issues may eventually hinge on whether hydrology studies in the area establish that water pumped from one place materially affects the flow of seeps and springs in another.

A RIVER'S WORK *After carving Grand Canyon, the Colorado River is now being considered as a source of drinking water that might protect the Canyon's seeps and springs.*

The beauty of a water pipeline proposal is that it appears to sidestep most of the difficult groundwater issues altogether, particularly when combined with restrictions on future groundwater development in the region. Interviews conducted for this report clearly indicate that pipeline water as a long-term solution would be welcomed with little hesitation in much of the region – for example, in Williams, Tusayan, Page, and the western Navajo communities in the study area. It is also likely that Flagstaff and Grand Canyon National Park would utilize pipeline water under certain conditions. But a regional pipeline could alter how growth occurs – and where.

One potential growth area of particular concern to many stakeholders is the western portion of the Coconino Plateau region, specifically the State Route 64 corridor north of Williams that serves as gateway to Grand Canyon. Most of this corridor presents scenic views of wide open spaces emblematic of the northern Arizona landscape. Much of this perceived open space, however, is actually comprised of either private land, or state trust land that could be converted for development. All of this potentially developable land lies in unincorporated areas of the county. While county area plans restrict commercial zones to specific locations along the highway, ranchette development is widely possible. What would be a pipeline's effect there?

Historically, little water has been available in the western portion of the study area due to the high expense of drilling wells into the deep underlying aquifer, and the ever present risk of failure. That situation combined with weak economic factors in recent years has resulted in growth and development that has been fairly modest and of small visual impact. A pipeline, however, could provide an assured water source of water for both large and small developments in the area. If, as the demographic projections in this report suggest, the proposed water pipeline could accelerate growth in the western portion of the region, some type of protective action would be demanded by those who want to protect the approach corridor to Grand Canyon.

Policy Choices: Moving the Growth Debate Forward

Throughout Arizona, growth and its impact on natural resources has become the centerpiece of public policy debate. While much of the discussion has focused on the state's major metropolises, rural areas such as the Coconino Plateau region face many of the same policy choices. Most prominent among these choices is how best to balance the perceived value of development against its impact on the environment.

The Coconino Plateau Regional Water Study has served to focus substantial planning efforts on ways to make water available in the region for a fast growing population over the next 50 years. The goal has been to protect the region's underlying aquifer while accommodating anticipated growth. This report examined the prospects for growth in the Coconino Plateau region, the tools that are in place to manage that growth, and the perspectives of local leaders and technical experts regarding the desirability of growth. In doing so, close attention was paid to the effect that the proposed water pipeline could have on the region's future.

A pipeline alternative offers several attractive benefits, including its potential to be utilized as a growth management tool. But as might be expected with almost any proposal that addresses both water and growth issues, a number of critical issues must be resolved. Many of the more immediate practical questions are not strictly growth-related: for example, how much will the project cost to build and operate, who will pay for it, and how can Colorado River water and diversion rights be obtained? Some broader issues are also not closely growth-related, such as questions of power supply for the project, and possible effects of decommissioning Glen Canyon Dam.

Several important questions, however, do concern the possible growth effects of a pipeline, and stakeholders need to address these questions prior to making a final decision in the matter. As the only regional governing body in a regionwide decision-making process, Coconino County is probably in the best position to provide the leadership necessary for reaching consensus.

Among the most critical growth-related issues to be decided regarding a regional pipeline:

- **Who will get the water?** The time to decide who has access to pipeline water is before construction begins. That decision will strongly affect future growth patterns in the region. If the water is available freely across the region, the highest growth rate would occur in the western portion of the study area, where concerns over development are the greatest and sprawl is seen as a threat. If pipeline access is restricted to discrete communities, growth will be most likely to occur in places where infrastructure and growth management tools are most robust, thereby discouraging sprawl.
- **How will pipeline water be treated and distributed?** Raw pipeline water would be almost unusable for low density subdivisions and most small communities, consequently a regional treatment authority would probably be needed to make the water potable for these residents. Without such infrastructure, growth would tend to be channeled toward more established communities, a circumstance that would discourage sprawl.
- **How much protection will the aquifer receive?** One major selling point for an outside water source for the region is the protection it affords regional aquifers. But if the price of pipeline water runs higher than groundwater, users with wells in their water system will want to maximize groundwater production before turning to more costly pipeline water to meet their needs. This possibility could undermine political support for the regional pipeline proposal. Therefore, to keep all stakeholders on board, decision-makers may need to consider some type of restriction on groundwater use or development as a corollary to construction of a regional pipeline.
- **How big should the pipe be?** The diameter of the pipe determines the maximum number of people that can be served. Decision-makers need to decide early on how much growth they want to accommodate. Whatever choice is made, it will not be easy to revisit this decision after a pipeline is constructed.
- **What growth management powers will the county wield?** Counties currently possess relatively few tools to manage growth in their unincorporated areas. They are particularly hamstrung when it comes to regulating the small and/or low density wildcat subdivisions that tend to spring up on unincorporated lands far from urban areas. While the state legislature or the ballot initiative process may eventually provide some assistance to counties in this regard, timing could be critical – much of the most sensitive land could already be platted by the time help arrives. Concerned stakeholders may want to push for faster action in the state capitol, and/or develop a regional plan for protecting sensitive lands through purchase, lease, or regulation.
- **Who will manage the pipeline?** The legal and management structure that is set up for administering the water pipeline will play a significant role in determining how water is allocated. Whoever controls those allocations – particularly for unencumbered water – will have a powerful tool to regulate the type and number of new subdivisions in unincorporated areas of the county. This, in turn, will influence how much population growth can occur there.

REFERENCES

Alder, Lin, May 14, 1998. "The 64,000 Acre Foot Question: A Conservationist's Perspective on Existing and Future Water Development in Washington County, Utah – Draft." Southwest Utah Advisory Board.

Arizona Department of Water Resources, 1999. "Phase One Report: North Central Arizona Regional Water Supply Study."

Arizona Office of the Auditor General, 1997. "Arizona State Land Department: Performance Audit."

Arizona State Land Department, 2000. "Annual Report."

Bell, D. Craig & Ricky S. Torrey, 1995. "Water Policy and Growth Management." Report prepared for the Western Governors' Association by Staff of the Western States Water Council.

Boyle Engineering Corp., Mar. 1995. "Purpose and Need Study." Washington County Water Conservancy District.

Boyle Engineering Corp., Dec. 1998. "Water Supply Needs for Washington and Kane Counties and Lake Powell Pipeline Study." Washington County Water Conservancy District and Utah State Division of Water Resources.

Canadian River Municipal Water Authority <http://crmwa.com/>.

Freese and Nichols, Inc., Aug. 2000. "Regional Water Plan: Panhandle Water Planning Area." Panhandle Water Planning Group.

GEO/Graphics, Inc., May 17, 1994. "Population Management Study: Washington County, Utah." Prepared for Washington County Water Conservancy District.

Greystone Environmental Planners, July 1997. "Sand Hollow Reservoir Project Report." Prepared for Washington County Water Conservancy District, Utah.

Groesbeck, John, Mar. 8, 1994. "The 1994 Economic Impact of Quail Creek Reservoir on Washington County, Utah." Prepared for Washington County Water Conservancy District.

"Growing Smarter." Arizona Senate Fact Sheet for H.B. 2361, 43rd Legislature, 2nd Regular Session.

Growing Smarter Commission, Sept 1, 1999. "Growing Smarter: Managing Arizona's Growth and Preserving Our Heritage." Final Report.

"Growing Smarter Plus." Arizona Senate Fact Sheet for S.B. 1001/H.B. 2001, 44th Legislature, 4th Special Session.

HDR Engineering for Llano Estacado, Jan. 2000. "Llana Estacado Regional Water Plan." Prepared for Llana Estacado Regional Water Planning Group.

Hydrosphere Resource Consultants, July 2000. "Review of Water Supply Needs in Washington County, Utah." Prepared for Grand Canyon Trust.

Kaibab National Forest, Aug. 1999. "Final Environmental Impact Statement for Tusayan Growth."

Meaney, Barbara, 2000. "Timeline and Summary of Arizona Growth Measures." Internal Memo prepared for Quarles Brady Streich Lang LLP.

Montgomery, James M., Consulting Engineers, Inc. Sept. 1979. "Water Master Plan: City of Gillette, Wyoming."

U.S. Bureau of Land Management, Cedar City District Office, July 1, 1983. "Quail Creek Reservoir Project: Environmental Assessment."

U.S. Bureau of Reclamation, July 1987. "Colorado River Water Quality Improvement Program Preconstruction Report, Lower Gunnison Basin Unit (Winter Water)."

U.S. Bureau of Reclamation, Phoenix Area Office, 2000. "Appraisal Level Peer Review Study of the Arizona Department of Water Resources: Phase One – North Central Regional Water Study."

U.S. Bureau of Reclamation DataWeb, "Canadian River Project Texas" <http://dataweb.usbr.gov/html/canadariver.html>.

SOURCES

Boyd Abelseth, *Director Water Division, City of Gillette, Wyoming.*

Lin Alder, *Consultant, Grand Canyon Trust, St. George, Utah.*

Jarrett Atkinson, *Local Government Services Director, Panhandle Regional Planning Commission, Amarillo,Texas.*

Taggie Aultman, *General Manager, Chipeta Water District, Montrose, Colorado.*

Geoff Barnard, *President, Grand Canyon Trust, Flagstaff, Arizona.*

Mike Berry, *General Manager, Tri-County Water Conservancy, Montrose, Colorado.*

Bruce Blalack, *Water Production Supervisor, City of Lubbock, Texas.*

Betty Blenkush, *Research Specialist, Campbell County Economic Development Corporation, Gillette, Wyoming.*

Bob Butler, *Director Public Works Department, Ivins City, Utah.*

Kerry Carpenter, *Region Engineer, Office of State Engineer, Utah.*

Bill Carson, *Public Works Director, City of Gillette, Wyoming.*

Dan Coffey, *Director Of Utilities, City of Amarillo, Texas.*

James Deacon, *Prof. of Environmental Studies, University of Nevada at Las Vegas.*

Rick Gibbons, *County Planner, Montrose County, Colorado.*

Mac Hall, *Director Public Works Department, Hurricane, Utah.*

Sheridan Hansen, *Special Projects Coordinator, Washington County Water Conservancy District, Utah.*

Jim Henson, *Business Development Vice President, Amarillo Chamber of Commerce, Texas.*

Scott Hirschi, *Director, Economic Development Department, Washington County, Utah.*

Jim Hokit, *General Manager, Uncompahgre Valley Water Users Association, Montrose, Colorado.*

Paul Holden, *Environmental Consultant, Bio/West Inc., Logan, Utah.*

John Jackson, *Administrator for Planning, Wyoming Water Development Community, Gillette, Wyoming.*

Greg Keller, *Project Manager for Arizona State Land Department, Phoenix, Arizona.*

Dave Margetts, *Director, Project 7, Montrose, Colorado.*

Merv Mason, *Administrative Process Manager for Arizona State Land Department, Phoenix, Arizona.*

Wayne McArthur, *Director Water and Power Department, St. George City, Utah.*

Jim McMahon, *Southwest Utah Director, Grand Canyon Trust, St. George, Utah.*

John McMillan, *General Manager, Menoken Water District, Montrose, Colorado.*

Frank Mesaric, *City Engineer, City of Montrose, Colorado.*

Ursula Montano, *City Long-Range Planner, City of Flagstaff, Arizona.*

Bob Nicholson, *Director Community Development Department, St. George City, Utah.*

Greg Novak, *Commercial Leasing Manager for Arizona State Land Department, Phoenix, Arizona.*

Sue Pratt, *Principal Planner, Coconino County, Arizona.*

Michael Shaw, *Director, Public Works Department, Washington City, Utah.*

Nick Simonetta, *Manager of Community and Legislative Affairs, Arizona State Land Department, Phoenix, Arizona.*

Philip Solomon, *Deputy Water and Power Director, St. George City, Utah.*

Gordon Taylor, *Planning Manager, Arizona State Land Department, Phoenix, Arizona.*

Ron Thompson, *Manager, Washington County Water Conservancy District, Utah.*

Brent Uilenberg, *Technical Services Division Manager, U.S. Bureau of Reclamation, Western Colorado Area Office, Grand Junction, Colorado.*

Lloyd Urban, *Director Water Resources Center, Texas Tech University, Lubbock, Texas.*

Larry Wester, *Principal Water-Wetstein Consulting Engineers, Gillette, Wyoming.*

John Williams, *General Manager, Canadian River Municipal Water Authority, Texas.*

Wayne Wyatt, *General Manager, High Plains Underground Conservation District, Lubbock, Texas.*

Jon Young, *Utilities Director, City of Gillette, Wyoming.*

Dave Zelinka, *Administrator for Finance, Wyoming Water Development Community, Gillette, Wyoming.*

APPENDIX A
STAKEHOLDERS INTERVIEWED

A total of 58 stakeholders were individually interviewed for this study. Although many of these stakeholders actually represent more than one group – for example, a land manager could also be an elected official – each person is only shown in the table below one time in the role most appropriate to the interview.

Entity Represented	Name	Title
Government/Community		
Arizona Department of Water Resources	Dennis Sundie	Director of Planning Department
Arizona Governor's Office	Bill Feldmeier	Director of Northern Arizona Office
Canyon Forest Village	Terry Hudgins	Resource Management
Canyon Forest Village	Barbara Fischer	Community Relations
Coconino County	Paul Babbitt	Board of Supervisors
Coconino County	Dora Harrison	County Manager
Coconino County	Bill Towler	Planning Director
Flagstaff	Dave Wilcox	City Manager
Page	Bob Bowling	Mayor
Page	Bill Plummer	Water Consultant
Parks Area	Donny Bridges	Chair, Area Planning Committee
Parks Area	Dave Duggan	Area Planning Committee
Parks Area	Roger Anderson	Area Planning Committee
Parks Area	Zane Morris	Area Planning Committee
Parks Area	Phyllis Johnson	Area Planning Committee
Parks Area	Jerry Jayne	Area Planning Committee
Parks Area	George Squyres	Area Planning Committee
Parks Area	Tom Collins	Area Planning Committee
Tusayan	John Rueter	Manager, Hydro Resources
Tusayan	Chris Thurston	Principal, Anasazi Water
Valle	Norm Gobeil	Chair, Area Planning Committee
Williams	Dennis Dalbeck	City Manager
Williams	Ron Stillwell	Water Supervisor
Land Managers		
Arizona State Land Department	Gordon Taylor	Section Manager, Planning
Arizona State Land Department	Steven Williams	Grazing, Phoenix Office
Arizona State Land Department	Gary Hase	Grazing, Flagstaff Office
Babbitt Ranches	Bill Cordasco	President
Coconino National Forest	Art Matthias	Supervisory Forester
Grand Canyon National Park	Jerome Montague	Chief, Branch of Natural Resources, Science Center
Grand Canyon National Park	Bill Hansen	Supervisory Hydrologist, Water Rights Branch of Water Resources Division
Kaibab National Forest	Tom Gillett	Public Services Branch Manager
Indian Tribes		
Bureau of Indian Affairs	Raymond Roessel	Water Resources
Havasupai Tribe	Roland Manakaja	Natural Resources Manager
Havasupai Tribe	Margaret Vick	Tribal Legal Counsel
Navajo Nation	Louise Yellowman	Coconino County Supervisor
Navajo Nation	Roberta John	Deputy Director, Economic Development
Navajo Nation	John Leeper	Branch Manager, Water Resources Management
Navajo Nation	Robert Shorty	Community Services Coordinator, Cameron Chapter
Navajo Nation	Al Johnson	Vice President, Navajo Nation Western Farm Board
Navajo Nation	Henry Lane	Senior Council, Bodaway/Gap Chapter
Navajo Nation	Calvin Hanks	Chapter House Clerk, Bodaway/Gap Chapter
Navajo Nation	Yvonne Bigman	Secretary/Treasurer, Lechee Chapter
Navajo Nation	Diana Slowtalker	Senior Center Supervisor, Lechee Chapter
Navajo Nation	David Neztsosie	President, District 3 Farm Board
Navajo Nation	Don Yellowman	Sec/Treasurer, District 3 Farm Board
Conservation Organizations		
Grand Canyon Trust	Nikolai Ramsey	Program Officer
Nature Conservancy	Shelley Silbert	Northern Arizona Program Manager
Infrastructure Providers		
Arizona Department of Transportation	Don Dorman	Flagstaff District Engineer
APS	R. T. Farthing	Area Supervisor, Flagstaff
APS	Dan Ray	Area Supervisor, Williams
APS	Larry Smith	Design Project Leader
Bellemont Water Company	Nona McClain	Vice-President
Citizens Utilities Company	Gary Smith	
Coconino County School District	Kathy Perko	Superintendent
Doney Park Water Company	Bill Linville	General Manager
Maine School District	Roger Studley	Superintendent
Qwest Communications (US West)	Carol Wilson	Field Engineer
Williams School District	Albert Sandoval	Superintendent

APPENDIX B
GROWTH ON THE COCONINO PLATEAU: A DEMOGRAPHIC ANALYSIS

January 2001

Prepared in conjunction with
Morrison Institute for Public Policy, School of Public Affairs, College of Public Programs, Arizona State University

John Kent Hill
Timothy D. Hogan
Tom R. Rex
Center for Business Research, L. William Seidman Research Institute, College of Business, Arizona State University
P.O. Box 874011, Tempe, Arizona 85287-4011
Phone: 480.965.3961, Fax: 480.965.5458, E-mail: tom.rex@asu.edu

TABLE OF CONTENTS

I. BACKGROUND 51
Entire Study Area 51
Western Subregion 53
Eastern Subregion 53
The Flagstaff Area Subregion. 53

II. BASELINE PROJECTION 54
Arizona Department of Economic Security Population Projections Model. 54
Projections for Coconino County. 56

III. ALTERNATIVE SCENARIOS 57
Factors Potentially Affecting Future Growth 57
High Growth Scenario 58
Low Growth Scenario 62

IV. POPULATION PROJECTIONS BY SCENARIO 63
Low Growth Without Pipeline. 63
Tourism High Growth Without Pipeline. 63
Manufacturing High Growth Without Pipeline. 64
Baseline With Pipeline 64
Low Growth With Pipeline 64
Tourism High Growth With Pipeline 64
Manufacturing High Growth With Pipeline 64

TABLES

1. Population Change in Coconino County 51
2. Net Migration to Coconino County, 1985-90 . . . 51
3. Age Distribution, 1990 52
4. Recreational Visits to Major Tourist Attractions . 53
5. Baseline Population Projections 54
6. Baseline Population Projections: Change in Population by Decade 55
7. Locational Attributes of High-Altitude Western Cities. 61
8. Economic and Demographic Characteristics of High-Altitude Western Cities. 61
9. Population Projections by Scenario 65

I. BACKGROUND

The purpose of this report is to examine possible effects on population growth in the Coconino Plateau Regional Water Study Area resulting from augmenting the region's water supply. A baseline population projection is reviewed and alternative population growth scenarios are presented.

Projections are necessarily tied to historical and existing conditions. This section reviews demographic and economic conditions in the overall study area and presents a brief overview of each subregion of the study area.

Entire Study Area

More than three-fourths of the population of Coconino County lives in the study area, according to projections for 2000. This proportion is expected to remain nearly stable over the next 50 years. Given this high and stable proportion and the lack of historical data that is specific to the study area, the county's economic and demographic history and demographic projections are used as a substitute for those of the study area in the following discussion.

Population Estimates and Projections

Coconino County's population was 18,800 in 1940. Historical and projected growth by decade since then is shown below.

Table 1: Population Change in Coconino County

Year	Numeric	Percentage
1940-50	5,100	27%
1950-60	17,900	75%
1960-70	6,500	15%
1970-80	26,700	55%
1980-90	21,600	29%
Projected		
1990-2000	26,700	28%
2000-10	24,100	20%
2010-20	21,900	15%
2020-30	20,600	12%
2030-40	21,700	11%
2040-50	24,100	11%

Source: U.S. Department of Commerce, Bureau of the Census, and Arizona Department of Economic Security.

Numeric population growth accelerated from the 1940s to the 1970s, though gains during the 1960s were much less than those in the 1950s – as they were throughout the West. Projected gains during the 1990s were the same as those during the 1970s, somewhat higher than those in the 1980s. This stabilization in numeric growth since about 1970 fits the pattern seen in most of Arizona.

Using population projections issued by the Arizona Department of Economic Security (DES), projected growth in Coconino County during the next five decades is expected to be between 20,600 and 24,100 per decade – a little lower than the 21,600 to 26,700 experienced between 1970 and 2000. The slightly lower projections reflect changes in the age distribution of the American population, discussed later in the "Baseline Projection" section. The DES population projections assume that population growth in Coconino County will continue for the next 50 years at the pace of the last 30 years, modified for changes in the age structure of the national population.

Despite only a small decrease in numeric population growth, Coconino County's percentage growth rate is projected to drop by nearly two-thirds in coming decades. However, since percentage population growth rates naturally decrease as the population base enlarges over time, the comparison of percent changes over long time spans is not very meaningful.

Migration

Net migration to Coconino County accounts for close to one-half of the total population growth. Based on the most recent census data from 1990, migration to Coconino County from elsewhere in the state was more important than intrastate migration was nationally. Migration from other states also was more important than the national average, as it was through much of Arizona.

Migration to and from Coconino County between 1985 and 1990 was highly age specific. Net in-migration was very heavy in the 18-to-24 age group. Some of this net in-migration was offset by net out-migration among those 25 to 34, especially among those in their upper 20s. Slight net out-migration occurred among those 70 or older. All other age groups experienced slight net in-migration, with the strongest among those in their 40s. The age pattern was somewhat different between those moving to or from other Arizona counties and those making interstate moves, as seen in Table 2. Among those making intrastate moves, nearly all of the net in-migrants to Coconino County were 18 to 24 years old.

Table 2: Net Migration to Coconino County, 1985-90

Age Group	Total	Intrastate	Interstate
5 to 14	200	-223	423
15 to 19	2,191	1,248	943
20 to 24	3,378	2,384	994
25 to 29	-1,329	-860	-469
30 to 34	-368	-203	-165
35 to 39	79	-91	170
40 to 49	698	15	683
50 to 59	166	-239	405
60 to 69	243	-125	368
70 to 79	-64	-109	45
80 or older	-75	-8	-67
TOTAL	5,119	1,789	3,330

Source: U.S. Department of Commerce, Bureau of the Census.

Demographics

The age distribution of Coconino County's population was considerably different from that of the nation or Arizona in 1990, as seen in Table 3. Coconino County in 1990 had a high proportion of residents less than 25 years old and a low proportion age 50 or older. Students at Northern Arizona University (NAU) and the young age of the American Indian population contributed to the county's age distribution being different from that of comparison areas.

Table 3: Age Distribution, 1990

Age Group Population as Percentage of Total Population

Age	Coconino County	Difference from Arizona	Difference from United States
Less than 5	8.9%	0.9	1.5
5 to 17	22.1%	3.4	3.9
18 to 19	5.5%	2.4	2.4
20 to 21	5.7%	2.6	2.6
22 to 24	5.9%	1.4	1.4
25 to 29	8.5%	-0.2	-0.1
30 to 39	16.8%	0.4	0.0
40 to 49	11.5%	-0.5	-1.2
50 to 59	6.7%	-1.6	-2.1
60 to 69	4.9%	-3.6	-3.4
70 to 79	2.5%	-3.6	-3.2
80 or older	1.0%	-1.6	-1.8

Source: U.S. Department of Commerce, Bureau of the Census.

The county's racial/ethnic makeup also differed from that of many areas in 1990, with the American Indian proportion being very high versus the comparison areas. Most of the variation resulted from the presence of the Navajo Nation in the eastern part of the county.

Educational attainment among adults 25 or older was relatively high in Coconino County in 1990. Nearly one-fourth had received at least a bachelors degree, compared to 20 percent statewide and nationally. This higher achievement resulted from the strong net in-migration of individuals attending NAU. However, this comparison is somewhat misleading in that educational attainment nationally and locally in 1990 was considerably lower among older residents than among younger adults. The county's low percentage of residents age 50 or older thus makes its overall educational attainment seem high in comparison to other areas.

The occupational profile from 1990 does not match that expected from a population with high educational attainment. Compared to the national and Arizona averages, a smaller proportion of Coconino County's working-age population had white-collar professional occupations while a considerably higher than average proportion worked in services occupations.

By industry, much higher than average proportions of the workers in Coconino County were employed in services and retail trade in 1990, reflecting the importance of tourism. Considerably fewer worked in manufacturing. Somewhat more than average were employed in public administration; transportation, communications and public utilities; and construction. Somewhat fewer than average worked in finance, insurance and real estate and in wholesale trade.

Determinants of Growth

Population growth in any area results from a combination of population and economic factors. Population-driven growth results from demand for goods and services made by seasonal residents, and retirees and college students who have migrated into the area. Economic-driven growth results from job creation in export-based sectors, particularly goods-producing industries such as manufacturing, mining and agriculture. Tourism is a mixture of population- and economic-driven growth.

Within the study area, population-driven growth has had varying degrees of importance. Tourism has been the primary factor driving growth through much of the study area. While tourists on average stay only a few nights, they are numerous in the study area and their average daily expenditures are quite high. College students have been a major factor in Flagstaff, a reflection of their nine-month-to-year-round residence. Retirement migration has had no impact on the growth of the study area.

Seasonal residences have been limited to the southern edge of the study area. The construction of second homes has a significant impact on the study area. After this, seasonal residents as a group have a smaller on-going impact than tourists and college students. Their primary contributions are in property tax and utility payments. Many seasonal homeowners have their primary residence in the Phoenix area, spending only some weekends and occasional longer periods at the second home. During these short visits, spending in the local economy may be limited.

Other than tourism, export-driven economic growth has been limited. Mining and agriculture play small roles in the county and have contributed little to growth. The timber industry no longer is significant, having declined over the last decade. The manufacturing industry other than timber is small and dominated by one company. It has contributed little to growth. The other sector significant to the economy is the federal government, but it too has not been contributing to growth.

Tourism is the leading economic activity in the study area. Tourism associated with the Grand Canyon dominates the sector, but the area also has many other attractions that draw tourists: Lake Powell (the Glen Canyon National Recreation Area), national monuments, mountains, forests, skiing, ancient Indian ruins and Indian reservations, and a cool summer climate.

For Coconino County as a whole, tourism employment accounted for one-third of total private sector employment in 1997. Including federal government employment, more than 14,000 people were employed in the tourism cluster in 1997.

The tourism sector has experienced continued growth during the 1990s – tourism cluster employment in Coconino County grew 33 percent through 1997, keeping pace with the county's overall growth of 32 percent during the same period.

This growth trend was able to continue even though tourism activity in the area was not growing rapidly, as measured by recreational visitor counts at the area's major tourist attractions. After substantial growth in the 1980s, recreational visitor counts at Grand Canyon National Park grew only 2 percent per year during the 1990-99 period, and tourist counts at the Glen Canyon National Recreation Area actually declined during the 1990s (see Table 4). A similar pattern of decline was also evident at national monuments in the area – for example, decreases occurred in the volume of recreational visits to Sunset Crater (11 percent), Walnut Canyon (9 percent), and Wupatki (2 percent) during the 1990-99 period.

Table 4: Recreational Visits to Major Tourist Attractions

Year	Grand Canyon National Park	Glen Canyon National Recreation Area
1980	2,304,973	1,571,491
1990	3,776,685	3,074,242
1999	4,575,124	2,639,860
1980-90 average annual growth rate	5.1%	6.9%
1990-99 average annual growth rate	2.2%	-1.7%

Source: U. S. National Park Service.

Western Subregion

The Western subregion of the study area extends from the western boundary of Coconino County east to east of Highway 64. The eastern boundary is ragged, corresponding to 1990 census geography. Few people live near the eastern boundary of this subregion. The land area of this subregion is 3,953 square miles.

The northeastern part of the subregion consists primarily of Grand Canyon National Park and the Kaibab National Forest lands. The southeastern portion also consists mostly of Kaibab National Forest lands. Ponderosa pine or pinyon-juniper woodlands cover most of the Park and Forest lands, with elevations ranging from more than 6,000 feet to more than 7,000 feet. The rest of the subregion is a mix of private and State Trust lands, much of it in the alternating square mile checkerboard fashion. Most of this area is covered with grasslands, with some pinyon-juniper woodlands. Elevations range from about 5,700 feet to more than 6,000 feet.

The total population of this subregion was projected to be only 7,350 in 2000. Grand Canyon Village (1,675 residents), Tusayan (675), Williams (2,925) and Parks (1,025) are included in this subregion. Valle and Howard Mesa are included in the rest of the subregion's 1,050 residents. (The Valle census tract's 205 square miles had only 123 residents in 1990 while the block group including Howard Mesa had a population of 331 in 495 square miles.) Thus, nearly all of the subregion's population lived near Highway 64 or along I-40.

Eastern Subregion

The Eastern subregion of the study area extends from the boundary of the Western subregion east to east of Highway 89, except for the Flagstaff Area. The boundaries are ragged, corresponding to 1990 census geography. At 3,557 square miles, the land area of this subregion is a little less than that of the Western subregion.

Most of this subregion consists of the western portion of the Navajo Indian Reservation. Page is located at the northern tip of the subregion while the sparsely settled southwestern edge of the subregion consists of a mix of private, state and national forest lands. Elevations range from less than 4,500 feet in Page and Cameron to more than 6,000 feet. The dominant vegetation type is high desert, with grasslands and pinyon-juniper at higher elevations.

The total population of this subregion was projected to be 14,550 in 2000, about twice that of the Western subregion. The only places in this subregion for which DES projects population are Page, with a projected population of 9,050 in 2000, and Cameron (675). More than 90 percent of the balance of the population (4,825 in 2000) lives on the reservation.

The Flagstaff Area Subregion

The Flagstaff Area subregion's 268 square miles are less than 10 percent the size of each of the two other subregions, but the subregion's 74,225 residents in 2000 are more than triple the number in the rest of the study area. The subregion is four times the size that Flagstaff city was in 1990, extending outward in all directions from the city limits. (While the subregion's land area is barely more than one-half the 525 square miles included in the Flagstaff Area Regional Land Use and Transportation Plan, its projected population of 101,250 in 2020 is only slightly less than the 104,000 projected for the larger area.)

Other than the high peaks north of Flagstaff, most of the subregion is near 7,000 feet in elevation. Most of the subregion is forested, though dotted with meadows. The elevation drops off at the eastern edge, with the forest giving way to grasslands. The Coconino National Forest is the primary landowner, but private lands are scattered through the subregion. Some state land extends from east to southwest of Flagstaff.

The bulk of the subregion's population lives within the Flagstaff city limits (a projected 60,700 in 2000). Other identified areas include Timberline/Fernwood (2,175) and Black Bill/Doney Park (5,800) to the northeast of Flagstaff and Fort Valley (650) to the northwest. Kachina Village (2,225) and Mountainaire (925) lie south of Flagstaff. The balance of the subregion has a projected population of 1,750 in 2000.

II. BASELINE PROJECTION

The population projections issued in 1997 by the Arizona Department of Economic Security form the baseline set of population projections for the study area. DES projected the population from 1997 through 2050 by county, incorporated place, and selected other places (see Table 5). The next subsection describes the process used by DES to generate the population projections.

Arizona Department of Economic Security

Population Projections Model

DES annually updates population estimates for the state, counties and incorporated places. Every five years, DES updates its population projections for the state, counties, incorporated places and unincorporated areas. More frequent updates of projections are banned by executive order. (An "estimate" is for a prior time period; a "projection" is for a future point in time.)

The estimates and projections are of the "permanent" population identified in the decennial censuses conducted by the U.S. Bureau of the Census. Seasonal residents that reply to the census at a different address are not included in the estimates and projections. For example, Flagstaff-area summer visitors and residents are not included in the population counts.

Projections are produced for a 50-to-54 year period (e.g. the most recent projections issued in 1997 were for 1997 through 2050). Annual projections are produced for the state and counties. Place populations are projected annually for the first 10-to-14 years and every five years thereafter.

Estimates provide the starting point for the projections. Since the estimates are tied to the latest census results, their accuracy declines with time elapsed since the last census. Errors in the estimates introduce errors in the projections.

The estimates are generated in a "top-down" approach in which the state is estimated first. Counties are estimated next, with the sum of the county estimates controlled to the state total. Likewise, subcounty estimates are controlled to the county total. For projections, counties are calculated first, with the state projections equaling the sum of the counties. Projections of incorporated places and unincorporated areas are made by a different methodology and are controlled to the county figures.

County Projections

The DES projection model is classified as a "demographic cohort-survival model." Each component of population change – births, deaths, in-migration and out-migration – is calculated separately. Since birth rates, death rates and migration rates vary substantially by age and also by gender, calculations in the model are made by single year of age and by gender, with the population "aged" across the forecast horizon.

Birth and death rates are based on the latest census results for Arizona, but are adjusted as necessary to match births and deaths recorded since the last census. In-migration rates are

Table 5: Baseline Population Projections

	1997	2000	2005	2010	2020	2030	2040	2050
Coconino County	**115,900**	**123,300**	**135,600**	**147,400**	**169,300**	**189,900**	**211,600**	**235,700**
Study Area	**90,125**	**96,125**	**105,700**	**114,775**	**131,750**	**147,900**	**165,200**	**184,650**
Western Subregion	**6,875**	**7,350**	**8,025**	**8,600**	**9,550**	**10,600**	**11,825**	**13,375**
Grand Canyon Village	1,625	1,675	1,800	1,900	2,050	2,225	2,400	2,650
Tusayan	625	675	750	825	900	1,000	1,150	1,375
Williams	2,750	2,925	3,125	3,300	3,600	3,925	4,325	4,825
Parks	875	1,025	1,200	1,325	1,600	1,900	2,250	2,700
Balance	1,000	1,050	1,150	1,250	1,400	1,550	1,700	1,825
Eastern Subregion	**13,625**	**14,550**	**16,200**	**17,900**	**20,950**	**23,725**	**26,525**	**29,475**
Page	8,400	9,050	10,100	11,125	13,050	14,850	16,725	18,775
Cameron	575	675	850	1,025	1,350	1,650	1,950	2,250
Balance	4,650	4,825	5,250	5,750	6,550	7,225	7,850	8,450
Flagstaff Area Subregion	**69,625**	**74,225**	**81,475**	**88,275**	**101,250**	**113,575**	**126,850**	**141,800**
Timberline/Fernwood	1,950	2,175	2,475	2,750	3,350	3,950	4,600	5,350
Black Bill/Doney Park	5,325	5,800	6,400	7,000	8,375	9,650	11,000	12,475
Flagstaff	57,100	60,700	66,575	71,975	81,975	91,525	101,900	113,700
Fort Valley/US180	625	650	700	750	850	950	1,075	1,175
Kachina Village	2,075	2,225	2,450	2,675	3,125	3,525	3,950	4,400
Mountainaire	875	925	975	1,050	1,200	1,350	1,475	1,650
Balance	1,675	1,750	1,900	2,075	2,375	2,625	2,850	3,050

Source: Arizona Department of Economic Security and authors.

based on national data from the latest census while out-migration rates are Arizona-specific. These rates are adjusted to fit the migration implied by the DES estimates since the last census.

These rates are held steady across the 50-year projection horizon. However, the number of births, deaths and migrants can vary substantially over the 50 years based on the changing size and age distribution of the population. For example, net migration to Coconino County is projected to drop from its current level of more than 1,100 per year to less than 700 per year, then rise back to more than 1,100 per year.

The modeling process is not entirely mechanical. Adjustments to rates can be made based on information supplied by local sources. However, this information must be of a substantive nature; adjustments are not made based on opinions or speculation.

The forecasts generally do not assess fluctuations in population growth resulting from the short-term economic cycle. However, in the two populous counties in which the local economy follows the national economic cycle, projections for the first three years of the projection period are adjusted.

Subcounty Projections

Each council of governments can choose to produce the subcounty projections for their region, following certain standards and with the total of all subcounty areas tied to the DES county projection. Since the Northern Arizona Council of Governments does not exercise this option, DES produces the subcounty projections for the region.

The methodology that DES uses for the subcounty projections is simple, based on the subcounty area's share of the county's total population in the latest census adjusted by the growth in incorporated places and the county estimated to have occurred since the latest census. In addition to incorporated places (four in Coconino County as well as part of Sedona), projections are provided for other subcounty areas identified in the census (eight such areas in Coconino County) and "named populated places" identified by the Arizona State Land Department (eight in Coconino). These identified areas do not include all of the unincorporated county.

As with the county projections, this mechanical approach can be modified based on local information. For instance, once a developer announced plans for a major residential area (or for a major center of employment that would require importing workers from outside the area), had those plans approved, and obtained financing, such information could be incorporated into the projections. Note, however, that the projections implicitly assume further growth of residential and commercial areas at a pace based on that of the past. To adjust the projections, a new development would have to be so significant as to raise growth rates beyond those already assumed in the model.

Other Considerations

DES produces only one series of projections; alternative scenarios are not considered. The modeling process is fairly sophisticated at the county level, but is almost entirely based on historical patterns of growth. Except for considering limited input on new developments, the modeling process makes no effort to identify conditions that might cause a break from historical growth patterns.

Table 6: Baseline Population Projections: Change in Population by Decade

	2000-10	2010-20	2020-30	2030-40	2040-50
Coconino County	**24,100**	**21,900**	**20,600**	**21,700**	**24,100**
Study Area	**18,650**	**16,975**	**16,150**	**17,300**	**19,450**
Western Subregion	**1,250**	**950**	**1,050**	**1,225**	**1,550**
Grand Canyon Village	225	150	175	175	250
Tusayan	150	75	100	150	225
Williams	375	300	325	400	500
Parks	300	275	300	350	450
Balance	200	150	150	150	125
Eastern Subregion	**3,350**	**3,050**	**2,775**	**2,800**	**2,950**
Page	2,075	1,925	1,800	1,875	2,050
Cameron	350	325	300	300	300
Balance	925	800	675	625	600
Flagstaff Area Subregion	**14,050**	**12,975**	**12,325**	**13,275**	**14,950**
Timberline/Fernwood	575	600	600	650	750
Black Bill/Doney Park	1,200	1,375	1,275	1,350	1,475
Flagstaff	11,275	10,000	9,550	10,375	11,800
Fort Valley/US180	100	100	100	125	100
Kachina Village	450	450	400	425	450
Mountainaire	125	150	150	125	175
Balance	325	300	250	225	200

Source: Arizona Department of Economic Security and authors.

No assessment is made, for example, of the chances of an area developing into a retirement haven or a new center of employment. Resource availability is not explicitly considered. Thus, the chance of an area running short on water and therefore limiting development is not assessed, nor is the possibility of a new water source that might allow the growth rate to accelerate.

Projections for Coconino County

In order to project population for the study area as a whole and for each of its three subregions, the DES projections for all places in Coconino County were subtracted from the population projected for the county. This "balance of county" was then split among the three subregions and the portion of the county outside the study area, using the 1990 population distribution as a guide. Throughout the study area, the baseline projection assumes population growth over the next 50 years (see Table 6) similar to that of the recent past, modified for changes in the national age distribution. Along with birth and death rates, migration rates vary substantially by age. Thus, the age distribution of the population has a strong impact on the rate of population growth in any area, particularly areas like Coconino County that receive net in-migration.

Nationally, people are by far most likely to make a long-distance move when they are young, particularly from around age 20 to 25. Migration rates drop substantially with increasing age. Because of NAU, Coconino County's net migration shows a peculiar pattern of extremely strong inflows from age 18 into the low 20s and net outflows from age 25 through 34.

The large size of the "baby-boom" generation born between 1946 and 1964 will continue to have significant effects on migration flows for another two decades. Its effect is even greater when compared to the small size of the "baby-bust" generation born from 1965 to around 1980.

Thus, the changing age distribution nationally translates to slightly lower growth prospects in Coconino County over the next few decades. The population of the study area still is expected to nearly double over the next 50 years in the baseline scenario. For the overall study area, this slower growth is reasonable. Less reasonable is that growth in all places of the study area will more or less follow the same pattern. In any forecasting model, a sizable error in the projections is more likely in smaller areas.

While not explicitly recognized, continued growth is assumed in the baseline projection in the various factors – such as second home development and NAU enrollment – that have driven growth in the recent past. In particular, the DES population projections already implicitly include a continuation of growth trends in the tourism sector similar to what occurred in the past decade. Given the importance of the tourism sector to the study area, it should be assumed that a substantial proportion of the growth in employment implied by the DES population projections would occur within the tourism cluster. Thus it appears the DES population projections are consistent with a moderate pace of growth in tourism activity in the study area.

Because they are available only for the county and incorporated places, the population estimates for 2000 that were released by DES in December 2000 have not been used to update the projections released in 1997. The county's 2000 population estimate was 1,250 (1 percent) higher than the projection. The 2000 census count that will supersede these figures will be available in March 2001.

The 2000 census count for Coconino County probably will be higher than expected – the state and national counts released in December 2000 were higher than projected. It is not yet known whether population growth between 1990 and 2000 was faster than anticipated or whether the Bureau of the Census did a more thorough count of the population in 2000 than in 1990. Thus, it is premature to conclude that the next set of population projections issued by DES (probably in 2002 or 2003) will be significantly higher for Coconino County than the current set.

III. ALTERNATIVE SCENARIOS

The baseline scenario generally assumes a continuation of conditions present in recent years. Thus, substantial growth is forecast in the study area. A variety of factors could lead to faster or slower growth. These factors first are discussed generally. Then, assessments of the factors are made by subregion within the study area under both low and high growth scenarios. In some cases, the provision of additional water could have a significant effect on potential growth.

Factors Potentially Affecting Future Growth

Tourism

Several factors depressed the growth of tourism activity in the study area during the recent past. The most important of these factors included a strong dollar that made it more expensive for foreign tourists to travel to the United States and cheaper for American tourists to travel abroad, and poor economic conditions in many foreign countries, particularly Asia and Latin America. To the extent that foreign economies recover (which generally has been occurring) and the value of the dollar declines, tourism activity could be expected to rebound – experiencing more robust growth than the recent past.

Stronger growth would stimulate the tourism sector in the study area and would produce more job growth in the sector than implied in the DES baseline population projections. Growth in direct employment in the tourism cluster would stimulate additional growth in the other sectors that support tourism. These new jobs would result in incremental growth in population as new workers and their families move to study area.

While the potential for stronger growth in tourism is a reasonable scenario for some period of years into the future, faster growth would itself produce conditions that would tend to restrain the continuation of such growth over time. In particular, increasing congestion and other capacity constraints at the Grand Canyon National Park can be expected to eventually reduce the rate of growth. But more generally, most tourists come to the area to experience the natural environment. Substantial increases in the number of visitors will tend to reduce the quality of these kinds of experiences, thereby limiting the growth rate.

The construction of the pipeline would have some impact on growth even without making any assumptions regarding the possibilities of low or high growth. Under the baseline scenario, the positive impact of the pipeline is assumed to occur entirely in the Western subregion, where growth already appears to have been affected by a shortage of water. The effect of the pipeline is more widespread across the study area and greater in magnitude under the high scenario.

If the proposed pipeline were constructed, it would have some effect on the future pattern of development in the tourism sector. Primary impacts would occur along the Highway 64 corridor – primarily in Tusayan and Valle – since this subregion has limited and expensive water supplies. The availability of additional water could be expected to spur development of additional lodging and other tourism-related facilities in both communities.

Even within the baseline scenario, availability of water could be expected to stimulate some additional development in Tusayan and/or Valle. Such development could be expected to have negative impacts on the lodging business in particular and more generally on other tourism-related businesses in the Flagstaff and Williams areas.

Northern Arizona University

The baseline scenario includes continued expansion of the student population at NAU, resulting from in-migration of students from elsewhere in the state and from out of state. Hypothetically, this influx could be different than that assumed in the baseline if the Board of Regents and the university were to make a decision to either slow or accelerate growth on this campus. It is unlikely that additional water delivered through the proposed pipeline would have an effect on such a hypothetical decision.

Second Home Development

Even with enhanced availability of water, most of the study area has limited potential for second home development. While views from the grasslands or lands covered by stunted pinyon and juniper may be an attraction, most buyers of second homes have shown a clear preference for forested areas. This preference likely is related to so many of the buyers of second homes being residents of the Arizona desert – accustomed to views but not to trees or shade from the sun. Most desert dwellers want to fully escape from the summer heat – a non-shaded location with 90 degree afternoon temperatures does not meet their needs. Further, the non-forested areas of the region have to compete with other places in Arizona offering similar conditions, some a shorter commute from the Phoenix and Tucson areas.

Continued growth in the number of second homes is inherent in the DES population projections. Faster growth in the number of second homes, and therefore in the permanent population, could result especially under the scenario of improved access to water. Since the potential for accelerated second home development is limited, and because owners of second homes are not counted as residents of the study area, the likely impact of greater second home development on projections of the year-round population in the study area is relatively small. In addition to affecting tourism under the baseline scenario, the pipeline probably would result in acceleration in second home development in the Williams-Parks area of the Western subregion. Since development in Williams already is limited by water, somewhat more economic growth likely would happen simply due to the availability of the pipeline water.

Retirement Communities

Most retirement-age people who move more than a short distance do so either to be closer to family or to live in a warmer climate. Some also are motivated by lower living costs. While many retirement-age migrants do not want to live within a large populous area, most wish to be close to such an area because of the amenities offered in cities, especially health care and recreation/entertainment. Southern Arizona, especially the Phoenix and Tucson urban areas, has attracted many retirement-age migrants for each of these reasons. Western Arizona has been a lesser attraction to retirees because of its distance from large urban areas. It has been sought out primarily by people retiring before the traditional age of 65.

The study area had few residents of either early retirement age or, especially, traditional retirement age in 1990. The 65-or-older proportion of the population was well below the national average of 12.6 percent in each of the subregions: 8.0 percent in the West, 5.7 percent in the East, and 4.1 percent in the Flagstaff Area.

Modest net in-migration to the study area occurred among people 50-to-69 years old, but the study area experienced a small net outflow of people age 70 or older. Retirement migration to the study area has been restrained by significant negative factors – contrary to the desires of most older migrants, it has cold winters, it is remote from both families and urban areas, and much of the area has high living costs. In addition, its high altitude is seen as a negative. These negatives seem even larger to interstate migrants who view nearby western and southern Arizona favorably.

Potentially, retirement migration to the study area could come from those residing in the Phoenix or Tucson metropolitan areas as well as from those making an interstate move. However, in the older age groups intrastate net migration has been weaker than migration with other states.

The remoteness of most of the study area works against its attracting retirement-age migrants. Across the country, only a few examples exist of isolated areas attracting retirees. In these cases, a relatively small number of early retirees (younger than age 65) are attracted either to an area of great beauty and recreational opportunities or to an area with a warm climate and low living costs. None of these successful areas are located as far above sea level as the study area.

Living costs are important to retirees, though the perspective differs depending on how high the costs are in the area from which the retirees are migrating. The high costs in much of the study area, especially Flagstaff, are a distinct disadvantage, especially to residents of Arizona's large urban areas, which have lower living costs.

Except for Page and portions of the Navajo Reservation, elevations throughout the study area exceed 5,700 feet. Such high elevations contribute to breathing difficulties in many older people. In addition, winters at such high elevations are colder than most migrating retirees will accept. Even Page's climate does not work in its favor, as its more moderate elevation combines with its more northern latitude.

Thus, retirement communities are not likely to become a factor contributing to growth anywhere in the study area in the next 50 years.

Export Industries

A possibility exists that new export-based firms and jobs will locate in the study area at a rate higher than what is implicit in the DES forecasts. The most promising candidates are new manufacturing firms, especially those that use relatively little water, pay high wages, and would appeal to local economic development officials. Export-based service firms, such as financial service firms and call center operations, are considered less likely to locate in the project area due to the high cost of living and the dominance of the Phoenix metro area as a competing site.

The place most likely to attract new manufacturing is the Flagstaff area. However, the high cost of living in Flagstaff lowers the probability of its attaining strong growth in manufacturing.

To assess the Flagstaff area's growth potential, information was collected on the economies of western cities similar to Flagstaff. The information was used to determine whether there has been a significant relocation of manufacturing to these cities and whether growth trends may have been under-represented in the DES projections for Flagstaff. This analysis is included in the Fast Growth Scenario subsection below.

Other Factors

In addition to the growth drivers discussed above, other factors could affect the rate of growth of the study area. Since these factors are much more likely to slow rather than increase the growth rate, they are discussed under the slow growth scenario.

High Growth Scenario

Western Subregion

Since so much of the Western subregion already is struggling with water issues, prospects of faster growth are limited without bolstering the supply of water.

Tourism

Tourism dominates the economy of the Western subregion. A resurgence of growth in visitors to the Grand Canyon would be expected to spur expansion of tourist facilities – primarily in the Tusayan area – leading to additional jobs in the tourism sector and indirectly to employment increases in other sectors that support tourism. However, a substantial portion of the

support jobs probably would be located in the Flagstaff Area. Greater availability of water that would result from construction of the pipeline could be expected to cause even more tourism-related development along the Highway 64 corridor.

Second Homes
In the southeastern portion of this subregion, excluding the Williams area, 60 percent of the 1,200 housing units counted in the 1990 census were held for seasonal or recreational purposes. These second homes largely are located in wooded areas with relatively easy access, not far from I-40. Few seasonal units existed elsewhere in the subregion.

The potential for accelerated second home development is greatest in the Parks area east of Williams, the development of which currently is limited by a lack of water. This area has considerable quantities of private land and is desirable because of its forests and meadows and cool summer temperatures. However, the proposed pipeline does not extend to this area, limiting the potential for more rapid development.

While a slightly longer drive from southern Arizona than the Parks area, the Tusayan area likely would have potential for a second home development if more water were available. Barring land trades with the Forest Service, however, developable land does not exist in this area. If land were to become available, a higher portion of it likely would be used to house permanent residents than in the southeastern part of the subregion.

Export Industries
Given the rural and isolated nature of most of the subregion, little chance of other forms of economic development exists. Williams has the greatest potential given its status as the largest town and its location on the interstate. Such development likely would be dependent on an improved water supply.

Residential Growth Resulting from Economic Development in Flagstaff
If the Flagstaff Area subregion were to achieve faster growth under the high scenario, some of the residential expansion likely would overflow into the Western subregion because of its lower housing costs. The number of workers residing in the Western subregion would be higher if the pipeline were built.

Eastern Subregion

Tourism
Increases in tourism activity in the Eastern subregion would be centered in the Lake Powell-Colorado River area, and the economic and demographic impacts would be concentrated in the Page area. More tourists would mean more jobs and additional population growth as workers and other household members moved to the Page area to take advantage of the employment opportunities. Given the small size and limited diversity of the Page economy, a substantial portion of the jobs in other sectors that would be created to support increased tourism activity in the Page area would be located in the Flagstaff Area subregion.

Even without stronger growth overall, the development of a new marina and more success in promoting tourism in the area could reverse the decline in numbers of visitors to Lake Powell – leading to more jobs and more people in the Page area.

In addition, the Navajo Nation has the potential to establish casinos and other tourist-related facilities on tribal lands south of Page and/or near the eastern entrance to the Grand Canyon at Cameron. While the tribe has chosen not to become involved in gaming to date, this economic development strategy has been successful for many other tribes across the nation. It is quite possible that the Navajos may have a change of heart at some point in the future and move to take advantage of the tourism traffic passing through or staying near their reservation. Establishment of a casino south of Page would provide tourists traveling to the Lake Powell area additional entertainment/recreational opportunities. Similarly, the tribe has the potential of expanding its tourism-related activities in the Cameron area with a casino and related facilities in connection with the promotion of the eastern portal to the Grand Canyon. Development of casino operations at either or both sites would add hundreds of tourism jobs in the Eastern subregion. Availability of water from the pipeline might stimulate larger-scale development in Cameron.

Population projections provided to the Navajo Nation by Northwest Economic Associates of Vancouver, Washington, indicate growth in the western portion of the Reservation to be [much greater than that in the past and] much more than projected by DES. These projections hold the percentage growth rate constant, which equates to accelerating numeric gains over the next 50 years. Such a situation is quite rare.

Between 2000 and 2050, the tribe's projections indicate a population gain of 14,400 from the 6,000 residents they show for 2000 (the DES projections indicate a 2000 population of 5,500). In contrast, DES shows a 50-year gain of only 5,200. For comparison, DES projects an increase in Page's population of 9,700 between 2000 and 2050. Even if efforts to develop tourism and other economic endeavors in the western part of the Reservation are successful, the population projected in the later years of the tribe's 50-year forecast could be difficult to attain.

Export Industries
The isolated nature of this subregion works against it in other forms of economic development. However, the Navajo Nation's interest in developing this portion of the Reservation and the nearby example of the Tuba City area, home to more than 8,000 in 1990, enhances the possibility of success. Cameron or Lechee seem the most likely targets of such development.

Second Homes
Few second homes existed anywhere in the subregion in 1990. Development on the Indian Reservation, most of the subregion's land, is unlikely. Moreover, as discussed in the Western subregion, the lack of trees and cool summer temperatures greatly limits the potential in the Eastern subregion. Thus, even with greater availability of water, significant second home development is not expected anywhere in the subregion in the next 50 years.

Residential Growth Resulting from Economic Development in Flagstaff

If the Flagstaff Area subregion were to achieve faster growth under the high scenario, some of the residential expansion likely would overflow into the Eastern subregion because some of the workers likely would be Navajos who would choose to live on the Reservation. The number of workers residing in the Eastern subregion would be higher if the pipeline were built.

The Flagstaff Area Subregion

Tourism

Most of the direct impacts of future growth of tourism activity probably would be concentrated in the Grand Canyon and/or Glen Canyon areas, unless future growth breaks with past trends and focuses on other types of activities that are located in the Flagstaff vicinity, such as skiing. But the Flagstaff Area subregion would benefit from resurgence in tourism because much of the additional business activity in support of tourism would be centered in Flagstaff, the largest city in the study area.

Construction of the pipeline would have a deleterious effect on tourist-related employment in the Flagstaff Area subregion. The presumed construction of new tourist facilities at Tusayan and/or Valle likely would siphon tourists away from Flagstaff. However, greater growth in tourism under a high scenario would benefit the subregion from an increase in demand for tourism support functions. The net effect under the high scenario would be positive.

Northern Arizona University

Substantial population growth overall and in the college-age population is likely in Arizona over the next 50 years. Despite the historically rapid growth, the number of university campuses has hardly grown, leading to the number of students at the main campuses of Arizona State University and the University of Arizona to either reach or approach their capacity. Thus, potential exists for NAU to receive a greater share of the state's increase in the higher education enrollment.

Since the probability of more rapid enrollment growth is low, this possibility is not included in the high growth scenarios discussed in section IV. If increased enrollment did occur, the effect on the area's population would be large. The students themselves would be counted as residents. An increase in enrollment would lead to a gain in NAU employment. Local spending on goods and services by the students, new NAU employees and their dependents would have the typical multiplier effect, leading to an increase in residents that work in the industries impacted by the additional spending.

Export Industries

Characteristics that distinguish Flagstaff from other cities include elevation/climate, scenic beauty and proximity to natural tourist attractions, a local university, access to major interstate highways, and proximity to a major urban area. Shown in Table 7 are eight other western cities with similar characteristics: Reno, NV; Pocatello, ID; Bozeman, MT; Laramie, WY; Logan, UT; Grand Junction, CO; Fort Collins, CO; and Santa Fe, NM. Each is relatively small in size and located at high elevation; each is close to a national forest or a major scenic attraction; each is adjacent to or close to a major interstate; and six of the eight have a local university. While no two cities are exactly alike, the cities are sufficiently similar to be considered competing alternatives by firms looking to site in a smaller western city with a life style that would appeal to young people oriented to the outdoors and with the economic advantages offered by a local university and interstate access.

Table 8 shows how fast the counties in which these cities lie grew over the period from 1988 to 1998. With the exception of Albany County (Laramie), the counties experienced broadly similar rates of population growth. Six of the nine counties registered an increase in population of between 21 and 23 percent over the ten-year period. Growth in Coconino County was slightly slower at 18 percent.

Table 8 also shows how important manufacturing is to the local economies of these western cities. A manufacturing location quotient is calculated by taking the percentage of total earnings in a county that are associated with manufacturing jobs and expressing that as a ratio of the nationwide share of earnings originating in manufacturing. A location quotient greater than one indicates that manufacturing activity is more important to the county than it is to the nation, and that a significant amount of manufacturing output is likely to be exported to customers outside of the local area. Income generated in export activities can be used to purchase goods and services imported from outside the county.

With the exception of Cache County (Logan) and Larimer County (Fort Collins), each of the manufacturing location quotients is well below one, indicating that the county is overall a net importer of manufactures. For these counties, imports must be paid for with capital income or labor income generated in other export-based activities such as tourism or government operations (e.g., university salaries paid for by non-local students or taxpayers).

Looking within the manufacturing sector, individual industries in each of the counties have location quotients greater than one. Predictably, some are natural-resource intensive, such as lumber and wood products or stone, clay and glass. But there is also a significant representation of the kind of high-technology that economic development officials welcome, industries such as industrial machinery and non-electrical equipment, electronics, and instruments. These industries pay more per job than the average in manufacturing and use only 50,000 to 70,000 gallons of water per year as compared to an average across all manufacturing industries of over 500,000 gallons per year.

Table 7: Locational Attributes of High-altitude Western Cities

City	County	Elevation	University	Proximity to Large Urban Area	Proximity to Tourism[1]	Proximity to Interstate
Flagstaff, AZ	Coconino	6,910	Northern Arizona	140 miles	Grand Canyon NP, NM, NF, Ski	17/40
Reno, NV	Washoe	4,498	U Nevada-Reno	225	Lake Tahoe, NF, Ski	80
Pocatello, ID	Bannock	4,474	Idaho State	160	NF, Ski	15
Bozeman, MT	Gallatin	4,795	Montana State	425	Yellowstone NP, NF, Ski	90
Laramie, WY	Albany	7,165	U Wyoming	150	NF, Ski	80
Logan, UT	Cache	4,535	Utah State	75	NF, Ski	near 15
Grand Junction, CO	Mesa	4,597	none	250	NM	70
Fort Collins, CO	Larimer	5,003	Colorado State	60	Rocky Mountain NP, NF	25
Santa Fe, NM	Santa Fe	6,950	none	60	NM, NF, Ski, Other	25

[1] NP=National Park, NF=National Forest, NM=National Monument, Ski=downhill skiing facility.

Source: Rand McNally Road Atlas.

Table 8: Economic and Demographic Characteristics of High-altitude Western Cities[1]

City	1998 County Population	1988-98 Population Growth		Manufacturing Location Quotient (LQ)[2]			Manufacturing Industries with LQ Greater than 1 in 1998[3]	1998 Cost of Living Index
		Numeric	Percent	1998	1988-98 Change	1978-88 Change		
Flagstaff, AZ	114,087	20,732	18.2%	0.44	0.02	0.10	1,6	109
Reno, NV	313,008	70,884	22.6%	0.49	0.16	0.02	7,9	114
Pocatello, ID	74,272	8,684	11.7%	0.66	0.09	-0.04	3	96
Bozeman, MT	62,561	13,744	22.0%	0.54	0.20	-0.01	1,2,3,7	100
Laramie, WY	29,251	-1,302	-4.5%	0.52	0.21	0.11	1	101
Logan, UT	87,227	18,815	21.6%	1.60	0.32	0.32	1,3,5,6,8,9,10	101
Grand Junction, CO	112,899	24,027	21.3%	0.50	0.09	0.11	3,6,10	102
Fort Collins, CO	231,104	50,494	21.8%	1.51	0.25	0.28	4,5,6,7,9	105
Santa Fe, NM	122,826	28,319	23.1%	0.23	0.03	0.04	7,9	113

[1] Data are for county in which place resides.

[2] Calculated from U.S. Bureau of Economic Analysis information on earnings by industry. See text for description.

[3] Manufacturing codes: 1=lumber and wood products, 2=furniture and fixtures, 3=stone, clay and glass, 4=industrial machinery and non-electrical equipment, 5=electric and electronic equipment, 6=instruments and related products, 7=miscellaneous durable goods manufacturing, 8=food and kindred products, 9=printing and publishing, 10=rubber and plastic products.

Source: U.S. Department of Commerce, Bureau of the Census and Bureau of Economic Analysis; American Chamber of Commerce Researchers Association.

Although the general manufacturing location quotients are well below one in most cases, a clear upward trend in these numbers has been present over the past two decades. Within the most recent ten-year period alone, manufacturing location quotients increased by at least 0.2 in four of the nine counties and by at least 0.09 in all but two of the counties. These trends provide evidence of a nationwide redistribution of manufacturing activity that favors high-altitude western cities, among others. Flagstaff itself appears to have enjoyed little of this manufacturing growth, as its location quotient has scarcely changed over the past ten years. But the numbers for Flagstaff are deceptive in that they are dominated by a decline in the earnings of one major industry – lumber and wood products. The lumber and wood products industry has suffered recently because of logging restrictions imposed in northern Arizona during the late 1980s and early 1990s. Excluding the lumber and wood products industry from both national and local totals, the Coconino County location quotient rose 0.12 over the period from 1988 to 1998 and 0.11 from 1978 to 1988.

The DES projections may have underrepresented the potential for manufacturing growth in northern Arizona for two reasons. First, the projections are based on migration patterns from 1985 to 1996 and so are highly sensitive to economic conditions during this period. As noted above, one special event of this period was a sharp contraction in the lumber and wood products industry related to government logging restrictions. Assuming this was a one-time event, manufacturing growth in the future should be higher than what was experi-

enced during the last decade. Second, as new manufacturing investment is directed to the West, it is quite possible that the most popular destinations, such as Fort Collins and Logan, will begin to suffer a deterioration in competitiveness due to rising land prices, congestion, and a general degradation in quality of life. Flagstaff, although somewhat remote and far from a major urban area, could become more competitive and claim a rising share of incremental investment in the West.

A high growth scenario could then be based on manufacturing growth that, for reasons given above, occurs at a more rapid rate than it has over the past few decades. To formalize and quantify this type of scenario, suppose that growth in manufacturing occurs at a rate high enough to drive the Flagstaff location quotient from its present value of about 0.45 to 0.75 by the year 2020 and to 0.90 by 2050. This kind of growth is in line with what many high-altitude western cities have experienced over the past decade, and it leaves the Flagstaff location quotient well below the current location quotients of Fort Collins and Logan. The location quotients are measured using data on earnings by industry. The following parameters were used to calculate the amount of growth in direct manufacturing earnings required to drive the scenario and to determine the direct and indirect impact of this growth on population: (a) earnings multiplier for manufacturing (e.g., high-tech manufacturing) equals 1.6; (b) each $1 million (in 1998 dollars) of direct manufacturing earnings gives rise to 42 jobs, including multiplier effects; and (c) each new job created is associated with 1.8 people.

However, Flagstaff's cost of living is higher than that of each of the comparison areas except Reno and Santa Fe. Relative to the national average, Flagstaff's cost of living in the last decade has increased, similar to the gain in the comparable areas. This high cost of living lowers the probability of the area achieving faster manufacturing growth.

Water studies cited in the Flagstaff Area Regional Land Use and Transportation Plan indicate that groundwater resources are more than sufficient to accommodate DES-projected growth through 2020. Pipeline water would have value only in insuring against droughts that could affect availability in peak summer months. Given that the kind of manufacturing growth envisioned in this scenario does not involve water-intensive industries, it would seem that the growth could be accommodated even without a pipeline. Additional water demands would be met by drilling new wells. A pipeline that significantly improves water availability outside of Flagstaff, especially in the lower-cost Western subregion, could affect commuting patterns, the location of families, and, to an extent, the location of manufacturing itself. Williams could attract some manufacturing in the same way that Kingman has. More importantly, much of the household growth could be located in the Parks area if water availability there improves significantly.

Second Homes

In 1990, only 8 percent of the housing units in the Flagstaff Area subregion were held for seasonal or recreational use. The majority of these units were in the southeastern portion of the city, in the vicinity of the country club. Approximately one-third of the housing units to the west and south of the city were used seasonally, but the number of units in these areas was relatively small.

As in the southeastern portion of the Western subregion of the study area, continued development of second homes west and south of Flagstaff is inherent in the baseline scenario. Proximity to Flagstaff, easy access from the Phoenix area, and general availability of water makes this a popular area. However, land costs in and around Flagstaff are higher than those in most of the rest of the study area. Given this set of conditions, second home development in the Flagstaff Area subregion probably would not increase significantly if the pipeline were built.

Low Growth Scenario

Since nearly all of the study area is heavily influenced by tourism, any condition that would result in less tourism worldwide likely would cause the study area not to reach the population projected in the baseline scenario. The most likely cause of a long-term slowdown in tourism would be a significant increase in energy costs. Some energy forecasts have predicted such an increase within the next 50 years. If such an increase occurs, tourists from distant locales would be more likely to bypass far-flung sites. This would be likely to affect the study area more than the average tourist destination because of its distance from large population centers. Tourism from within the state also could be adversely affected. Similarly, second-home ownership might become less popular given the increase in cost to commute to the second dwelling.

Another factor that could adversely affect the study area would be a slowing of growth in the state's major metropolitan areas from the continued rapid gains forecast by DES. Residents of Arizona's urban areas account for high shares of second home owners and NAU students and a significant share of the area's tourists.

While the numeric population growth forecast in the baseline scenario is slightly less than the peaks of the 1970s and 1990s, effectively the baseline continues the rapid growth period for a total of 80 years. Growth in any region, however, follows a life cycle in which numeric growth is slow at first, and then rises to a peak. Gains may stay at the peak for some length of time, but then growth inevitably slows. The life cycle of the study area could be such that the peak period will not extend for eight decades.

Western Subregion

The Western subregion would be especially susceptible to reductions in tourism and second home ownership caused by an increase in energy costs. It also could be affected by a reduction in tourism from another cause: a restriction to visitation at Grand Canyon National Park. Such a limitation could result if studies indicate that existing levels of visitation are causing environmental damage.

Adequate supplies of water already are an issue in the Western subregion. Much of the water comes from wells. If pumping of underground water were curtailed, again due to environmental damage in the Park, the growth of the subregion could fall short of that of the baseline scenario.

Eastern Subregion

Reductions in tourism caused by an increase in energy costs also would affect the Eastern subregion. Boating on Lake Powell could be particularly reduced.

A more dire possibility is the demolition of Glen Canyon Dam. While the destruction of the dam is highly unlikely in the near term, attitudes to restoring the natural flow of the river could change during the next 50 years. Silting problems could contribute to such a decision.

The Flagstaff Area Subregion

Several possibilities for slower growth in the Flagstaff Area subregion exist. An increase in energy costs would directly affect the subregion, but also would indirectly affect local businesses that serve tourism or other activities in the other subregions. Similarly, restrictions in groundwater drilling could directly affect the subregion, while restrictions in the Western subregion that reduced tourism there would also affect the Flagstaff Area subregion. In a similar way, long-term drought would have negative consequences on the area's growth.

Slower growth also would result from a cap in enrollment at NAU; closure of the Gore manufacturing facility, which currently employs more than 1,000; or adoption of more restrictive growth boundaries that limit the number of dwellings built.

IV. POPULATION PROJECTIONS BY SCENARIO

Population projections are presented in Table 9 for eight scenarios: the baseline, low growth, and two high growth options, one based on tourism and one induced primarily by manufacturing growth in the Flagstaff vicinity. Two versions of each are presented: under conditions of existing water supply and with an enhanced supply.

The baseline projection by far has the greatest likelihood of occurring. The probability of the high growth scenario based on tourism is greater than high growth resulting from manufacturing gains. The low growth alternative has about the same probability as the high growth possibility based on manufacturing. The odds of both high growth scenarios occurring are quite small, thus a very high growth alternative that combines the effects of these two scenarios and other potential causes of faster growth is not presented.

Low Growth Without Pipeline

In the low growth scenario, a combination of some of the negative factors discussed earlier is assumed to gradually occur. The slow growth experienced during the 1960s provides a relatively recent example of how a combination of conditions can markedly affect population growth. The result of the assumed conditions in the low scenario is to gradually slow population growth over the next 50 years relative to the growth of the baseline, returning growth to a pace between that of the 1950s and 1960s. Such a pattern of slowing growth following a period of higher growth fits the life cycle of regional growth throughout the United States.

By the 2040-50 decade, the population change in the low scenario is one-third lower than in the baseline. Overall, however, the slowing assumed in this alternative is modest, with the study area's 2050 population only 16,450 less than in the baseline. This type of slowing has a real chance of occurring. More severe slowing is possible, but the odds of this diminish with increasing magnitude of the slowing.

In this scenario, slower growth than in the baseline is assumed to occur throughout the study area. The impact is a little greater in the Flagstaff Area subregion than in the rest of the study area.

Tourism High Growth Without Pipeline

Compared to the baseline population projection, this high growth option results in a study area population 15,750 (9 percent) higher in 2050. The impact is assumed to be greatest in the first two decades of the 50-year period, with gradually

lesser effect thereafter. All subregions of the study area are expected to benefit from higher tourism, but numeric gains are projected to be less in the Flagstaff Area subregion than in the other subregions. Because of the varying sizes of the 2000 population base, the impact in 2050 is far greater in the Western subregion (a 44 percent higher population than in the baseline); the Eastern subregion's population is 20 percent higher while the gain in the Flagstaff Area subregion is only 3 percent.

Manufacturing High Growth Without Pipeline

Results for the manufacturing high-growth scenario indicate that the population of the entire study area would be 142,950 by 2020. This compares with a DES projection of 131,750. The difference is 11,200 (9 percent). By the year 2050, the population would be 210,250, in contrast to a DES projection of 184,650, a difference of 25,600 (14 percent). Relative to the baseline, the effect of this scenario is expected to diminish over time, as in the high tourism scenario. (While the projected population is higher than in the tourism high growth scenario, the latter is more likely to occur.)

About 90 percent of the population growth in this scenario is located in the Flagstaff Area subregion with about 5 percent in each of the other subregions. Thus, the Flagstaff Area subregion's population in 2050 is anticipated to be 16 percent higher than in the baseline, while the increase in the Western subregion is 10 percent and that in the Eastern subregion is only 4 percent. This scenario provides the highest population in the Flagstaff Area subregion.

Baseline with Pipeline

Construction of the pipeline alone could raise population growth in the study area. Population gains in this scenario are higher than those of the baseline scenario in the Western subregion, which has a 2050 population 30 percent higher than in the baseline. However, some of this additional growth is offset by lesser growth in the Flagstaff Area subregion, which suffers from greater competition for tourists from facilities closer to the Grand Canyon. The Eastern subregion's population is not anticipated to be different from the baseline under this alternative. The effect on the overall study area is minimal, with slightly greater impact foreseen soon after the pipeline is built compared to later in the 50-year forecast period.

Low Growth with Pipeline

To the extent that slower growth is a result of restricted use of wells, presence of the pipeline would moderate the slowing of growth under the low growth scenario. In addition, the effects on the baseline forecast due to the pipeline would apply to the low growth scenario, though only in part. Thus, slightly stronger growth in the study area is projected in this scenario than in the low growth without pipeline possibility. Compared to the baseline, the Western subregion experiences faster growth, but growth in the other subregions is less.

Tourism High Growth with Pipeline

Compared to the baseline scenario (with pipeline), the Western subregion's numeric population increase ranges from 2.5 times higher between 2000 and 2020 to twice as much from 2040 to 2050. The result is a 2050 population of about 31,000, which is 13,600 (78 percent) higher than in the baseline (with pipeline) and the highest figure among the scenarios.

The impact of this scenario is less in the Eastern subregion, with the 2050 population 7,500 (25 percent) higher than in the baseline (with pipeline). The Eastern subregion also has the highest population under this scenario. The net effect on the Flagstaff Area subregion is minimal, with the 2050 population 3,275 (only 2 percent) higher than in the baseline (with pipeline).

Manufacturing High Growth with Pipeline

The 2050 population for the study area is nearly the same in this scenario as in the high tourism scenario. The pipeline project is assumed to have no effect on the magnitude of growth that results from the assumed faster growth in manufacturing. Water availability, however, does affect the distribution of growth across the study area's subregions. With a pipeline, only 70 percent of the additional people locate in the Flagstaff Area subregion; 20 percent locate in the Western subregion and 10 percent live in the Eastern subregion.

Because of the Western subregion's small population base, the subregion's 2050 population under this scenario would be 29 percent higher than in the baseline (with pipeline) scenario, compared to the Flagstaff Area subregion's population being 13 percent higher. The increase in the Eastern subregion would be 8 percent; the figure for the entire study area is 14 percent.

Table 9: Population Projections by Scenario

	WITHOUT PIPELINE				WITH PIPELINE			
	Baseline	Low Growth	Tourism High Growth	Manufacturing High Growth	Baseline	Low Growth	Tourism High Growth	Manufacturing High Growth
ENTIRE STUDY AREA								
Population								
2010	114,775	114,000	118,475	120,375	115,100	114,300	120,950	120,700
2020	131,750	129,200	139,150	142,950	132,500	129,900	144,200	143,700
2030	147,900	142,400	158,525	164,300	149,000	143,500	165,725	165,400
2040	165,200	155,200	178,600	186,400	166,600	156,700	187,525	187,800
2050	184,650	168,200	200,400	210,250	186,300	170,100	210,675	211,900
Population Change								
2000-10	18,650	17,875	22,350	24,250	18,975	18,175	24,825	24,575
2010-20	16,975	15,200	20,675	22,575	17,400	15,600	23,250	23,000
2020-30	16,150	13,200	19,375	21,350	16,500	13,600	21,525	21,700
2030-40	17,300	12,800	20,075	22,100	17,600	13,200	21,800	22,400
2040-50	19,450	13,000	21,800	23,850	19,700	13,400	23,150	24,100
WESTERN SUBREGION								
Population								
2010	8,600	8,550	9,900	8,900	9,525	9,275	12,725	10,625
2020	9,550	9,400	12,150	10,150	11,500	10,850	17,900	13,700
2030	10,600	10,300	14,400	11,475	13,400	12,350	22,600	16,625
2040	11,825	11,225	16,725	12,925	15,325	13,825	26,925	19,500
2050	13,375	12,375	19,275	14,675	17,425	15,450		22,500
Population Change								
2000-10	1,250	1,200	2,550	1,550	2,175	1,925	5,375	3,275
2010-20	950	850	2,250	1,250	1,975	1,575	5,175	3,075
2020-30	1,050	900	2,250	1,325	1,900	1,500	4,700	2,925
2030-40	1,225	925	2,325	1,450	1,925	1,475	4,325	2,875
2040-50	1,550	1,150	2,550	1,750	2,100	1,625	4,100	3,000
FLAGSTAFF AREA SUBREGION								
Population								
2010	88,275	87,700	89,225	93,275	87,675	87,275	88,475	91,675
2020	101,250	99,300	103,150	111,250	100,050	98,550	101,650	108,050
2030	113,575	109,300	116,275	128,225	111,875	108,350	114,150	123,575
2040	126,850	119,000	130,225	145,850	124,750	117,900	127,575	139,850
2050	141,800	128,700	145,725	164,800	139,400	127,525	142,675	157,600
Population Change								
2000-10	14,050	13,475	15,000	19,050	13,450	13,050	14,250	17,450
2010-20	12,975	11,600	13,925	17,975	12,375	11,275	13,175	16,375
2020-30	12,325	10,000	13,125	16,975	11,825	9,800	12,500	15,525
2030-40	13,275	9,700	13,950	17,625	12,875	9,550	13,425	16,275
2040-50	14,950	9,700	15,500	18,950	14,650	9,625	15,100	17,750
EASTERN SUBREGION								
Population								
2010	17,900	17,750	19,350	18,200	17,900	17,750	19,750	18,400
2020	20,950	20,500	23,850	21,550	20,950	20,500	24,650	21,950
2030	23,725	22,800	27,850	24,600	23,725	22,800	28,975	25,200
2040	26,525	24,975	31,650	27,625	26,525	24,975	33,025	28,450
2050	29,475	27,125	35,400	30,775	29,475	27,125	36,975	31,800
Population Change								
2000-10	3,350	3,200	4,800	3,650	3,350	3,200	5,200	3,850
2010-20	3,050	2,750	4,500	3,350	3,050	2,750	4,900	3,550
2020-30	2,775	2,300	4,000	3,050	2,775	2,300	4,325	3,250
2030-40	2,800	2,175	3,800	3,025	2,800	2,175	4,050	3,250
2040-50	2,950	2,150	3,750	3,150	2,950	2,150	3,950	3,350

Source: Arizona Department of Economic Security and authors.

APPENDIX C
GROWTH-RELATED PLANS ANALYZED

"Bellemont Area Plan," July 1985. Bellemont Planning Committee, Coconino County, Arizona.

"City of Williams, Arizona, General Plan: Draft," Nov. 1995. Williams General Plan Committee.

"City of Page General Plan Update," Mar. 1996. BRW Sunregion Associates, Inc.

"Coconino County Comprehensive Plan," April 1990. Coconino County Comprehensive Plan Committee.

"Coconino National Forest Land and Resource Management Plan," Aug. 1987. Forest Service: Southwest Region, U.S. Department of Agriculture.

"Doney Park Area Plan," July 1988. Doney Park Planning Committee, Coconino County, Arizona.

"Flagstaff Area Regional Land Use and Transportation Plan: Draft," Nov. 15, 1999. Balloffet & Associates, Inc.

"Fort Valley Area Plan," Feb. 1990. Fort Valley Planning Committee, Coconino County, Arizona.

"Grand Canyon General Management Plan," Aug. 1995. National Park Service, U.S. Department of the Interior.

"Growth Management Guide 2000," April 1987. City of Flagstaff, Arizona.

"Kaibab National Forest Land Management Plan," June 1996. Forest Service: Southwest Region, U.S. Department of Agriculture.

"Overall Economic Development Program," 1998. Navajo Nation Division of Economic Development.

"Red Lake Area Plan," Sept. 1992. Red Lake Planning Committee, Coconino County, Arizona.

"Tusayan Area Plan," May 1997. Tusayan Planning Committee, Coconino County, Arizona.

"Valle Area Plan," 1999. Valle Area Planning Committee, Coconino County, Arizona.

"Water Resource Development Strategy for the Navajo Nation," July 17, 2000. Navajo Nation Department of Water Resources.

APPENDIX D
AN ARIZONA GROWTH MANAGEMENT TIME LINE

The Growing Smarter Acts of 1998 and 2000 were accompanied by a great deal of publicity, but they were not the first, nor are they the only, growth management efforts undertaken in Arizona in recent years. Following is a brief time line of statewide growth management actions since the mid-1990s.

1996

- **Arizona Preserve Initiative (API)** enacted by the state legislature to give the Land Department authority to reclassify, lease, and sell state trust lands to local governments and nonprofit organizations as open space for conservation purposes.

1997

- **Arizona State Parks Board** given authority by the state legislature to grant public monies for the acquisition of state trust land classified for conservation purposes.
- **Conservation Acquisition Board** established by state legislature as advisory body to Arizona State Park Board to solicit donations, help identify conservation areas, and recommend appropriate grants from Land Conservation Fund.

1998

- **Growing Smarter Act** enacted by the state legislature to provide comprehensive municipal, county and state land department land use planning and zoning reforms; to establish tools for acquisition and preservation of open space; to establish Growing Smarter Commission to study issues relating to land use policies; and to place on the ballot Proposition 303 (see 1998 Growing Smarter Provisions below for further information).
- **Proposition 303 – Growing Smarter Matching Funds** initiated by the state legislature and passed by majority of the voters to provide $220 million in matching funds over 11 years, primarily for the acquisition of state lands for open space.
- **Citizens Growth Management Act,** an initiative effort supported by the Arizona Center for Law in the Public Interest and the Sierra Club, intended to establish urban growth boundaries and increase citizen oversight of planning and zoning issues; this initiative effort failed to get requisite signatures to qualify for the ballot.

1999

- **Municipal Planning Bill** enacted by the state legislature to extend the deadline for amending or adopting municipal general plans until December 31, 2002 for cities and towns with populations between 2,500-75,000; to establish a program within the Land Department to provide grants and technical assistance for communities with populations between 2,500-15,000; and to grant appropriation of $250,000 to be shared among communities.
- **State Land Department Omnibus** enacted by the state legislature to make numerous changes to Land Department authorities, procedures and requirements; and to expand duties of the Urban Land Planning Oversight Committee to recommend procedures and strategies to create conceptual land use plans for urban state trust land and other trust lands.
- **Growing Smarter Commission** issued report with recommendations, all of which are subsequently contained in the Growing Smarter Plus Act. (See Appendix E.)
- **Joint Legislative Study Committee on Land and Water Use** established by the state legislature to compose policy components of the Proposition 100 initiative and work parallel to the Growing Smarter Commission.
- **Growing Smarter Plus** enacted by the state legislature to make changes based on recommendations of Growing Smarter Commission; to expand the basic framework of 1998 Growing Smarter Act; and to define the components of its associated initiative, Proposition 100. (See Appendix E.)
- **Proposition 100 – Growing Smarter Plus** initiated by the state legislature and qualified for November 2000 ballot, seeking to amend the Arizona Constitution to create Arizona Conservation Reserve lands; to allow for the donation of public school state trust land to school districts; to permit exchange of state trust land for other public lands; and to propose that lands not suitable for conservation purposes may be suitable for small lot sales.
- **Proposition 202 – Citizens Growth Management Initiative,** an initiative effort supported by the Sierra Club and qualified for November 2000 ballot, seeking to establish urban growth boundaries based on population projections and increase citizen oversight of planning and zoning issues.
- **Conservation Acquisition Board** recommended to State Parks Board first round of monies for acquisition of land for conservation purposes.

2000

- **Proposition 100 – Growing Smarter Plus** voted down in November 2000 ballot election by a slim margin; consequently, several provisions of Growing Smarter Plus enacted by the Arizona legislature removed from the bill.
- **Proposition 202 – Citizens Growth Management Initiative** voted down in November 2000 ballot election by wide margin.

APPENDIX E
HIGHLIGHTS OF THE GROWING SMARTER ACTS

1998 Growing Smarter Act

Prior to the Growing Smarter Act of 1998, cities were required to adopt general land-use plans, and counties comprehensive plans, but they were not required to follow these plans. In addition, cities and counties were not required to review or renew their plans on a periodic basis. Growing Smarter proposed to strengthen general/comprehensive plans by requiring all rezoning to "conform" with plans. Major provisions are as follows:

City and County Planning

- Required that general/comprehensive plans be readopted or reformulated every 10 years.
- Required that all zoning and re-zoning "conform" to general/comprehensive plan.
- Required 2/3 vote of appropriate governing body before general/comprehensive plan or major amendment is adopted or readopted.
- Required public participation for adoption of general/comprehensive plans or "major amendments."
- Required four new elements to be included in plans for municipalities with populations over 2,500 and counties with populations over 200,000: open space, growth areas, environmental planning, and cost of development.

State Trust Land Planning

- Required State Land Commissioner to create conceptual land use plans every 10 years for urban state trust lands.
- Required State Land Commissioner to create five-year disposition plans for all state trust land.
- Authorized sale of development rights on state trust land throughout state.
- Established Urban Land Planning Oversight Committee to provide guidance and recommendations regarding land use and disposition plans.

Open Space Acquisition/Preservation

- Permitted purchase of development rights of state trust lands through API with certain conditions.

Other Major Provisions

- Established 15-member Growing Smarter Commission to recommend changes to rules governing planning and state trust lands.

2000 Growing Smarter Plus Act

Based on recommendations of the Growing Smarter Commission and input from the Study Committee and Conservation Trust Task Force, the 2000 Growing Smarter Plus Act made several revisions and additions to the original Growing Smarter Act. Major provisions are as follows:

City and County Planning

- Required that voters ratify general/comprehensive plans.
- Required citizen review process for rezoning.
- Exempted certain municipalities from including four growth-related elements in their general plans – those with a population between 2,500 and 10,000 and growing at less than 2 percent per year over a 10 year period.
- Added water resources to the required elements of plans for non-exempt municipalities and counties with a population over 125,000.
- Established that private land may not be designated as open space or rezoned without written consent of landowner.
- Stipulated that annexed land must have a plan that provides appropriate level of infrastructure for 10 years.
- Established requirements for "infill incentive districts."
- Required seller of five or fewer parcels of unsubdivided land in unincorporated areas to furnish buyer with written disclosure affidavit.
- Gave counties the authority to regulate land divisions of five or fewer lots of 10 acres or smaller, and set a time limit of 30 days for approval or denial.
- Authorized municipality and county to set infrastructure service boundaries and to limit or prescribe service outside those boundaries.
- Permitted counties to assess development fees that bear "reasonable relationship" to costs imposed on county.

Open Space Acquisition/Preservation

- Established Development Rights Requirement (DRR) Fund to grant monies for purchase, lease, or transfer of development rights of private lands.

Not Enacted: Proposition 100 – Growing Smarter Plus

Certain provisions contained in the 2000 Growing Smarter Plus Act that governed state trust lands were intended to become effective only if Proposition 100-Growing Smarter Plus were approved by the voters. Since voters rejected Proposition 100 in the November 2000 election, the following provisions never became law.

State Trust Land Planning

- A provision to permit the School Facilities Board to receive and evaluate requests from school districts for the donation of state trust lands for school sites.
- A provision to require the Land Use Commissioner to review recommendations and hold at least one public meeting before donation made and title conveyed.
- A provision to allow the Land Use Commissioner to donate state trust land to local governments if cost-benefit analysis shows benefit to remaining state trust lands.
- A provision to establish the Arizona Conservation Reserve (ACR) Commission to evaluate state trust land for ACR designation, and including the process for consideration.
- A provision to provide that lands not suitable for conservation purposes may be suitable for small lot sales.

MORRISON INSTITUTE FOR PUBLIC POLICY

Morrison Institute for Public Policy conducts research which informs, advises, and assists Arizonans. A part of the School of Public Affairs (College of Public Programs) at Arizona State University, the Institute is a bridge between the university and the community. Through a variety of publications and forums, Morrison Institute shares research results with and provides services to public officials, private sector leaders, and community members who shape public policy. A nonpartisan advisory board of leading Arizona business people, scholars, public officials, and public policy experts assists Morrison Institute with its work. Morrison Institute was established in 1981 through a grant from Marvin and June Morrison of Gilbert, Arizona and is supported by private and public funds and contract research.

Special thanks to the following people for sharing their insights regarding key research findings:

Ed Fox, *Vice President, Communication, Environment and Safety,* Pinnacle West
Grady Gammage, *Founding Partner,* Gammage & Burnham
Richard Morrison, *Attorney & Partner,* Salmon, Lewis & Weldon
Jack Pfister, *former General Manager,* Salt River Project
Karl Polen, *CFO, Sr. Vice President,* Robson Communities
Fritz Steiner, *Director,* ASU School of Planning and Landscape Architecture

The assistance of the following people is gratefully acknowledged:

Karen Leland, Public Affairs/Publication Coordinator | Nielle McCammon | Cherylene Schick | Alice Willey | Karen C. Heard, Chalk Design

Historic photography the Collection of Jeremy Rowe ©2001 | Additional photography by Rick Heffernon ©2001

MORRISON INSTITUTE FOR PUBLIC POLICY

School of Public Affairs
College of Public Programs
Arizona State University
P.O. Box 874405, Tempe, Arizona 85287-4405
Phone: 480.965.4525 | Fax: 480.965.9219
www.asu.edu/copp/morrison