TUCSON SDAT

One Million Reasons to Plan for Sustainable Growth

A Sustainable Design
Assessment Team Report

Tucson
June 11–13, 2007

AIA Communities by Design
ENVISION. CREATE. SUSTAIN.

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AIA Communities by Design

ENVISION. CREATE. SUSTAIN.

EXECUTIVE SUMMARY

> "Sustainability envisions the enduring prosperity of all living things. Sustainable design creates communities and buildings that advance enduring public and environmental well being."
>
> *AIA Committee on the Environment, 2007*

In November 2006 Pima County's (Ariz.) population reached 1 million, and AIA Southwest Arizona applied to the Sustainable Design Assessment Teams (SDAT) program, seeking a sustainable direction for growth in the Tucson area. A preliminary visit by the SDAT team leader and AIA staff in April 2007 discovered a city with many green initiatives, many caring citizens deeply involved in the preservation of place, and many environmental and social crises looming on the horizon.

Tucson's SDAT initiative has the potential to address some of the region's major regional and local environmental issues in this time of climate change and population growth. Tucson is on the same sun belt as Baghdad, a city at war, and Shanghai, a city that is becoming the greenest on the planet. Climate cannot be equated merely with latitude, and the sun's path only defines a small portion of the sustainability issues facing American cities.

What Did We Learn from Tucson?

The city has a wealth of environmental initiatives. Over three days the AIA team listened to more than 200 people discuss the city's growth, water practices, energy and conservation programs, health, culture, social issues, and planning directions. At the initial visit, we learned of many of the city's existing sustainability initiatives, causing us to wonder why we were needed and question if our visit would provide a catalyst for future plans and programs. Our hope is that our findings will reinforce the work already in place and provide additional direction for sustainable growth in the region.

Overall Analysis

The city and county have already created some of the basic keystones for sustainable growth. Both have created departments and recruited staff to coordinate and create opportunities for sustainability education, design, and planning. Neighborhoods also have created loose coalitions. Citizen awareness of the impact of growth management

has influenced infill design practices and code development, with some unintended consequences of continued expanding development outside the city boundaries. University of Arizona has developed programs and institutes to continue to engage the community and also provides major research in areas of water management, landscape, solar design, alternative energy, and planning.

Environmental organizations, particularly the Sonoran Conservation Institute, have created conservation plans for future planning guidelines. The business community has begun a town-hall planning program to review a broad range of developmental, social, economic, and environmental issues. Individuals have created pockets of eco-friendly environmental best-practice case studies. Architects have begun to work with developers to create good examples of mixed-use, pedestrian-friendly, and Leadership in Energy and Environmental Design (LEED®)—rated buildings. AIA architects have provided design assistance and charrettes for the past 20 years, since the Tucson Regional/Urban Design Assistance Team (R/UDAT) visited in 1984, and their concerns brought SDAT to Tucson to review existing sustainable practices and provide recommendations for future growth processes.

While learning *about* Tucson, the team also learned *from* Tucson, and many of the following recommendations echo the comments, concerns, and dreams of the many people we listened to during our stay. Across the United States, SDATs are learning about the ongoing and growing crises in our current practices of unmanaged growth. We used our time in Tucson to develop a series of recommendations based on best practices that we have seen succeed in other cities and communities, with the understanding that to be successful, Tucson needs to grow its own regional and local solutions to meet the challenge of sustainable development.

Critical to success in any community is solving the gaps in communications and networking. In the report, our recommendations include the development of an *inclusive*, broad-based civic leadership umbrella organization that represents all sectors of the community, with a mission to collect and distribute information, provide education, and initiate programs. Change cannot occur, however, without an equally powerful decentralized system of neighborhood clusters, composed of individuals committed to change. Identifying, linking, and marketing geometric clusters of neighborhood plans will provide the support for growth. Lastly we ask that Tucson study its capacity for growth in an area limited by water resources in a dry climate.

An all-inclusive capacity study will integrate all the issues the team investigated—three-dimensional modeling of Tucson's downtown, transportation corridors' infill capacity, conservation easements, cultural plans, roads, sewers, energy modeling, a projection of population growth, and a build-out plan using existing zoning and the just-completed water management study plan. To be sustainable, Tucson's capacity for economic, social, and environmental health should equal the community's capacity to meet the challenges of growth. The Tucson SDAT participants scoffed at planning for 100 years; they said Tucson is ready for the challenge of planning well beyond a century.

INTRODUCTION

In January 2006 Tucson submitted a proposal to the AIA for an SDAT to assist the town and its citizens in addressing key issues facing the community. The issues ranged from capacity for growth given limited water resources to capitalizing on solar energy and other renewable energy resources.

The AIA accepted the proposal and, after a preliminary visit by a small group during April 1–3, 2007, the SDAT members arrived in Tucson on June 10. For three days, the team members, working closely with local officials, community leaders, technical experts, and citizens, studied the community and its concerns. During those three days, the team came to understand the issues and used its expertise to frame a wide range of recommendations, which were presented to the community in a public meeting on June 13.

This report is a more detailed version of the findings and recommendations that were presented to the community on June 13. After a brief overview of the SDAT program and process, and a short discussion of Tucson and the issues it is facing, the report covers

- Renewable energy and green resources
- Water resources
- Transportation
- Regional design
- Neighborhood infill
- Downtown

A closing section offers some thoughts on how the community can best move forward to address the range of issues and recommendations covered in the report.

What is the SDAT Program?

The SDAT program is an interdisciplinary community assistance program that focuses on principles of sustainability. Launched in 2005 the program represents an exciting new chapter in the AIA's history of supporting communities with volunteer design expertise.

The SDAT program is modeled on the AIA's R/UDAT program. While the R/UDAT program provides communities with specific design solutions, the SDAT program provides broad assessments to help frame future policies or design solutions in the context of sustainability, and helps communities plan the first steps of implementation. The SDAT program is based on an understanding of design as a process that

- Is integrative, holistic, and visual
- Is central to achieving a sustainable relationship among humans, the natural environment, and the place
- Gives three-dimensional form to a culture and a place
- Achieves balance among culture, environment, and economic systems

The SDAT program is grounded in the AIA design assistance team values, which call for a multidisciplinary approach, objectivity of the participating team members, and broad public participation.

Why is the SDAT Program Valuable?

Many communities are immobilized by conflicting agendas, politics, personalities, or even an overabundance of opportunity. Many communities have not yet taken stock of their current practices and policies within a sustainability framework, while others have identified issues of concern but desire assistance in developing a plan of action to increase sustainability. The SDAT process ensures that alternative solutions are given a fair hearing and that options are weighed impartially. The SDAT process

- Informs the community of opportunities and encourages them to take action to protect local and regional resources
- Helps the community understand the structure of the place at various scales and contexts—from regional resources to the neighborhood scale
- Explores and articulates the larger contexts and interactions of ecological, sociological, economic, and physical systems

- Visualizes potential futures
- Recognizes and describes the qualities of a place by preserving the best elements of the past, addressing the needs of the present, and planning for the needs of future generations
- Identifies and describes choices and consequences
- Connects plans and actions
- Advances the principles of quality sustainable communities
- Helps the community define the roles of various stakeholders
- Develops a roadmap for the implementation of more sustainable policies and practices

The key to SDAT success is diversity and participation; the process involves multiple disciplines and multiple stakeholders. The SDAT process includes not only the expert team but also government agencies and officials, private businesses, schools and students, community members, and other parties as appropriate.

Who are the Key Participants in the SDAT Process?

SDATs bring a team of respected professionals, selected on the basis of their experience with the specific issues facing the community, to work with community decisionmakers to help them develop a vision and framework for a sustainable future. Team members volunteer their time to be a member of the SDAT. To ensure their objectivity, they agree to refrain from taking paid work for three years from the date of completion of the SDAT project. A distinct team is assembled for each project based on the project's unique features. The team consists of a leader, five to seven members, and a staff person from the AIA Center for Communities by Design.

The SDAT members' professional stature, their independence, and the pro bono nature of their work generate community respect and enthusiasm for the SDAT process, which in turn encourages participation by community stakeholders. The passion and creativity that are unleashed by a top-notch multidisciplinary team of professionals working collaboratively can produce extraordinary results.

Local Steering Committee

The steering committee is the key organizing group for an SDAT project. It is responsible for assembling local and regional information, organizing the preliminary meeting and SDAT visit, and generating local media coverage during the entire project. After the SDAT visits, the steering committee typically evolves into a group that is dedicated to implementing the SDAT recommendations.

Local Technical Committee

The local technical committee is the technical support group for the SDAT project, including local design professionals, environmental professionals, economists, and others whose skills and experience parallel those of the SDAT members and who bring with them detailed knowledge of local conditions, issues, and information resources. Their presence magnifies the team's effectiveness.

Citizens

In the end, the community's citizens are the critical players, both for their insights and observations during the team visit and for their support for the new directions that emerge from the SDAT process.

On behalf of the Tucson SDAT and the AIA, it is hoped this report will be a useful guide to the Tucson community as it charts its future for the coming years and for coming generations.

RENEWABLE ENERGY AND GREEN RESOURCES

"The Earth belongs to each…generation during its course, fully and in its own right. The second generation receives it clear of debts and encumbrances, the third of the second, and so on. For if the first should charge it with a debt, then the earth would belong to the dead, and not to the living generation. Then, no generation can contract debts greater than may be paid during the course of its own existence."

Thomas Jefferson

This quote from the third president of the United States was presented to America's citizens some 200 years ago. It forms the basis for most if not all sustainable thought and operations and is as valid today as is was then. It suggests that for any society to be truly sustainable, it must be in balance with the resources that support it.

"Energy Conscious (Sustainable) design is a hallmark of indigenous and urban and architectural form—adopting site, climate, and materials carefully throughout with environmental awareness—reconciling form and function."

This quote comes from the 1984 Tucson R/UDAT report, when the AIA assessed the region's growth and potential. Although sustainability was not a regularly used term in the design field at that time, energy-conscious design formed the basis for much of what sustainable thinking is about today.

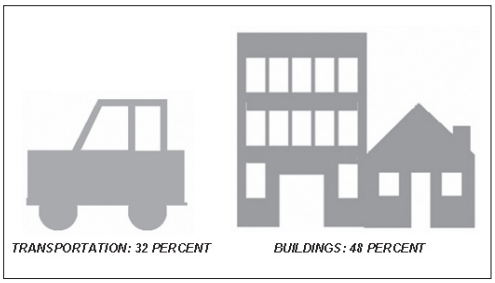
Tucson should embrace these two positions as it moves forward and evolves during the next 23 years—moving toward 2030 and beyond. In this section, energy is broadly referred to as both fuel and power necessary to nourish the community, and green resources are those elements that are regionally based and regenerative.

Overview

The City of Tucson and Pima County, Ariz., are a sensitive, enlightened, and engaged community, and many of its citizens and several organizations have an increased awareness of and concern about energy and environmental issues. Not unlike many other communities across the United States, Tucson is currently at a crossroads. Tucson is questioning whether its consumption of energy is balanced and what its relationship to the indigenous nature of the region, and its adoption of site, climate, and materials as a basis of future sustainable development is and should be about. As energy costs continue to rise, and fuel availability remains volatile and unpredictable, dependence on imported and nonrenewable, petroleum-based sources appears tenuous at best.

Greenhouse gas emissions, particularly carbon dioxide and methane, are inextricably linked to nonrenewable fuel consumption. There is now widely accepted scientific evidence that global climate change is occurring and even slight changes are being shown to have significant effects on weather patterns, ecosystems, agricultural productivity, and health. The country and the world continue to see record-setting temperatures and calamitous weather events such as flooding, tornadoes, and hurricanes.

Electricity has been shown to be a major generator of greenhouse gas emissions (more than 50 percent), particularly when this power is generated from nonrenewable sources. Buildings are the major consumers of energy (nearly 50 percent) and when this share is added to transportation (the second highest consumer, with more than 30 percent), these two sectors account for a majority of all energy consumption. Construction and development are continuing in the Tucson region; it is estimated that the building mass will be doubled by 2030.



Energy, for buildings and their occupants in particular, is a multimillion-dollar-per-year industry in the Tucson area, and 70–80 percent of this revenue leaves the local economic stream immediately. As the stability of our energy future is clouded in uncertainty, the opportunity—and necessity—for Tucson to redirect its consumption and production patterns is vital.

Strengths and Assets

Tucson has a relatively clear understanding of its energy consumption, growth patterns, and projections for the region. It has a community dedicated and committed to addressing

these issues and has initiated several programs to reinforce this commitment. There is local expertise, talent, and experience within the professional community, the University of Arizona, and the community at large.

Tucson recently established an Office of Conservation and Sustainable Development, which is charged to ensure that sustainability remains a key focus in the city's programs and operations. It endorsed the United Nations' Urban Environmental Accords in 2005 and signed on to the U.S. Mayors Climate Protection Agreement in 2006. The local utility, Tucson Electric Power Company (TEP), provides a Guarantee Home Program encouraging energy-efficient new building construction. The Greenwatts and Sunwatts programs also are available from local utilities. The city recently received a Clean Renewable Energy Bond (CREBS) to fund solar-power systems for municipal buildings. Sustainable Tucson is a network of networks providing information on sustainable resources. A regional chapter of the U.S. Green Building Council was recently established to support the development of LEED-certified buildings in the area. Additionally civic and residential projects such as the Pennington Street Garage, the Community of Civano, and Armory Park del Sol exemplify the opportunities for a sustainable lifestyle the region can continue to nurture. These efforts and initiatives underscore the momentum the city has in realizing its need to evaluate, investigate, and evolve into a more renewable, green, and carbon-neutral environment. This momentum must be cultivated.

Augmenting the community and professional efforts is the area's warm and welcoming climate. Tucson provides a mild winter climate (approximately 1,500 heating degree days) and a moderate summer climate (approximately 3,500 cooling degree days). It is blessed with abundant sunshine—approaching 85 percent of the annually possible. Although this is not the highest value within the state (Yuma, Ariz., has a value of approximately 90 percent), it is clearly well above the national average and could be used as a catalyst for Tucson to become the solar capital of the world.

Obstacles and Impediments

Although Tucson boasts commitment and talent, there remain some impediments that should be addressed and assessed in attempting to increase momentum on the renewable energy and green resource front.

First, an overdependence on nonrenewable fuels remains. The TEP is the area's major energy supplier and relies primarily on coal, supplied from outside the region, representing approximately 93 percent of power production fuel sources. In addition this power

generation requires significant water consumption. The community has a significant existing energy-inefficient building stock, and many structures are below acceptable current efficiency standards. Furthermore, there is no accepted or adopted state energy code. Finally, while there is neither disinterest nor unawareness, there appears to be a general fragmentation of efforts by, and a division among, policy makers, developers, and community organizations.

Visions and Opportunities

Given the efforts of the city and region to date, as well as the observations and input of community members during the SDAT visit, it appears that Tucson has a clearly established foundation for and interest in a sustainable energy base grounded in renewable energy. Tucson should continue to nurture this foundation as the cornerstone of its future sustainable energy agenda. Conservation programs should be emphasized to minimize energy use and energy use when needed should be optimized by using efficient, high-performance systems.

Conservation of energy is the first line of defense in establishing an energy budget and deriving energy use. Any necessary energy use must be minimized. Saving energy becomes the wisest energy resource. Energy efficiency logically follows. Regardless of the fuel type used in building and operational systems, highly efficient and high-performance heating, cooling, lighting, and other mechanical systems should be selected and maintained.

Diversification of renewable energy offerings should be maintained. Since the city and region is blessed with an abundance of sunshine, it should continue to capitalize on this asset, and develop methods, techniques, applications, and programs to further the harvesting of solar energy in order to become the region's primary renewable energy source. At the same time, other renewable sources of fuel and power can and should become a part of the overall renewable energy portfolio. The city should investigate renewable energy and green resources at all levels—the regional level, the community or public level, and the individual or building-scale level.

Green resource harvesting also should be adopted to balance out the renewable energy equation. Natural building materials and indigenous products and methods of construction can reinforce sustainable thinking and living. Rammed earth, adobe, straw bale, and other materials can be cultivated and harvested. Recycling and reuse of waste and materials can and should be reintroduced into the building, material, and use stream.

Recommendations and Suggestions

Opportunities for Tucson to become more energy independent, improve its quality of life, raise public awareness, reduce atmospheric emissions that contribute to global warming, and become a model citizen of energy use for the region and state can be broadly clustered around four areas:

- Reach for the Sky
- Dig Deep
- Jump Beyond the Barrel
- Stretch Out and About.

Reach for the Sky

Implementing Go Sun strategies by harvesting solar energy is Tucson's wisest opportunity when considering renewable energy. As mentioned previously, the city boasts a percent of possible sunshine value of 85 percent annually, second in the state only to Yuma. Annually enough solar energy falls on a typical rooftop in the region to meet all of the building's energy needs for the entire year. Harnessing the sun for space heat conditioning, both passively and actively, can easily be achieved, given the mild winter climate. Solar cooling opportunities also exist. Daylighting is a well-established method for illuminating interior spaces. Solar water heating for domestic use and recreational pool systems is both low-tech and energy-efficient and easily adaptable to the region. Solar cooking, especially for camping, off-use periods, and as an alternative to barbequing, should be encouraged.

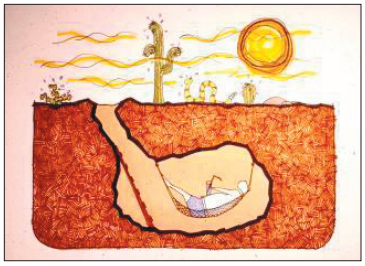
In particular power generation from the sun using photovoltaic (PV) systems for electrical generation should continue to be developed. Small-scale applications abound in the area, representing a good start to what could become a major enterprise and power source for the region. The relationship between the local utility, TEP, and the community could be expanded to provide further incentives for PV applications, as well as to establish a more equitable rate structure for power being returned to the grid by users. At a regional level additional solar farms,

either tied directly to the grid or with the utility, could be privately owned, cooperative based, or added to the mix of the municipal utility's supply options. Reducing reliance on coal-based fuels for electrical power not only would reduce greenhouse gas emissions, but also would significantly reduce water consumption required at the electricity generation plant. Even with the present first-cost gap between traditional electrical power generation and PV, favoring the traditional approach, continued development of PV technology, mass production of units, and rising fossil fuel costs is quickly creating a more competitive PV market.

Another opportunity for cooling would be further expansion of the use of cooling towers, and incorporating new technologies and investigation into traditional evaporative cooling concepts, such as two-stage evaporative cooling and other methods being investigated.

Deep-space radiation is a unique cooling approach for buildings, offering a highly viable comfort conditioning concept for a climate like Tucson's, which has clear night skies during summer months. Roof ponds and living roofs add rooftop thermal mass and allow absorbed heat captured during the day to radiate to deep space, thus cooling buildings and increasing the occupants' comfort, in addition to ameliorating microclimate conditions.

Dig Deep



Understanding ground climate, conditions, and temperatures can help to save energy and use it wisely. The ground and the earth's thermal mass easily tempers above-ground temperature swings and extremes. Earth sheltering as a design concept can temper heat loss and gain through a building's skin. Air/earth heat exchangers (coolth tubes) can help to cool a building's interior. Geothermal systems could be used where appropriate.

Jump Beyond the Barrel

Local fuels could be cultivated to increase opportunities to move to a more regionally based fuel economy and reduce dependence on imported fossil fuels. In general biodiesel, which is already used for some municipal fleets in the area, could be expanded and incorporated into school bus fleets and blends could be increased to B-50, B-85, or beyond. Biofuels derived from sources such as cottonseed, native plants, new plant hybrids, and even algae should be explored and researched.

Grease recycling for fuel has begun as small entrepreneurial efforts in the area, and this opportunity could easily multiply. It is estimated that more than 3,000 restaurants operate in the region, generating upwards of 1 million gallons of waste grease and oil per year. Much of this goes into the sanitary system, creating system overflows and requiring more water to flush this waste. Capturing this waste for fuel could provide a combined benefit of increased renewable energy and decreased water usage.

Spreading Out and About

Continuing to explore methods and means of energy conservation and wise energy use should remain a non-stop and explorative process. Technologies continue to develop and a regular review of various renewable energy and green resource opportunities must be kept current. Being creative and alert could uncover options previously unimaginable. A partial listing of important considerations and valuable possibilities include, but is not limited to, the following:

- Water conservation. One of the largest generators of water use is the toilet. Increased use of composting, waterless, or dual-flush technology, as well as waterless urinals, would significantly mitigate this.
- Solar shading. Protecting buildings' skin and interior from excessive sunlight (not daylight) will help reduce cooling loads and power consumption. Maintaining and expanding the Trees for Tucson Program and initiating similar efforts should be encouraged.

- Recycling. Tucson Recycles is a good start to recycling for the area. Recycling capacity could easily be doubled.
- Graveyard materials. The Air Force's fleet of unused and decommissioned planes could be tapped for scrap metal to be recycled for various building products, finishes, and furnishings. A design or artists competition could be developed.
- Methane support. Continued methane production from the local landfill and other areas should be encouraged.

- Solar-powered transit support. Solar-powered or solar-assisted public and mass transit, including signage and advertising and cooling options for transit stops, offers further opportunities for turning what might be a seasonal liability (waiting for the bus in the summer sun) into an asset.
- Internet shopping. Although this might reduce social interaction and dialogue, purchasing consumables and products online reduces energy use and greenhouse gas emissions.

Getting Started

The following list identifies several areas that could add to the already solid momentum Tucson has begun:

- Revamp and revitalize evaporative cooling. This should be explored particularly for the residential market, and off-peak cooling conditions. Investigate current and developing evaporative cooling technologies.
- Organize a Sustainable Design Alliance (SDA). Bring together stakeholders on a unified front—including representation from the Pima County, the City of Tucson, the university, and neighborhood representatives.

- Initiate a renewable energy rooftop initiative (RERI). Kick off renewable energy opportunities with an RERI, offering, showcasing, and providing incentives for rooftop installations that exemplify green technologies and approaches (e.g., PV, solar thermal, roof ponds, living roofs).
- Develop a sustainable user's guide. Commission and prepare a healthy and comprehensive guidebook and handbook, with sections focusing on strategies for groups such as homeowners, builders, developers, planners, architects/designers, and building managers. Create incentives to reinforce these guidelines to reward efforts that embrace sustainable ideas, and penalize or tax those that don't.
- Create a Center for Solar and Sustainable Communication. The center would be a showcase building exemplifying sustainable design ideas, offering exhibits and workshops, and serving as a central clearinghouse for information dissemination and networking.
- Use edges and ends. During the SDAT visit, almost all interior spaces were uncomfortably cool, bordering on cold. Be more generous with the fringes of the comfort zone, especially allowing higher-comfort dry-bulb temperatures and increased humidity levels, providing healthier and more energy-conserving interior conditions.

Onward and Upward—Just Do It!

The time is right and the time is now. Tucson must transition from energy dependence to energy independence—from imbalance to balance. It has the dedication, resources, and opportunity to achieve this but it must act quickly, efficiently, and assertively to achieve the autonomy it needs for a sustainable future:

- Advocate (educate). Collaborate and share expertise, resources, intentions, and directions. Integrate sustainable ideas and direction. Promote all efforts on a unified front, locally and regionally.
- Demonstrate. Lead by example, with the city and county implementing and showcasing the region's future direction. Identify the best practices that will make Tucson the world's solar capital.

- Generate. Develop new eco-enterprises, including artistic, blue-collar, and labor-based efforts, as an outgrowth of energy and economic independence.
- Transition. Move from a petroleum-based economy toward a renewable energy–based economy, with an annual goal of 4–5 percent reduction in total fossil fuel use—combining conservation, efficiency, and renewables—to achieve carbon neutrality by 2030.
- Celebrate. Share the successes and reward your accomplishments—celebrate your sustainable achievements.

WATER RESOURCES

In Pima County, water resource sustainability is most critically related to the sustainable use and management of its primary water resource, groundwater. Accelerating groundwater pumping to meet growing demands is resulting in the de facto mining of a nonrenewable resource, causing water tables to drop and land to subside. Arizona has attempted to address this through its Groundwater Management Act (GWMA) and Assured Water Supply Rules, implemented in an attempt to install a water management structure to control the overuse of groundwater and lowering of groundwater levels. These laws require most groundwater use within active management areas (AMAs) to be replenished. To this end, Central Arizona Project (CAP) water is the primary means by which groundwater in the Tucson Active Management Area (TAMA) is replenished.

As CAP is the central element used to try and achieve the goals of the Tucson AMA Safe Yield Task Force, the assumption is that CAP will be able to meet all sustainability goals and future water needs. There are several competing demands on CAP that may undermine this ability. These include native claims, climate change's impacts on CAP allocation, and unknown demand from Central Arizona Groundwater Replenishment District claims. As a result of these significant areas of uncertainty surrounding CAP's groundwater replenishment capability, TAMA and Pima County will need to look beyond CAP as the sole solution to achieving sustainable water use.

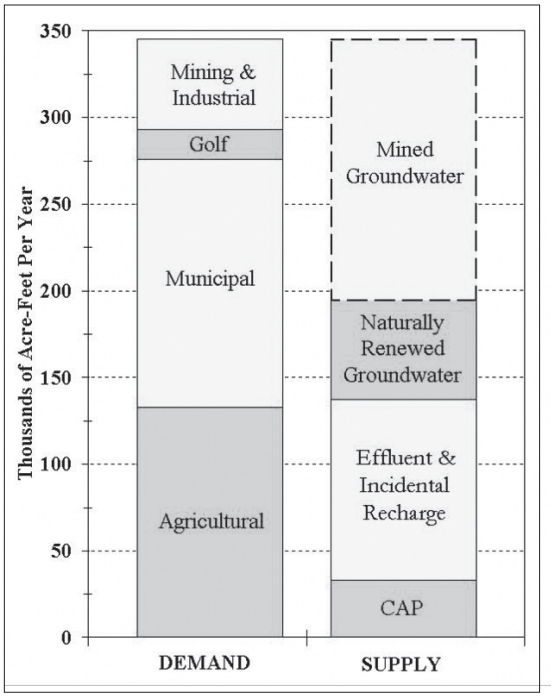


Figure 1. Water demand sectors and supply sources

TAMA water is used by three key sectors: municipal, agricultural, and mining/industrial (Figure 1). The next few years will result in significant growth in the municipal sector relative to other sectors. Much of this demand will continue to be met by groundwater, most of which is not renewed naturally. This is further supported by figures from Sharon Megdal's report, *Water Resource Availability for the Tucson Metropolitan Area*. The analysis from this report, based on figures from TAMA's Third Management Plan, indicates that in every case (1998, 2003, and 2025), and despite the GWMA's Assured Water Supply Rules, groundwater use exceeds natural and incidental recharge, translating into a continued net overdraft of the groundwater resource underlying TAMA.

The remainder of the water supply portfolio consists of water from CAP and effluent/incidental recharge. The lack of diversity in TAMA's water supply portfolio heightens the need for entities within TAMA to fully use the supplies that are available to them (reclaimed water, conservation).

Many opportunities exist, at multiple spatial and political scales, to get closer to the goal of stabilizing groundwater levels in Pima County and the TAMA. This section highlights some opportunities that can be undertaken by individuals and neighborhoods, at the city/regional level, and at the state/regional level.

Opportunities at the Individual Site/Neighborhood Level

The underlying aim at this level is to decrease the need for groundwater in the first place by (in order of priority) reducing demand and reusing available water resources.

Goal 1: Decrease Demand for Water

- Offer rebates to encourage retrofitting older homes. Significant water savings are available at the household level. Toilets, showers, washing machines, and faucets represent up to more than 75 percent of water use in the home (see Figure 2). Retrofitting a typical house with water-efficient technologies offers a 43 percent water savings over a nonwater-efficient household. While Tucson has historically been progressive in its approach to setting aggressive and increasing block rate structures to incentivize water-efficient practices, promoting the retrofitting of older homes with water-efficient technologies is a low-hanging fruit that would offer substantial decreases in water demand. For example, replacing a conventional toilet with a 1.0 gallon-per-flush toilet would result in a savings of 12,717 gallons per household per year. Given this significant water savings potential, offering rebates to retrofit older homes makes sense. A successful example of the long-term advantage of municipality investment in water conservation is that of the Southern Nevada Water Authority's Water Efficient Technologies Program, which offered commercial and multifamily property owners up to $150,000 in financial incentives to convert to water-saving technologies. This program was able to save more than 1 billion gallons since the program started in 2001.

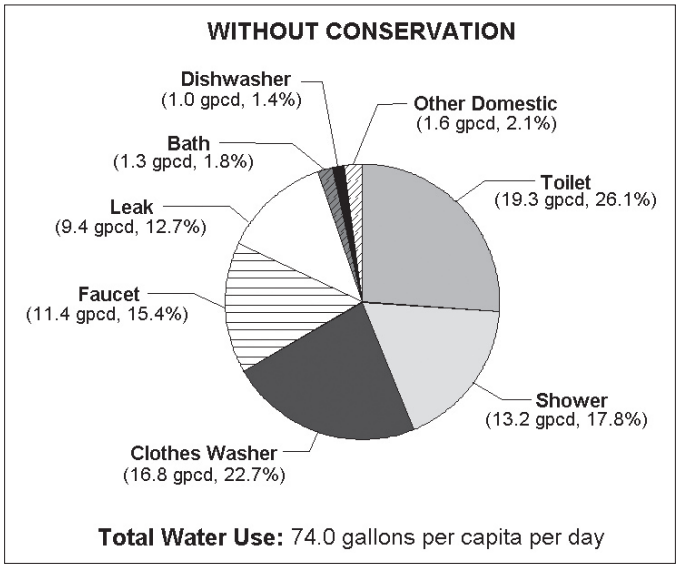


Figure 2. Water usage without water-efficient technologies

- Require water-efficient technologies in new homes. While ordinances require water-efficient technologies in multiple-unit residential structures, no current regulations require water-conserving fixtures in single-family homes. Again, given the substantial water-saving opportunities available from water-efficient technologies, it may make sense to extend the ordinance to require this of single-family residential units.

- Provide information on water-and cost-saving appliances to better inform consumer decisionmaking. Numerous water-and energy-efficient appliances are on the market, many of which offer significant potential water and energy savings. Consumers, however, often do not have sufficient information to make well-informed decisions in their purchasing decisions and how this can translate into cost, water, and energy savings over time. Explore opportunities to expand upon the U.S. Environmental Protection Agency's WaterSense Program (analogous to the Energy Star program) to help disseminate this type of information.

Goal 2: Use and Reuse Available Alternative Water Resources

Thirty percent of residential water use is for landscaping. Maximizing the use of rainwater, graywater, and reclaimed water not only would decrease demand for municipal water, but offer the benefits of recharging aquifers and decreasing burdens on stormwater systems.

- Promote reuse in the design phase. Sustainability is most effective when it is integrated into the design phase, rather than added onto a design as an afterthought. Landscapes should be designed to capture and maximize the use of rainwater. Similarly new homes should incorporate graywater stubouts and reclaimed water systems to offer consumers the option of using reclaimed water or graywater for their landscaping needs.

- Coordinate an educational program to encourage adoption of rainwater harvesting and reuse technologies. There is public interest but a lack of understanding on how conservation, rainwater harvesting, graywater reuse, xeriscaping, and other water-sparing techniques can be done hinders this. A coordinated program (public and private) to educate industry (e.g., homebuilders, landscape architects) and the public on how water-saving technologies and designs (e.g., home, landscape) can be incorporated would help encourage greater and more widespread adoption.
- Provide financial incentives for use of alternative water resources. Many communities have access to reclaimed water; however, the high cost of accessing, using, and maintaining reclaimed water systems often serves as a significant disincentive to its use. An example of an incentive program would be to reduce water bills for homeowners who install rain barrels. Some communities provide the equipment at low or no cost to the home owner.

Opportunities at the City/Regional Level

Objectives identified at this level include decreasing demand for groundwater use (by increasing the use of renewable water resources), increasing supply (by enhancing recharge), and fostering partnerships and integration opportunities.

- Increase the use of renewable water resources. Given the previously mentioned lack of diversity in TAMA's water supply portfolio, there is a heightened need for TAMA to fully use the supplies available to it. Stormwater and reclaimed water, key renewable water sources, are underused in Pima County.
- Maximize stormwater use. On average 1 million gallons of stormwater is lost for every one-mile stretch of residential street per year. In Tucson much of this water runs into the Santa Cruz River before flowing north where it is lost to use by Tucson. At the city and county levels, stormwater use can be maximized by designing streets and sidewalks to capture and transport rainwater to irrigate the landscape. It is possible to have pedestrian-friendly, lush streetscapes without the use of municipal water supplies. The building code and utilities and road development can incorporate various Low Impact Development (LID) principles.
- Maximize the use of reclaimed water. Effluent is one of Tucson's three primary water resources. Currently effluent use meets only about 5 percent of municipal water demand while the remainder is simply discharged to the Santa Cruz River

Channel, thereby leaving the Tucson service area with no means to legally recover it. Significant opportunities exist to increase the use of reclaimed water for nonpotable uses. In homes at least 20 percent of potable water used indoors is simply flushed down toilets, while 30 percent of potable water goes to landscaping. TAMA golf courses account for 10 percent of all municipal water use; although only 35 percent of this water use is met by reclaimed water sources. Key considerations here include ensuring that infrastructure is in place to allow individuals and businesses the option of using reclaimed water and providing economic incentives to promote its use. This may be especially critical to influence entities not required to secure renewable water supplies (e.g., agriculture, industry).

Table 4: Water Scenarios Based on Third Management Plan

	1998	2003	2025
Municipal Sector (Includes Exempt Wells)			
Total Demand	163,198	185,199	247,100
Total Supply	163,198	185,199	247,100
Groundwater	153,535	124,113	63,000
CAP	200	50,998	146,400
Effluent	9,463	9,811	37,700
Surface Water	0	277	0
Agricultural Sector			
Total Demand	94,809	102,959	54,200
Total Supply	94,809	102,959	54,200
Groundwater	70,862	85,617	41,200
Groundwater (in lieu)	22,947	17,342	10,000
CAP	0	0	0
Effluent	980	0	3,000
Industrial Sector			
Total Demand	57,544	47,430	75,400
Total Supply	57,544	47,430	75,400
Groundwater	56,844	45,721	70,700
CAP	0	160	0
Effluent	700	1,549	4,700
Indian			
Total Demand	100	14,196	16,000
Total Supply	100	14,196	16,000
Groundwater	100	788	200
CAP	0	13,408	15,800
Effluent	0	0	0
Other Demand Riparian	3,705	3,705	3,705
Total Demand	**315,651**	**349,784**	**392,700**
Total Groundwater Use	**308,013**	**277,286**	**188,805**
(Less) Net Natural Recharge	62,045	62,045	62,045
(Less) Net Incidental Recharge	81,972	43,257	32,516
(Less) Cuts to the Aquifer	2,341	8,362	45,200
Total Overdraft	**161,655**	**163,622**	**49,044**
Net Artificial Recharge	22,688	56,919	13,500

Figure 3. Water scenarios based on the Third Management Plan

- Enhance groundwater recharge. Channeling stormwater off the landscape and into treatment facilities, or allowing it to run off into the Santa Cruz River, results in the loss of that water to Tucson. Streets should be designed to channel water to groundwater recharge zones while simultaneously decreasing the burden on wastewater facilities. Alternatively planning for growth should encourage the use of pavement (impervious surfaces) in a way that will enhance infiltration to the aquifer. Plans to preserve sensitive recharge regions should prohibit impervious pavement in these areas.
- Explore and foster opportunities for integration. Foster and build relationships with other entities with shared priorities and objectives (see Figure 3). What opportunities exist in the transportation department to maximize the use of stormwater along streets, neighborhoods, and pedestrian districts? It is possible for wastewater entities to subsidize water conservation and stormwater management efforts to minimize the burden on sewer systems. Many efficiencies can be captured by working together.

Considerations for the State/Regional Level

Key policy considerations that must be addressed to prevent undermining Pima County's/Tucson's efforts at achieving sustainability with regard to water use and water resources include the need to assess the cumulative impacts of land-use decisions on water resources, engage sectors not required to use renewable water resources, and determine whether water savings from conservation will simply be reallocated or contributed toward long-term water use sustainability.

- Assess the cumulative impacts of land-use decisions. Given Pima County's arid nature and the resulting intimate relationship between land-use decisions and water-supply needs, a greater effort needs to be made to build stronger linkages between land-use decision-making processes and water-resources planning. To aid in this process, a greater understanding must be developed on questions surrounding the overall impact (current and proposed) of development in the region (watershed or aquifershed) on the water resources and, further, what the projected current and future costs to existing users might be (rather than evaluate each project one by one). Pima County needs to foster nascent efforts to bridge this gap by asking these questions earlier in the decision-making process (planning and zoning phase), rather than after a subdivision has already been planned for development.

- Engage sectors not required to use renewable water. In Tucson 52 percent of water use is attributed to municipal demand, while 30 percent is attributed to agricultural demand and 18 percent to industrial demand. The municipal sector, however, is the only sector required to secure renewable water supplies. Significant opportunities exist to achieve water savings in the other sectors, whether through the provision of financial/economic incentives to use graywater or reclaimed water or assistance in implementing water-conservation practices and technologies. Although this may call for investment up front, long-term cost benefits may be realized through future diminished needs to acquire additional water supplies. Further state-level legislation that allows the exemption of private wells and de facto subdivision created through lot-splitting are loopholes that will only continue to undermine regional efforts to achieve water sustainability.
- Determine reallocation or sustainability. Will water savings achieved through conservation efforts be contributed to overall regional water sustainability or allocated to support more growth? This is a critical question raised by the citizen participants and, if not addressed appropriately, will undermine public trust in the need for water conservation and sustainability. Many communities (e.g., Renewable Energy Mitigation Program in Aspen, Colo., and a lot-level water budget in Greeley, Colo.) in the West have attempted to address this issue through the development and use of energy or water budgets for either individual lots or the community as a whole.

In the next 20 years, TAMA's population will increase by approximately 40 percent. Given this, decisions on how and where Pima County will choose to grow will inevitably run headlong into water supply questions. Undeniably we all want a reliable source of safe, palatable, and environmentally benign water, provided to our communities not only today but long into the future. But the question remains: what can we do today to ensure enough clean water for future generations? The decisions that are made today and in the next few years will have critical and lasting consequences. By creating a political framework for communications and planning, thirsty Tucson will find the water it needs for the future.

TRANSPORTATION AND CONNECTIVITY

A sustainable transportation system is one that

- Allows basic access for all
- Offers a variety of transportation options
- Limits waste and uses energy efficiently

Transportation is linked to all aspects of community life. The natural environment, economic vitality, and community health and social well-being depend on transportation systems that are efficient, clean, and equitable. A sustainable transportation project analysis weighs equally transportation objectives, impacts on the environment, and impacts on community values, and may help avoid delay and other costly obstacles to project implementation.

Sun Belt or Road Belt?

An overarching question facing the Tucson region related to transportation sustainability is: How much longer and how much more new capacity will Tucson add to its existing road system?

Tucson should plan for increasing fluctuation in oil availability and prices. As fuel prices increase the costs of city services and the delivery of goods and services also will rise. The growing population and increasing number of commuters demands additional transportation options serving residential areas. Increasing these options will help remove the barriers to downtown residential and commercial growth and neighborhood connectivity.

Commuter Rail and Other Services

Pima County's Regional Transportation Authority (RTA) reports that over the next 20 years the population will increase by 54 percent, resulting in a 550 percent increase in severe travel congestion. The commuter population also is predicted to grow, especially commuters traveling north on I-10. The circles in Figure 4 indicate areas of projected high growth in employment over the next 20 years. Five distinct employment areas or employer clusters are projected to experience significant growth. Three of these areas could be served in the near term by high-capacity bus service or express

bus service. As Tucson implements its $2.1-billion RTA plan, keeping the door open to fixed transit service will be important. Key corridors for further study include Broadway and Alvernon Way (shown in Figure 4). Alvernon Way is a logical north/south corridor for study because its southern terminus is the Tucson International Airport, its northern terminus is newer housing developments, it passes through downtown commercial and higher-density residential areas, and transit ridership on this corridor is relatively high today. Tucson also should consider further study of a north/south commuter rail service that would support travel between Phoenix and Tucson and connect residential areas to the other two employment growth centers, along I-10.

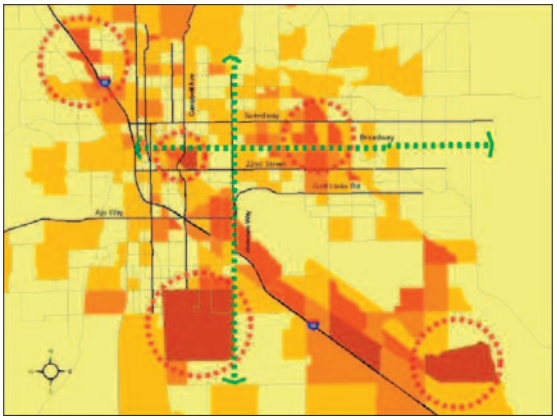


Figure 4. Tucson's employment growth centers and corridors

Connectivity

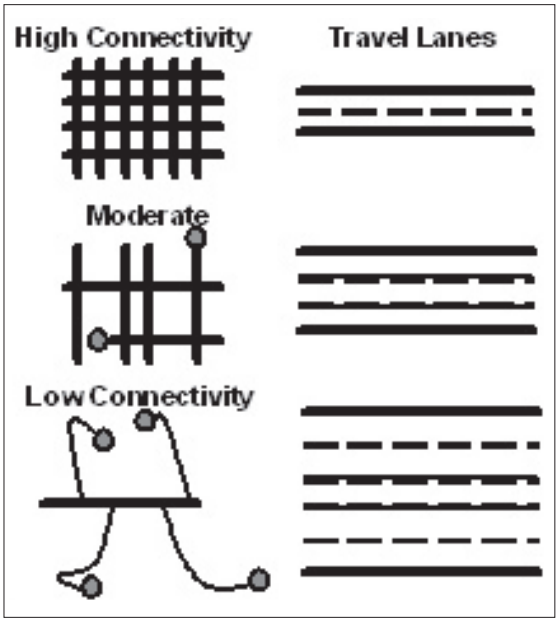


Figure 5. Transportation connectivity

Transportation connectivity can be defined as making the community's transportation system within and connecting commercial centers and neighborhoods safe and convenient for all area residents. See Figure 5 for a graphic representation of transportation connectivity.

A growing body of research compares traditional grid transportation networks with hierarchy systems of roads and streets or "superblocks," and discusses the benefits of grids for overall cost, health benefits, safety, walkability, traffic congestion, and resulting air quality and carbon dioxide levels. Recent studies have found higher traffic fatality rates in outlying suburban areas than in central cities and inner suburbs with smaller blocks and more connected street patterns.[1]

1 William H. Lucy and David L. Phillips, *Confronting Suburban Decline: Strategic Planning for Metropolitan Renewal* (Washington, D.C.: Island Press, 2000).

Tucson should prioritize connections between and within superblocks by making improvements, including

- Small street connections
- Pedestrian and bicycle connections
- Improved transit connections
- Addition of wider sidewalks, thereby narrowing some of the major arterials
- Medians (native vegetation)
- Roundabout/traffic circle intersection treatments

By implementing these changes, the city would return to a more traditional grid system that has been proven to be safer and more efficient.

Context-Sensitive Solutions for Tucson

Transportation projects are now being designed using a process that engages communities, commonly called context-sensitive solutions. This new approach weighs transportation needs, community values, and environmental goals on equal footing when determining a final project design. Transportation planners and engineers working with community members, from project inception through project delivery, is fundamental to this new approach to transportation project development.

The Importance of Roads That Fit In

One tool that will help the city provide more information and visuals to the community about what type of arterial is within their neighborhood (e.g., parkway, boulevard, avenue) is "typing" the thoroughfares within the city's urban growth boundary. Thoroughfare type is established based on the surrounding context and governs the selection of thoroughfare design criteria and configuration. Typing streets and thoroughfares will improve safety and ensure accommodation of the appropriate mix of modes for each context.

Figure 6 provides an example of how Tucson could incorporate the concepts of context-sensitive design into its current road and street standards. In addition to amending road and street standards, the city should require each transportation project to produce a clear and concise purpose and need statement prior to its inclusion in any local or regional transportation plan.

Urban Thorough-fare Types	Function	Max. Number of Lanes	Target Posted Speed	Intersection Spacing	Transit Service Emphasis	Median	Curb Parking	Pedestrian Facilities	Bicycle Facilities
Boulevard	Principal or Minor Arterial	4–6	35	to mile	Express with some Local	Required	Provisional	Sidewalk	No—Separated Trails and Limited Crossings
Avenue	Minor Arterial or Collector	4	25–35	1/8 to mile	Local	Optional	Yes	Sidewalk	Yes—Boulevard or On Street
Street	Collector	2	25	300 feet to 1/8 mile	Local	Optional	Yes	Sidewalk	Yes—On Street or Boulevard

Figure 6. Example roadway types for urban street standards

Roundabouts as a Congestion Strategy

Although they are not suitable for all intersections, roundabouts are being used in context-sensitive projects because they can offer some advantages over conventional intersections: increased capacity; reduced delay and related fuel consumption and emissions,[2] reduced conflict points, and elimination of signal maintenance. They can be attractive and fit into neighborhoods better, from an aesthetic standpoint, than traffic signals. Roundabouts have been proven to be safer than traditional signalized intersections.[3]

Modern roundabouts are yield-controlled. Motor vehicles must wait for a gap in traffic flow before entering the circle. Modern roundabouts require low speeds for entering and circulating traffic by design of small diameters and deflected (curved) entrances.

2 T. Redington, *Roundabout Topics: Findings and Trends from Vermont and Beyond* (Transportation Research Board, 2005).

3 R.A. Retting et al., "Crash and injury reduction following installation of roundabouts in the United States,"*American Journal of Public Health 91* (2001):628–31.

They also virtually eliminate wait time at intersections as vehicles are never required to stop. For safety as well as operating efficiency, roundabouts in urban settings should be designed so that the speed of all vehicles in the roundabout is no more than 30 miles per hour. If designed properly, roundabouts can be safer for bicyclists and pedestrians than signalized intersections.

Roundabouts as an alternative to traditional signalized intersections should be considered for all new and reconstruction projects and at intersections that currently present safety and congestion challenges.

Parking as a Congestion Strategy

Parking management is another approach to relieving congestion that does not involve constructing expensive new road capacity. Tucson should consider removing minimum parking requirements, even if only in selected parking control zones. Also, by offering developers opportunities to mitigate parking demand by investing in car-share programs, offering employee or resident transit passes, and implementing parking fees, parking can become a tool to help communities reduce traffic congestion.

Creating a Bicycle Commuter System

In 2004 Tucson was honored with the League of American Bicyclists' Bike-Friendly Community Award. Tucson's weather conditions and the public attitude toward biking and being active in the outdoors create an ideal circumstance for establishing a comprehensive bicycle commuter system. A bicycle commuter system or a network of bicycle facilities to serve people bicycling to work, school, or shopping might include

- A connected system of on-street bike lanes
- Separated paths through high-traffic or high-risk areas
- Bike stations at or near primary commuter destinations and modal centers
- Bike lockers and bike racks throughout the city (may be required in development standards)
- Informational kiosks, maps, and online tools to help cyclists find destinations, local bike shops, and other resources

- A community policing policy or a policy that supports law enforcement interaction with and education of the community to improve safety
- Bicycle police patrols
- A public service campaign aimed at bicycle commuters and motor vehicle drivers

Tucson has included wide shoulders on several streets throughout the city. Few of these, however, are marked and signed as bicycle lanes in accordance with the Manual for Uniform Traffic Control Devices (MUTCD). A relatively cheap and easily implemented first step toward a more comprehensive bicycle commuter system would be to mark and sign these shoulders as bicycle lanes, consistent with MUTCD standards.

Pedestrian Safety and Mobility

Pedestrian safety and mobility should be Tucson's top transportation priority in coming years. Strategic investments in pedestrian safety and mobility will produce the greatest return on investment as the city moves toward a more sustainable transportation system. One unique challenge the city faces is pedestrian-level lighting that is fully shielded and meets Tucson's dark sky requirements. Pedestrian lighting and medians are currently the most cost-effective means of improving safety and walkability.

Several manufacturers supply fully shielded pedestrian lighting that is approved by the International Dark Sky Association. Costs for these fixtures appear to be similar to the costs of other pedestrian lighting types. To enhance and extend downtown's vitality, Tucson should use pedestrian-level illumination along downtown corridors.

Studies show that people are generally willing to walk about 0.25–0.5 miles to transit and other destinations and wait about 30 seconds before attempting to cross the roadway. To increase pedestrian safety and convenience, Tucson should consider establishing a block size of 600 feet or less in commercial centers and providing a leading pedestrian interval (three seconds before the green light) or curb extensions at longer crossings.

As an immediate next step, Tucson should evaluate and prioritize locations with a known history of or high risk for pedestrian-involved motor vehicle crashes, especially those near schools or in areas with high populations of older road users. Consider pedestrian lighting, medians, and other low-cost improvements at these locations in the near term. In the longer term, pedestrian zones that are either car-free or give clear priority to pedestrian travel should be established.

Establishing Sustainable Transportation Indicators of Success

Tucson needs to set quantifiable, area-specific targets and performance measures derived from community safety, environmental, and health objectives. The city needs to anticipate transportation-related decisions' environmental and social impacts, rather than react to them after they have occurred. This will result in considerable cost savings because transportation decisions often involve costly, long-term infrastructure investments.

Several examples of quantifiable performance measurement tools commonly used for transportation systems and projects include the following:

Connectivity indexes

- The number of roadway links divided by the number of intersections or nodes—a higher index means travelers have more route choices.
- Average trip length—the distance community or neighborhood residents travel normalized by population or area (e.g., per capita or TAZ). This can serve as a land use–mix indicator and a transportation connectivity indicator.
- Intersection density—the number of intersections within a defined area (e.g., square mile, TAZ, other).

Project citizen input

- Design charrettes
- Visual preference surveys
- Stratified sample surveys

Goals for reducing carbon dioxide and air toxins

Pedestrian and bicycle safety measures

- Fatal and serious crashes per capita

By using these methods, the city can begin to prioritize projects that will create greater connectivity, reduce traffic conflicts, and help move toward a more sustainable transportation system.

Building Consensus, Building Trust, Moving Forward

Over the course of our discussions, participants raised several questions. It became clear that it will be difficult for Tucson to move forward until consensus across the community is reached on important issues. Tucson needs a deep, communitywide, inclusive conversation to come to a consensus regarding the Tucson region's future:

- How much population growth can Tucson accommodate? What is its capacity? How much growth do we *want*?
- What is it that we want to grow (e.g., population, jobs, the economy, quality of life)?
- Where should physical growth occur?
- What are our values as a community that should guide all of our decisions regarding development and growth?

As the community tackles these questions, all parties should recognize that it is in the best interest of everyone—citizens, business leaders, environmentalists, developers—to preserve Tucson's most important asset and economic engine: its quality of life. With this shared goal, it is possible to find common ground.

An Umbrella Organization for Civic Leadership

Many expressed frustration at a lack of concrete action in past planning efforts. There seems to be no identifiable civic leadership to take on the sustained effort needed to push ideas forward. We recommend that an *inclusive*, broad-based civic leadership umbrella organization be formed, one that represents all sectors of the community.

This will be difficult but it is imperative that this group comes together in a way that will allow it to be viewed as truly neutral and able to build trust between different community sectors. Many participants thought the city might be the best party to select the membership for this group. While city, county, and other government representatives should be in communication with this civic organization and participate in its meetings, there would be no official government membership in the group.

Not until opposing groups are able to come together around common issues will positive changes be possible. In Austin there was little ability to address environmental, economic, and community problems until bridges were built (through efforts led by

the mayor) between the Chamber of Commerce and the local Sierra Club, two powerful groups who traditionally were opposed to one another. Once all sectors began to pull together, the community was able to take significant, concrete steps on important issues. More formal organizations that might serve as models include Envision Utah and Partners for Prosperity in Washington State. In time as the Tucson organization becomes established and more formalized, a funding source should be identified that will allow a staffed office to provide support to volunteer efforts.

This group would be able to undertake several important activities:

- Take action. An identifiable party that will be responsible for moving things forward and seeing through ideas and action items that come out of community processes is clearly needed. This needs to be a nongovernmental civic group that is trusted by and can speak for the community and has the longevity for the sustained efforts that will be required.
- Serve as a forum for ongoing conversation. Many participants said that different groups don't have enough opportunities to talk to one another. An umbrella group can bring everyone together on an ongoing basis.
- Serve as a conduit and clearinghouse for information and discussion.
- Educate the community on the issues so that informed decisions can be made. Hold workshops, lecture series, and exhibits to build consensus around a regional physical vision. For instance, an exhibit that allows the community to explore the possibilities of the city's future physical form might be mounted through the University of Arizona, perhaps with a scale model of the region that citizens can manipulate to help them visualize planning choices' physical implications.

Addressing Sprawl

If Tucson wants to limit sprawl, it must be recognized that the public sector is currently an active participant in the development of its edges. Many current public policies and public investments are enabling this development:

- The county encourages development in new areas by permitting or building new roads, sewers, and schools. Although important

desert habitat admirably has been set aside through the Sonoran Desert Conservation Plan (SDPC), it appears that everything outside the conservation areas has been targeted for development. A planning effort similar to the SDPC should be undertaken but with expanded criteria beyond habitat issues—including infrastructure capacity, transportation linkages, retail and community services, walkability, jobs/housing balance, and affordability.

The county administration, the Tucson Department of Transportation, and other public agencies promise to "meet demand" without recognizing that this promise itself stimulates that demand. Developers are allowed to build in undeveloped areas, knowing that public services will be required to follow. A regional growth plan would allow public agencies to locate facilities in areas where development is desirable, rather than in reaction to unplanned growth. Many communities in other states use public infrastructure, such as sewer system tie-ins, to control where development occurs.

Consider adopting a regional adequate public facilities ordinance that will disallow development in areas that currently doesn't have the infrastructure to support it.

- Recognize that public investment in new roads, sewers, and schools on the fringes are dollars that are not being spent in existing communities. For example, if a community builds a beautiful, state-of-the-art high school far from town, while allowing aging central city schools to languish, it is no wonder that population growth occurs at the edge. Direct public dollars to areas where you want growth to occur.
- The requirement that high schools be built on 40- or 50-acre parcels makes it very difficult to build new schools in already urbanized areas. This policy should be reexamined or altered to create separate requirements for urban schools. There are clear advantages to educating students in a walkable, urban environment that is physically connected to the community and has convenient access to public amenities such as libraries, museums, and public transportation, that cannot be met on an isolated 40-acre parcel. Urban schools can be built more compactly, with a smaller floor/area ratio, less surface parking, and less need to provide facilities directly on site. This allows them to fit on smaller sites or on separate but contiguous parcels.

If Tucson is going to continue to develop on its edges, what best practices will minimize negative impacts?

- Coordinate planning decisions, particularly between transportation and land use. A systemic approach to planning, where decisions are made to work in concert toward community objectives, can lead to a healthier built environment, one that includes a mix of uses, diverse businesses and housing, walkability, and more usable open space.
- Build first on the land closest in; build where there is existing infrastructure. Rather than allowing development to leapfrog out into the desert, encourage compact, contiguous physical growth by targeting the closest-in parcels for development. Areas already served by infrastructure also should be prioritized over undeveloped land.
- Establish development patterns that will keep Tucson's transportation options open. Leave room for future transit lines, cluster development in "villages" around potential transit stops.
- Establish a network of streets and connectivity both within and between development areas. A network system is more efficient than a collector arterial system, which only leads to more congestion at intersections and road widening, as Tucson is experiencing. A finer-grain network allows traffic to be distributed over many, smaller streets, and is more easily navigated by pedestrians and bicyclists. Street right-of-ways and connections should be established before any development occurs, to preclude neighborhood opposition to through traffic.
- Revise the land use requirements for walls around development parcels. The current requirements, as applied to standard site design with setbacks that place buildings in the center of parcels surrounded by parking, only exacerbate barriers, disconnects, and travel distances. Tucson should take cues from its traditional architecture and use walls in conjunction with buildings placed at the edges of individual parcels to create private courtyards and screened service areas, while allowing permeability for pedestrians through public areas.
- Preserve desert belts and fingers to provide desert access. These should take advantage of natural drainage patterns, existing vegetation, and habitat corridors.
- Retain and build on a sense of place and a sense of community in new development. Tucson should be commended for preserving and celebrating its native landscape and desert views, in contrast to other desert communities.

The Houghton Area Master Plan offers the opportunity to demonstrate best practices, especially by preplanning and coordinating development at such a large scale. There is a concern, however, that the release of such a large area for development outside the city

will absorb the market for contiguous and infill development. Flooding the market also may dilute the ability to generate the highest income for the state's coffers. State trust land must be brought to market in a controlled, predictable, and well-planned way.

Encouraging Infill Development and Revitalization

As in many communities, we heard that in Tucson it is easiest to build in areas where it is least desired from the community's standpoint (on the edges) and most difficult to build in areas where development is desired (appropriate infill). If Tucson wants to limit sprawl and encourage infill, this balance needs to be reversed. Make it so the path of least resistance for a developer leads to targeted infill areas. To encourage infill development in these target areas, several obstacles to such development must be mitigated:

- Obstacle: Complicated land assembly for vacant parcels. A typical obstacle to development in urbanized areas is the availability of large-enough parcels. Many vacant parcels are under multiple ownerships. To encourage development of vacant areas where desired, the city can assist with land assembly, or proactively assemble development parcels, then control their development through a request for proposals (RFP) process.

- Obstacle: Longer, more complicated approval processes within the city, primarily due to more oversight and stricter requirements from the city than from the county, stakeholder involvement in the process, and neighborhood scrutiny and opposition. The city can help neighborhoods preplan targeted areas, and streamline the approval process for developers who adhere to the plan.
- Obstacle: Impact fees are higher within the city than outside the city limits. Impact fees should be retained but a regional fee structure is needed to level the playing field. As an incentive to develop targeted areas, fees could be reduced or eliminated for development in those areas. Conversely fees could be increased for areas in which development would have more adverse impacts.
- Obstacle: Higher construction and land costs. Frequently development costs in urbanized areas are too high for the market to bear. Land often is more expensive. Construction costs are higher due to more stringent building requirements and more complex staging. Infill developments often require more expensive infrastructure, including structured parking and street and sewer upgrades. The public sector can encourage desired infill development with land write-downs, gap financing, and tax increment financing (TIF) to provide necessary infrastructure, street improvements, and structured parking.

NEIGHBORHOOD INFILL

Tucson is experiencing rapid change and growth. How the city and region should grow, however, is the subject of widespread debate. Residents who have called Tucson home for decades fear losing the intrinsic qualities that make their neighborhoods unique. Concurrently regional market pressure has expanded the boundaries of Tucson far beyond its beginning as a small town. When rapid growth lands in established neighborhoods, the debates heat up. Density, parking, affordability, design, and conflicts between new and existing residents become rallying points for fighting development and subsequently sustainable growth that is focused on existing infrastructure. For Tucson to truly exemplify a sustainable city, sustainability needs to recognized and encouraged "from the ground up."

Sustainability as an Act of Civic Regionalism

Sustainability, as the term is commonly used, incorporates a network of complex systems that are affected by decisions made well beyond the scale of an individual neighborhood. Water, energy, and transportation are critical issues that require coordination at a regional level. Sustainability is much more than an environmental issue, however. True sustainability also takes into account social, political, and economic factors that drive growth and development decisions.

For this reason, the SDAT views sustainability as an act of "civic regionalism." This approach recognizes that change happens from the top down and bottom up. In this model, regional coordination, planning, and policy are coupled with grassroots efforts to improve neighborhoods. Success stems from strong leadership and grassroots activism that leads to neighborhood sustainability.

Neighborhood sustainability encompasses six interlocking goals:

- Build neighborhood empowerment and capacity
- Encourage economic and social integration
- Build green
- Reduce automobile dependence
- Promote walkability
- Grow up, not just out

Build Neighborhood Empowerment and Capacity

A key element in building effective and sustainable grassroots activism is ensuring that the capacity exists for neighborhoods to undertake planning and implementation on their own terms. Civic associations and nonprofit organizations can raise funds that public agencies cannot. The strongest cities are born of a successful collaboration between forward-thinking city leadership and active community organizations that bring additional dollars, people, and knowledge to the table to effect change.

- Bring together a neighborhood council. Neighborhoods have varying levels of capacity and knowledge. Many neighborhoods also share similar issues and concerns. An effective means to help neighborhood leaders learn from one another is to form a citywide neighborhood council. The council would serve as a forum for communities to share information and more effectively express community concerns to the city in a unified voice. A neighborhood council can bring added perspective and creativity to the decision-making process and help city leaders better understand the needs of local communities. A neighborhood council also would serve to provide stability, regardless of changes in individual community or city leadership. With a focus on collaboration, the council should comprise not just neighborhood leaders but also representatives from a wide range of organizations that directly and indirectly affect neighborhood health, including realtors, developers, lenders, business owners, and city and county staff. The council also should set a strong agenda and form subcommittees to coordinate solutions to a wide range of common neighborhood issues, from stormwater management and greening to improving neighborhood-serving retail and local safety.

- Develop meaningful neighborhood and subarea plans. As in many other cities, Tucson has yet to find the right mix of public leadership and grassroots planning. Because few comprehensive neighborhood plans exist, implementation is uncoordinated and, at times, lacking a long-term focus. In an age of shrinking resources, planning with strong community guidance is more important than ever. Each neighborhood should be encouraged to undertake its own specific, comprehensive neighborhood plan. This will help to build capacity and pride among residents about their community and its future.

  The community plans should become templates for investment decisions, identifying where city funds would be best used to maximize impact and leverage other dollars. The plans also should identify the community's expectations for new public and private development and articulate a clear community review process for development plans. The result will be a transparent community development review process, understandable to the city and developers.

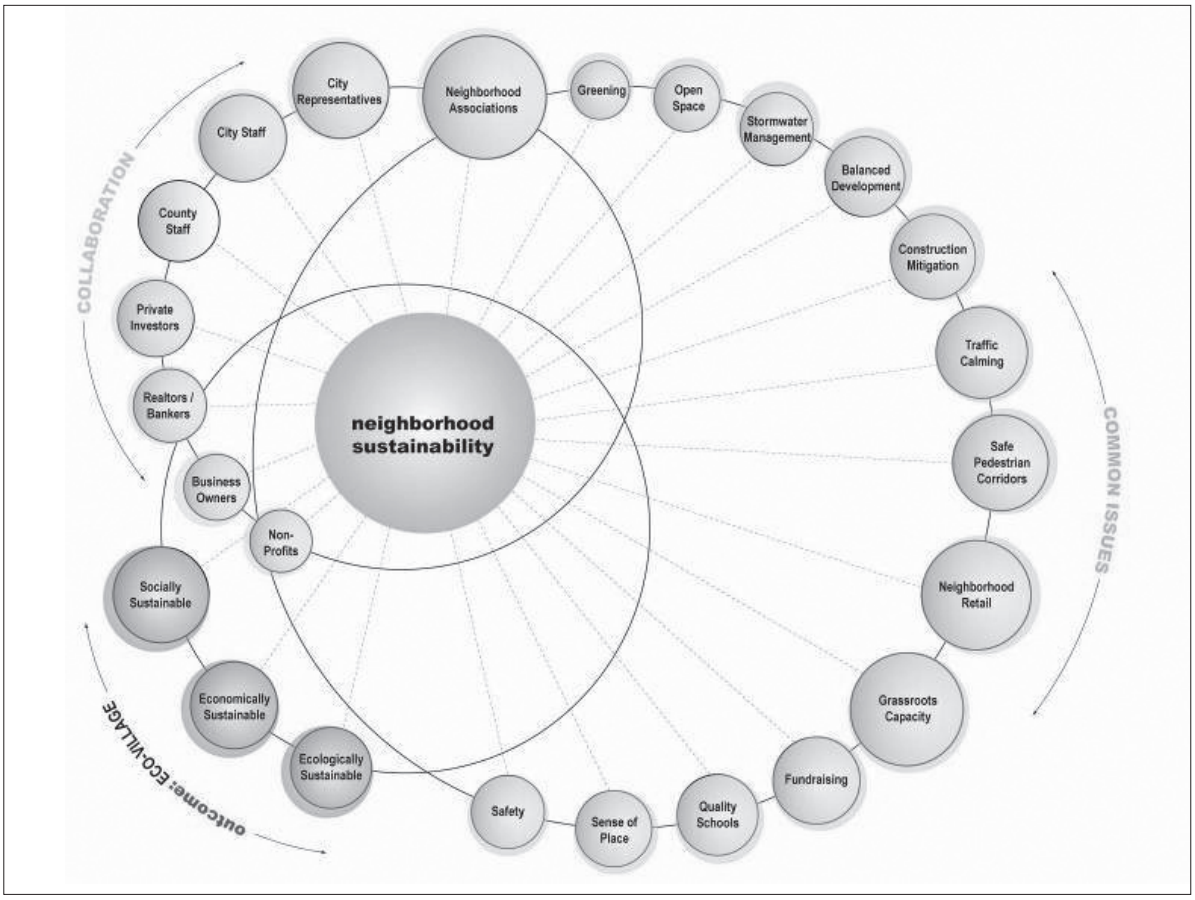


Figure 7. Neighborhood sustainability through collaboration

A key observation about actively promoting neighborhood planning is that not every neighborhood is ready to plan. Some communities lack capacity, while others lack dollars to hire assistance for planning. Promoting neighborhood planning is a process that needs to evolve. Communities with existing capacity can and should be the first to move forward with this effort. The city should assist three or four neighborhoods in preparing comprehensive plans as a first step in this process.

- Create a neighborhood planning challenge fund. To further promote neighborhood planning and build capacity, the city and its partners should create a planning challenge fund. The fund would provide grants for neighborhood planning and subsequent dollars for implementation after the plan is complete. Philadelphia's Wachovia Regional Foundation, for instance, provides $100,000 neighborhood planning grants and implementation grants of up to $750,000. The funding would be competitive with the intent of funding the most comprehensive proposals that meet the requirements.

- Create a community design center. Architects, landscape architects, planners, and other related disciplines need opportunities to engage with community groups and residents outside the boundaries of a traditional project. At the same time, community groups greatly need to rely on and trust the skills of these professionals. A community design center should be created that links these professionals to community groups on a pro bono basis. A program of this nature in Tucson is currently beginning and already is popular. In other cities, the local AIA component spearheads such organizations and links willing professionals to community groups for specific projects such as the conceptual design of a park or community building.
- Raise awareness and educate the public. Many neighborhood leaders would simply benefit from having a true liaison to the city to understand the range of services, funds, and assistance available to help their communities. The city should create a neighborhood ombudsman, with the ability to pull together and coordinate the resources and information necessary across all city departments to help communities help themselves. The University of Arizona's Neighborhood/Regional Design Center is another resource that could help neighborhoods get a jump start on planning. The center could use students to map key indicators and arrange a community database of indicators that illustrate the state of each neighborhood.
- Build neighborhood pride. Every neighborhood has a story to tell. Tucson's stories should not go unnoticed any longer. Improvements to key neighborhood gateways and new signage that identifies and brands neighborhoods will help to reinforce neighborhood boundaries, histories, and pride in Tucson's diverse communities.

Encourage Economic and Social Integration

Environmental sustainability stems from economic and social sustainability. Sustainability, as a practice of building healthy neighborhoods, should strive to integrate the patchwork of different ethnic and economic backgrounds. This will entail thoughtful and proactive policies as well as a diverse physical environment to capture the widest range of families and lifestyles.

- Build for a mix of incomes. Market-rate housing is a key ingredient to Tucson's neighborhoods, yet lower-income families' access to housing opportunities is just as important. In neighborhoods that already have or promise to soon have a strong housing market, affordability should be built into communities through two policies: an inclusionary housing policy and reverse mortgages.

Through an inclusionary housing policy, the city should advocate for mixed-income development (for projects of 20 or more units) that blends market-rate units with an established percentage (10 percent) of units set aside as affordable for renters or buyers earning equal to or less than 80 percent of the area median income. With regard to reverse mortgages, Mortgage assistance often is available to qualified elderly households through a deferment on paying increased taxes until their property is sold. Some cities have extended this policy to all low-income households, which helps them to remain in place regardless of rising housing costs in their neighborhood.

- Encourage a diverse housing stock. Nationally the housing market for the past half century was based on the traditional family—married parents with children—which resulted in a boom in single-family detached homes, mostly in suburban areas. A growing number of families, however, are looking for housing options other than the standard single-family detached home. Interest in single-family homes on smaller lots, town houses, apartments, lofts, and condominiums has spiked. Tucson needs to be proactive in promoting and encouraging a diversity of housing products, keeping in mind that housing must offer choices for all families, regardless of race, income, age, size, or physical disabilities.
- Sponsor neighborhood festivals and events. Small-scale, regularly scheduled events create spaces in which community identity can be formed and flourish. Just as participation in community meetings grows over time, regular community events can nurture the community atmosphere that is needed to bring about real neighborhood change. Events are ways to transform each neighborhood from a place to a destination by attracting commuters that regularly pass by the individual neighborhoods that collectively comprise Tucson, without knowing or appreciating their unique qualities.

Events are also a way to embrace and celebrate growing racial diversity. Tucson should seek opportunities to open dialogue between groups of different backgrounds through cultural events and festivals. These events also can be used as an opportunity to market the city, as they may draw attendees from various locations. Examples include street fairs that focus on a particular ethnic group; cultural awareness days that involve schools where the day's activities and teachings are focus on one particular group to understand their traditions, dress, and foods; and the establishment of a diversity roundtable or forum to provide regular opportunities for dialogue regarding issues faced by various racial and ethnic groups.

- Create a Youth Advisory Council. Tucson's youth population will continue to grow as more people choose the city as a place to raise their families. The preservation of the city's traditional role as a place of tolerance, diversity, creativity, activism, and sustainability relies on the transmission of those values to community youth. To ensure that sustainability will play a continuing role in how residents and leaders guide Tucson's future, youth must play a role now in communicating their values and concerns regarding Tucson's environment.

A citywide Youth Advisory Council should be created to add depth to outreach activities and planning with regard to development and sustainability. The youth council would communicate city youth's local concerns, interests, and activities to neighborhood and city leaders and further serve as a source of imaginative and innovative solutions to key neighborhood issues. As active participants and emerging leaders, the young are apt to develop the neighborhood pride and sense of identity shared by adult residents. Further, membership in a Youth Advisory Council would give kids an opportunity to work on a productive project outside of the classroom setting, help to strengthen their individual identity and skill sets, and give them access to mentors and contacts who could become valuable partners in creating future opportunities.

Build Green

Decades ago the terms green and low-impact development were rarely used in the context of design or planning. Green or low-impact development is oriented toward reducing development's environmental impact while reducing energy consumption and promoting healthier communities. Using Energy Star appliances and recycled materials, limiting construction waste, effectively managing stormwater runoff, and building walkable neighborhoods are key objectives associated with growing green.

- Expect green development throughout Tucson by enacting a green building ordinance. A growing number of cities expect development to be environmentally responsible, and the initial fears that green development could not be done affordably have subsided. A study in 2006 by New Ecology Inc. and the Tellus Institute found that green projects cost, on average, 2.4 percent more to build but that occupants save an average of $12,637 in utility costs over the life of each home. The benefit to the occupants reinforces the larger communal benefits, including a reduced strain on local infrastructure

and enhanced neighborhood pride that stems from a green and attractive environment. Jurisdictions including Chicago (now known as the greenest city in the United States); Boulder, Colo.; Oakland; Berkeley; Portland, Ore.; and Arlington County, Va., have legislation in place that either requires or promotes green construction. Tucson should create a green building ordinance that requires all new public buildings be built to LEED silver standards; converts all city passenger vehicles to hybrids; requires green design as part of city-funded affordable housing developments; and promotes green design in the private market through a green checklist, developed and maintained by the city, for use by developers

- Develop a handbook to retrofit existing homes. Tucson's climate and housing stock are unique. Most of its homes were not built in an era of environmental responsibility but, in light of growing concerns about local energy and water use, strategies must be developed to retrofit the existing housing stock into more energy-efficient models. The city, along with the University of Arizona's Neighborhood/Regional Design Center, should develop a manual that collects research on materials, system upgrades, costs, and other strategies to significantly reduce the energy and water used by a typical Tucson home.
- Offer subsidized upgrades as a part of city repair programs. Tucson offers many programs that provide residents with basic systems repair and residential rehabilitation. In the context of these repairs, additional upgrades such as new windows, white-coated roofs, and composting toilets should be considered to improve homes' energy efficiency. The short-term increase in costs on a per-home basis will be balanced by long-term savings to both the city and the residents in their utility bills. Federal dollars such as community development block grants can pay for these upgrades for low-income families. A funding source with more flexibility, however, should be used to encourage middle-and upper-income households to make similar upgrades. In the case of these households, the monies would be used to subsidize improvements and not pay for them outright.

- Consider a housing trust fund for sustainability. Many cities have created or are creating housing trust funds to flexibly fund local priority projects. The fund could be a source of funding that can, in some cases, provide assistance without regard to income in order to stabilize or jumpstart a market or attract middle-income homeowners. Other localities have used deed stamps or other real estate transactions to produce trust fund income. Once in place, the city should consider earmarking some fund proceeds for growing green by writing down the cost of green affordable housing or encouraging the private market to lead by example.

Reduce Automobile Dependence

Reducing traffic and greenhouse gas emissions and improving residents' health are all related to the goal of reducing automobile dependence. People will not give up their cars in the near future but, where possible, city organizations and their partners can promote alternatives to driving. Neighborhoods should be multimodal and offer transportation choices to all families.

- Promote car sharing. Car-share fleets are taking cities by storm, providing an affordable, accessible alternative to owning a car in the city. Zipcar, PhillyCarShare, and similar organizations rent hybrid cars and allow easy membership by any resident. In Philadelphia PhillyCarShare has eliminated 7,000 cars from city streets, reduced members' driving by 53 percent, and saved them $4,000 annually. A similar service would help provide flexibility in Tucson.
- Create a strong bicycle network and culture. Some Tucson streets are beautifully landscaped and outfitted with designated bicycle lanes. Many others are wide expanses of pavement. There is already a strong bicycle culture in Tucson, which could be strengthened by more attention to cyclists' needs. Bicycles should be welcome on every street and facilities for cyclists should be created, including bike racks and, in downtown or near the University of Arizona, bicycle stations. A full bicycle network should be mapped and improved in phases to encourage more cycling.
- Evaluate the possibilities of neighborhood electric vehicles (NEVs). In warmer climates like Tucson's, NEVs can provide a supplementary means of transportation for short trips within a community. Playa Vista, Calif., instituted these as a part of its development. NEVs reduce emissions, occupy smaller parking spaces, and save their owners the money and gasoline that typically would be used for short trips to the store or café. Promotion, awareness, and education of NEVs' costs and benefits are needed to encourage the market to use them in Tucson.

- Consider creating a community-based transportation service. Tucson transportation faces a "perfect storm." The overwhelming majority of residents drive, there is a gap between job locations and affordable housing, and the existing bus system's hub-and-spoke model greatly extends travel times. A lack of effective transportation options significantly reduces families' housing choices. For this reason, Tucson should work with local partners to explore the possibility of creating a community-based transportation service. The service would use vans that operate on demand. Many cities have started similar programs and enlisted local corporations to subsidize fares for lower-income families.

A first step would be to undertake a community-based transportation plan to identify the full needs and options available for addressing service gaps. California's Metropolitan Transportation Commission provides a good model for the planning process (www.mtc.ca.gov/planning/cbtp).

Promote Walking

Urban neighborhoods are unique because of their density, diversity, and walkability. City residents should be encouraged to walk and explore. For this to happen, Tucson needs to emphasize urbanity and pay attention to pedestrian needs.

- Make urbanity legal. It was made clear during our visit that some of the places in Tucson most valued by residents are now illegal according to the zoning code. Building to the lot line, promoting outdoor seating, requiring façades with activity and transparency, and placing parking in the rear are basic urban principles that encourage walkability and should not be illegal. The zoning code should be adjusted to accommodate these characteristics or alternatively an overlay zone for key urban districts should be considered to allow density and a mix of uses in urban site design.
- Make the zoning code more user-friendly. A graphic appendix to the zoning code, that uses drawings and photographs to describe its requirements, should be considered. Many people think the code is too difficult to digest and debate. A community resident should be able to understand the code as easily as a seasoned developer, if we are to plan for a walkable Tucson.
- Promote and encourage active street fronts. Related to the zoning code, the city and neighborhood organizations should encourage developers to open their development to the street. Tucson's development climate needs to pay closer attention to the on-street experience in site and building design.

- Create design standards for fencing and walls. One of the greatest impediments to walking in Tucson is the proliferation of walls that line not just gated developments, but buildings of all shapes, sizes, and uses. Although walls provide the privacy residents are looking for, they should be approached with imagination, creativity, and environmental sensitivity. The city should consider creating design standards for these walls to transform them into "living walls." A living wall should be landscaped and designed to help manage stormwater runoff. At times these living walls could also be viewed as local expressions of identity through public art. The city may also want to consider sponsoring a national design competition to develop a range of ideas for retrofitting existing walls into more attractive and engaging urban elements.

Grow Up, Not Just Out

Tucson is expanding and, despite active regional planning, continues to sprawl. With increased time spent in traffic and national interest in living in cities growing, Tucson should plan for new growth in established neighborhoods. Density should be encouraged but in ways that understand the city's underlying characteristics:

- Protect residential cores. Tucson's structure is based on a one-mile grid. Each element of the grid contains individual communities and varying local streets. Within the center of each one-mile tile exists a core residential area that should be protected. This "sweet spot" offers a density and quality of life into which a majority of residents have bought and invested. The city must work with neighborhood groups to manage development in ways that augment and reinforce this environment.
- Encourage higher densities along major corridors. The major arterials surround each residential core. Each arterial represents significant opportunities to grow upward. With nationwide increased interest in condominiums, apartments, and lofts, arterials are natural places to focus this investment and further support ground-floor retail use. Careful attention should be paid to the transition between these dense arterials and the residential cores. A true capacity study should be undertaken for the corridors and downtown, including a visual model to be prominently displayed in the planning department or public library.

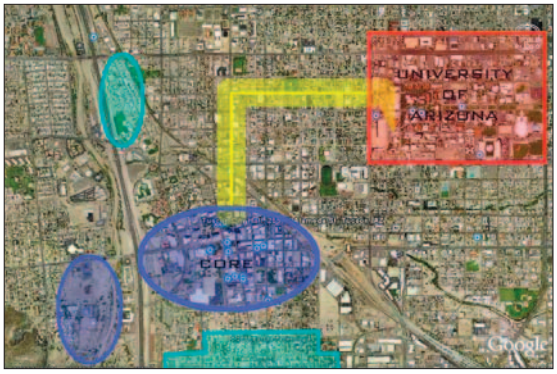
- Build for transit. The concept of transit-oriented development (TOD) builds density and a mix of uses around rail stations. Tucson's current transit consists of bus service, with plans for fixed-line trolley service. Both of these systems incorporate stops at every corner. Thus TOD in Tucson is less a point and more of a line. In other words, to truly make transit successful, corridors for which transit service is planned should be built up to the highest densities, along the entirety of the trolley line. This will not always be possible due to existing constraints but increasing density will grow ridership and support more local services, making these neighborhoods diverse and walkable.

DOWNTOWN

Defining Downtown

Downtown Tucson is composed primarily of large civic and government blocks. These superblocks separate the street grid and create pedestrian barriers. Although few of the elements of a much smaller, historic street grid remain intact in areas like Congress Street, hotels, small clubs, and a struggling commercial district remain. A new transportation hub and restored depot will create new entry points to the downtown district upon completion.

Residents enter downtown through several connecting streets. The first noticeable residential connections to the core are two neighborhoods to the north and south. North Main Avenue is composed of high-end single-family residential homes, while South Tucson is composed of mixed-use areas with small commercial and residential uses. The next connections, not as easily accessible by pedestrians, are the West Tucson area across I-10 and the University of Arizona area across the railroad tracks.



The university area could make a significant contribution to downtown's diversity and character. Immediately upon crossing the railroad, there is a dramatic change in the character of the streets and commercial districts. The railroad, I-10, and large street corridors that run through downtown are challenges to a vibrant and connected community. Connections to the city and the creation of a strong multiactivity, 24/7, Main Street culture should be addressed aggressively in order to create a more sustainable downtown.

Organizing Elements

Downtown Tucson grew out of the need for civic and governmental organizations. These large-scale buildings, isolated from the commercial district, damaged the downtown planning process. The city's geography funnels drivers to the north and converges with the railroad and I-10, while the south pathways open up toward the suburban districts. The University and West connections seem to be the most desired for creating a stronger downtown but also the most difficult to achieve because of the barriers. The railroad is the primary barrier.

Focus should be given to strengthening the downtown grid by improving the existing infrastructure's walkability. Models such as East Congress Street and Pennington Street should be encouraged throughout downtown's core.

The best organizing elements for downtown are the linear elements such as boulevards and the new streetcar. The streetcar has great potential and should be used daily, with extended hours for people who are going downtown in the evening. Boulevards are great movement organizers, as they allow vehicular and pedestrian movement to coexist, while allowing trees, lighting, and other infrastructure to maximize the use of the city's right of way. These linear elements can be enhanced and walkability encouraged by the use of inviting sidewalks, trees, open public spaces, storefronts, public art, and lighting similar to the new walkways and streetscape towards South Tucson.

Connectivity Weaving

Downtown unification will require aggressive connectivity. The bridging and linking of existing amenities are crucial to the success of a sustainable downtown. Creative elements such as the "snake pedestrian bridge" should be encouraged in order to invite and encourage connections. Look for pockets and nodes of opportunity for development and promote commercial infill near funded public projects. This is also crucial to prevent downtown from sprawling out beyond a walkable area. Weaving a walkable grid back into downtown also will encourage infill opportunities and disperse vehicular traffic throughout the downtown area. Historic maps of downtown areas typically show a more dense and walkable street grid; this can be used as a guide to reconnecting the current grid. Alleys often are a forgotten element of the street grid that can provide vast opportunities for rediscovering lost space. These alleys often are the most creative uses of downtown areas.

Infrastructure

Part of Tucson's sustainability will grow out of using the existing downtown infrastructure. If Tucson can build up (infill) and not out, it will maximize the benefit for the cost of existing and new infrastructure. Codes and zoning regulations should encourage and reward development that tackles difficult infill sites. Above-, below-, and at-grade infrastructure is important to create a functional, high-density downtown block. Just as floors, walls, and ceilings create a room in a building, so should sidewalks, storefronts, and trees build an urban space. Communication between utilities and planning departments should be encouraged and strengthened as necessary to recognize opportunities for reconstructing streetways when utilities are installed.

Urban Zoning and Codes

To blend into historic downtown trends, zero lot-line zones and zero parking requirements should be allowed in high-density areas. Downtown zoning and in some cases code exceptions or variances should be explored in order to create and maintain a dense population in the downtown core. Fire districts and historic classifications should be studied in order to allow new developments to be created and encourage serving downtown's needs. A survey of existing historic building stock should be done to gain an accurate perspective on infill opportunities. In some cases exclusion of fire district areas should be considered to encourage residential developments. Review boards and public participation in projects' design phases also help to create projects that will serve the community and create a successful project.

Tucson should prepare a sustainable overlay code or guideline for downtown projects to promote green buildings that use less energy. Cooperative projects in dense areas should be encouraged, such as joint utility through steam or cogeneration.

Big-Block versus Micro Development

Big-block developments tend to lack the human scale element. Large-scale parking blocks also lack the human scale or allow for pedestrian movement. Tucson should avoid big-block development in the future because there are many examples of these in existence already. Microdevelopment can add infill and character to the downtown area. Examples of infill are located on West Congress and throughout downtown. This works because small businesses can afford to exist downtown and more small businesses create diversity and interest along the street edge. Surface parking lot edges and garages' pedestrian levels could be opportunities for storefronts or microretail. Sacrificing parking at the pedestrian level would be worth several times over the gain of a walkable and interesting street edge. Consolidating surface parking to the interior of a big block and allowing new parcels on the perimeter would allow new development opportunities and create a walkable edge with buildings or cart vendors. Microdevelopments begin to create the weaving effect to knit the community and big blocks together, thus creating a more dense and sustainable downtown.

Lost Opportunities

Development opportunities downtown are vast, as shown in the diagram. There always will be obstacles to core development, and it will take a close public/private partnership to overcome these. An infill study of the downtown area should be done to determine capacities and strategies for residential and commercial infill. Parking often is a prime obstacle and can be addressed by on-street parking, garage, and timesharing agreements. The importance of infill cannot be stressed enough; it will add character and activity on the street that creates a safe environment in which to live, work, and play.

Some good examples of infill exist in Chattanooga, such as the Bijou movie theater, which has eight screens with activity on the ground floor and five parking levels of parking above it. It also contains an alley that was converted into a retail area that is now downtown's busiest lunchtime destination. Chattanooga's downtown community has maintained income diversity through programs such as artist grants to encourage home ownership and diverse downtown neighborhoods. Other grants were created for school teachers, police, and other low-income citizens who are community assets but otherwise would not be able to afford a home downtown.

Caption-Figure 8. Lost development opportunities within downtown Tucson

Promote and Communicate

Marketing and activities should be an aggressive part of the downtown community. Many communities have created businesses that have a mission of keeping downtown active at all times. Concert series, open houses, festivals, and many other activities create a vibrant and active place to live. Public and private funds and cooperation are crucial to make an effective campaign for a downtown community.

Arts/Culture/Activity

Interpret, celebrate, remember, and treasure Tucson's unique culture. This is the springboard to creating a community that appeals to everyone in the Tucson area and around the region. The community's common thread exists, it just needs to be cultivated and encouraged to come together. The absurd example of the SDAT team's proposed "running of the Javelinas" based upon Pamplona's running of the bulls was used in the slide presentation to show the unique heritage of Tucson. When compared to Spain's Running of the Bulls it does not seem so outrageous. Many communities have created public policies that encourage the creation of cultural interpretation and celebration. The Tucson arts district should be encouraged

and promoted. Each district, area, or street should have its own culture and flavor, celebrating Tucson's diversity.

District Character

An area's residents should have some ownership in their district and take pride in their surroundings. This will encourage a clean and well-respected district that is unique in its own way. This is most common in historic districts, but it is also noticeable along North 4th Avenue. This activity should be encouraged through the funding of local art, public art, and regional diversity.

Partnership and Leadership

Some of the most successful communities have strong public and private partnerships. These partnerships can range from pilot construction projects to public festivals. The community will need to establish what areas to focus on and are in the greatest need of this type of collaboration. Everyone needs to be involved. Some areas that would benefit are outside developer coordination, local business expansion and encouragement, minority engagement, and general business guidance. Core downtown areas tend to be cumbersome to navigate and the more help businesses and developers can get the more progress can be made. If the city and existing private leadership can assume this role, it will be able to guide development in the right direction to ultimately create the downtown community that Tucson desires.

Persevere

It will take a consistent effort from everyone to bring about a vibrant and sustainable downtown. Chattanooga introduced the concept of an aquarium 20 years ago to stimulate the rebirth of its downtown. This idea was met with great opposition and without leadership, funding, courage, and determination Chattanooga would be a historic steel factory town, living in the suburbs. It now boasts a booming tourist economy and a downtown community that many people want to join. The diverse culture and 24-hour activity creates an exciting and vibrant downtown in which to live, work, and play.

MOVING FORWARD

Tucson has the elements of planning, commitment, and initiative for sustainable development and growth. The next steps will require continued strategic planning. The Alberta Urban Municipalities Association's *Comprehensive Guide for Municipal Sustainability Planning (2006)* includes a process for implementing change and tracking success. By "backcasting," or identifying end results, the city can begin to provide a path and process for change and indicators of success. The SDAT report will remain simply a document unless it initiates action. What is the expectation for change, and what are the levels of involvement that need to be identified, individually, locally, in the county, state, and region?

Personal commitment and neighborhood changes will occur if there is development of an implementation framework and continued openness by the planning department to neighborhood input. Individuals are responsible for their personal actions: changing light bulbs, meeting neighbors, using cars less, and walking more. Neighborhoods are places for information networks—the geometric cell that connects to the larger issues affecting personal choices. Individuals and neighborhoods should look for support from government and develop tools with incentives. Change should be recognizes and rewarded and training and mentoring programs should encourage future leaders for long-term initiatives.

Some issues are at different scales of processes and policy. Coalition building will occur at the city and community levels and engagement in the political process at the state, national, and global arenas. Education, dialogue, opportunities for involvement, and advocacy are broader and slower processes for change. The region has identified major issues that are of concern—land use, water use, uncontrolled growth, transportation, and affordability. Who will be responsible for identifying the path to progress? Who will initiate the difficult conversations and meetings with other communities, developers, legislators, and citizens? What will be the indicators of progress?

The municipal guide identifies five phases for success in Alberta; these phases also can be applied to Tucson's development:

1. Structure the planning process. This is a step the city and county have already begun, through their appointment of sustainability and green building staff. A meeting to continue this dialog is scheduled for fall 2007, at which time continued discussion of planning structures will begin to be developed. Assigning individuals to monitor and create process is important at all levels of planning, from neighborhood groups to regional initiatives.

2. Create shared understanding of sustainable community success. Community meetings such as the SDAT begin to provide forums for discussion. A central site for information should be established, such as a searchable Web site, and regular dissemination of progress to all segments of the society, such as a column in the newspaper, cable access programs, or eNewsletters. In addition care should be taken to provide multilingual information for dissemination. The Tucson Office of Conservation and Sustainable Development's recently published Sustainability Report 2006–2007 is available on the Web and is a good example of documenting success.
3. Analyze issues to community success—what will the strategy look like if success is achieved and what is the current reality? Recent development of the water management plan began to backcast the reality of water use. How large will Tucson's population have grown 100 years from now, and how much water will domestic, agriculture, and industry uses require? What is the vision of success, and who needs to be engaged in achieving this vision?
4. Identify initiatives to move from the current reality towards success. In particular generate sufficient economic and political return, with a foundation to seed future investments of time and money. Keeping an eye on the goal requires continued long-term development of incentives and rewards as well as reprisals. The punishment for failure does not have to be legislated, it will occur when the last drop of water leaves the tap or the last barrel of oil is consumed.
5. Create ongoing monitoring and implementation. Measuring change through indicators of success and/or failure is important. Thinking outside the existing structures for development might include new models for development. For example, Detroit has created a nonprofit economic development team to knit together pieces of the community that might otherwise be unable to move quickly through its existing bureaucratic process. As technology, talent, and innovations increase over time, new methods will be discovered to change the equations for energy, water, and power. Constant vigilance will provide both a means to celebrate accomplishments as well as provide incentives to reach new goals and find new processes for change.

Key Recommendations for Change

- Create indicators for personal home initiatives for energy savings and provide education as to water conservation and solar opportunities
- Define growth—analyze the city's infill capacity in a true capacity-planning exercise; open a serious, data-driven review of water policy statements and management plans
- Initiate neighborhood coalitions through challenge grants
- Create and fund an inclusive planning process
- Focus on downtown development
- Complete bike path linkages and opportunities for transit-oriented development
- Support the Office of Conservation and Sustainable Development, the county's sustainability initiatives, and the Sonoran Desert Conservation Plan
- Encourage the adoption of a green building code, providing case studies of water resource management best practices

In its SDAT application, the Tucson team identified as its goal "that the community collectively come together and formulate a plan for the future development and growth of Pima County and the City of Tucson." More than 200 members of the community met with the SDAT over the three days of the visit. The SDAT provides in this report our snapshot of the issues, which are challenges to sustainable growth in Tucson and possible strategies for change. Tucson is well on the path to sustainability through its continued commitment to leadership in the preservation of this extraordinary high-desert environment and diverse community.

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