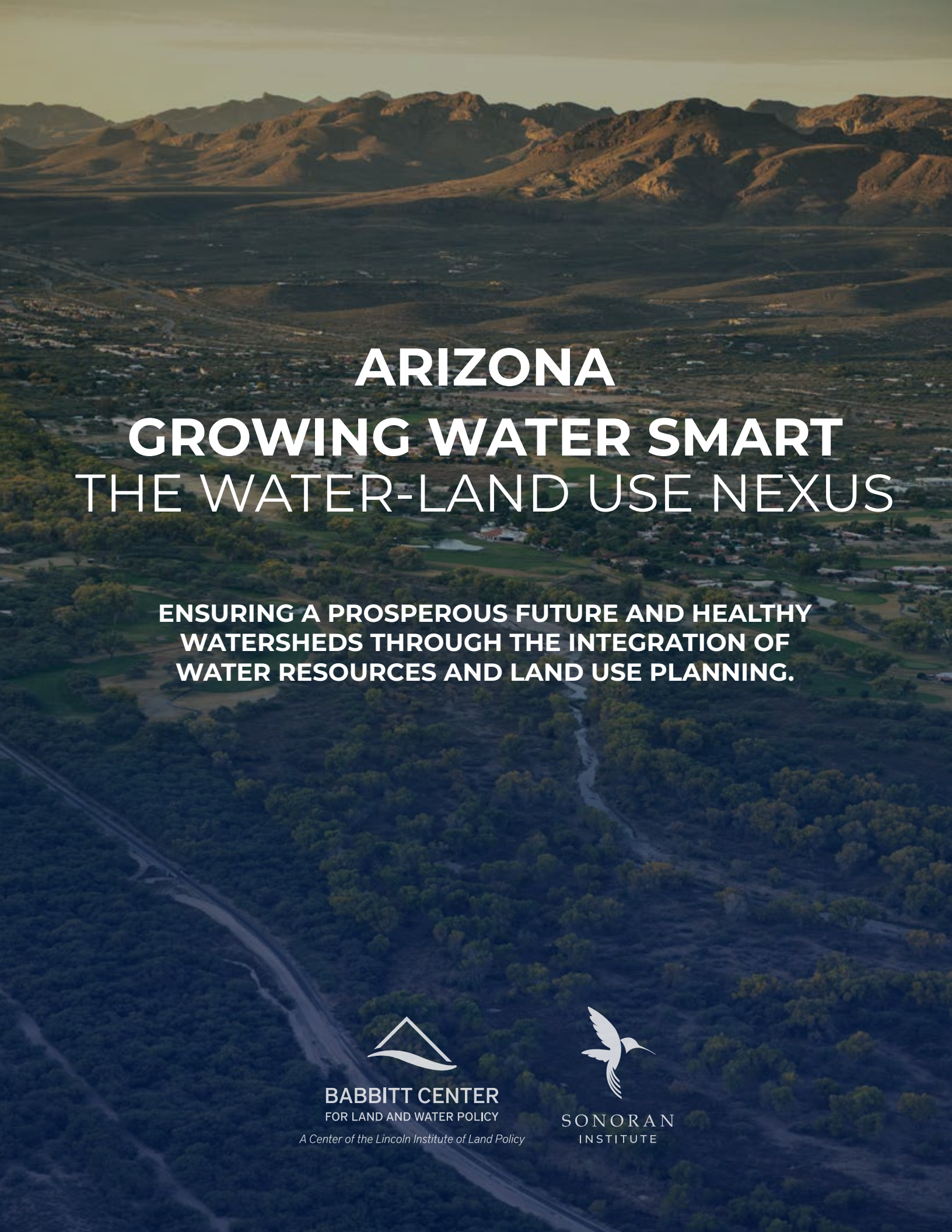

ARIZONA
GROWING WATER SMART
THE WATER-LAND USE NEXUS

ENSURING A PROSPEROUS FUTURE AND HEALTHY WATERSHEDS THROUGH THE INTEGRATION OF WATER RESOURCES AND LAND USE PLANNING.

BABBITT CENTER
FOR LAND AND WATER POLICY
A Center of the Lincoln Institute of Land Policy

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ABOUT GROWING WATER SMART

The Sonoran Institute and Babbitt Center for Land and Water Policy's Growing Water Smart program introduces communities to the full range of communications, public engagement, planning, and policy implementation tools to realize their watershed health and community resiliency goals. Through Growing Water Smart, Colorado communities can learn how they can integrate land use and water planning.

ABOUT SONORAN INSTITUTE

The Sonoran Institute's mission is to connect people and communities with the natural resources that nourish and sustain them. We work at the nexus of commerce, community, and conservation to help people in the North American West build the communities they want to live in while preserving the values which brought them here. We envision a West where civil dialogue and collaboration are hallmarks of decision making, where people and wildlife live in harmony, and where clean water, air, and energy are assured.

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The Babbitt Center for Land and Water Policy, a center of the Lincoln Institute of Land Policy, was established in 2017 to advance the integration of land and water management to meet the current and future water needs of Colorado River Basin communities, economies, and the environment. The Babbitt Center develops tools and best practices to guide decisions through research, training, and partnerships for sustainable management of land and water resources in the Basin and beyond.

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SHIFTING OUR FOCUS: FROM SUPPLY TO DEMAND SIDE MANAGEMENT

By 2050, Arizona's population is predicted to increase by half, putting pressure on our State's already limited water resources. A growing population can escalate the costs of operating local utilities, the need for enhanced and expanded infrastructure, and, if the water supply is constrained, the cost of acquiring new sources. In the past, water resource managers and water providers have turned to supply side management to meet growing demand by investing in water acquisition, treatment, and storage and distribution projects.

However, these options come with a significant price tag and can be more resource intensive.

An alternative to these costly investments is more efficient use of existing supplies. Increasingly, communities are turning to demand side management - an approach that seeks to reduce the demand for water. A demand side approach generally includes:

- **WATER CONSERVATION:** Encouraging water users to reduce how much water they use by modifying behaviors
- **WATER EFFICIENCY:** Encouraging or requiring the use of technology, building or site designs that uses less water.
- **WATER REUSE:** Treating or converting grey and black water to replace or augment water supply.

One of the more promising strategies in water demand management is integrating land use planning with water conservation and efficiency. Communities throughout the West have found that by increasing development density, utilizing technological efficiencies, and aggressive conservation programs, they have been able to continue to grow without acquiring new supplies. Water smart land use planning can reduce the negative financial impacts of increased water demand through efficiency and conservation measures implemented prior to, during, and after construction. This approach increases the cost to benefit ratio of capital investments by using the same amount of water and infrastructure to serve more people per dollar spent. This approach not only benefits the environment and ensures a more sustainable future, it's also good for the triple bottom line.

COMMUNITY OPPORTUNITIES FOR INTEGRATING WATER AND LAND USE

The planning and regulatory mechanisms that guide how and where a community develops each provide an opportunity to strengthen the nexus between water and land use. Determining where to intervene will depend upon a community's political readiness and capacity, what water demand management initiatives have been initiated to date, and the level of aggressiveness desired in achieving water saving goals. The intervention opportunities include:

INTERVENTION POINT	MECHANISMS	PURPOSE
1. Planning & Policy Making	Water Plans Comprehensive & General Plans Capital Improvement Plans Water Budgets for Build Out	Establishes goals and objectives for managing the intersection of natural resources and the built environment.
2. Pre-Development	Water Adequacy Requirements Water Allocation Policies	Links new development to water supply planning.
3. At Development Review	Zoning and Subdivision Regulations Annexation Policies Planned Development Policies Development Agreements Water Budgets on Development and Site Plans Offset Programs	Determines what water resource management, conservation and efficiency requirements are applied to development.
4. At Building & Construction	Building, Plumbing and Landscaping Codes & Inspections	
5. Post-Occupancy Education	Conservation & Efficiency Incentives Outdoor Watering Restrictions Water Budgets & Auditing Online Dashboard & Apps	Empowers and incentivizes homeowners and renters to reduce water consumption.

THE LAND USE - WATER NEXUS RESOURCE GUIDE

This resource guide is intended to help your community identify the most appropriate intervention points related directly to land use that will help you achieve your community's water resource management goals. It is divided into five sections.

SECTION 1 **Planning & Policy Making**
Summarizes the opportunities provided by integrating water and land use during planning processes.

SECTION 2 **Ensuring Adequate Water Demand for Development**
Provides a review of the State of Arizona's requirements for new developments to have an assured or adequate water supply and how to develop standards for municipal and county water supply.

SECTION 3 **Water Smart Land Use Policy**
Introduces planning principles that can make a community's development pattern water smart.

SECTION 4 **Healthy & Resilient Watersheds**
Provides guidance on how to protect your water supply to support community resilience and ecological systems.

SECTION 5 **Conservation Rate Structuring**
Summarizes how a utility can manage water demanded of households through market-based incentives and pricing mechanisms.

Each section includes:

1. A **rationale** for why a particular approach should be considered.
2. A **case statement** that provides justification for each approach and what water saving impacts can be expected.
3. A **toolbox** of the particular policy or management actions a community can take to achieve water conservation and efficiency outcomes for this approach.

A resource list of where to find more information including community case studies and policy examples is included in the **Growing Water Smart Resource Appendix.**

SECTION 1:

PLANNING & POLICY MAKING

The sustainability of a community is dependent upon the availability of water; consideration of future water needs must be integral to decision making.

CASE STATEMENT

The State of Arizona provides limited guidance for drafting policy to link land use and water in required plans. However comprehensive planning, water planning, and capital improvement planning are all interrelated. Integration of these planning processes will require breaking down the traditional planning and operational silos of different departments and agencies. Land use planners have focused on how much and what type of growth may take place in their communities while water resource managers have focused on ensuring adequate and reliable water availability. An integrated water resource and land use management approach can ensure:

- A community's vision for the future considers water and growth together.
- A water resource management plan, capital improvement plan and economic development plan consistent with the vision for future land use and the community's sustainability and resilience goals.
- Development occurs in a way that protects the watershed including ecological functions and the quality and quantity of water supplies.

TOOLBOX: PLANNING

1. COMPREHENSIVE PLANNING

Comprehensive or General plans guide how a community will manage future land use and its implications for a wide variety of functions including: transportation networks, parks and open space, natural resources, housing, economic development, and future infrastructure needs. One of the greatest values of a comprehensive planning process is that it provides one of the few opportunities for a communitywide dialogue about the future.

By state statute, almost every municipality or county in Arizona is required to create a comprehensive or general plan. In Arizona, the State's comprehensive planning requirements for **municipalities** and **counties** require a water element in most plans, but do not indicate how to link water with land use planning or other elements. Integrating water related goals into one wholistic plan or across plan elements ensures the complex interrelationships between water systems, human systems, and ecological processes are considered together. Comprehensive plans also offer an excellent educational opportunity in helping the community understand the:

- Projections for future population and drivers of growth.
- The type of development occurring in the community and where.
- The source, capacity, and conditions of a community's water supply, distribution systems, and water related infrastructure.
- Adequacy, sustainability, and vulnerability of the water supply.
- Health conditions of the watershed.
- Current programs and projects.
- The tradeoffs required to best achieve the community's goals.

A comprehensive plan can help a community identify opportunities to integrate water into traditionally land use focused comprehensive plans by including goals for:

- Water supply and demand management
- Wastewater treatment and disposal
- Watershed processes and health
- Floodplain and stormwater management
- Interagency coordination and collaboration

[1] California, Arizona, and New Mexico provide guidance on integrating water into land use. To review content of the Arizona requirement visit **https://www.flagstaff.az.gov/DocumentCenter/View/48421/VI-Water-Resources?bidId** To review content of the California optional element visit **http://opr.ca.gov/docs/General_Plan_Guidelines_2003.pdf.**

2. VISIONING

Some communities incorporate a robust visioning process into their comprehensive plans or water resource management plans. A visioning process identifies how a community can intervene to most positively influence the development of their community in response to change. Some of these visioning exercises take the form of clarifying community values and choosing from among a series of desirable futures. This normative approach to long range planning aims to create a clear vision for the future, most frequently through using visualization tools that illustrate alternative scenarios. These models can assist in decision making by assessing the impact of different development patterns on indicators such as water demand, air quality, and vehicle trips.

Exploratory approaches to considering the future take a slightly different approach. This approach is most effective when used to consider and strategize responses to uncertainties. Rather than selecting a preferred scenario and developing a plan to achieve that particular future, this approach explores how a community may need to adapt and manage different outcomes for a variety of scenarios driven by forces that are often out of one's control. The use of exploratory scenarios is being applied across the West in water and planning departments wanting to think strategically about water, growth, and climate change. To learn more, visit ResilientWest.org/ExploratoryScenarioPlanning

3. WATER SUPPLY PLANS, DROUGHT PREPAREDNESS PLANS, CONSERVATION PLANS

All Community Water Systems are required to submit a system water plan[2] to ADWR. A system water plan generally consists of a water supply plan, a conservation plan, and a drought preparedness plan, though depending on size and location, not all water systems need report on all three.

A water supply plan inventories supply and infrastructure in an evaluation of a systems ability to meet their customers needs. ADWRs guidelines recommend that the plan should consider probable and worst-case scenarios for surface water and groundwater supplies. A drought preparedness plan is an evaluation of strategies to reduce demand in response to drought conditions and should include specific demand reduction measures. A water conservation plan increases water efficiency in the system and encourages consumer conservation efforts. The plan should include demand and supply management measures, an educational component, and an evaluation component.

Municipal water providers located inside an Active Management Area (AMA) are exempt from some of these plan requirements. Instead, they are subject to regulatory requirements dictated by the Arizona Groundwater Code[3] including mandatory conservation requirements established in the AMA Management Plans.

[2] ARS § 45-342
[3] A.R.S. § 45-401 through A.R.S. § 45-704

CASE STUDY

WATER SMART COLLABORATION - WATER & WASTEWATER INFRASTRUCTURE, SUPPLY & PLANNING STUDY (WISP), CITY OF TUCSON & PIMA COUNTY

In 208, the City of Tucson and Pima County recognized the need for "a new paradigm" for water and land planning. The two jurisdictions launched a joint effort for sustainable water resource planning, eventually called the **Water & Wastewater Infrastructure, Supply & Planning Study (WISP).** The primary goal was to assure a sustainable community water source given continuing pressure on water supply caused by population growth.

"The new paradigm for water resource planning and management: · recognizes scarcity and uncertainty · puts the environment at the table where water is distributed · balances water supply and demand management · builds upon the crucial link between urban form and water resources · elevates public dialogue to a central position in future planning"

An eleven-member Citizen Oversight Committee met eleven times between April and December 2009 and identified community values, detailed four principles of sustainability and a working definition of sustainability, and provided additional recommendations for future action.

Interdisciplinary teams of City and County staff developed 10 technical reports, with an additional four reports developed by outside consultants. These reports covered a range of topics according to the guiding principles and generated a lengthy set of recommendations. City/County staff organized the recommendations into a set of four interrelated elements: demand management, water supply, comprehensive integrated planning, and respect for the environment. From these elements and recommendations, water sustainability goals were set for the 2011-2015 planning horizon.

The City of Tucson Mayor and Council and the Pima County Board of Supervisors adopted this framework through City and County resolutions (No. 21478 and 2010-16 respectively).

Following formal adoption, City/County staff drafted the **Action Plan for Water Sustainability.** This implementation plan outlined the necessary activities to meet each of their goals under the four elements, a timeline (2011-2015), the relevant existing programs and partnerships that would be involved, and the kinds of new partnerships that would need to be established to ultimately meet all adopted goals.

Lengthy progress reports in 2015 and 2018 list the major achievements and milestones that have resulted from the WISP effort. The resulting multi-year process included a collaborative effort across jurisdictions and departments that was "unprecedented in our history."

4. CAPITAL IMPROVEMENT PLANS

Planning departments, parks, public works, and water and wastewater utilities often rely on grants and bonds to invest in green and grey infrastructure improvements or new construction. Capital Improvement Plans (CIPs), which forecast and match projected revenues and capital needs over a multi-year period, provide the greatest opportunity to create a long-term investment strategy for the infrastructure improvements identified in a comprehensive plan or water resource management plan. A CIP ensures resources are allocated to community priorities.

STRATEGIES FOR PLANNING & POLICY MAKING

- Link water supply and demand to projected land use patterns, not just growth projections in both comprehensive plans as well as water plans.
- Use visioning processes and scenario planning to assess vulnerabilities and uncertainties affecting water resources as the future unfolds
- Create an independent water element in the comprehensive plan or add a water conservation plan as a supplement.
- Use the CIP to ensure investments are made in water management physical infrastructure or projects including stormwater management, green infrastructure, growth area infrastructure, disaster mitigation, and watershed restoration.

CASE STUDY

INTEGRATED WATER RESOURCE PLANNING – PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

The WISP study, discussed in a previous case study, took place concurrently with Pima County's update for *Pima Prospers: Pima County Comprehensive Plan*. Integrating outcomes from the WISP into Pima Prospers has allowed Pima County to achieve outcomes from the WISP and sustain progress from these collaborative efforts. One example is the Preliminary Integrated Water Management Plan (PIWMP) which integrates water supply review at the site analysis and entitlements stage of planning review process.

Site analyses are required in Pima County for a rezoningthat is · Greater than one acre in size to be developed for nonresidential uses; · Greater than one acre in size to be developed at a residential density of four or more residences per acre; or · Greater than five acres in size. · Greater than one acre in size to be developed as a mixed use residential/nonresidential project.

The Pima County Regional Flood Control District (RFCD) revised the water element development review process to assess the water resource impacts. The 2015 comprehensive plan update requires rezoning applicants to submit a PIWMP or Water Supply Impact Review at the site analysis stage. The content varies according to the projects water supply:

- Projects providing renewable and potable supplies at the development review stage must make a commitment to meet a certain threshold of actions from a Water Conservation Measures table, which includes a range of options in indoor water use, outdoor site design, and infrastructural improvements.
- Projects providing non-renewable supplies will have to provide the above, plus RFCD staff will assess the lack of infrastructural access to renewable supply sources and evaluate potential impacts to environmentally sensitive areas. If sensitive areas, including subsidence areas and groundwater-dependent ecosystems like springs, intermittent and perennial streams, and shallow groundwater areas, are impacted then RFCD will recommend the application be denied unless the project accepts additional Water Conservation Measures.

The new process "minimizes impacts of development upon water supply for existing and future residents followed by appropriate conservation measures." The 2015 update shifted the project hydrologic impact assessment from the applicant to the County to ensure expertise and consistency to the process. The new version reduced the mitigation range from a 5-mile to a 1-mile radius to maintain the scientific rigor of the impact study.

After site analysis, staff prepares the impact assessment, which includes: a) Availability of renewable and potable water supplies; b) Water use estimates for maximum build out-under existing and proposed zoning; c) Current and projected depth of groundwater and groundwater trend data at the site or wells serving the site; d) Proximity of site and wells serving the site to known or potential subsidence areas; e) Proximity of site and wells serving the site to groundwater-dependent ecosystems; and f) Hydrogeologic basin, including depth to bedrock.

RFCD writes and reviews the impacts analysis during the entitlement phase and the developer proposes the mitigation measures. A second RFCD department reviews the final mitigation plan at the time of permitting/development. Integrating site analysis with water resource studies supports a sustainable water future through linking the form and location of growth with the efficient allocation of water to serve growth.

SECTION 2:

ENSURING ADEQUATE WATER DEMAND FOR DEVELOPMENT

Provides a review of the State of Arizona's requirements for new developments to have an assured or adequate water supply and how to develop standards for municipal and county water supply.

CASE STATEMENT

Water adequacy rules link supply side management to demand side management. States across the West have adopted state statutes intended to protect communities from the threat of not having adequate water supplies for new development recognizing that:

- New development creates new water demand.
- Government has a role to play in ensuring sustainable and adequate water supplies for new and existing property owners.
- Growth pressure on water supplies requires stronger connection between land use approval and water planning at the State, regional, and local level.
- Collaboration between local governments and water providers is essential to ensuring reliability.

TOOLBOX: Arizona Water Rules

The Arizona Department of Water Resources (ADWR) Assured and Adequate Water Supply programs were created to address the problem of limited groundwater supplies in Arizona. Both the Assured and Adequate Water Supply programs evaluate the availability of a 100-year water supply considering current and committed demand, as well as projections for future development and population growth. Given scarcity and uncertainty, local governments should be wary of ceding their mandate and police power for ensuring the health, safety, and welfare of their constituents through permitting development in areas where regulated basic and essential services cannot be provided. And increasingly, local actions should consider cumulative impacts to the region's environmental and economic systems that sustain local quality of life

Assured Water Supply Program (within AMAs)

The Assured Water Supply Program, managed by the Arizona Department of Water Resources, is intended to protect and preserve the limited groundwater supplies within Active Management Areas (AMAs) designated as the regions where groundwater reserves have been historically depleted. Developments are approved only if they are able to demonstrate a 100-year Assured Water Supply. A community water supplier can prove an assured water supply by showing physical, legal, and financial capability to provide a quality water supply, and consistency with the AMA Management Plan and Management Plan goals.

The Assured Water Supply rules apply to subdivisions with six or more plats inside AMAs. Lot splitting into 5 or fewer lots creates a gap in policy regulation and has contributed to localized water level decline.

Adequate Water Supply Program (Outside AMAs)

The *Adequate Water Supply Program* applies to most areas outside the AMAs. A water adequacy determination from ADWR is not required prior to recording a plat and initiating lot sales. However, developers may apply to the Department for an adequate or inadequate water adequacy determination, prior to initiating the final plat approval process with the local jurisdiction and filing for a public report with the Arizona Department of Real Estate. While subdivisions can be approved if the water supply is determined to be inadequate, the first buyer of the property is informed of the inadequate water supply. This process is intended to protect the consumer from unknowingly purchasing land or a home where there is an unsustainable supply of water.

Only the first five criteria in the table below must be demonstrated to obtain an Adequate Water Supply determination. State statute requires subdivision developers to obtain a determination from ADWR regarding water supply availability before marketing lots. If there is an inadequate water supply, it must be disclosed in the public report and in any promotional or advertising material provided to potential first purchasers.

ADWR DETERMINATION CRITERIA

CRITERIA	DESCRIPTION
Physical Water Availability	Sources of water have specific requirements for demonstration of physical availability. A list of those specific requirements can be found in the Arizona Administrative Code. (See: A.A.C. R12-15-716)
Continuous Water Availability	Water providers or developers must demonstrate that the water supply is uninterruptible for the 100-year period, or that sufficient backup supplies exist for any anticipated shortages. (See: A.A.C. R12-15-717)
Legal Water Availability	An applicant must demonstrate legal rights to all water supplies included in the application. (See: A.A.C. R12-15-718)
Water Quality	Proposed sources of water must satisfy existing state water quality standards and any other quality standards applicable to the proposed use after treatment. (See: A.A.C. R12-15-719)
Financial Capability	Water providers or developers must demonstrate financial capability to construct the water delivery system and any storage or treatment facilities. Financial capability for developers is typically considered through the local government's subdivision review process. A demonstration is also required that adequate delivery, storage and treatment works will be available to the applicant or the applicant's customers for 100 years. (See: A.A.C. R12-15-720)
Consistency with the Management Plan (Assured Water Supply Only)	Each AMA's Management Plan prescribes water conservation requirements for municipal water providers. Water demand associated with proposed subdivisions is evaluated in accordance with these conservation requirements. (See: A.A.C. R12-15-721)
Consistency with the Management Goal (Assured Water Supply Only)	Applicants must demonstrate consistency with the management goals of each AMA. (See: A.A.C. R12-15-722)

Adapted from the ADWR website

Please refer to the Arizona Administrative Code Title 12, Chapter 15 to access the rules listed above.

View the **Guidelines for Hydrologic Studies for Assured and Adequate Water Supplies.**

BEST PRACTICES FOR ENSURING ADEQUATE WATER SUPPLY.

Adequate water supply standards require development to demonstrate that a new project has a legally and physically adequate quantity of water that is reliable into the future. Best practices for adequate water supply standards include:

1. **Definition of both Adequate and Sustainable Supply:** A clear definition of an adequate and sustainable water supply addresses quality, quantity, dependability, and availability. Communities are updating their regulations to both include these definitions as well as any relevant additional description of these indicators.
2. **Articulation of Water Source(s):** Definition of and clearly identified allowable water sources whether from a water provider, individual wells, shared wells, or cisterns.
3. **Water Rights Inventory:** Legal demonstration of future water source(s) by either the acquisition or dedication of surface water rights or approval for future wells. Most communities require the water demand projections at pre-development and the securing of the actual water rights at final plat.
4. **Demonstrations of Water Availability**: For each source(s) as defined by requirements for water quantity (e.g. pump rates or water supply plan), the expected availability of the water supply (e.g. availability under drought and normal conditions), the water supply plan timeframe, etc.
5. **Development Water Demand Projections:** A projection of the amount of water (water budget) that a proposed development will likely require at full buildout for proposed development. Many communities are now including a specific methodology for determining this projection based on issues in the past with developments underestimating water demand.
6. **Water Efficiency, Conservation or Demand Management Practices:** Include pre-development requirements or incentives for developments to reduce projected water demand through efficiency and conservation practices.
7. **Uniform or Specific Area Application:** Effective development regulations apply to all new development or define specific zones where water resources are particularly scarce or there are variations that trigger specific requirements (e.g. recharge zones, different water provider service areas, specific hydrological zones, etc.)
8. **Maps:** Maps of geographic locations or zones where different adequacy requirements or review processes apply.
9. **Defined Review Processes:** Specificity on what is required for the review and when in the process as well as who conducts the reviews.
10. **Engineering Standards for Water Distribution System:** Except for individual

wells, the engineering requirements for a water system connection or distribution system clearly articulated in development regulations or reference to specific guidelines.

11. **Requirement, where necessary, for augmentation:** Augmentation requirements differ across the State, but generally is either a requirement for an augmentation plan or purchase of a certificate from an approved supplier.

TOOLBOX: Mandatory Adequacy Programs

To address the State's lack of water resource management outside the AMAs, some Arizona cities, towns, and counties have instated a Mandatory Adequacy Program (ARS 11-806.01.) In these jurisdictions, the Arizona Department of Real Estate cannot approve sale of a property without an adequate water supply determination. Yuma County, Cochise county, Town of Patagonia and City of Clarkdale have all adopted a requirement that ADWR determines adequate water supply before final plat approval. If a county adopts this rule, it applies to all jurisdictions within it.

TOOL: Water Budgeting

A "water budget" is an estimation of water demand. Water budgets can be estimated at various scales and used to inform decisions and encourage conservation. Calculating a "water budget for buildout" can allow a community to carefully craft a vision within the constraints and resilient to the uncertainties of their water supplies. Like financial budgeting, every line item of the vision should be accounted for and the tradeoffs and opportunity costs carefully considered when allocating resources. Having this macro budget provides guidance for approvals at the development or site scale. Adding water budgets to development review processes and site plans seizes an opportunity to optimize site performance, conformance with the community's vision and stewardship of the overall water budget for buildout.

Provide guidance or require a consistent calculation methodology. While the State provides a calculators to estimate water budgets (eg. for developments In AMAs and the Generic Demand Calculator for outside water use), :the City of Flagstaff's methodology tends to result in higher estimates. Connecting water billing and actual land use data using GIS can improve the granularity and accuracy of estimations, inform rate structuring and advance efficiency programs. The City of Westminster, Colorado, a leader in water and land use planning integration now calculates water demand on an acre-foot/square foot of land use to better understand what it means to convert property from perhaps retail to restaurant, residential or other uses. It also helps them understand the water use patterns of land uses and densities they've never before seen in the city. Shifting a demand measurement from a "per-acre" scale to a "per-unit" or "per square foot of building area" scale can help account for increasing density in residential and commercial developments.

CASE STUDY

PROJECTING WATER DEMANDS USING ENTITLEMENTS – CITY OF GOODYEAR

Cities and private utilities use many methods to estimate future water demand. Combinations of the different approaches can complement each other for a comprehensive analysis. Population projections alone will not capture the range of land uses, industry needs, the type of crops grown, or the type of landscaping in your front yards. Cities can link their population projections with the underlying land uses to understand these characteristics.

Logically, projection outcomes will be more certain when the data inputs are more granular. Since zoning codes typically allow a range of permitted uses and densities, development entitlements offer a more certain alternative. "Entitlements" are development plans and permits legally approved by the local regulatory department, including rezoning, variances, special use permits. Entitlements such as Planned Area Developments and Master Planned Communities are the key sources of high-resolution data that refine land use zones and enhance water demand projections. Though they may not be built on the ground, entitlements are committed developments that have a right to water.

The City of Goodyear used this approach to refine their projections, which fostered collaboration between the planning department and water resources.

First, the City of Goodyear used billing records co-located with land use and other data to estimate their base demand, then added non-revenue water use. Non-revenue water includes well waste, operational use, flow tests, system losses and City department use (fire, street cleaning). This is not insignificant; the City of Goodyear's non-revenue water is approximately 14% of their annual total water production.

Next, they developed a growth model by integrating multiple data layers in ArcGIS model builder and assigning a tiered "water service commitment level" according to the status of entitlement:

- Tier 1: Lands with entitlements
- Tier 2: Lands with preliminary entitlements and state land zoning process initiated
- Tier 3: State land within the planning area without zoning and other areas without entitlements
- Tier 4: All other land within the planning area, using the general plan to inform assumptions on land use and base demand.

Finally, the city projected water demand by geographic area and entitlement level using the tiered priority system. This approach shows where, when, and how much new water supplies are needed based on commitment level. Using entitlements upped the level of confidence. The process also shows how growth patterns align with the Goodyear general plan vision, all at a higher resolution than a projection based on land use zones alone.

TOOLBOX: Water Allocation Policies

Water allocation rules are policies, laws and mechanisms that offer municipalities a formal means to direct growth by strategic dedication of their water resources in accordance with their community's needs, vision and overall water budget. Allocation policies link water supply to land use, economic development and community revitalization plans, and can be tailored to suit the strategic goals of a community.

Without a water allocation policy, supply agreements are often made on a "first come, first served" basis. This informality can unintentionally lead to resource-intensive development without compensatory benefit to the supporting community. Cities with limited supplies and a projected surplus alike can benefit from water allocation strategies with sustainability and quality of life in mind. Currently, the cities Chandler, Mesa and Gilbert have allocation policies in place.

Tool: Aggregated Plan Review

Approving developments individually on a rolling basis can hinder decision makers from understanding the aggregate impact of all approvals. This can be especially problematic in sensitive areas and those with limited infrastructure, water or land. Periodic and aggregated review can provide decision makers an opportunity to better consider the cumulative impacts of their approval. on water supply, as well as watershed and public health, transportation, and other community interests. The urbanizing and land-locked City of Westminster, Colorado has adapted their approval process to better manage the buildout of a section of the city with limited infrastructure that they want to ensure they develop right.

CASE STUDY

WATER ALLOCATION POLICY – CITY OF CHANDLER, ARIZONA

In Arizona, the City of Chandler has acquired the water supply needed to accommodate all projected growth. They see their remaining un-used water supply as an opportunity to incentivize the kinds of developments that offer the most support to their residents. In 2015, Chandler adopted a water allocation policy that would manage plan approvals for large volume water users. It is an attractive tool in economic development because it gives Chandler credibility as a long-term investment.

Their process started with an examination of their general plans, master plans and water budget to understand how much of their supply was committed. They averaged the water use of existing buildings under each land use type and projected water consumption using these consumption rates at a square foot unit rate. The unallocated portion of the supply was re-branded "quality of life" water to reflect its intended use.

Next, the city council defined their "quality of life" priorities to guide how that surplus water will be allocated for strategic developments. Three strategic goals were identified:

1. Economic Development, primarily technology and knowledge-based industries and the expansion of existing business
2. Adaptive reuse of buildings within existing neighborhoods
3. Revitalization in downtown and north central areas, including specific transit needs

The City developed a tiered framework for allocating water supplies to new water users:

- Tier 1: The base allocation which is applied to all Chandler non-residential water users. The City anticipates that they will be able to meet the water demand of almost all applicants with tier 1 supply allocation.
- Tier 2: The Quality of Life allocation applies to new high-volume users that need additional supply beyond tier one. New developments qualify for tier 2 allocations if they sufficiently address the priority goals identified by the City. Chandler identified their goals in a stakeholder process, outlined above.
- Tier 3: If a new user's water needs exceed tier 1 but do not meet the quality of life benefits in tier two, then they are considered a tier three user. Proposals from this category are approved only if they provide additional water supply to the city. This may include reimbursing the city for purchasing the water at market-rate.

New water users are required to provide documentation that justifies their requested water allocation which prevents new users from mis-representing their needs to fit into a certain tier. Approved users are granted their allocation through a Sustainable Water Service Agreement. This contract lists the strict allocation volume and penalties for using more water than their allocation. Users are limited to the allocation at the time of entitlement.

Toolbox: Water Demand Offset Programs

Water Demand Offset Programs can be a way to meet future water demand by requiring new development to offset water demand either through conservation in existing development or transfer of water rights. They address chronic supply shortages through a requirement for new development that would create increased water demand to offset such demand through purchasing new supplies or implementing water demand management practices. The demand management initiatives could occur on site or elsewhere within the water supply system. The goal is that all new development, including the expansion of existing homes or businesses, is "water neutral" in the water supply system. This concept can also apply to offsetting energy, wastewater, air quality, historic preservation, or watershed health impacts.

Santa Fe, NM has one of the top performing water demand offset programs in the nation including a toilet retrofit program, a water bank to hold conservation credits for future development and a Water Conservation Credit Program. This program includes:

- The additional of rebates for more types of water efficient appliances or retrofits of older ones and for outdoor watering equipment.
- A water budget program where a water user enters into an agreement to use less water, the City monitors usage and pays the customer for the reduction in use..
- A "free stuff" program including low-flow faucets and shower heads.

CASE STUDY

WATER SMART SUPPLY - SANTA FE COUNTY, NEW MEXICO

Santa Fe County, New Mexico has been working for nearly forty years to integrate water and land use planning by applying a development suitability lens to reduce natural resource degradation.

The County's efforts began in 1980 with the Santa Fe County General Plan. The growth management approach was to locate new growth in locations with adequate services and infrastructure while trying to limit growth in areas constrained by limited or low-quality water and natural hazards. In areas dependent upon groundwater, the County was divided into four hydrologic zones where a minimum lot size (base zoning) was set to reduce groundwater depletions. Within these zones, a 100-year water supply was required with demand calculated based on an estimate of 1-acre foot per lot, the same as permitted by the State. The minimum lot sizes for the four zones included: 160 acres, 80 acres, 40 acres and 10 acres. The development code was updated to include a requirement for new developments to conduct an analysis of land suitability, available infrastructure, and water resources. Developers could increase density if they completed a geo-hydrological study or entered into an agreement to use less than the allowed one-acre foot of water articulated in a conservation plan.

A 1999 update to the comprehensive plan continued to link new development to locations with suitable water, services, and infrastructure. In 2001, the County's Sustainable Development Growth Plan changed direction. After thirty years of trying to protect natural resources by linking lot size and hydrological zones, the County adopted new zoning districts and development standards intended to better protect sensitive land, preserve open space and ensure high quality infrastructure and services. The new approach identified three growth tiers:

- A priority growth area to accommodate new compact development served by surface water or community system and adequate public facilities and services.
- A future development area for infill development likely to occur within the limits of groundwater availability.
- And low-density agricultural land, environmentally sensitive land and conservation areas.

The code includes a Water Supply, Wastewater and Water Conservation requirement (Chapter 7 Section 7.13.) that defines how developers can satisfy the need for an adequate water supply. The location and scale of the development, the lot size, and proximity to water infrastructure determine whether a development uses a community water system or well. If applicants are connecting to the County utility, the only requirement is a written agreement to provide services. However, if the applicant is not on the County utility, then a more stringent set of requirements must be met. For a minor subdivision over 5 lots that is zoned to permit an individual or shared well, the County requires a valid Office of the State Engineer's well permit and a hydrological study. Standards for the hydrological study include proof of an adequate water supply for 99-years and well test requirements for pump rates and recovery days linked to the different hydrological formations.

As part of development review, a Water Service Availability Report summarizes how a development meets the requirements for an adequate water supply. The WSAR includes an analysis of: existing system capacity of the public water or wastewater supply proposed for use; well field capacity or stream, spring, or other source of raw water supply; historical average and peak use of potable water; the number of hook-ups and the estimated potable water demand per hook up; and the number of hook-ups for which contractual commitments have been made or previous development orders have been approved.

Developments must also meet water conservation requirements and file a signed water restrictions and covenants with the plat or site development plan committing to not using more than 0.25 acre foot per year per lot. Water conservation requirements include:

- Low water landscaping/xeriscapes.
- Drip irrigation and mulching.
- Kentucky bluegrass is prohibited, non-native grass is limited to 800 sq feet, and must be watered by water harvested or grey water.
- Water is permitted for new landscaping for up to two years, but thereafter only for viability.
- Between May and November, outdoor watering is prohibited between 11 am and 7 pm
- Rain sensors.
- Fugitive water **prohibition.**
- Rainwater catchment for all new construction to capture a minimum of 85% of the roof area drainage.
- A domestic well metering program and sub-metering of landscape water use.
- WaterSense certified or equivalent plumbing toilets, urinals, lavatory faucets, and showerheads.
- EnergyStar certified or equivalent dishwaters, washing machines.
- Water and energy efficiency hot water systems
- For food service, water available only upon request.
- For lodging services, daily linen services only upon request.
- Conservation signage and literature distribution.

SECTION 3:

WATER SMART LAND USE POLICY

As a population increases, the demands on water supply and water related infrastructure including water treatment plants, delivery systems, wastewater and watersheds will also increase.

CASE STATEMENT

Water demand is a function of household size, income, residency and conservation behaviors/ habits. But water demand is also a function of how we plan, design, and maintain our communities. Research indicates that when it comes to saving water, where and how we build really matters.

Efficiencies can be found in density [development patterns], building, site and systems design, especially landscaping. We know that:

- Certain land use types consume more water than others.
- Certain building types and development patterns consume or conserve more water than others.
- Newer appliances and plumbing fixtures are more efficient than old ones.
- Plant species and soil health drive outdoor water demand.
- Irrigation technology can mitigate outdoor water consumption.
- Households that conserve water save money for themselves and the water provider and water for other people and nature.

To use less water, the best policy is to make water smart development the easiest type of development to build. Three types of tools are available to communities to do that:

- Promote higher density and compact development, especially where existing infrastructure already exists.
- Promote high performing, water efficient plumbing and building standards.
- Promote water saving and climate appropriate landscaping standards and maintenance practices.

TOOLBOX: COMPACT DEVELOPMENT

While the majority of water conservation and efficiency efforts related to land use have primarily focused on outdoor watering and indoor plumbing fixtures, there are considerable benefits to encouraging more compact development patterns. Water usage studies have consistently demonstrated that in urban areas, the largest consumption of water is by large lot single family homes where 70% or more[4] of the water consumed is used for outdoor use during spring and summer. The density of a development can mean less water consumption. Research in some western states like Colorado has demonstrated that developments between 3-8 units per acre have the greatest gains for water conservation[5].

Promoting water efficient land use patterns provides many additional benefits than simply saving water. It can also support the more efficient use of existing infrastructure, protect natural resources, promote walkability, control flooding and enhance neighborhood or community vibrancy.

STRATEGIES FOR PROMOTING COMPACT DEVELOPMENT

- At pre-development review, make rezoning, annexations, and Planned Unit Development applications conditional on meeting water conservation standards.
- Develop future land use plans that establish designated future growth areas, both infill and greenfields, where adequate infrastructure exists for accommodating growth at higher and/or more urban densities.
- Change the zoning code to permit smaller lot sizes and higher densities by right in designated districts.
- Reduce or remove development standard barriers to compact development such as: parking requirements, minimum lot sizes, lot setbacks. As for height limitations, evidence shows water demand begins to climb at the point a cooling tower is needed for the building. Craft your code for your climate and context.
- Change zoning code to permit multiple types of residential development (multiplex, townhomes, apartments, ADUs) by right in designated growth areas to provide a diversity of housing options.
- Change zoning code to permit compact mixed-use development by right in designated growth areas.
- Change zoning code and use green infrastructure to promote public open space, shade, placemaking and active living.

[4] https://new.azwater.gov/conservation/landscaping
[5] http://www.keystone.org/wp-content/uploads/2018/10/CO-Water-and-Growth-Dialogue-Final-Report_September-2018.pdf

- In exurban and rural areas, change zoning code to permit and incentivize cluster and conservation development by right.
- Manage commercial uses by making water intensive uses, such as car washes, nurseries, etc. conditional instead of by right. Permit based on standards to meet water conservation and efficiency standards such as water recycling.
- Provide incentives for increased densities using development or utility fee reductions/waivers and density bonuses.

CASE STUDY

LEADERSHIP OUTSIDE OF AMAS – CITY OF FLAGSTAFF

Communities outside of Active Management Areas have fewer state-level regulations and guidelines to follow. Regardless, the City of Flagstaff is proactively managing the uncertainties driving its future with leading water conservation programs and efforts to link land use and water resource planning.

Flagstaff's population is rapidly expanding. With surface water from snowmelt variable and unreliable and about 60% of water supplies coming from groundwater, additional water supplies, and optimally efficient development are critical. The city purchased the Red Gap Ranch with promising supplies that require an expensive and controversial 40-mile pipeline to deliver. While the city is planning its construction, they are also working to mitigate and prolong the need for this infrastructure by managing demand and the location of growth.

Flagstaff Regional Plan 2030, the comprehensive plan for the city and county cites goals and policies prompting water smart development strategies, green infrastructure, and water infrastructure financing. By 2030, the aim is to manage water supply through conservation, reuse, innovative treatment technologies, and smart development choices.

Best practices in Flagstaff include:

- Impact analyses for every site plan or zoning request determine if existing water infrastructure is sufficient, requires a new well and impacts to the city's water budget.
- Compact and cluster development to preserve open space. Higher density, mixed-use infill projects utilize existing infrastructure and steward water supplies, energy and other resources more than single-family residential.
- Stormwater Management/Low Impact Development – all new subdivisions are required to control run-off and recharge on-site. The city provides low-impact development and stormwater manuals.
- Landscaping code –requiring native/xeric plants, the use of hydro-zones (organizing plants according to water demand and microclimate) and using rainwater, greywater or reclaimed water (non-potable) for irrigation.
- Rainwater harvesting – Flagstaff was the first in Arizona to pass **rainwater harvesting guidelines** in 2012. The ordinance adds a rainwater harvesting requirement to existing Low Impact Development ordinances, making active rainwater harvesting systems mandatory in new residential development unless it demonstrates low outdoor water demand.

TOOL BOX: WATER EFFICIENT LANDSCAPING

In Arizona, outdoor watering for urban landscapes accounts for 75 percent or more of water providers total annual water demand during spring and summer. Most communities can see their peak demand double in the summer, requiring storage and infrastructure to provide a reliable supply. Communities working to make landscaping water smart from the start can integrate tools to reduce water demand from new construction. There are numerous tools available to local governments that integrate best practices into their development code for water conservation and efficiency. These include requirements for:

- The types of plants that are best suited for the climate and irrigated by hyrdozones.
- A total amount of landscaping permitted based on lot size percentage or square footage.
- The type and amount of turf allowable based on square footage or total landscaped area.
- Low flow and efficient irrigation system technology including drip, bubblers, or low flow sprinklers
- Rain sensors with a shut off device to reduce watering during natural rainfall events.
- Evapotranspiration (ET) Sensors to adapt irrigation to changing weather and soil conditions.
- A water budget for outdoor water use, ideally tied to tiered rate structuring that sends a price signal to the rate payer.
- Soil enhancements and mulching.
- Scheduled timing of irrigation to limit evapotranspiration.
- Code enforcement and fines for violations of standards.
- Training for landscape professionals on water saving landscaping.
- Model Maintenance Standards and Agreements for HOA's and others to use in contracting landscape services.

Since mandatory requirements significantly increase water savings, the goal of a community committed to water conversation should be to make all new developments and retrofits meet water efficiency standards.

STRATEGIES PROMOTING WATER SAVING LANDSCAPING

- Conduct an assessment of saving potential by comparing annual water demands on a new property against an older property or properties with comparable area, plantings, and irrigation methods.
- Develop a landscaping design manual that provides specific guidance to individuals and developers on water saving tree and plant types and sizes, planting seasons, soil enhancement, mulching, and watering times appropriate for local climate.[6]
- Promote and/or incentivize the use of individual household rain water harvesting for outdoor irrigation.
- Develop an incentive promoting the removal of water intensive landscaping by offering landscaping conversion rebates.
- Provide incentives for developers to use water efficient or xeric landscapes through reduction of tap fees.
- Change your subdivision code to include residential, commercial, and public landscaping standards that reduces use of water for irrigation by regulating:
    - irrigated lot coverage
    - plant types
    - irrigation system efficiency
    - rain sensors and/or evapotranspiration (ET) sensors that adjust watering to changing site conditions.
    - watering schedules (before 8 a.m. and after 8 p.m., scheduled by zones and day of the week)
    - soil amendments
    - water loss limits

Non-regulatory options include property owner behavior change education managed by the water provider:

- Rebate programs for water efficient plumbing fixtures such as low-flow toilets, showerheads, and front-loading washing machines.
- Rebate programs for turf removal and replacement with low-water use landscaping.
- Education about xeriscaping and water efficient irrigation systems.
- Water audits that educate property managers and evaluate systems.

[6] Water Smart Landscaping Principles are widely promoted in educational programs as well as adopted into landscape and water conservation plans. http://www.davidclarkedesign.com/images/DCD_flyer_xeriscapeprinciples.pdf

TOOL BOX: WATER SMART PLUMBING FIXTURES AND BUILDING EFFICIENCY

Reducing indoor water use in residences and businesses can be accomplished through water-efficiency standards for indoor plumbing fixtures. Arizona's maximum water efficiency rates for indoor plumbing fixtures are higher than federal standards (A.R.S. 45-312 and 45-313), which translates to less-efficient requirements. WaterSense labeled products are not required at the state level to be installed by new development, so local jurisdictions can have more rigorous requirements or incentivize water efficient plumbing in local ordinances and in retrofit programs.

	E.P.A. WaterSense products	Arizona Statutes (45-312)	Federal Standards
Residential toilets	1.28 gallons / flush	1.6 gallons / flush	1.6 gallons / flush
Bathroom faucets	1.5 gallons / minute	3.0 gallons / minute	3.0 gallons / minute
Showerheads	2 gallons / minute	3.0 gallons / minute	2.5 gallons / minute

STRATEGIES FOR PLUMBING FIXTURES AND BUILDING EFFICIENCY STANDARDS

- Use the green plumbing code as a guide or adopt the green plumbing code requiring high-efficiency faucets, showerheads and toilets in the plumbing code.
- Adopt building code standards that permit the use of water recycling systems.
- Adopt building code standards for submetering of multifamily units.
- Incentivize the replacement of older less efficient toilet and faucet technologies with water wise ones through rebates or free fixtures.
- Create incentives for developers to receive lower tap fees for meeting water efficiency standards beyond the building code.
- Link tap fees to water budgets to guarantee that the low demands projected when tap fees are paid will be observed over time.
- Empower staff, HOA's and maintenance companies with a command of desert plants, soil health and watering best practices. Like any infrastructure, it requires ongoing maintenance to maintain efficacy.

CASE STUDY

EFFICIENT DESIGN - SCOTTSDALE'S GREEN BUILDING PROGRAM

A national survey showed Arizona as second highest in the nation for having the most efficient water faucets. However, when it comes to efficient toilets, the state is around national average. Arizona state statutes do not require high-efficiency fixtures, but some local jurisdictions have passed their own local ordinances or have implemented rebate programs to incentive WaterSense products. Scottsdale, Avondale, Gilbert, Chandler and Tucson offer rebates for WaterSense fixtures, including irrigation controllers. The City of Scottsdale, Arizona amended the plumbing code to require new residential and commercial buildings to use the same water efficiency rates as WaterSense products.

The process started when Scottsdale was updating their general plan in 1998. One of the guiding principles was to "Seek Sustainability". Scottsdale started an interdepartmental committee that looked at sustainable communities. One of their staff suggested Scottsdale create a voluntary green building program based on the success of the Austin green building program. The committee wasn't sure if there would be local buy-in until an environmental builder and environmental products manufacturer approached the city to recommend such a program as part of a new pilot home project.

A green building advisory committee was formed comprised of a few citizens, architects, designers, home builders, state environmental office representatives, utility representatives and university architecture professors. They modeled the educational and outreach components after the Civano Sustainable Community in Tucson, and green building programs from Austin, TX, Denver, CO and Kitsap County, WA. The committee created regionally based standards and established the first city-wide Green Building Program in Arizona. City of Scottsdale buildings receive a designation if they meet a threshold of site, water, energy, indoor environmental quality and material resource standards. Currently, these include but are not limited to:

- Kitchen faucets with default maximum flow rate of 1.8 gallon per minute.
- Roof with 50% run-off diverted into landscape areas.
- Smart irrigation controller that regulates irrigation based on weather or soil moisture conditions.
- All primary building entrances protected from direct summer sun (east, west, south) with recessed or covered elements.
- Minimum 5% improvement over the city energy efficiency code.
- Commercial buildings include individually sub-metered supplies for water features, swimming pools, irrigation and cooling towers.

Since the voluntary program was established, several amendments have been adopted into Scottsdale's plumbing code pertaining to water, including:

- High-efficiency Toilets, urinals, lavatory faucets and showerheads -- This plumbing code amendment goes beyond the federal standard for low-flow fixtures. It was easy to pass because the local market had already shifted to HE as the norm, and many builders were already unwittingly meeting this standard already.
- Water Heaters – In order to deliver hot water faster and more efficiently, water heaters need to be located near the point of use (bathrooms, kitchen, laundry room) or configured with a whole-house manifold system where each plumbing fixture is supplied with a dedicated hot water line directly from the water heater, analogous to an electrical circuit panel. A demand-controlled hot water recirculation loop and pump is required when the most remote plumbing fixture hot water supply line exceeds 21 feet for 3/4 inch pipe, 32 feet for 5/8 inch pipe, 43 feet for 1/2 inch pipe, and 50 feet for 3/8 inch pipe.
- Scottsdale adopted the 2015 International Green Construction Code for commercial buildings in specified zoning districts as a condition of zoning bonuses. If a developer wishes to increase building height beyond the maximum allowed limits in downtown and mixed use/commercial zones, they must follow the green construction code.

Note, there's a distinction between "low-flow" and "high efficiency:" When "low-flow" fixtures (e.g. - 1.6 gallons/toilet flush) were federally mandated in the early to mid-1990s, they were very efficient because manufacturers only made inconsequential changes to meet the standards. The faulty design often required multiple flushes to remove waste. Alternatively, "High Efficiency" fixtures (1.28 gallons/flush) have been completely re-engineered and tested to meet set updated standards.

Today, several other green building programs and water smart certification programs have been established in the state.

SECTION 4:

HEALTHY & RESILIENT WATERSHEDS

The effects of increasing development, climate change, and natural hazards can all degrade the quality of the watershed impacting both water yield and water quality.

CASE STATEMENT

In addition to managing water use it is important to safeguard a community's water supply. The quality and quantity of a community's water is inextricably linked to the health of the watershed. Human and naturally occurring factors can degrade ground and surface water quality and quantity including:

- Pollution from urban and agricultural runoff and natural disasters.
- Sedimentation due to soil disturbances, vegetation loss, and erosion from roads and new development.
- Destruction of riparian areas due to development and changes in climate.
- Increased stormwater due to increase in impervious surfaces from development.
- Decrease or lack of water infiltration resulting from impervious surfaces and more rapid runoff.
- Inconsistency in water supply caused by periodic droughts.

TOOLBOX: WATERSHED PROTECTION

Landscape scale changes resulting from both human and natural forces have a significant impact on natural ecosystems and water resource availability. Safeguarding available water resources through watershed protection standards and policies is an important, but often overlooked goal in Western communities. Watershed planning and protection has often been considered a function of collaboratives and non-profits working with local governments to restore ecological processes and functions. The way communities develop and redevelop can either escalate the threat our watersheds or nurture nature and harvest the returns.

Watershed sensitive planning focuses on minimizing negative impacts as new development occurs. Watershed protection goals are generally included in a wide variety of community plans such as comprehensive plans, emergency management plans, watershed plans, water resource management plans and open space plans. Converting these goals into concrete policy in development codes is essential to preventing watershed degradation and enhancing community resiliency.

STRATEGIES FOR WATERSHED PROTECTION STANDARDS

- Map all sensitive areas including wetlands, riparian corridors, infiltration zones, water supply watersheds, groundwater basins, and natural disaster-prone areas.
- Adopt plans for wildfire mitigation, watershed management, stormwater management, and floodplain management that designate sensitive areas and goals for mitigation.
- Minimize development in sensitive areas through clustering or limited development densities and design standards or at the least, guidelines.

- Create zoning districts with lower densities and/or cluster development to protect surface and groundwater sensitive areas.
- Adopt development standards for stream buffers and setbacks to protect water quality.
- Adopt vegetation protection standards that minimize disturbance to vegetation within the riparian corridor.
- Adopt stormwater management and site design standards that utilize best practices for low impact design reducing storm event runoff and increasing water infiltration.
- Adopt site level soil erosion mitigation standards for new development to reduce sedimentation and run-off and protect water quality from land disturbance.
- Adopt surface and/or groundwater districts with standards to minimize contamination of streams and shallow aquifers that will protect existing and potential sources of drinking water supplies.
- Participate in collaborative efforts to restore watershed functions through watershed restoration projects.

CASE STUDY

COLLABORATIVE RESTORATION AND CREATIVE MESSAGING- CITY OF FLAGSTAFF AND COCONINO NATIONAL FOREST WATERSHED PROTECTION PROGRAM

Whether a mountain or a desert town, Arizona communities are often surrounded, at least partially, by natural open space. Even if outside your jurisdiction, the health of those natural lands can help or hinder water management.

The City of Flagstaff has been successful in restoring forest lands within and adjacent to the city in order to mitigate fire risk and the associated flood and water quality issues. Much of the land was state or federally managed, yet in 2012 voters supported a $10 million bond to support key watershed restoration work. This is a rare example of federal land restoration being funded by a municipality, and the only known instance where such an effort is funded from municipal bonds.

The City of Flagstaff is groundwater dependent, and their water supply is highly dependent on the precipitation and run off from the San Francisco Peaks. Fires can create major water quality and quantity concerns: a wildfire and subsequent erosion could ruin up to 50% of the city's water supply.

Another immediate concern was public safety. Flood risks dramatically increase after forest fires. Streetside signage was placed throughout town to indicate the extent of flooding likely to occur without intervention. This public messaging campaign was key in building community support for this unprecedented bond election.

TOOL BOX – Green Infrastructure or Low Impact Development

Green Infrastructure (GI), sometimes known as Low Impact Development (LID) is the retention or restoration of natural hydrologic patterns by using landscape and site design to keep as much rainwater as possible from leaving the site. Instead of designing a site to funnel stormwater off site as fast as possible, LID uses natural vegetation, detention basins, and porous materials to "slow the flow" and encourage the infiltration and harvesting of stormwater.

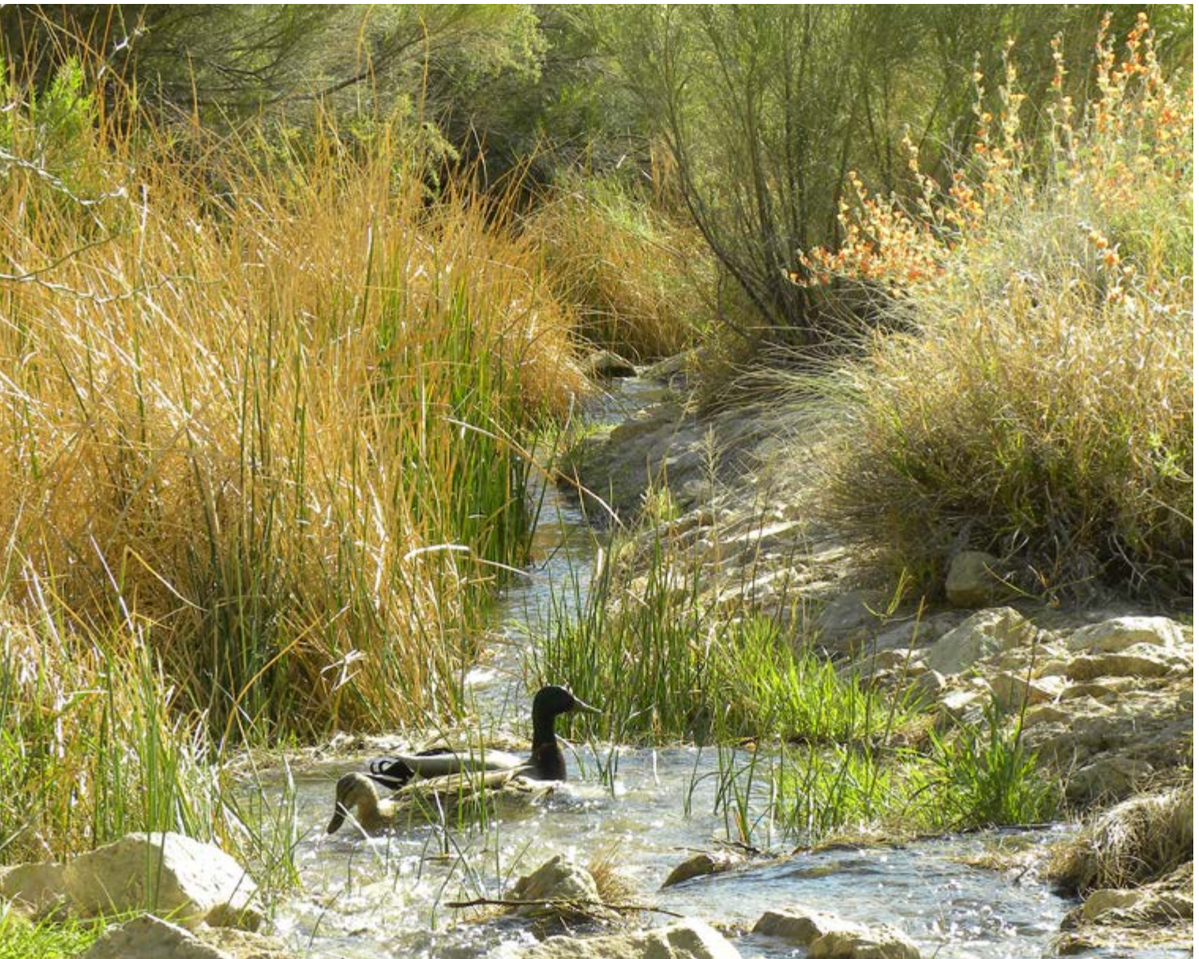
GI comes in many forms for different applications. Some of the more common techniques include:

- Bioretention basins, stormwater harvesting basins or rain gardens, all similar in concept, are small to large scale planting areas within the hardscape containing shrubs, trees and grasses.
- Bioswales are shallow and uncovered channels that induce meandering and are placed inline within a drainage channel.
- Curb extensions, or chicanes, are where the street curb bumps out into the street and the extra buffer space becomes a bioretention planter. Curb openings are cut into existing curbs to divert stormwater off the street or parking area into bioretention basins along the right of way or parking strip. Sediment traps are installed at the inlet of the curb opening to provide an area for sediment to deposit and prolong efficiency of the system.

- Domed overflow structures, or detention basins, pond water and allow overflow during large storm events.
- Permeable pavement, gravel, or pavers, allow infiltration and can be used in low to moderately trafficked areas like sidewalks and parking lots

The benefits of green infrastructure include:

- Reducing peak flooding and treating stormwater on-site reduces pollutant loads and risk of sewer overflow.
- Reducing the need for outdoor irrigation and landscaping; native plants can revegetate channels and basins on naturally occurring rainfall.
- Life-Cycle Cost savings - the value of health and ecosystem services supported by green infrastructure solutions are only partially understood. But GI is effective at mitigating heat, improving groundwater recharge, soil and stream health, absorbing carbon and pollutants, and fostering active, healthy lifestyles, thus mitigating the cost of solving the problems caused by reversing those trends. For these goals, traditional gray infrastructure tends not to perform as well.



Strategies for Green Infrastructure

- Work with Transportation and Civil Engineers to update development standards and map areas and streets with the highest flood potential and the widest setbacks where there will be room for tree plantings.
- Use Green Infrastructure for traffic calming, beautification and place making. Consider placing GI along areas with high speed vehicles or with bicycle and pedestrian traffic.
- Consider the potential to use stormwater recapture for a centralized urban natural open space. Requiring onsite retention can result in large, underutilized areas within urban sites, but conveying this water to a common area or neighborhood park may better suit your community or neighborhood's vision.

CASE STUDY

PLANNING & FUNDING GREEN INFRASTRUCTURE – TUCSON

Stormwater harvesting programs and policies often focus on green infrastructure: using natural spaces within the built landscape to capture stormwater, to reduce fugitive water (i.e., water runoff from a site), and to mitigate urban flood risk.

The **City of Tucson Green Streets Policy**, passed in 2013, requires Tucson Department of Transportation to incorporate green infrastructure (GI) into the design of public roadways during new construction and reconstruction projects that include a landscaping element. It also requires that GI costs and benefits are evaluated and incorporated into project budgets. The main goal of this policy was to address flooding issues in Tucson's street network. Secondary benefits included heat island mitigation, improved streetscape aesthetics, and traffic calming.

Initially, the transportation department was responsible for maintenance but were too constrained by funding, so the city had shifted responsibility to the residents and neighborhood groups. It became apparent that neighborhood groups are ill-equipped to handle maintenance projects, and the poorly maintained basins had become ineffective at stormwater harvesting, further diminishing street safety and aesthetics.

In 2019, voters approved the City of Tucson Green Stormwater Infrastructure Plan and **Green Stormwater Infrastructure (GSI) Fund** to support the maintenance of existing GI features, plus the planning, construction of new stormwater harvesting basins in new areas of the city.

Tucson Water used the recommended maintenance cost rate of $2.84 per square foot of GSI features per year, plus a thorough inventory of the existing317 GSI features in the city to estimate overall costs. The approved fund added a flat rate charge which ranges from approximately $1.00/month for low income families to around $2.00/month for commercial users. The total annual budget for this program is approximately $3 million, covering program administration, feature maintenance, and capital improvements.

Additional benefits of the GSI fund included a centralized responsibility for city-wide integrated implementation which avoided duplicated and counter-productive efforts. This initiative of Tucson Water is consistent with several goals of the voter approved *Plan Tucson: City of Tucson General and Sustainability Plan 2013* and Tucson Water's One Water management strategy.

CASE STUDY

EFFLUENT MANAGEMENT & ECONOMIC DEVELOPMENT – TUCSON WATER'S HERITAGE PROJECT ON THE SANTA CRUZ RIVER

Reclaimed water, or treated wastewater, is an exciting new frontier for water policy and land use planning. Rapidly improving treatment technology is making reclaimed water more appealing for wider use. The Flagstaff-area private ski resort made headlines for their use of reclaimed water for snowmaking. Scottsdale has become the first in Arizona— and third in the nation—to have a permit for direct potable reuse. In Tucson and Marana, reclaimed water is restoring habitat and supporting economic development along the Santa Cruz River.

The Santa Cruz River is an ADWR-permitted, managed recharge facility (MUSF – see Appendix for more explanation) in Tucson and Marana with surface water flows that depend almost entirely on treated wastewater from Pima County. In 2013, Pima County invested $600 million to upgrade their two treatment plants that release water into the river. With the improved water quality, rare aquatic habitat has been restored, water infiltrates and restores aquifers at a faster rate, and the pleasant river corridor fosters outdoor recreation and economic development opportunities. ***Living River* reports,** produced by Sonoran Institute in partnership with Pima County, summarize these long-term improvements which have created conditions that favor keeping the water in the river channel.

However, the future of this restored habitat was uncertain because reclaimed water is often used to offset potable demands in urban areas, and water owners were obligated to put their water to the optimal use financially and for the long-term water supply. Since ADWR permitted 50% credit for water recharged in MUSFs, off-channel uses were incentivized—that is, until a recent exception was made

In 2019, via the Arizona Drought Contingency Plan, ADWR approved a 95% credit for the water that infiltrates in a limited number of existing MUSFs, including parts of the Santa Cruz River. This new policy gives effluent owners nearly full credit for the water that remains in the river and all but assures water will remain in the river channel. The aesthetic watershed improvements and the certainty of flows supports major investments in the river corridor, such as the Santa Cruz River Heritage Project.

One of the first and highly visible projects that resulted from the crediting change was the **Santa Cruz River Heritage Project**, which was launched by Tucson Water in June 2019. This project uses existing infrastructure to bring a portion of Tucson Water's share of recycled water to a stretch of the Santa Cruz River near downtown Tucson where it recharges within city limits. The city expanded the pipeline to include a minor filtration process and an outfall into the river corridor. The existing infrastructure kept costs to approximately $850,000.

The primary obstacle was how to maintain the river channel for flood conveyance. The introduced water increases vegetation growth, which then reduces the river channel conveyance capacity during flood events. The river channel is especially constricted by riverside development in downtown Tucson. Tucson Water and Pima County Regional Flood Control District have established collaborative agreements to address the location of the flowing water and channel maintenance in the Heritage Project vicinity.

Under the new policy ADWR policy, Tucson Water receives 95% credit for this water, considerably incentivizing, though not guaranteeing, the long-term dedication of this reclaimed water to flow in the river channel. This reliable influx of water is actively restoring a historically perennial stretch of river near downtown, reconnecting community members to the river and providing an attraction for growth in an area adjacent to downtown Tucson.

SECTION 5:

WATER CONSERVATION RATE STRUCTURING

Utility pricing, or rate structuring, can incentivize consumers to use less water, maximizing conservation benefits.

CASE STATEMENT

Water demand varies due to size and type of property, seasons, weather, income, education, and conservation habits. For individual households and businesses sensitive to the price of water, rate structuring is one of the more effective ways to prompt conservation behaviors.[5] Most water providers use declining block or uniform water rate structures that do not encourage conservation. Rate structuring aims to incentivize water conservation by charging higher prices as a household or business uses more water. Common goals for adopting water conservation rate structures include:

- Reducing daily peak usage.
- Reducing seasonal peak usage.
- Reducing total system demand.

When well executed, rate structuring can produce significant water savings and expedite shifts in water use behavior.

[5] Higher income households are less sensitive to rate fluctuations.

TOOL BOX: CONSERVATION RATE STRUCTURING

Water utilities set rates to collect the revenue they need to operate the water utility, invest in its infrastructure, and protect public health. With a revenue goal identified, utilities can develop a rate structure to meet additional objectives including water conservation and acquisition of supplies, but prioritizing conservation can ensure costs are mitigated by right-sizing any acquisition or storage to meet a mitigated demand.

Water rates are determined by two factors. First, the fixed costs of water determined by the costs of acquisitions of water and the costs to establish and maintain the infrastructure to convey the water. Second, a variable cost based on the amount of water consumed by a consumer. If the current price of water presents a revenue challenge if customers conserve beyond a point, consider having a public dialogue to design solutions and rate structures that reflect the community's values. Also consider how less demand pressure can reduce strain on water system infrastructure, delaying maintenance, retrofitting or building of new infrastructure, cumulating into considerable cost-savings over time

There are a variety of rate structuring options:

- **Drought Demand Pricing**: Rates are higher during drought periods.
- **Excess Use:** Rates are higher for above average water use.
- **Inclining Block:** Rate per block increases as water use increases.
- **Indoor/Outdoor:** With separate meters, rates for indoor use are lower rates than for outdoor use.
- **Penalties:** Customers are charged for exceeding allowable limits of water.
- **Scarcity Pricing:** The costs of developing new supplies is added to bills.
- **Seasonal Pricing:** Water rates are higher during the season with the most demand.
- **Sliding Scale:** The unit price increases based on an average consumption.
- **Spatial Pricing:** Water rates are determined by the actual costs to supply water to specific locations.
- **Time-of-Use:** Water rates are higher during peak days or specific hours of the week.
- **Water Budget:** Block rate is defined for each individual customer based on efficiency projections/expectations for that customer.

STRATEGIES FOR CONSERVATION RATE STRUCTURES

- Develop a utility water conservation plan to clarify water conservation goals.
- Conduct a rate assessment to determine options for rate structuring.
- Develop a rate structuring plan and conduct community education and outreach to minimize opposition to potential rate increases.
- Adopt a conservation rate structuring strategy.

CASE STUDY

TIERED RATE STRUCTURES & CONSERVATION FEES - TUCSON WATER

Water rates are a key tool for managing demand as well as generating enough revenue for operations, maintenance, and capital improvement projects. A key challenge for water providers is finding ways to maintain financial sustainability as customers embrace water conservation.

Tucson Water uses an inclining block rate structure for their residential customers' potable water delivery. This structure disincentivizes higher water use, because as water volume use increases, so does the unit price for that block. One unforeseen challenge with this system was summer growing season.

Some of the most loved foods of Sonoran Desert dwellers, peppers and tomatoes, grow in the hot summer months. Thus, gardening in the summer is quite popular. This was a major barrier to community gardens, which were treated as a residential customer in Tucson Waters system. A garden with several plots will have a significant water demand, often putting them at the highest price per ccf block of water use. Unable to afford these bills, many gardens would close during the summer months.

In response, Tucson Water designed a three-year pilot program to offer community gardens a more affordable rate of $3.36 per ccf, which is somewhere between the lowest and second lowest block rate. Gardens qualify for this program if they have a designated irrigation meter and backflow prevention devices. Tucson Water estimates that this can save gardens up to $2,000 in water bills.

The City of Tucson utility bill includes a conservation fee on top of the tiered block rate. Tucson Water started their conservation fee of $0.03 per ccf of potable water sales in fiscal years 2008/09. The fee has increased gradually overtime and is currently set to $0.10 per ccf, with exceptions for low income households. This fund covers the operating expenses for Tucson Waters conservation initiatives which include research, training and education, conservation audits, rebate programs, rainwater harvesting, and stormwater harvesting programs.

TOOLBOX: Smart Water Metering

Water metering is a method of measuring water consumption. Advanced metering technology, called "smart meters" ease the data collection process and increase the specificity of the data. This increased granularity of information makes opportunity for easily justifiable rate structures, rapid leak detection, and customized demand management programs. Utilities that pair metering and commodity rate structures report a 15% to 30% reduction in water consumption.[7]

Furthermore, sub-metering multi-family, commercial and outdoor uses can provide data granularity to empower refinement and optimization of water policies, rates and fees. The value of information may be worth more than the cost of installing an extra meter.

Toolbox: Messaging Strategies that help motivate changes in behavior

Utility bills often include an educational insert or other content designed to inform the reader on policy changes and to encourage water savings tips and tricks. There is a widely held belief that warnings and fear-inducing messaging is effective. However, studies show that negative information have limited impacts in changing behavior. This is because the fear responses of fight, flight or freeze have their neurological equivalents. In response to negative information, people will defend themselves by rationalizing why the new information doesn't apply or ignore it outright. When given two seemingly contradictory pieces of information – one positive, one negative, people tend to believe the more positive alternative and reject the negative. In any case, poor behavior continues unless new positive framing techniques are used.

THE TYPES OF INFORMATION & PHRASING THAT MOTIVATE CHANGE INCLUDE:[8]

- **Sense of Control** – the behavior must be something that the person feels they can control or influence. Provide tangible acts or decisions they can make to "move the needle" towards a goal.
- **Social Incentives –** generally people want to either be the same or be better than their peers. Offering comparisons to peer networks, like neighborhoods, or sharing figures that show high compliance (9/10 residents pay their water bills on time) will encourage behavior change.
- **Immediate Rewards** – near-term rewards make people feel good. This reward structure can even motivate behavior changes that relate to long-term goals or outcomes that are not immediately visible. The reward can be external or intrinsic.
- **Progress Monitoring** –the brain is better at integrating information about progress and not decline. Given an opportunity to describe a trend, note progress and not the downward trends. This relates back to Positive Language – a person will be more likely to believe and act on positive information than negative information.

[7] https://www.allianceforwaterefficiency.org/resources/metering

[8] Tali Sharot, "How to motivate yourself to change your behavior," October 28, 2014. TEDxCambridge. https://www.tedxcambridge.com/talk/how-to-motivate-yourself-to-change-your-behavior/

CASE STUDY

BIG WATER DATA ADVANCED METERING INFRASTRUCTURE - CITY OF TEMPE

System-wide data collection in real time assists rapid responses to water emergencies, regulating usage, and helping customers manage their water demand by providing consumer water use trends down to the hour.

The City of Tempe was the first in the Valley to use a state-of-the-art system called Advanced Metering Infrastructure (AMI) to track residential customer water meters. A series of digital "collectors and repeaters" installed on light posts read and transmit water use data to the service provider. Until this big jump to AMI, the City of Tempe had been manually reading each of their 43,000 water meters.

The AMI system isn't perfect, but the challenges primarily relate to the systems that meter electricity. Water metering is more straightforward to install, and costs are decreasing with improving technology.

The AMI data allows the City and each individual consumer more tools to reduce water consumption.

- The city can tailor their conservation incentive program to target customers who could benefit from free consultations and water audits.
- The automated system helps the city avoid fluctuating billing periods for customer consistency.
- Tempe residents can monitor their use in real time and see the peaks in their demand at hour intervals. This data shows them the real time benefits from the improvement measures they take.
- Customers can identify leaks by looking for water use that occurs during periods when the property is vacant or during sleeping or working hours. This gives them a greater sense of contol over thier water demand.
- Customers can compare themselves to larger social groups, such as the neighborhood average or city-wide average.

Other ways to read water meters electronically include either an employee driving past each house with a computer inside the vehicle reading meters one-by-one, or in Automatic Meter Reading (AMR), an employee will visit various central points and with a specialized computer to read every meter within a half-mile or so.

CONCLUSION

The toolboxes outlined in this guidebook highlight some of the methods communities might strengthen water demand management.

Ultimately, by linking land use (and landscaping) to water demand, we can wisely manage our limited resources in a way that sustains thriving economies, healthy environments and vibrant communities in Arizona for future generations.

GROWING WATER SMART RESOURCES

This section highlights some of the best research, tools, guidebooks and policies from Arizona, other western states, federal agencies, and non-profit organizations that relate to land use and water resource management.

CITIZEN GUIDES ON ARIZONA WATER LAW

1. The University of Arizona Water Resources Research Center **Layperson's Guide to Arizona Water Law** in 2004
2. Section 2 of the 2015 Arizona Town Hall report, **Keeping Arizona's Water Glass Full** is another resource for understanding water law.

THE IMPORTANCE OF INTEGRATING WATER AND LAND USE.

3. **A simple rationale** for integrating water and land use in plain language.
4. Western Resource Advocates have developed **many high-quality resources** linking water and land use. The overview, New House New Paradigm, provides a good explanation of the benefits of this approach and the tools available.
5. A comprehensive review of the land use and water nexus is available in the **Colorado's Water Plan - Land Use and Water: Story Map** of Land use planning and water management in Colorado.
6. Colorado APA, CWCB, and DOLA worked together to develop resources for Breaking Down Silos. It includes a resource guide and a series of deep dive webinars that cover case studies across Colorado for integrating water and land use. These resources can be found at the **Colorado State Water Plan Linking Land Use and Water** page.

PLANNING & POLICY MAKING

Integrate water efficiency and conservation into land use planning through comprehensive plans.

7. The Babbitt Center for Land and Water Policy has studied how communities have integrated water into their comprehensive plans. Here are some of their picks from Arizona and other states:

- **The City of Gilbert**
- **The City of Flagstaff**
- **Pima County**

- City of Florence
- Santa Fe County has an integrated Water, Wastewater, Stormwater Management plan that is a great example of how a plan can be both educational and strategic.
- The City of Greeley, CO has adopted a landscaping plan that is a supplement to the Comprehensive Plan. The plan outlines goals and strategies for achieving water conservation and efficiency in outdoor landscapes.

8. The Sonoran Institute's Is Arizona Growing Smarter reviews plans in Arizona to evaluate the effectiveness of the "Arizona Growing Smarter" Act, and includes a useful summary of planning requirements and a range of successful planning examples.
9. The American Planning Association has developed a guide for developing comprehensive plans that sustain places.

Using exploratory scenarios as a tool to explore links between water & land use

The Lincoln Institute of Land Policy and Sonoran Institute have been integrating exploratory scenarios into land and water planning.

- Exploratory Scenario Planning
- Embracing Uncertainty

ENSURING ADEQUATE SUPPLY FOR DEVELOPMENT

Policy Reviews

10. A comprehensive review of Western States water adequacy requirements & recommendations
11. The State Assured Water Supply Study by Anne Castle
12. The OECD policy report on viable water allocation policies

Methods for Projecting Water Demand for Land Use

13. The Pacific Institute released a useful resource, A Community Guide to Calculating Future Water Demand. It outlines some of the methodological concerns with water demand forecasting and provides a checklist to utilize when reviewing water demand projections (pages 3-6) for accuracy. It includes a summary of the methodologies used in water demand forecasts (pages 9-11) followed by the best practices that should be integrated into water demand forecasting.
14. The ADWR Assured Water Supply Program demand calculator is available for download from their FAQ page.
15. The ADWR Non-AMA Demand Calculator
16. EPA Water Budget Tool and Resources
17. California workbook to assist water demand projections for land use. Starting on page 9 is an explanation of the methodologies for projecting water demand by either dwelling unit or per acre.
18. The Water Efficiency Rating System (WERS) is a tool developed and used by the City of Santa Fe and Green Builders Coalition but is now available for universal use. WERS is a third-party verified tool that is used by developers to predict water use for new and existing properties. It allows for developers to identify water efficiency goals and determine what design modifications will allow them to reach that water demand goal.
19. Colorado Water and Growth Dialogue's Residential Land Use and Water Demand Tool is useful for stimulating discussion about how residential development patterns and demand are interrelated.

WATER SMART LAND USE POLICY

Models & Case Studies for Land Use Policy

20. This model ordinance is for water neutral development from Net Blue.
21. City of Santa Fe water demand offset ordinance summary. Their toilet retrofit requirement was a nationally recognized success.

Promoting more efficient development patterns

22. This Smart Growth America guide illustrates the most effective zoning and ordinance strategies for more efficient development patterns.
23. Clarion Associates did a comparison of the different development typologies across the West to identify water savings from land use patterns and density. Read the report here.
24. The American Planning Association as part of its Sustaining Places program has developed guidance on integrating water into comprehensive plans in the new "Planners and Water" report.
25. Compact form, mixed use development, and placemaking have benefits for communities beyond water conservation – they also contribute to economic development. Community Builders Place Value report provide the rationale for thinking about downtowns and neighborhoods that promote walkability, include mixed uses, a variety of housing types, and places supporting social interaction as ways to build a thriving economy.
26. Western Resource Advocates comprehensive report on Integrating Water Efficiency Into Land Use Planning in the Interior West: A Guidebook for Local Planners
27. ADWR Matrix that links conservation best management practices with service area characteristics:
28. Colorado Water Conservation Board updated its Water Efficiency Plan Guidance to include: Best Management Practices for Implementing Water Conservation and Demand Management Through Land Use Planning Efforts

Promoting water conservation and efficiency through water smart landscaping and plumbing codes.

29. Examples of communities who have integrated water into their code:

- City of Scottsdale Arizona has adopted the 2015 International Plumbing Code and amended it to include HE fixtures, improvements to water heater systems and conditions for re-zoning
- City of Flagstaff, Arizona Landscaping Standards integrates hydrozones
- City of Tucson Emergency Water Conservation Response (Chapter 27 article VI) and Drought Preparedness and Response Plan (Chapter 27 article VIII)

30. Metropolitan Water District, San Diego County Water Authority, and Southern Nevada Water Authority's turf replacement programs highlighted in a water research foundation webinar.
31. Western Resource Advocates has developed resource guides for communities working to link water and land use. The Codes and Ordinance Fact Sheet is a good overview of landscaping and plumbing fixture benefits.
32. Comprehensive best practices guide for water conservation and efficiency for prepared for the Colorado Water Conservation Board.

Additional Landscape Standard Resources

33. The ADWR low-water-use plant lists for each AMA. These lists are to be used in public medians and rights-of-way in the AMAs. Local jurisdictions can incorporate these lists into local ordinances, design standards. AMWUA native plant list includes plant combinations for optimal outdoor water efficiency.
34. Guidance on matching irrigation systems with plant needs
35. Soil Amendments From University of Arizona Cooperative Extension
36. Federal Energy Management Program Estimating Unmetered Landscapes
37. EPA WaterSense Water Efficiency Management Guide Landscaping and Irrigation
38. City of Prescott has digital tours of xeriscaped gardens tours in their city limits. Example gardens include rural/urban and small and large. The digital tours have call-outs of plant types as well as tips and explanations of the techniques shown in each photo.

HEALTHY & RESILIENT WATERSHEDS

Protect ground and surface water resources through watershed protection standards and restoration projects.

39. How do you fit into the larger watershed? The University of Arizona's NEMO Watershed based plans are large-scale watershed-based plans to aid in achieving water quality standards and protection goals for each of Arizona's major watersheds. These plans identify areas that are susceptible to water quality problems and pollution, sources that need to be controlled, and management measures that must be implemented to protect or improve water quality.
40. WRRC outlines the best methods for quantifying environmental flow needs in the Arizona Environmental Water Needs Methodology Guidebook
41. The Water Alliance One Water Roadmap
42. Protecting Water Resources with Smart Growth (2004) is for communities, local governments, state and regional planners, and other audiences already familiar with smart growth who are seeking more ideas for protecting water resources. The document compiles 75 policies designed to protect water resources and implement smart growth strategies.
43. Maricopa County floodplain management regulations
44. Colorado Water Plan chapter on watershed health and collaborative watershed management
45. Managing the upper watershed often requires collaborative approaches with public land agencies and private land owners. This resource created by the Colorado Water Conservation Board and Colorado State Forest Service reviews the key principles of managing forest lands for watershed health.
46. The Colorado Department of Local Affairs (DOLA) Division of Local Government released Planning for Hazards: Land Use Solutions for Colorado a guide and website designed to help Colorado counties and municipalities prepare for natural disasters and reduce risks through the integration of resilience and hazard mitigation.
47. The Colorado Water Conservation Board drought planning resources can help communities manage their response to drought.
48. The Northwest Counties Council of Government's Water Quality & Quantity Committee completed a water quality protection & model water quality standards resource guide in 2018.

Green Infrastructure

49. Watershed Management Group provides GI Plans and Design Standards from Arizona
50. EPA Operation and Maintenance of Green Infrastructure
51. ASU Green Infrastructure and Low Impact Development Handbook
52. Conserve2Enhance programs provide grants to community groups for watershed restoration and neighborhood green infrastructure projects. The program is funded by donations water consumers, equal to the money saved from other conservation steps they've taken around their property.
53. Pima County Low Impact Development & Green Infrastructure Guidance Manual

RATE STRUCTURING & METERING TECHNOLOGY

Use available management tools of pricing and technology investments to incentivize household water demand behavior.

54. City of Gilbert **avoided costs analysis** on the impact of water conservation on water and wastewater rates
55. **An excellent resource for utility managers** for managing water supply and demand for the financial health of the utility.
56. A comprehensive study of water rate structuring best practices, Designing Water Rate Structures for Conservation and Stability, was conducted for Texas communities by the University of North Carolina and the Sierra Club in 2014.
57. Western Resource Advocates A Guide to Designing Conservation Oriented Water System Development Charges
58. Western Resource Advocates **fact sheet on submetering for multifamily units.**
59. Alliance for Water Efficiency provides **multiple resources on water metering, dedicated irrigation meters, smart metering, submetering, and cost-benefit analyses.**
60. The Federal Energy Regulatory Commission has a useful w**rite-up on Automated Metering Infrastructure** technology's benefits and considerations for use.

Public Education on conservation programs and incentives.

61. City of Tucson's **"Pete the Beak"** rallies Tucson Water customers to "Beat the Peak" and conserve water all year long.
62. Denver Water's **Use Only What You-Need campaign** has won national attention for its water education programs to raise awareness about water conservation.
63. The City of Santa Fe, NM began a **"lead by example" Water Conservation Program** in 1997, building a comprehensive and effective program which has resulted in Santa Feans reducing per capita water consumption by more than 50% since tracking began in 1995. Much was done through public education. The success of the conservation awareness program and an aggressive rebate program are demonstrated by water demand. While most major NM cities are all below 100 gpcd, Santa Fe is at 56.
64. Santa Fe's more recent efforts is the **"It's Not Coming Back"** campaign.

GENERAL RESOURCES

Improve water management

65. The following professional service organizations all provide tools to support communities working on water conservation. They include:

- **Alliance for Water Efficiency**
- **American Water Works Association**
- **EPA Water Sense**

66. There are many movements or philosophies all proposing that we need to manage water differently. **The One Water initiative** of the US Water Alliance is working to integrate water resource management in a holistic and coordinated manner.
67. **Integrated Water Resource Management (IWRM)** is about the management of water in all its forms – drinking water, stormwater, wastewater and source water.
68. Environmental Law and Policy Center's **Land Use Tools to Protect Groundwater Quality: Overlay Districts**
69. **APA Integrated Water Resource Management**
70. Northwest Colorado Council of Government's **Quality and Quantity Commission's Model Water Quality Protection Standards**

PUBLIC OUTREACH, COMMUNICATION, AND ENGAGEMENT

71. AWWA has an entire webpage dedicated to **communication strategies for utilities**, including sharing their own messaging platform.
72. A research agency conducted a poll of US water users and identified **which values and messages resonated the most in water messaging**.
73. For organizations and agencies with fewer resources, the **Use It Wisely** campaign provides opportunities to integrate conservation education into your website.
74. **Central Yavapai County Water Aware** resource guide to assist citizens in their water efficiency efforts

Be Resilient.

ResilientWest.org

Through our Growing Water Smart workshop series, we've trained over 135 community representatives and impacted the lives of over 3,000,000 Coloradoans in the last two years. We are still scaling the program. By the end of 2020 we aim to train and assist communities serving over 60% of Colorado's population, we will have grown into Arizona, and established a program in California.

By continuing to support Growing Water Smart more communities will have the opportunity to take advantage of Sonoran Institute's expertise and share in lessons we have learned over nearly thirty years of shaping the future of the West.

JOIN US. MAKE THIS WORK A REALITY.

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