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Conversion of Turf Areas in Arizona

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Abstract

Converting turf areas to low water use landscapes is encouraged in arid climates to save water and lower maintenance costs. Steps necessary for the conversion begin with designing the new landscape, followed by the removal of existing turf and irrigation, installation of an alternative ground cover, and appropriate irrigation system if necessary. Different options for ground cover include alternative vegetation to traditional turf or inert ground covers, each with advantages and disadvantages. Maintaining functional irrigation and protecting the root zone of existing trees that will remain in the new landscape is essential during construction and post-construction. This publication provides an overview of the entire process and suggestions for the implementation of the different steps.

Reasons to replace turf with low water use landscapes

Conversion of ornamental turf areas not used for recreation to low water use landscapes is promoted in arid and semi-arid climates to save potable water and reduce maintenance costs. Additional benefits include improved water quality when removing the recurring fertilizer and pesticide applications in managed turf areas. Strategies to encourage water savings in residential and commercial landscapes include education on drought and water shortages, water use restrictions for lawns, and incentives for turf replacement for low water use landscapes (Price et al., 2014). These conversions saved up to 21% of water consumption in the Las Vegas area (Baker, 2017). Conversion from turf to xeriscape in southern Nevada found participants used, on average, 30% less water per year or an annual savings of 55 gallons per square foot, with the greatest savings during the summer months (Socovool, 2005). Lower maintenance costs ot xeriscape versus turf landscapes saved $206 on average per year. Converting turf to xeriscape landscapes can reduce outdoor water use by 50% (AMWUA, 2024a). For example, a Bermuda or Bermuda hybrid lawn with winter overseed in the Arizona low desert requires more than 55 inches of irrigation per year while the average xeriscape requires less than 18 inches per year.

Incentives for removing turf in Arizona

Incentives for converting turf areas into low water use landscapes in Arizona are available in several cities located in the greater Phoenix area, in Prescott, Flagstaff, and Tucson (AMWUA, 2024b). Programs are offered for residential customers, commercial properties, and homeowner associations, and require the removal of healthy turf followed by conversion into xeriscapes with a minimum plant cover of 50% when the low water use plants have reached maturity. Some rebate programs offer incentives for the installation of passive rainwater harvesting basins or active rainwater harvesting systems (AMWUA, 2024b). In addition to specifying planting of low water use plants, some municipalities do not allow the installation of artificial turf as a replacement ground cover in non-residential landscapes.

Effects of turf removal on erosion, nutrients, cooling potential

Roots of turfgrass are effective in stabilizing the soil and supporting water infiltration. Loss of soil particles to erosion through rain or wind poses a risk, especially in semi-arid areas where extended periods of drought are interrupted by infrequent, often heavy rains. Soil particles lost to erosion by wind can increase air pollution and dust. A change from turfgrass to lower density plant cover, artificial turfgrass, or mulch can result in soil erosion of small particles and loss of nitrate and phosphorus in runoff within the first year (Chang et al., 2022). In the Phoenix area, long-term nitrate losses were documented from the plant rooting zone with substantial amounts lost between 4 to 13 years after turfgrass conversion (Heavenrich and Hall, 2016). Soil texture, frequency and amount of irrigation and rainfall, fertilization, the percentage of plant cover, and residual soil minerals impact potential losses of nitrogen and phosphorus in the soil. While the roots

of new trees, shrubs, and other plants will take up some of these nutrients, their lower density will not cover the entire previous turf root zone which retained the majority of nutrients.

Lawns are comprised of tightly spaced grasses with a large leaf area, contributing significant cooling from surface transpiration to the area. Surface temperatures over lawns can stay 10°F to 14°F cooler than over concrete or asphalt, which helps reduce cooling costs for homes and reduce the heat island effect (Maryland Institute of Applied Agriculture, 1996). Removal of the dense turf cover will reduce the cooling effect and, depending on the replacement surface covers, can result in increased surface temperatures.

Supplementing irrigation for xeriscapes with rainwater harvesting

Turf irrigation systems will be removed before or during the conversion to a low water use landscape. Irrigation needs to be maintained or installed to ensure a continuous water supply for existing trees, large shrubs, and other plants that require consistent watering to remain healthy. Rainwater harvesting is an effective way to supplement irrigation and conserve potable water (Lancaster, 2019). Passive rainwater harvesting through contouring of the soil surface creates berms and basins to collect water during rain events and allow infiltration. When built and maintained correctly, strategically placed basins or swales will supply water to the root zone of plants that are installed after turf conversion (Schuch and McCormick, 2021). Depending on the site and plant material installed, irrigation can be combined with rainwater harvesting to offset the use of potable water.

Implementing turf conversion

Conversion of traditional turfgrass lawns to alternative landscapes requires several steps, starting with planning, preservation of existing trees, turf removal, installation of alternative ground covers, and aftercare. Details for this process are listed in Table 1. While some of the steps can be completed anytime, others are sensitive to the time of year, especially regarding transplanting and protecting remaining trees as well as turf removal. A project manager will be responsible for overseeing the planning and implementation of the project.

Table 1. Steps for successful turf conversion including tree preservation in semi-arid climates

Initial Planning	Final Planning	Demolition	Installation	Installation	Monitor
1. Establish Budget 2. Create Scope of Work 3. Get Rough Estimates 4. Revise Budget and Scope of Work 5. Repeat Steps 1-4 Until Satisfied	6. Create Tree Inventory 7. Work With Consultants: Irrigation, Arboriculture, Design 8. Evaluate Tree Health and Suitability to Retain, Create Removal List 9. Design: Create Grading, Irrigation and Planting Plans 10. Create Request for Proposals and Screen Bids	11. Interview and Hire Contractor 12. Create Root Protection Zone for Retained Trees with Fencing, Mulch, Temporary Irrigation 13. Complete Steps for Chemical Removal of Actively Growing Turf 14. Remove Trees and Plants Not Suitable	15. Surface Removal of Dead Turf with Verticutter, Deeper is Harmful to Trees 16. Carefully Grade Soil as Needed Beyond Dripline and Tree Protection Zone 17. Consider Shallow Depressions at Tree Driplines for Irrigation and Rainwater Capture 18. Install Irrigation System with Irrigation Consultant or Arborist	19. Plant New Trees and Other Plants 20. Install Mulch, and/or Granite (with Pre-emergent)	21. Check Irrigation System Regularly and Monitor Tree Health Closely During the First Summer 22. Monitor Trees for Recovery and New Trees for Establishment During the First Spring 23. Begin Weed Management Plan Ahead of Next Weed Germination Cycle

Once the type of conversion has been decided, a budget drafted, and contracts for the removal of turf, irrigation, and vegetation, tree preservation, and installation of new irrigation and plants are completed, the work can begin. Herbicide removes turf while it is actively growing during the summer months from June to September. Removing the sod and roots, grading and contouring the site, and installation of the new irrigation system are the next steps. The best planting time is from late fall to early spring to minimize the stress of transplanting during the hot summer months. Follow-up tasks include adding mulch to the soil surface, controlling weeds, irrigating remaining and new plants on the site appropriately, and regularly assessing plant health, growth, recovery, and establishment during the following growing season. The remaining trees need to be monitored closely as stress from the conversion can become apparent two or more years after the work has been completed.

Removal of living turf

The most effective way to remove a Bermuda grass lawn is to apply the herbicide glyphosate while turf is actively growing (Kelly, 2005) and daytime temperatures are above 80°F and nighttime temperatures above 55°F. Glyphosate is a non-selective herbicide, and once absorbed by the plant, it will move to above and below-ground plant parts and kill them. More than one application may be necessary to kill the Bermuda grass root system completely. Detailed instructions on how to remove a Bermuda grass lawn are outlined by Kelly (2005). A word of caution regarding the selection of the herbicide formulation. Glyphosate is now available in many formulations, some of them containing other active ingredients that can cause permanent damage to plants, including killing them. This publication explains the different products and their potential effects on non-target plants such as trees and shrubs (Umeda et al., 2021). Once irrigation is no longer necessary to water the turf, especially since repeat applications are needed to completely eradicate Bermuda grass, the irrigation system for the turf area can be removed or, if feasible, converted to drip irrigation. Dead grass may be taken out by scalping down to the soil level with a verticutter. When using a sod cutter to remove grass roots, this will also remove shallow feeder roots from trees or shrubs and will cause additional stress to plants.

Alternatives to turf

There are several options to replace ornamental turf by installing xeriscapes with low water use plants or groundcovers, installing artificial turf, covering the area with gravel or organic mulch, or leaving the soil surface bare, each with its own trade-offs.

- **Xeriscape landscapes** consist primarily of native, or desert adapted plants that require little water. Some higher water use plants, such as annuals or vegetables, may be included, but their use is limited to small areas or containers. While water conservation up to 50% is a key factor, the loss of the evaporative cooling effects of lawns can be a drawback when converting turf to a typical xeriscape with considerably lower plant density and, therefore, less evaporation and cooling potential. Surface temperatures over lawns can stay 10°F to 14°F cooler than over concrete or asphalt, which helps reduce cooling costs for homes and reduce the heat island effect (Maryland Institute of Applied Agriculture, 1996). Therefore, the less area previously covered with turf will be planted with low water use plants, higher temperatures in the area can be expected. This will further be modified by the soil surface or the material covering the soil.

Fig. 1. A low water use landscape with trees (mesquite, palo verde) and shrubs (Mexican bird of paradise, rosemary).

- **Water efficient groundcovers** offer green space with greater water efficiency and less maintenance than traditional turfgrass. There are many options of perennial, woody groundcovers, drought-tolerant grasses such as big galleta, Plains lovegrass, buffalograss, or blue grama (Burayu and Umeda, 2021), or herbaceous groundcover mixes that can aid in erosion control. Most groundcovers require little water, infrequent mowing, and minimal additional maintenance input. Depending on plant type and density, they will provide cooling, the appeal of a lawn, and may support limited foot traffic.

- **Artificial turf** is an option for those preferring the aesthetics of green grass. Artificial turf does not require mowing or irrigation like live grass; however, it is not maintenance free. Artificial grass care includes regular removal of organic debris,

brushing the turf, maintaining clean edges of the lawn, controlling weeds, and periodically rinsing the area with water. Heat retention is a major concern as surface temperatures on artificial lawns can reach 120°F to 180°F on a hot day (AMWUA 2024a). Playing on synthetic turf can result in injuries as surface temperatures of artificial turf can measure 37°F higher than asphalt, and more than 86°F higher than natural grass under the same conditions (Maryland Institute of Applied Agriculture, 1996).

Installation of artificial turf requires the removal of existing turf as outlined above. After the grass is completely killed, the root system should be removed to a depth of 1" to 2" with a sod cutter. Additional soil can be removed to a depth of 3" to 4" to install and compact the gravel base. All irrigation system components should be removed during this phase. Removal of the soil and root system of the grass will also strip off the root systems of woody perennials growing nearby, especially mature trees and shrubs. Compaction of the gravel base under artificial turf is usually required up to 95%, which makes the area unsuitable for the root systems of live plants. The steps to ensure a solid base for the artificial turf will damage tree and shrub roots that may have been growing in the turf root zone for many years. This damage could result in the death of trees and shrubs unless precautions are taken to protect the root zones of these plants.

- **Inorganic mulch** such as rock gravel is commonly used in Southwest landscapes and has been shown to reduce evaporation, aiding in water conservation (Singer and Martin, 2008). Soil surface temperatures and soil temperatures were similar to bare soil, and rock gravel does not provide any cooling effects in an area compared to plants. Rock mulch can prevent erosion, and larger rocks are often used to stabilize contours for rainwater harvesting (Lancaster, 2019). Rock mulch requires maintenance by removing debris, controlling weeds, and keeping the mulch in place.
- **Organic mulch** such as shredded landscape trimmings or pine residue is commonly used to cover the soil under trees and shrubs. These materials conserve soil moisture, reduce soil temperature below ground compared to bare soil or rock mulch, and have higher soil surface temperatures during the day and lower ones at night compared to bare soil or rock mulch (Singer and Martin, 2008). Erosion can be prevented and over time, decomposing mulch will add organic matter to the soil. Maintenance of organic mulch includes weed control, removing debris, keeping the mulch in place, and periodically adding new mulch.
- **Bare soil** may appear as a low-maintenance option, but it has significant downsides. Without vegetation, bare soil is prone to erosion, especially during heavy rain events. In semi-arid climates, these rains are often intense, and exposed soil can wash away, especially on slopes. Soil particles lost to erosion can be carried by wind and increase air pollution and dust. Additionally, bare soil tends to heat up more than planted areas, which could increase temperatures in the surrounding area. Bare soil will need maintenance such as debris removal and weed management.

Preserving existing trees

When trees and shrubs grow in or near lawns, they depend on the abundant irrigation and fertilization continuously applied to the lawn. Abrupt removal of the lawn causes severe stress, especially to large trees and shrubs. Mature trees are valuable assets, especially if they have a long lifespan; they impart many benefits that may take decades to achieve after young trees are planted. For the management of trees during construction, an arborist will know how to preserve mature trees during construction. The process starts with an inventory, recommending trees that are suitable to remain, to transplant, or to remove (ISA, 2021; Matheny et al., 2023). A tree protection zone outlines the root area to prevent damage to the trunk, branches, and roots, and the area that requires regular irrigation during

Fig. 2. The root zone of this tree is growing under the turf grass. If the turf is removed, root protection and irrigation of the root zone are essential to preserve plant health.

Fig. 3. Irrigation tubing with drip emitters waters the root zone and beyond the canopy.

and after the project. Tree protection is essential as damage to trees can take several years to become noticeable and may be irreversible.

Drip irrigation is the most efficient method of watering existing trees in a landscape where turf has been removed. Irrigation tubing with built-in drip emitters is placed in circles or parallel lines to irrigate 75% or more of the root zone under and beyond the canopy (Fig. 3) (Call et al., 2017). Irrigation tubing is spaced based on soil type; sandy soils will require closer spacing, and tubing over soil with a greater clay content will be spaced further apart. Once the irrigation is in place, evaluate the system's effectiveness to ensure the root zone is adequately covered and determine how long it takes to irrigate to a depth of 3 feet. Cover the area with a 3 - 4-inch-thick layer of organic mulch to conserve soil moisture and protect tree roots. The arborist will continue to monitor tree health and site conditions to ensure long term health and survival of trees.

Preserving existing trees

- The planning process determines the scope of work and a realistic budget with plans for unforeseen cost increases.
- The project manager oversees the process and makes sure that contract specifications are met during the separate phases. Small projects often default to the homeowner being the project manager while larger projects are managed by a professional.
- Timing is important, especially for turf removal, transplanting new trees, and protection of mature trees. Avoiding hot summer months for planting assists the establishment of plants.
- Protection of tree roots includes using tree protection zones, mulch, and minimal invasive disturbances.
- Document the different project phases by comparing the plans for site preparation and installation (plant removal, irrigation installation, transplanting) with the final products, collect pictures of installation, and obtain final 'as built' plans.
- Continue monitoring the site and ensure the conversion is completed and remains in place according to the plan.

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