Review of Landscaping Standards & Use of Artificial Turf
City of Glendale
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City of Glendale
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APPENDIX

Appendix A: Turf Alternatives
Appendix B: Findings Summary on the Use, Selection, and Implementation of Artificial Turf
Artificial turf is often seen as a viable long-term alternative to turf, or other landscape options. It is commonly viewed as a green product that saves water, reduces maintenance, and eliminates chemical inputs. After review of current literature and research data, however, it was found that artificial turf may not save water, reduce maintenance, nor eliminate chemical inputs more than well-planned turf. In addition, artificial turf does not provide a similar level of environmental benefit, and the environmental cost may be significant, both to the immediate property, and on a larger temporal scale. There are however, appropriate locations for artificial turf, and there are property owners who prefer the aesthetic.

The installation and use of artificial turf has drawn mixed and at times polarized opinions from the public. While there are potential benefits to property owners installing artificial turf, many of the environmental and public health concerns are not sufficiently addressed in current literature to ensure that the positives outweigh the negative impacts.

To research and address the issues of installation of drought tolerant landscapes and the use of artificial turf in publicly visible landscapes, the City of Glendale engaged ReScape California to prepare a comprehensive report. The consultant team reviewed current literature, the City’s existing codes, ordinances and guidelines, and prepared the following document.

The following tables provide a summary of findings. Table 1 compares the potential benefits and concerns for home/property owners when considering natural turf, artificial turf or a drought tolerant landscape. Table 2 summarizes potential environmental benefits and concerns with the natural turf, artificial turf, or drought tolerant landscapes. A detailed discussion of the information listed on these tables can be found in Appendix B: Findings Summary on the Use, Selection, and Implementation of Artificial Turf.
### Table 1: Comparative Summary of Benefits and Concerns for Home/Property Owners

<table>
<thead>
<tr>
<th>Aesthetics/Design</th>
<th>Sustainable Landscape</th>
<th>Conventional Turf</th>
<th>Artificial Turf</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HIGH VALUE</strong></td>
<td><strong>PRO</strong></td>
<td><strong>LOW VALUE</strong></td>
<td><strong>LOW VALUE</strong></td>
</tr>
<tr>
<td></td>
<td>Curb appeal - natural, engaging, looks like it belongs there</td>
<td>Curb appeal - clean, tidy, manicured look</td>
<td>Consistent manicured appearance</td>
</tr>
<tr>
<td></td>
<td>Integrated with ecosystem functions</td>
<td>Conforms with current landscape paradigm</td>
<td>Remains uniform over product useful life</td>
</tr>
<tr>
<td></td>
<td>Promotes sense of place - ‘fit’ within the landscape</td>
<td>Evokes pastoral, park-like feeling and affluence</td>
<td>CON</td>
</tr>
<tr>
<td></td>
<td>Showcases color, textures, seasonality, diversity</td>
<td>Remains fairly uniform over time</td>
<td>Varies from short, unnatural - fake appearance to more realistic color and texture</td>
</tr>
<tr>
<td></td>
<td>Native turf and groundcovers can be used</td>
<td>CON</td>
<td>Can appear cheap</td>
</tr>
<tr>
<td></td>
<td>Evolves over time</td>
<td>Monoculture</td>
<td>True “Zero-Scape”, or a non-living landscape</td>
</tr>
<tr>
<td></td>
<td>Xeriscape compatible</td>
<td>Monochromatic</td>
<td>No ecosystem integration</td>
</tr>
<tr>
<td></td>
<td>Opportunity to create multiple outdoor ‘living’ spaces</td>
<td>Minimal ecosystem integration</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not xeriscape compatible</td>
<td></td>
</tr>
<tr>
<td><strong>CON</strong></td>
<td>Requires proper design</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Can be difficult to ‘visualize’ by clients</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Installation</th>
<th><strong>COMPLEX</strong></th>
<th><strong>MODERATE</strong></th>
<th><strong>EASY</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRO</strong></td>
<td>Installation can be phased</td>
<td>PRO</td>
<td>Product installs quickly</td>
</tr>
<tr>
<td></td>
<td>“Right Plant, Right Place” improves success of plant materials</td>
<td>Installs quickly -- seed, plugs, sod</td>
<td>No ‘establishment’ period</td>
</tr>
<tr>
<td></td>
<td>Disturbance by wildlife causes less noticeable disruption in appearance and function as compared to turf</td>
<td>Establishes fairly quickly</td>
<td>No irrigation required</td>
</tr>
<tr>
<td><strong>CON</strong></td>
<td>Installation costs vary considerably depending upon complexity of design.</td>
<td>Sensitive to intensity of sunlight - different blends needed for shade vs. full sun</td>
<td>Not sensitive to variable sunlight intensity</td>
</tr>
<tr>
<td></td>
<td>Requires more preparation and education than a simple turf and foundation shrub landscape</td>
<td>Requires a period of time to become established</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subject to highly visible damage from wildlife disturbance (birds, feral pigs, gophers, pets)</td>
<td>CON</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Requires separate irrigation system installation</td>
<td>Site preparation negatively impacts soil quality - compaction, infiltration, soil biology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Can be disturbed by wildlife (gophers)</td>
<td>Backing material often not permeable (urine &amp; feces not washed out)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Risk of melting</td>
<td>Prone to ruts and wrinkles if not compacted properly</td>
</tr>
</tbody>
</table>

"Review of landscaping standards and use of artificial turf"
<table>
<thead>
<tr>
<th></th>
<th>Sustainable Landscape</th>
<th>Conventional Turf</th>
<th>Artificial Turf</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost</strong></td>
<td>AFFORDABLE</td>
<td>CHEAP</td>
<td>EXPENSIVE</td>
</tr>
<tr>
<td></td>
<td>$8 - $10 per sqft</td>
<td>$0.50-$1.50 per sqft (irrigation separate)</td>
<td>$10-$25 per sqft(^1) (for at least a medium quality product (irrigation for cleaning, cooling separate)</td>
</tr>
<tr>
<td><strong>Irrigation Savings</strong></td>
<td>SIGNIFICANT SAVINGS</td>
<td>NO SAVINGS</td>
<td>MODERATE SAVINGS</td>
</tr>
<tr>
<td></td>
<td>Requires minimal or no irrigation needed when established</td>
<td>High water-use (Consider alternative turf or ground cover for water-savings)</td>
<td>Lower water use for product cleaning and surface cooling</td>
</tr>
<tr>
<td><strong>Maintenance</strong></td>
<td>ANNUAL</td>
<td>WEEKLY</td>
<td>MONTHLY</td>
</tr>
<tr>
<td></td>
<td>Little to no maintenance after establishment</td>
<td>Regular maintenance required</td>
<td>No need to mow</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>


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1 http://www.homedepot.com/b/Playsets-Recreation-Parks-Playsets-Playhouses-Park-Furnishings-Artificial-Grass/N-Syc1vZc5pq.
### Table 2: Comparative Summary of Environmental Benefits and Concerns

<table>
<thead>
<tr>
<th>Chemical Exposure</th>
<th>Sustainable Landscape</th>
<th>Conventional Turf</th>
<th>Artificial Turf</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO RISK</td>
<td>No chemical inputs needed</td>
<td>PESTICIDE, HERBICIDE, FUNGICIDE, AND FERTILIZER INPUTS CONTRIBUTE TO:</td>
<td>POTENTIAL RISK</td>
</tr>
<tr>
<td></td>
<td>Contributed to natural biogeochemical cycling - eliminating the need for synthetic inputs</td>
<td>• LOSS OF BENEFICIAL ORGANISMS</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• GHG EMISSIONS</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• WELL DOCUMENTED HEALTH EFFECTS ON CHILDREN AND PETS</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• IMBALANCE/LOSS OF SOIL MICROORGANISMS</td>
<td></td>
</tr>
<tr>
<td>Thermal Effects</td>
<td>NONE</td>
<td>NONE</td>
<td>HIGH</td>
</tr>
<tr>
<td></td>
<td>No documented adverse thermal effects</td>
<td>No documented adverse thermal effects</td>
<td>Significant surface and ambient temperature increases - recorded surface temperatures up to 200°F</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Heat stress is well documented</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No scientifically proven prolonged method to mitigate thermal effects (lowering temps by 20-30°F)</td>
</tr>
<tr>
<td>Microbial Exposure</td>
<td>LOW RISK</td>
<td>LOW RISK</td>
<td>POTENTIAL RISK</td>
</tr>
<tr>
<td></td>
<td>No documented adverse microbial effects</td>
<td>No documented adverse microbial effects</td>
<td>INCREASED RISK OF INJURY LEADING TO RISK OF INFECTION3</td>
</tr>
<tr>
<td>Climate Change/Heat Island Effect</td>
<td>POSITIVE EFFECT</td>
<td>CONTRIBUTOR</td>
<td>CONTRIBUTOR</td>
</tr>
<tr>
<td></td>
<td>Diverse planting including shrubs and trees can contribute to beneficial microclimate creation</td>
<td>PRODUCTION OF TURF CHEMICALS CONTRIBUTE TO GHG EMISSIONS</td>
<td>SIGNIFICANTLY INCREASES SURFACE AND AMBIENT TEMPERATURES</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MAINTENANCE EQUIPMENT CAN CONTRIBUTE TO GHG EMISSIONS</td>
<td>INCREASES CO2 EMISSIONS AND HEAT ABSORPTION</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PRODUCTION AND INSTALLATION CONTRIBUTE TO GHG EMISSIONS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PRODUCT USE SHOULD BE MINIMIZED AND CONFINED TO SITE WHERE BENEFITS ARE MAXIMIZED</td>
</tr>
<tr>
<td>Water Quality</td>
<td>IMPROVES</td>
<td>DEGRADATION</td>
<td>DEGRADATION</td>
</tr>
<tr>
<td></td>
<td>Contributes to nutrient attenuation</td>
<td>CONTRIBUTES TO EUTROPHICATION WHEN HIGH N AND P FERTILIZER IS USED</td>
<td>ZINC ENTERING STORMWATER EXCEEDS TOXICITY LIMITS FOR AQUATIC ORGANISMS</td>
</tr>
<tr>
<td></td>
<td>Reduces/eliminates erosion when planted to slow and filter overland flows, and for root mass to keep soils connected</td>
<td>CONTRIBUTES TO POLLUTANT LOAD OF WATERSHED WHEN CHEMICAL INPUTS ARE USED</td>
<td>SANITATION AGENTS MAY BE HARMFUL/TOXIC TO AQUATIC ORGANISMS</td>
</tr>
<tr>
<td></td>
<td>Traps and holds sediments</td>
<td>LEACHATE MAY BE HAZARDOUS TO AQUATIC ORGANISMS</td>
<td>MAY PRODUCE A HARMFUL/TOXIC CHEMICAL COCKTAIL LEACHATE</td>
</tr>
<tr>
<td></td>
<td>Sequesters and degrades pollutants</td>
<td>PERFORMS SOME FILTERING AND SEDIMENT TRAPPING</td>
<td></td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Wildlife Habitat Potential</th>
<th>Sustainable Landscape</th>
<th>Conventional Turf</th>
<th>Artificial Turf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wildlife Habitat Potential</td>
<td>HIGH</td>
<td>LOW</td>
<td>NONE</td>
</tr>
<tr>
<td>Waste Potential</td>
<td>VERY LOW</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td></td>
<td>Green waste can be recycled on-site</td>
<td>If turf clippings are left onsite (grasscycling) or taken to a greenwaste facility</td>
<td>No potential for reuse/recycle</td>
</tr>
<tr>
<td>Other Issues</td>
<td>Contributes to ecosystem functions including air, water, and soil quality</td>
<td>Contributes to soil compaction under heavy use/traffic</td>
<td>Compaction of soil prevents infiltration of water for groundwater recharge</td>
</tr>
<tr>
<td></td>
<td>Contributes to biodiversity - ecosystem resilience to climate change</td>
<td></td>
<td>Compaction of soil eliminates carbon sequestration capacity</td>
</tr>
<tr>
<td></td>
<td>Contributes to carbon sequestration</td>
<td></td>
<td>Gopher holes cannot be patched, and may require entire lawn replacement</td>
</tr>
</tbody>
</table>
CONCLUSION

When comparing artificial turf to natural turf, the economic and environmental benefits of a living lawn appear to outweigh the advantages of installing artificial turf. A living lawn is not inherently water wasting and is still a possible landscape solution within the latest State regulations. Per the July 2015 State Model Water Efficient Landscape Ordinance (MWELO), residential landscapes can have 25 percent to 49 percent of the landscape in turf when the remaining plants have low or very low water use requirements. Nonresidential landscapes can have 10 percent to 37 percent of the landscape in turf with low or very low water use for the remaining. Unlimited amount of recreational lawns are also allowed in non-residential landscapes. Lawns have traditionally wasted water due to overspray, runoff and poor spray head distribution that requires overwatering to cover the entire area.

Water savings can significantly increase when switching to a climate appropriate landscape. A drought tolerant landscape irrigated with a drip system operating at 0.81 irrigation efficiency, which is the measurement of the amount of water beneficially used divided by the amount of water applied, can use less than one-third the amount of water needed for an efficiently irrigated lawn. In addition, there are many green groundcovers and turf alternatives that require less water than a standard lawn.

The multiple benefits of a living landscape include cooler temperatures, potential urban wildlife habitat, healthy soils that can sequester carbon, stormwater infiltration, and much lower installation costs. Maintaining a lawn or drought tolerant landscapes organically will also eliminate concerns for contaminated runoff from pesticides and fertilizers.

THE CONSULTANT TEAM

This report was prepared by ReScape California, with assistance from PlaceWorks. ReScape California is an advocate and resource in the creation of sustainable landscapes for commercial, multi-family, and public spaces as well as single-family residences. It promotes a new, holistic, resource-efficient landscape aesthetic for California through its Bay-Friendly Rating System. ReScape is a non-profit organization governed by the Bay-Friendly Coalition Board, comprised of landscape professionals, industry experts and public agency representatives.

PlaceWorks serves both public- and private-sector clients throughout the state in the fields of landscape architecture, community outreach, comprehensive planning, environmental review, urban design, and Geographic Information Systems (GIS). PlaceWorks’ talented, multidisciplinary team thrives on working with communities to tackle complex problems and develop workable solutions.

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REPORT ORGANIZATION

This report is organized into the following chapters:

Chapter 1: Introduction. This chapter describes the purpose of this document and outlines the previous review and actions concerning the use of artificial turf in City landscapes.

Chapter 2: Summary of Research and Findings. The existing State and local ordinances, and guidelines that will influence the design, installation and maintenance of drought tolerant landscapes and artificial turf are summarized in this chapter. A comparison of other city ordinances and restrictions concerning the use of artificial turf, and a general comparison of the benefits and costs of landscapes using natural turf, drought tolerant plantings and artificial turf conclude this chapter.

Chapter 3: Environmental Considerations. This chapter provides a summary of the many environmental considerations, positive and negative, to take into account when evaluating the use of natural turf, drought tolerant plantings and artificial turf in the landscape.

Chapter 4: Preliminary Design Guidelines. This chapter discusses design considerations when considering the use of natural turf, drought tolerant landscapes and artificial turf.

Chapter 5: Next Steps. Chapter 5 outlines recommended changes to City ordinances, steps towards adoption and implementation of revised ordinances, and opportunities for public outreach and education to guide successful implementation of water conserving landscapes throughout the City.

Appendix: The appendix includes two documents. Appendix A: Turf Alternatives provides a description and photos of many turf alternatives suitable for use in Glendale that could replace a traditional turf lawn and provide a consistent, water conserving green carpet. Appendix B: Findings Summary on the Use, Selection and Implementation of Artificial Turf, provides more detailed research and discussion of the benefits and concerns of artificial turf use in residential and commercial landscapes.
1. Introduction

The City of Glendale is located at the juncture of the San Fernando and San Gabriel Valleys, and is the third largest city in Los Angeles County. The City incorporated in 1906 and boasts a rich cultural history with many buildings of historic interest and significance. Residents within the 34 distinct neighborhoods that ultimately formed the City of Glendale enjoy a high quality of life that is reinforced by a number of design guidelines and a city-wide landscaping ordinance enforced as part of the City’s Municipal Code.

In response to ongoing drought conditions and increasing water use restrictions, the City of Glendale is interested in amending existing ordinances and regulations to include more guidance on the design, installation, and maintenance of drought tolerant landscapes and is considering expanding opportunities to use of artificial turf in residential, multi-family and non-residential properties.

The City’s landscaping ordinance currently restricts the use of artificial turf to areas not visible from public streets. With the current drought conditions and water reduction mandates, and with no relief in sight, artificial turf is being proposed as a suitable substitute for existing turf and landscaping in front yards. The City, in response to these requests, recognized the need for a well-researched technical report that explores all costs and benefits of using artificial turf in the public realm, focusing on single-family dwellings, multi-family buildings, and typical land uses in commercial, industrial and mixed use zones.

Over the past several years, the City has reviewed and addressed artificial turf in the city. In 2009, the Glendale City Council adopted rules relating to artificial turf or artificial grass, permitting it in very limited situations: only in the R1 single-family zoning district and only where not visible from the public street immediately in front of the property (essentially, the rear yard).

In 2011, City staff revisited the issue with a working group of landscape architects and, later, with a citizens’ advisory group. The landscape architects group advocated no change to the existing regulations, while the citizens’ group advocated no change to the existing restrictions in single-family zones, but was split on allowing more use in multi-family or non-residential zones. In the end, the City Council did not adopt any changes.

On April 28, 2015, the City Council adopted a resolution declaring a Phase III water emergency (GMC 13.36 Water Conservation). The watering restrictions thereby imposed threaten the viability of many traditional lawns, although the declaration of an emergency prohibits enforcement of the landscape provisions of the Zoning Code through normal Code Compliance procedures (Chapter 30.31 of the Glendale Municipal Code).

The purpose of this report is to provide guidance, based upon established goals and objectives for landscaping within the City as documented in adopted design guidelines, codes and ordinances, and evaluate the opportunities and challenges to be considered when amending these existing documents to address drought tolerant landscapes, limits on natural turf and artificial turf installation.
1. Introduction

REVIEW OF LANDSCAPING STANDARDS & USE OF ARTIFICIAL TURF
2. SUMMARY OF RESEARCH AND FINDINGS

PLANNING CONTEXT

A number of State and local planning documents include standards, policies, and/or design guidelines that are considered pertinent to the design of new and renovated landscapes within the City of Glendale. These documents are summarized below.

State Water Efficient Landscape Ordinance

Governor Brown’s Drought Executive Order of April 1, 2015 (EO B-29-15) directed the Department of Water Resources (DWR) to update the State’s Model Water Efficient Landscape Ordinance (MWELO) through expedited regulation. The California Water Commission approved the revised MWELO on July 15, 2015. The deadline for local agencies to adopt the MWELO or adopt their own, that must be at least as effective in conserving water, is December 1, 2015. The deadline for local agencies creating a regional ordinance is February 1, 2016.

The 2015 MWELO includes a number of revisions to further increase water conservation in the landscapes that directly impact the design and review of residential and commercial landscapes in the City. Key revisions to the MWELO include:

- **Purpose:** Broadened focus to include a watershed based approach to build landscapes that create conditions to enhance soil life, increase carbon storage & oxygen production, conserve energy, and protect air and water quality and habitat. Broadens intent of the MWELO from just water use efficiency to include a comprehensive approach to sustainable landscaping.

- **Applicability:** Lowered threshold to 500 square feet from 2,500 square feet. Landscapes between 500 to 2,500 square feet can utilize Appendix D checklist in the MWELO document for the prescriptive compliance option, which is much easier for smaller landscapes (see Appendix).

- **Water Budget Reductions:** The evapotranspiration factor (ET) for calculating landscape water budgets has been lowered from 0.70 to 0.55 for residential landscapes and .45 for non-residential landscapes. This reduction still allows for a percentage of the landscape to be high water use plant material, including lawn, depending upon other factors, such as the irrigation system efficiency and other plants in the landscape.

- **Recreational Turf:** Residential lawn can no longer be considered a special landscape area and is limited to 25 percent of the landscape, or as permitted by a complaint water budget.
City of Glendale Ordinances and Guidelines

Glendale’s plans, ordinances, and guidelines define the multiple goals and objectives for City growth and change, while also listing specific requirements for new construction and renovations. Documents that provide guidance and define requirements for single- and multi-family residential, commercial, and industrial landscapes include:

City of Glendale Comprehensive Design Guidelines

These guidelines were prepared to provide a consistent vision and framework for the design and review of projects applying for permits form the City of Glendale. The following summarizes the issues and recommendations pertinent to the design of public and private landscapes.

Chapter 1: Vision, Purpose, Process and Principles

This chapter discusses the City’s design guidelines and the design process. The guidelines provide predictability for residents, property owners, land developers and other interested parties and are the minimum standard for good design; exceeding these standards is encouraged. Innovative designs consistent with the intent of the guidelines will be considered. Criteria for evaluating a site design and context include:

- **Median Landscapes**: No turf or other high water use plants, as defined by WUCOLS, or other state recognized reference, in medians.

- **Compost and Mulch**: Requires incorporation of 4 cubic yards compost per 1,000 square feet (1.3 inches) and maintaining a layer of 3 inches local recycled organic mulch to improve soil health and reduce evaporation.

- **Automatic Irrigation Controllers**: Utilizing either evapotranspiration or soil moisture sensor data utilizing non-volatile memory shall be required for irrigation scheduling in all irrigation systems.

- **Pressure Regulation**: If the water pressure is below or exceeds the recommended pressure of the specified irrigation devices, the installation of a pressure regulating device is required.

- **Recycled Water and Gray Water**: Using greywater or recycled irrigation water to satisfy all irrigation needs allows for unlimited lawn and high water use plants.

In addition, requirements from the 2009 MWELO that remain in the 2015 ordinance that will influence new and renovated landscapes include:

- **A Soil Management Report**: To reduce runoff and encourage healthy plant growth.

- **Turf on Slopes**: Turf is not allowed on slopes greater than 25 percent where the toe of the slope is adjacent to an impermeable hardscape.

- **Spray Irrigation Near Paving**: Overhead irrigation shall not be permitted within 24 inches of any non-permeable surface, unless the paving is permeable or drains back into the landscape area.

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6 [http://ucanr.edu/sites/WUCOLS/Plant_Search/](http://ucanr.edu/sites/WUCOLS/Plant_Search/)
- The age of the site (i.e., is the site in a historical district?)
- The current development pattern on the surrounding blocks
- The street frontage (i.e., does the site appear inviting from the street?)
- Special characteristics of the neighborhood (e.g., significant landscape characteristics).
- Does the landscape design complement the building design and conserve water?
  - Design should employ drought tolerant plants and water conserving irrigation (1.6.13).
  - Low Impact Development (LID) standards should be incorporated (1.6.14).
  - Design should enhance the site and complement the building (1.8.4).
- The types of landscaping in the neighborhood?
  - The level of maintenance?
  - Location and configuration of open space.

Chapter 2: Single-Family Design Guidelines

In this chapter, the design guidelines are applied to single-family residences. The chapter is broken into three sections: Site Planning, Mass and Scale, and Design and Detailing.

Guiding principles for landscape design include:

- Complement the building design.
- Use native and or drought tolerant plant material.
- Maintain existing trees.
- Minimize use of turf areas.
- Minimize stormwater runoff.
- Use landscaping instead of a wall or fence.
- Use landscaping to soften the visual impact of retaining walls.

Chapter 3: Hillside Design Guidelines

The chapter focuses on the hillside regions of Glendale and is broken into four sections: Site Planning, Mass and Scale, Design and Detailing, and Grading Aesthetics. Design recommendations include:

- Flat yards may not be possible or appropriate in hillside properties.
- Open space should include drought-tolerant landscaping.
- Use landscaping to soften the visual impact of retaining walls.
- Minimize stormwater runoff including permeable paving and or “Hollywood” style driveways (tracks for cars separated by strips of green lawn).
- Landscape design should complement the building design
- Use native and or drought tolerant plant material that are fire-resistant
- Provide a natural look to soften structures built into the natural hill.
- Incorporate landscape that complements the site design.
- Maintain existing trees.
- Minimize use of turf areas.

**Chapter 4: Commercial Design Guidelines**

In this chapter, the priority for the landscape design of commercial properties is to improve the pedestrian experience. The chapter is broken into two groups, Main Street Corridor and Suburban Corridor.

**Main Street Corridor**
- If feasible, provide landscape adjacent to alley garage entries.
- Landscape area with 3’ tall planting is required in parking is located near a street.
- Use landscape or open space between street and parking structures when commercial uses are not feasible.
- Landscape design should complement the building design.
- Use native and or drought tolerant plant material.
- If possible, use planting instead of site walls.
- Incorporate landscaping to soften retaining walls.

**Suburban Corridor**
- Project design depends on open space with well-designed landscaping.
- Provide landscape adjacent to sidewalk to improve pedestrian experience.
- Provide landscape buffer between sidewalk and parking.
- Provide landscape buffer between commercial and residential developments.

**Chapter 5: Implementing the Vision: Multi-family Residential and Mixed-Use Design Guidelines**

This chapter addresses multi-family and mixed-use properties.

- Common open space landscape should complement the building design.
- Landscape hillsides to soften new construction and grading.
- Use native and or drought tolerant plant material.
- Minimize use of turf areas.
- Reduce paving to maximize permeability of the site.
- Permeable paving and or "Hollywood" style driveways (tracks for cars separated by strips of green lawn) should be used to reduce stormwater.

**North Glendale Community Plan**

The North Glendale Community Plan is a manual for residents, property and business owners, developers and government agencies to guide the development of the North Glendale area. The plan ensures development follows sustainable land use patterns, and maintains the unique character of the community. In addition, the plan represents the city’s goals for stewardship of the people and area, enhancing the economic, social, and physical health, safety, welfare, and convenience of the people in North Glendale.
Landscape development within North Glendale must be consistent with the community vision that defines the community as having a “rural, suburban lifestyle”, living close to nature, recognizing the connections and views to the San Gabriel Mountains, and acknowledging the history of the area. The plan’s vision also seeks to protect open space, advocate sustainable and responsible development, and enhance neighborhood character to preserve the stability and charm of the community.

**Glendale Municipal Code**

**Chapter 12.40 City Street Trees**

This chapter establishes regulations and standards to promote the benefits of a healthy urban forest. Section 12.40.030 Duties and Prohibitions states that it is unlawful for any person to cause or allow damage or interference with the root systems of any city street tree with the application of any paving materials.

According to the recommendations of this report, installation of artificial turf requires removal of the top four inches of soil and compaction of base materials to 90 percent, which is equivalent to pavement installation. In addition, this compacted base layer prohibits percolation of surface water down to the established root system.

**Chapter 13.36 Water Conservation**

This chapter is a city-wide mandatory water conservation plan to conserve water use and share the impacts of water shortage. The no water waste policy (Section 13.36.060) bans overspray and runoff from all landscapes and irrigation during or within 48 hours of a rainfall event. The ordinance encourages the use of California-friendly plants in landscapes, as described on the Metropolitan Water District’s Garden Guide Catalogue and defines phases of water use restrictions (Section 13.36.070) that further restrict water use as drought conditions and water shortages increase. The Glendale City Council approved Phase III on April 28, 2015, allowing customers to only water their landscapes on Tuesdays and Saturdays for 10 minutes at each watering station.

**Chapter 13.42 Stormwater and Urban Runoff Pollution Prevention Control**

The City of Glendale added this chapter to the municipal code, to address stormwater pollution issues in development and construction projects, and adopted County of Los Angeles Department of Public Works Low Impact Development Standards Manual as the City of Glendale Low Impact Development Standards Manual. The document outlines prohibitions on discharges and spills from construction and industrial activities, and defines illicit discharges and connections. Prior to obtaining a building or grading permit, the director of public works shall review and approve a plan, submitted by the applicant, outlining the best management practices to be followed during construction.

**Chapter 13.43 Low Impact Development (LID) Standards**

The purpose of this document is to guide development to lessen the adverse impacts of stormwater runoff, minimize pollutants and erosion. Thresholds for percent of new or modified pervious surfaces vary with Designated Projects, from 10,000 square feet with new industrial parks and commercial malls, to 5000 square feet for redevelopment projects. These projects are required to retain 100 percent of the stormwater volume.

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7 [http://www.bewaterwise.com](http://www.bewaterwise.com)
through infiltration, evapotranspiration and/or rainwater harvest and reuse. Single-family homes are required to conserve natural areas, divert roof and surface runoff into vegetated areas before discharge unless this diversion would result in slope instability. A development project consisting of four or fewer residential units shall implement at least two of the following: disconnect impervious surfaces, use porous pavement, capture runoff in landscaped areas, and install a green roof.

Chapter 16.08 Subdivision Design Standards

This chapter focuses on the preservation of primary and secondary undeveloped ridgeline areas within the City as a “precious scenic resource”. Slope revegetation must use a “naturalizing plant palette,” as defined in the hillside development landscape guidelines. Section 16.08.270 Passive Heating or Cooling states that the subdivision shall provide to the extent feasible for future passive or natural heating or cooling opportunities. As described elsewhere in this document, artificial turf has been documented to increase ambient temperatures significantly.

Chapter 30.31 Landscaping

The Landscaping chapter of the Municipal Code defines the minimum requirements for landscaping residential, multi-family, commercial, industrial and mixed use zones within the City of Glendale.

Single-Family Residential Zones

Landscaping requirements for the ROS, R1 and R1R zones include the following:

- The total lot areas shall be a minimum of 40 percent permanently landscaped open space that is more than 50 percent live plant material.
- All street setback areas shall be landscaped with plant materials or a combination of plant materials and permeable surfaces.
- Plant materials shall compose a majority (more than 50 percent) of the street setback areas, exclusive of permitted driveways.
- Nonliving materials, permeable materials may be used as ground cover including, but not limited to: wood chips, bark, decorative rock, and stone.
- Neither the interior nor the street setback areas shall be completely paved or covered with gravel.
- Topdressing, as approved by the Community Development Director,
- Other than permitted hardscape, all areas not planted shall be covered (top dressed) with materials such as wood chips or approved alternative.
- Permeable surfaces are encouraged throughout.

Multi-Family, Commercial, Industrial, and Mixed-Use Zones

- The total lot areas shall be permanently landscaped open space that is more than 50 percent live plant material. Minimum percentage of total lot area to be permanently landscaped open space:
  - R-3050: 30 percent
• R-2250, R-1650, R-1250: 25 percent
• IMU-R, SFMU, CPD: 10 percent
• C1, C2, C3, CR, CH, CA, CE, CEM, IND, IMU, MS, PS Overlay: Not Applicable
• P Overlay: The front and street side setback and landscaping requirements for parking areas in the P overlay zone shall be subject to the provisions of the residential zone in which the property is located and/or Chapter 30.32 of this title, whichever is the most restrictive.

Artificial Turf
Artificial turf is specifically prohibited in this chapter in ROS and R1R zones and may not be installed in R1 zones where it would be visible from the public street immediately adjacent to the property. Artificial turf is also not allowed under tree canopies and is not considered as a live plant material. The code requires that 40 percent of the total lot areas be permanently landscaped open space and more than 50 percent of that areas must be live plant material. In all multi-family, commercial, industrial, mixed use, CE and MS zones, artificial turf may not be installed where it would be visible from the public street immediately adjacent to the property.

Chapter 30.32.160 Landscaping of Parking and Loading Areas
This chapter describes the landscape requirements for landscaping adjoining street right of way and interior parking lot landscaping. A brief summary of the planting requirements are as follows:

- Buffer along Street Planting strips, generally 5-foot minimum width, shall be landscaped.
- Any planting within the required planting strip that is within 10 feet of an entry or exit driveway shall not be permitted to grow higher than 30 inches.

Interior Parking Lot
- Not less than 5 percent of the interior parking lot area shall be landscaped, except for parking areas located in enclosed structures.
- Planting along the exterior perimeter of a parking lot shall not be considered as part of the required interior landscaping.
- If approved by the City, two-fifths (2/5) of the required interior landscaping may be decorative walkways, constructed of permeable materials, which provide pedestrian paths through the parking lot. Such paths shall be lined with trees as required by the City.

Artificial turf is not permitted in any landscaped areas adjoining the street right-of-way nor within the interior parking lot landscaping.

Greener Glendale Plan: The City of Glendale’s Sustainability Plan
The Greener Glendale Plan, adopted by the City Council in 2012, outlines a comprehensive framework for a more sustainable City and adapting to climate change while also addressing State legal requirements, per Assembly Bill (AB) 32, to reduce greenhouse gas (GHG) emissions to 1990 levels by the year 2020.
The report includes two volumes: Municipal Operations and Community Activities. The latter volume acknowledges that the community’s actions will play a much larger role in achieving the City’s sustainability and GHG reduction goals and defines a comprehensive set of goals and objectives organized within the seven key topic areas described in the United Nations Urban Environmental Accords: Urban Design, Waste, Energy, Urban Nature, Water, Transportation, and Environmental Health. Glendale added two additional topics to their framework: Cross-Cutting Approaches and Economic Development.

Within each of these topic areas, numerous objectives were defined, with several strategies for implementation that relate to landscape design, installation and/or maintenance, which are summarized below. For a more detailed description, refer to Appendix B: Findings Summary on the Use, Selection and Implementation of Artificial Turf.

Objectives and Strategies that Relate to Landscape Development

Economic Development

Objective ED 4 discusses promoting Glendale’s profile as a forward thinking, “green” city. Many of the City’s existing policies, guidelines and ordinances support this intent, including many goals and objectives listed in Greener Glendale.

Urban Design

Objective UD3 refers to expansion of the City’s Green Building Standards to increase requirements for utilizing cool paving, cool roofing and permeable and natural landscaping. Objective UD5 recommends incorporating Greener Glendale sustainability concepts into Community Plans and other General Plan documents, including:

- Encourage the retrofit and new development to increase energy and water efficiency, reduce waste, reduce use of toxics, and increase the use of natural landscaping including native trees and plants.
- Work toward achieving Zero Waste in the community.

Waste

Objective WS1 encourages promotion of Zero Waste through community education and outreach addressing “deconstruction”/salvaging of materials in all remodeling projects, working with developers and builders to incorporate materials and furnishings made from recycled content, reducing use of disposable, non-renewable products.

Urban Nature

Objective UN2 addresses increasing Glendale’s tree canopy coverage by 20,000 trees by 2035 through the following strategies:

- Explore ways to encourage residents to preserve existing trees.
- Ensure trees are planted in at least 50 percent of all sidewalk planting sites.
- Planting of 7,150 trees by 2020, and an additional 13,375 trees by 2035, by the Public Works Department.

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Objective UN3 discusses implementation of programs to increase biodiversity in Glendale by promoting diverse landscaping palettes instead of monocultures and encouraging citizens to provide habitat for wildlife in their yards and gardens.

**Water**

Objective WT1 outlines strategies to reduce community water consumption through promotion, education, and outreach campaigns, including:

- Launch award program to recognize Glendale’s most water efficient buildings and landscapes.
- Encourage natural, low-water use landscaping in yards and parkways – natural landscape supports urban nature, reduces urban heat island effect, helps clean water runoff, and has a cleaner life-cycle (e.g. reduced or no fossil fuel based energy or materials to produce, does not emit artificial toxins, creates a biodegradable waste product, etc.) than artificial landscaping.

Objective WT2 promotes reduction of community water consumption through incentive and rebate programs for replacement of turf with native/drought tolerant plants.

Objective WT4 identifies several strategies to facilitate and coordinate community water conservation projects by replacing lawns in any public parkways (parkways adjacent to private property are the responsibility of the property owner) with native and low-water use plants and utilizing low-water use landscaping in public works projects and on public rights-of-way.

Objective WT5 promotes implementation of stormwater runoff management practices to protect water quality and replenish local groundwater supplies. It also notes that promoting the use of permeable paving and incorporate rain gardens, rain water capture/biofiltration applications, and bioswales into Public Works projects will also have the potential to reduce greenhouse gas emissions by reducing the energy required to import water and by increasing urban nature (which absorbs GHGs and reduces heat).

**Environmental Health**

Objective EH1 promotes reduction of the use of toxics city-wide by implementing an education and outreach program to curb the use of toxic products in gardening and landscaping. Synthetic fertilizers, herbicides and pesticides used in landscape care have been linked to many environmental and public health concerns; the toxicity of some of the artificial turf materials requires more research.

Collectively, these objectives and strategies promote a holistic approach to landscape design, installation and maintenance that uses live plant material, nurtures soil health and prevent compaction, protects air and water quality, conserves water, promotes habitat and respects the community and historic character.

**Comparison with Other City Ordinances**

A review of ordinances and regulations of various Southern California cities reveals that although some cities allow artificial turf in public locations, the majority of those allowing it put limitations on the application.
City of Bellflower requires residents to present their landscape design to the Planning Department in City Hall. Please note that pavers, rocks, stone, brick or other decorative hardscape may be used in the landscape design as an accent and a permanent irrigation system is required. The City Council has recently approved an artificial turf pilot program, which allows for artificial turf to be installed in front yards.  

Simi Valley allows no more than half of the front yard to be artificial turf. It does not regulate side and back yard.

Elk Grove allows replacing grass or natural turf with artificial turf, provided it is pervious and allows for water to drain through it into the ground...

The City of Los Angeles allows artificial turf in parkways.

The City of Cerritos has determined that using artificial turf in residential applications is not an adequate substitute for organic plant material and that it does not meet the City’s development standards as established within the Cerritos Municipal Code for residential applications.

The City of Cypress surveyed 29 Orange County cities to determine their requirement for synthetic turf. Twelve of the 29 cities surveyed do not address artificial turf in their City Codes. The remaining 17 cities allow artificial turf subject to various criteria or standards. Most of the cities surveyed require that property owners submit samples of the proposed turf to City staff for approval prior to installation.

In Southern California, some of the larger water suppliers are allowing rebates for artificial turf. Municipal Water District allows some rebates for replacing turf with artificial, but the guidelines are vague. LADWP allows rebates for artificial turf in parkways.

In summary, regulation of artificial turf in public areas varies widely from city to city. Many locations have yet to address the topic. With the drought it is expected that this will continue to be a topic of consideration, and a well-developed plan will help to keep standards and aesthetics consistent.

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10 Semi Valley Ordinance 1241.  
14 http://www.ci.cypress.ca.us/administration/2014_agd_mins/2014_staff_reports/032414%20Staff%20Reports/2_Zoning_Amend_RE_Artificial_Turf_032414.pdf.  
16 https://ladwp.com/ladwp/faces/wcnav_externalId/a-w-c-parkway?_afrWindowMode=0&_afrWindowId=12qu0lr089_14#%40%3F_afrWindowId=12qu0lr089_14%26_afrWindowId%3D0139175502119548%26_afrWindowMode%3D0%26_adf.ctrl-state%3Dx7277w6sf_4.
**Comparison of Turf, Drought Tolerant Landscapes, and Artificial Turf**

When comparing the various landscape options a property owner can consider, there are multiple variables, benefits and challenges with the installation, maintenance and costs associated with natural turf, drought tolerant landscapes, and artificial turf. These benefits and challenges are summarized in Table 1 in the Executive Summary.

**Turf**

Natural turf lawns have been the mainstay of residential and commercial landscapes for decades in Glendale and many communities throughout Southern California. The increasing water restrictions have left many homeowners with no apparent option other than to let their lawns die. There are many options available that can help property owners keep all or a part of their lawn while meeting water conservation mandates.

**Irrigation Savings**

Most irrigated turf is overwatered, based on comparison of applied water and actual need. As stated earlier, many homeowners have realized up to 30 percent or more water savings simply by replacing their controller with a self-adjusting model as required by the MWELO and repairing leaks. Using the formulas provided in the new Model Water Efficient Landscape Ordinance (MWELO), it is possible to have some irrigated lawn and still meet the new requirements.

**Installation and Maintenance Costs**

Natural turf is the least costly alternative, compared to a drought tolerant landscape or artificial turf, at $.50 to $1.50 per square foot (not including irrigation) and maintenance costs for a small yard can run $100 to $300 per month\(^1\) for a detached single-family residence with a gardening service.

**Sustainable Maintenance**

Traditional turf maintenance relies heavily on gas-powered mowers, blowers and edger and regular applications of synthetic fertilizers, herbicides and pesticides. A more sustainable approach, using Integrated Pest Management and grasscycling can limit chemical inputs and reduce potential toxic exposure to waterways, children, and pets.

**Turf Alternatives**

Newer turf blends have been developed that require much less water than traditional blends and there are a number of traffic tolerant turf alternatives and low growing green groundcovers that tolerate much lower water applications. Refer to Appendix A: Turf Alternatives.

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Drought Tolerant Landscapes

With decreasing water supplies and ongoing drought conditions, homeowners and businesses are considering replacing their lawns with water-conserving plants.

Design Challenges

Shifting from a turf dominant landscape to one emphasizing drought tolerant plantings can be challenging to the average do-it-yourself homeowner. Creating an interesting and pleasing composition requires a different approach that includes base planting, accent plants, a focal element and accessories, such as boulder or planters, to create an interesting and balanced design.

Irrigation Savings

The reduction in water demand between an irrigated turf landscape and one using high-efficiency drip irrigation and plants adapted to Glendale’s Mediterranean climate is considerable. A 10-year study conducted by the City of Santa Monica comparing the two approaches determined that over a nine year period, that the traditional garden with turf and exotic plants used over 700,000 gallons of water while the garden planted with natives using drip irrigation only consumed 130,000 gallons.\(^\text{18}\)

Installation and Maintenance Costs

A landscape properly designed and installed will require far less maintenance than a turf lawn. Plants adapted to the summer-dry climate, irrigated only when needed, and planted in healthy soils and with the proper sun or shade exposure will need monthly attention at most. Weeds can be substantially controlled using sheet mulch and maintaining a layer of organic mulch. The Santa Monica study also compared installation and maintenance costs between a drought tolerant landscape and traditional turf based landscape and cited the total maintenance hours required over the years at 528 hours vs. 167 hours respectively.\(^\text{19}\)

Artificial Turf

Many homeowners and business have turned to artificial turf as a means of replacing their existing lawns with a similar green surface that does not require irrigation or mowing. It is often challenging for many property owners to redesign a turf-less landscape and maintain the curb appeal they are accustomed to; artificial turf resembles the green lawn they are replacing.

Material Quality and Proper Installation

A variety of artificial turf products have flooded the market, with varying levels of aesthetics and durability. When visible to the public, the artificial turf needs to meet specific criteria to be as natural appearing as feasible. Refer to Chapters 4 and 5 and Appendix B for a more detailed description of acceptable materials.

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\(^{19}\) http://www.smgov.net/uploadedFiles/Departments/OSE/Categories/Landscape/garden-garden-2013.pdf.
**Irrigation Savings**

Artificial turf does not require irrigation, but does need regular applications of water to wash off dirt, pet feces, and food. If the turf is to be used as a play or walking surface, hosing will be required on an as-needed basis to lower the surface temperatures to a tolerable level when used during warm weather.

**Installation and Maintenance Costs**

The cost of installation varies considerably, but is much more per square foot than natural turf or drought tolerant landscapes. The following table summarizes a range of costs for homeowner installed artificial turf.

<table>
<thead>
<tr>
<th>Supplier/Retailer</th>
<th>Materials</th>
<th>Additional Installation Costs*</th>
<th>Total</th>
<th>Per Sq. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home Depot</td>
<td>$4,596.00</td>
<td>$1,751.00</td>
<td>$6,347.00</td>
<td>$6.35</td>
</tr>
<tr>
<td>HouseLogic</td>
<td>$10,749.00</td>
<td>$1,751.00</td>
<td>$12,500.00</td>
<td>$12.50</td>
</tr>
<tr>
<td>Bay Area Turf</td>
<td>$9,000.00</td>
<td>$1,751.00</td>
<td>$10,751.00</td>
<td>$10.75</td>
</tr>
</tbody>
</table>

Table 3 assumes a 1000-square-foot relatively flat lawn with no irregularities and does not include the cost of any equipment rental. Additional costs include an estimate for the base layer materials, weed barrier, and disposal of removed lawn.

<table>
<thead>
<tr>
<th>Supplier/Retailer</th>
<th>Per Sq. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass-Tex</td>
<td>$10 to $15</td>
</tr>
<tr>
<td>Easy Turf</td>
<td>$14</td>
</tr>
<tr>
<td>Heavenly Greens</td>
<td>$15 to $17</td>
</tr>
</tbody>
</table>

Table 4 provides estimates for artificial turf installed by a qualified contractor.
3. ENVIRONMENTAL CONSIDERATIONS

When evaluating the differences between natural turf, drought tolerant plants and artificial turf, it is important to consider the broader environmental context. As noted previously, there are multiple and interrelated environmental benefits to a living landscape, whether natural turf or primarily drought tolerant plants. These benefits accrue, however, only when the landscapes are planned, installed and maintained following eco-friendly practices. Many of these practices are described below, and a complete description of a holistic approach to landscape design, installation and maintenance can be found in the Bay-Friendly Landscaping Guidelines: Sustainable Practices for the Landscape Professional and Bay-Friendly Gardening Guide: From Your Backyard to the Bay.20

Artificial turf does reduce water use over conventional turf and can reduce the potential runoff of pesticides and herbicides commonly used in turf maintenance, but also comes with several environmental concerns. Refer to the Findings Summary on the Installation and Use of Artificial Turf for the City of Glendale, August 14, 2015, in the Appendix, for a more detailed description of artificial turf concerns.

The following summarizes the environmental benefits and concerns with the installation and maintenance of natural turf, artificial turf and drought tolerant landscapes. These pros and cons are summarized on Table 2 in the Executive Summary.

Water Conservation:

The current drought conditions and the State’s mandates requiring that Glendale reduce water consumption by 20 percent city-wide. Landscapes must address water conservation. This can be accomplished by reducing the city-wide acreage of irrigated turf and other water thirsty landscapes, improving the efficiency of irrigation systems, and eliminating wasteful runoff when irrigating. Related environmental benefits and concerns include:

- Water Use and Energy Savings: Over 19 percent of the State’s energy demand is for the transport and delivery of water, thus reducing water use will result in energy savings.21
- Reduced Water Demand for Drought Tolerant Landscapes: Landscapes installed using climate adapted native plants and a high-efficiency irrigation system can save as over 50 percent of the water typically used on a conventional turf-based landscape.22

■ Reduced Water Demand for Irrigated Turf: Turf is often over-watered, resulting in wasteful runoff. High-efficiency irrigation systems including a self-adjusting irrigation controller that increases or decreases watering times in response to real-time climate data combined with spray nozzles with matched precipitation rates that cover the area evenly can significantly reduce water use. Many homeowners experience a 30 percent or greater water savings after installing a new controller without removing any existing lawn or landscaping.

■ Water Use with Artificial Turf: While artificial turf does not require regular irrigation, frequent water applications are required to wash off dirt and pet waste, and to cool down the surface temperatures.

■ Soil Health and Carbon Sequestration: The ability of healthy living soils to store carbon has been recognized as a key approach to addressing increased CO₂ levels in the atmosphere.

Climate Change

Landscapes have a tremendous potential to mitigate the impacts of climate change as well as reduce and/or sequester carbon emissions into the atmosphere. Depending upon the choice of materials, construction, and maintenance methods, a landscape can also contribute more CO₂ emissions. Key issues include:

■ Soil Health and Carbon Sequestration: The ability of healthy living soils to store carbon has been recognized by as a key approach to addressing increased CO₂ levels in the atmosphere. According to Rattan Lal, director of Ohio State University’s Carbon Management and Sequestration Center, “Soils of the world must be part of any agenda to address climate change, as well as food and water security. I think there is now a general awareness of soil carbon, an awareness that soil isn’t just a medium for plant growth.”[23]

■ Trees and Carbon Sequestration: Plants sequester (remove) carbon from the atmosphere through growth. Carbon dioxide is converted into plant tissue through photosynthesis.[24] In order to realize this benefit, trees must be planted to optimize growth and survival, with sufficient room for root growth in healthy uncompacted soils.

■ Natural Turf and Increased Carbon Emissions: In 2009, the Texas Commission on Environmental Quality found that an hour of gas-powered lawn mowing produces as much pollution as four hours of driving a car.[25]

■ Waste and increased carbon emissions: landscapes designed to minimize green waste through sheet mulching and avoiding overplanting reduces landfill and resulting methane emissions from decomposing vegetation.

■ Transportation and carbon emissions: choosing locally sourced materials reduces shipping distances.

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Urban Heat Island

Many of the materials and surfaces installed in urbanized areas can increase the ambient temperatures by several degrees, resulting in what has been dubbed the urban heat island effect. Darker colored surfaces, such as asphalt paving and some roofing materials, absorb heat during the day and re-radiate back at night. Natural turf, artificial turf, and drought tolerant landscapes can contribute to, or mitigate this effect as noted below.

- Natural Turf: Can provide a cooling effect, especially when irrigated with overhead spray.
- Artificial Turf: heats up quickly in full sun to temperatures often exceeding 150 degrees or more. This heating effect is similar to surrounding a home or building with a parking lot.26
- Drought Tolerant Landscapes: Shading from tree canopies provides a cooling effect. Large stature trees provide the most benefit.

Public Health

The ability of landscapes to impact public health has been well researched and documented, from exposure to chemicals and airborne pollutants to the intrinsic healing benefits of spending time in a natural landscape setting. Public Health benefits and concerns with living landscapes and artificial turf focus on the following four areas:

- Air Quality: Pollutants from gas-powered equipment, as noted previously, adds to air pollution.
- Chemical Exposure: From artificial turf infill and from synthetic herbicides, pesticides, and fertilizers when utilized in the landscape.
- Thermal Exposure: Temperatures of artificial turf on bare skin can cause injuries and raise ambient temperature.
- Microbial Exposure: Potential injuries on artificial turf can put open wound in contact with pathogens. While the research focuses on sports fields, there is a potential for exposure to pathogens on private artificial turf play surfaces as well.27

Stormwater, Site Drainage, and Water Quality

Landscapes play a major role in protecting our watersheds by slowing and filtering runoff before it reaches our streams and water bodies. Water quality and runoff can be impacted positively or negatively from:

- Water Retention On-Site: Natural landscapes with rain gardens and permeable surfaces will slow runoff from rain and encourage absorption into the soil, which can minimize downstream flooding and water-borne pollutants.

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Artificial Turf and Runoff: While some artificial turf systems are designed with a permeable base layer, the 90 percent required compaction does not permit water absorption into the subgrade.

Wildlife Habitat

The decline in urban habitat for birds, bees, and other beneficial wildlife is resulting in significant impacts to eco-systems locally and globally. At a residential scale, an abundance of native and insectary (attract beneficial insects) plants along with other habitat-friendly practices can benefit fruit trees and vegetable garden productivity. Factors that impact habitat value include:

- Diversity of Plants: A diverse palette of native and insectary plants will provide a variety of year-round beneficial insects, butterflies and birds.
- Eliminate Chemicals in the Landscape: Chemical use can be directly harmful to beneficial insects and disrupt the soil food web.
- Provide Shelter and Water: Bird baths, small fountains, boulders, large native shrubs or trees provide the additional habitat needs.

Waste

The urban waste stream is an ongoing challenge and Glendale’s policies and ordinances, including the Construction & Demolition Debris Recycling Ordinance, support State goals for waste reduction. Landscape installation and maintenance practices can decrease or increase contributions to the landfill:

- Turf Conversions with Sheet Mulching: Sheet mulching natural lawn in place eliminates the green waste and resulting GHG emissions when placed in landfill.
- Artificial Turf Disposal: Artificial turf has a limited lifespan and will ultimately end up in the landfill. In addition, preparing the base for artificial turf requires removal of the existing turf and plantings to a depth of four inches. These materials will end up in the landfill as well if the associated soil and rocks cannot be greencycled.

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4. PRELIMINARY DESIGN GUIDELINES

This chapter outlines preliminary guidelines for the design of water conserving landscapes in the City of Glendale. These recommendations reflect the goals and requirements presented in many of the City’s existing and design guidelines including:

- Promote Water Conservation
- Increase Permeability
- Protect Water Quality
- Reduce Exposure to Pollutants
- Eliminate Waste
- Promote Habitat
- Create Healthy Soils
- Preserve Community Character and Historic Districts

Natural landscapes, whether they include irrigated turf or solely drought tolerant plants, can address all of these goals and provide multiple environmental and aesthetic benefits to property owners, and broader community. Recommendations to the use of turf and drought tolerant plants in residential, multi-family and commercial, industrial and mixed use zones are described below. The use of artificial turf does not support most of these city-wide goals and is addressed separately in this chapter, per each use zone.

RECOMMENDATIONS FOR NATURAL LANDSCAPES

General Requirements

A holistically designed, water conserving landscape will provide multiple aesthetic and environmental benefits. Key best management practices that comply with the updated Model Water Efficient Landscape Ordinance (MWEO) and encourage a healthy and robust landscape include:

- **Restore Soil Health**: relieve compaction and reintroduce vital soil organisms either by sheet mulch existing turf in place, which also reduces waste, or if no turf is present, incorporating 4 cubic yards per 10 square feet of high quality compost into the top 12 inches of soil.

- **Design to the Water Budget**: The planting design and irrigation system are designed to a water budget with an evapotranspiration factor (ET) of 55 for residential landscapes and 0.45 for non-residential landscapes.

- **Mulch**: Maintain a 3-inch layer of local recycled organic mulch to reduce evaporation.

- **Controller**: Install a self-adjusting irrigation controller that uses evapotranspiration or soil moisture sensor data utilizing non-volatile memory.
- **Slopes:** Turf is not allowed on slopes greater than 25 percent where the toe of the slope is adjacent to an impermeable hardscape.

- **Spray Irrigation:** Overhead irrigation shall not be permitted in areas 10 feet or narrower, nor within 24 inches of any non-permeable surface, unless the paving is permeable or drains back into the landscape area.

- **Avoid Invasive Plants:** Check with CAL-IPC’s “Don’t Plant a Pest” brochure.

- **Choose Native Plants:** Encourage habitat by using at least 50 percent natives in the garden.

- **Provide Room for Trees:** Provide ample room for trees to grow and spread their root systems. Avoid compacting the soil under the driplines.

**Residential**

Residential landscapes typically include a front yard visible to the public and a private, enclosed rear yard. Given the front yard landscape contributes to the overall neighborhood character; consider the following recommendations for new and renovated landscapes:

- Residential lawn is limited to 25 percent of landscape (front and back yard combined).

- Design shall provide a unified composition with a pleasing repetition of colors and textures.

- Parking strips shall include a combination of permeable paving and planting.
Multi-Family Residential

The landscape areas surrounding apartment and condominium complexes are typically subdivided into entry/streetscape landscapes; perimeter common areas that provide buffer planting along adjacent properties and between buildings; and the common use and recreation areas, including play areas, swimming pools and outdoor picnic areas. The use of turf as a universal, low cost groundcover can shift to an attractive, water conserving landscape that ultimately saves the property owner considerable water and maintenance costs. One case study in San Ramon, California converted multiple acres of thirsty common area lawn and a large water feature that was leaking substantial water into a colorful water-conserving landscape with a dry stream bed, and outdoor patios with umbrellas. The owner realized a $45,000 reduction in the maintenance and water costs the first year, and the occupants love watching birds and butterflies visit the gardens from the new outdoor seating area.

Recommendations for the use of natural turf and drought tolerant landscaping includes:

- Lawn is limited only to recreational use areas.
- Replace unused turf around project perimeters with low groundcovers and accent plants (see photo above).
- Replace annual beds with perennial, drought tolerant plants that will last 3 to 5 years before needing replacement.
- Keep plantings within 25 feet of driveways below 30 inches to allow sufficient sight distance.
- Protect the investments in mature, healthy trees by protecting the roots zones from compaction. Enlist a qualified arborist, if needed, to assess specific needs.
- Adopt an Integrated Pest Management (IPM) approach to landscape maintenance that utilizes chemicals as a last resort.
Commercial, Industrial, and Mixed-Use Zones

Landscaped areas within these zones are generally limited to the property entrance and perimeter buffer planting; interior parking lot landscaping with a requirement for trees per the City’s Municipal Code, Chapter 30.32.160, Landscaping of Parks and Loading Areas; and interior courtyards and/or rooftop areas.

Guidelines for the use of natural turf and drought tolerant landscapes in these zones include:

- Turf is limited to recreational areas only.
- Replace turf in parking strips and narrow planting strips with water conserving plantings and drip irrigation.
- Replace annual beds with perennial, drought tolerant plants that will last 3 to 5 years before needing replacement.
- Keep plantings within 25 feet of driveways below 30 inches to allow sufficient sight distance.
- Protect the investments in mature, healthy trees by protecting the roots zones from compaction. Enlist a qualified arborist, if needed, to assess specific needs.
- Adopt an Integrated Pest Management (IPM) approach to landscape maintenance that utilizes chemicals as a last resort.
RECOMMENDATIONS FOR ARTIFICIAL TURF USE

Given the multiple concerns of the use of artificial turf in the landscape, and the high cost of installation, many property owners will choose a natural landscape alternative. When choosing to install artificial turf, the following requirements shall be met:

General Requirements

The following criteria shall be required for all artificial turf installations. See Appendix B for a more detailed description.

- The material must meet the minimum visual criteria.
- The artificial turf must be properly installed by a licensed professional.
- Artificial turf cannot be installed under the dripline of existing trees and within the expected mature dripline of newly planted trees.
- Artificial turf must be calculated as a non-living material.
- Artificial turf cannot be installed on slopes exceeding 25 percent (4:1) without a grading plan stamped and signed by the civil and/or geotechnical engineer.
- Areas covered in artificial turf shall drain to a landscaped based rain garden or biotreatment area. No runoff from hosing down the artificial turf shall be allowed to directly enter the storm drains.
- Artificial turf shall not be installed in any of Glendale’s Adopted Historic Districts where visible from the public right of way, including all residential front and side yards.

Poor quality material with streaks and stains. Boulder seems out of place.

Artificial turf installations should integrate natural landscaping to provide a more natural garden aesthetic.
Residential

Placement of artificial turf in areas not visible from the public right of way is permitted, providing the location complies with the general criteria, above.

Placement of artificial turf in front or side yards where visible from the public right of way shall comply with the following:

- Artificial turf does not exceed 40 percent of the total square feet of the front and side yard.
- Live plant material shall compose a majority (more than 50%) of the street setback areas, exclusive of permitted driveways.
- A minimum 36 inches natural landscaped buffer is maintained along the building edge.

Multi-Family

Placement of artificial turf in common areas not visible from the public right of way, including roof gardens, is permitted, providing the material selection, location and installation complies with the general criteria, above, and the following:

- Artificial turf does not exceed 25 percent of the total square feet of the landscaped area.
- When on roof garden/podium landscapes, the subsurface drainage systems shall be engineered to provide proper drainage and eliminate any risk of leakages through the slab.
- When used for pet runs, a means of daily rinsing and elimination of potential pathogens without causing runoff directly into the storm drain must be provided.

Placement of artificial turf in front or side yards where visible from the public right of way shall not be allowed.

Commercial, Industrial, and Mixed-Use Zones

The landscaped areas surrounding commercial and industrial generally include a limited landscape setback along street frontages, planting islands with trees in interior parking lots, planting areas at the building entry and perimeter, and often, an interior landscape areas for employees. Artificial turf installation must comply with the General Requirements, above, and is limited to the interior landscaped areas where not visible from the public right of way.

Mixed use zones generally have limited street frontage to plant and need to maximize street tree plantings to enhance the pedestrian environment, shade the roadways, and provide additional canopy for the urban forest. Artificial turf is not compatible with tree plantings and is limited to residential rooftop gardens, and as defined in General Requirements.
5. NEXT STEPS

RECOMMENDED CHANGES TO CITY ORDINANCES

Chapter 13.36 Water Conservation

The City will need to respond to the State Department of Water Resources by December 1, 2015 stating that the City has adopted the Ordinance or adopt their own ordinance, which must be at least as effective in conserving water as the State’s Ordinance. Amending Chapter 13.36 to adopt the updated Model Water Efficient Landscape Ordinance (MWELO) by reference would be the simplest approach, with a hot link that can be immediately accessed on from the City’s website. The City can also incorporate and attach a copy of the MWELO Appendix D: Prescriptive Compliance Option which is a much easier method for smaller projects (500 -2,500 square feet) to comply with the State ordinance.

Chapter 30.31 Landscaping

This chapter will need substantial revisions to reflect a shift to more drought tolerant landscapes, the new MWELO requirements, and increased applications for artificial turf. Recommended additions/revisions include:

- Expand descriptions of planting requirements to limit the allowable square footage of natural and artificial turf.
- Clarify acceptable criteria for installation of drought tolerant landscapes visible to the public.
- Expand acceptable locations for artificial turf installation as described in Chapter 4: Preliminary Design Guidelines.
- List requirements for artificial turf installation, including:
  - Quality of materials: Shall include three separate blade types: greens and a straw “thatch” blade, must also have a durable backing that is permeable.
  - Grading plan to confirm slopes do not exceed 4:1. A photo of the existing area to receive artificial turf is sufficient when grades are visibly flat.
  - When grades exceed 4:1 submit a report, stamped by a licensed civil and/or geotechnical engineer, clearly stating the measures to be taken to provide a stable slope capable of receiving the artificial turf and subbase installation.
  - Submit proof of contract and valid contractor’s license.

Poor quality artificial turf material installed on too steep a slope.
• If installation is not completely properly, resulting in drainage problems, tripping hazards and/or eroding edges, contractor to remove and reinstall at own expense.

• When installing artificial turf on rooftop gardens, submit plans indicating installation details with anchoring and edge treatments, grading and drainage measures, and maintenance requirements, including sanitation requirements from pet feces.

City of Glendale Guidelines for Residential Buildings in Adopted Historic Districts

Update the guidelines to address appropriate approaches to landscaping front and side yards with drought tolerant landscapes and/or artificial turf.

Additional Recommendations

Given the challenges of designing more complex front yards with reduced or no lawn, a city-wide design manual would be useful, in conjunction with design workshops for residents.

ADOPTION AND IMPLEMENTATION

Following staff review of this draft report, edits will be incorporated and submitted as the Final Report to be presented to the Glendale City Council in October. Based upon Council direction, draft ordinances will be prepared and presented at public hearings before Planning Commission, then to the City Council for final adoption.

PUBLIC OUTREACH AND EDUCATION

The City of Glendale has prepared this report to determine whether or not to expand the use of artificial turf in residential and commercial landscapes, and to provide guidance and recommendations on the conversation of existing landscape to a more drought tolerant approach. The information provided in this report was compiled from a multitude of sources and stands as an overview of the most recent research and findings about artificial turf. Property owners can use this report to help assess their own need for and use of artificial turf or other natural alternatives.

Existing City Programs and Resources

Glendale currently offers programs to help residents’ landscapes keep their neighborhoods beautiful and attractive while at the same time reducing waste, energy, and water usage.
The City of Glendale’s Public Works Department’s *Free Mulch Program* allows residents to pick up loads of mulch left over from the City’s tree trimming operations. Utilizing the mulch allows residents to give back to the environment by converting unusable green material into a valuable resource. A mulched landscape suppresses weeds and improves the overall health of the soil and is a natural alternative to artificial turf.

The City also runs the *Tree Power Program*, helping residents save energy by offering free shade trees to plant on their property. The findings in this report show that the installation of artificial turf can impact the growth of trees on the landscape. Residents should take this into consideration when installing artificial turf.

The City of Glendale Water & Power’s Water Wise Gardening Website helps residents create low-water use landscapes by providing many examples of landscape designs, plant lists, and other landscaping resources.

The City of Glendale’s Integrated Waste Management Division provides information and how-to’s about backyard composting. They also host free Compost Workshops throughout the year so help residents reduce their food waste at home and create a new valuable resource.

**Keeping the Public Informed**

As the City looks to make changes to their landscape policies and ordinances, residents should be informed of these changes as well as the most current research and recommendations surrounding artificial turf so they may make landscaping decisions appropriate for their yard.

The City should develop and disseminate educational materials that inform residents about any changes to City Ordinances and also direct residents to other resources where they could find more information. To provide information to residents, the City could:

- Create and design informational publications such as flyers, brochures pamphlets and newsletters to be distributed to homeowners and property owners door-to-door or at other community events, such as Glendale’s Downtown Farmers Markets or public libraries.
- Develop a page on the City’s website that provides resources and links to information for homeowners and property owners seeking to comply with new city landscaping ordinances.
- Make accessible to residents copies, both in print and digital, of the Landscaping and Artificial Turf Report.

Along with the educational materials the City could develop, the city could also run educational programs, talks, classes and seminars that focus on landscape design and implementation.

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Classes, Seminars, and Trainings

The City should continue to provide workshops and seminars to residents who are looking to take an active role in the design and maintenance of a healthy, beautiful and drought resistant landscape. The following are suggestions of programs the City could offer that are inspired by other public agencies doing similar work.

- **Trainings for Landscape Designers and Maintenance Professionals.** ReScape California offers landscape professionals the opportunity to become certified as a *Bay-Friendly Qualified Professional*. Through a multiple day training course, landscape professionals learn about native, drought tolerant and sustainable landscaping practices and how they can incorporate these practices into the design and maintenance of their clients’ landscapes.

  The Santa Clara Valley *Urban Runoff* Pollution Prevention Program, initiated by public agencies, cities and water districts of Santa Clara County, offers a *Green Gardener Training Program* designed to train landscape maintenance workers, contractors and professional gardeners about sustainable gardening practices. Professionals who complete the course appear on the program’s website and on promotional materials.

  The City of Glendale could offer a similar program and certification system for landscape professionals in the area. For more information about ReScape’s Professional Training Program, visit [www.bayfriendlycoalition.org](http://www.bayfriendlycoalition.org). For more information about Santa Clara Valley’s Training Program, visit [www.mywatershedwatch.org](http://www.mywatershedwatch.org).

- **Rated Landscape Program.** ReScape California has developed *Bay-Friendly Rated Landscapes*, a rating system for new landscape projects throughout the Bay Area. This voluntary, third-party verified rating system provides property owners and landscape professionals with a flexible, systematic framework for creating healthy, environmentally sound landscapes. Landscapes are rated based on Landscape Guidelines created by ReScape and are recognized by their sustainable landscape design, construction and maintenance practices. The City of Glendale could work with ReScape to license this program for Glendale, or create their own rating system for landscapes and incorporate all of the aspects of the City’s landscaping policies and ordinance into the rating system. For more information about ReScape’s Rated Landscaping Program, visit [www.bayfriendlycoalition.org](http://www.bayfriendlycoalition.org).

- **Community Training Events.** StopWaste, a public agency in Alameda County, offers landscaping programs aimed to reduce waste. StopWaste’s *Lawn to Garden Parties* Program allows a homeowner to transform their lawn into a drought tolerant, native landscape while also teaching other members from their community about sustainable landscaping practices.34

  The City of Glendale could create a similar program through the Neighborhood Services office which is responsible for providing community improvement services to neighborhoods throughout Glendale.35 A leader from the community could receive training about new landscape policies and practices and then go out into

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their neighborhood and teach others. For more information about StopWaste's Lawn to Garden Parties Program, visit www.stopwaste.org.

- **Partnerships with Other Public Agencies and Water Districts.** The City of Glendale, located in one of the nation’s largest counties, has a unique opportunity to partner with a multitude of other public agencies, water districts and cities to develop a plan to provide comprehensive information, training, and resources to their residents.

Building on the success of the Glendale Water-Wise Gardening program, the City could further develop talks, lectures and seminars that address new changes to the City’s landscaping policies and ordinances.
5. Next Steps

REVIEW OF LANDSCAPING STANDARDS & USE OF ARTIFICIAL TURF
# Appendix A
## Turfgrass Alternatives

<table>
<thead>
<tr>
<th>Name</th>
<th>Example Photo</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native Mow Free</td>
<td></td>
<td>4”-6” tall 50% shade Low water Provides soil stabilization for sloped areas</td>
</tr>
<tr>
<td>Delta Bluegrass Company</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Idaho fescue/Festuca idahoensis, Molate fescue/Festuca rubra, Western Mokelumne fescue/Festuca occidentalis)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Native Bentgrass</td>
<td></td>
<td>1 ½ “-2” tall Full sun/Part shade Low water Good wear recovery due to self-repairing rhizomes</td>
</tr>
<tr>
<td>Delta Bluegrass Company</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Agrostis pallens)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delta Grassland Mix</td>
<td></td>
<td>4”-6” tall Part shade Low water moderate wear resistance</td>
</tr>
<tr>
<td>Delta Bluegrass Company</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Junegrass/Koeleria macrantha, Slender Hairgrass/Deschampsia elongata, Molate Fescue/Festuca rubra)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biofiltration Sod</td>
<td></td>
<td>4”-6” tall Full sun Low water Reduces soil erosion and provides weed barrier For roadsides, bio-swales and other environmental mitigation areas</td>
</tr>
<tr>
<td>Delta Bluegrass Company</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Purple needlegrass/Stipa pulchra, Molate fescue/Festuca rubra, California Barley/Hordeum californicum, Meadow barley/Hordeum brachyantherum)</td>
<td></td>
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</tr>
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</table>
### Drought Tolerant Turfgrass

<table>
<thead>
<tr>
<th>Name</th>
<th>Example Photo</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native Preservation Mix</td>
<td><img src="image1" alt="Native Preservation Mix" /></td>
<td>4”-6” tall&lt;br&gt;Part shade&lt;br&gt;Low water&lt;br&gt;Good for sloped hillsides, median and roadside applications</td>
</tr>
<tr>
<td>Delta Bluegrass Company</td>
<td><img src="image2" alt="Delta Bluegrass Company" /></td>
<td></td>
</tr>
<tr>
<td>(Junegrass/Koleria macrantha, Purple needlegrass/Stipa pulchra, Nodding needlegrass, Nessella cernua, Molate fescue/Festuca rubra)</td>
<td><img src="image3" alt="Junegrass/Koleria macrantha" /></td>
<td></td>
</tr>
</tbody>
</table>

### Turfgrass Alternatives

<table>
<thead>
<tr>
<th>Name</th>
<th>Example Photo</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dymondia/Dymondia margaretae</td>
<td><img src="image4" alt="Dymondia/Dymondia margaretae" /></td>
<td>1”-3” tall&lt;br&gt;Full/Part shade&lt;br&gt;Moderate to occasional water</td>
</tr>
<tr>
<td>Thyme/Thymus sp.</td>
<td><img src="image5" alt="Thyme/Thymus sp." /></td>
<td>2”-3” tall&lt;br&gt;Full/Part shade&lt;br&gt;Moderate to occasional water&lt;br&gt;Prefers good drainage</td>
</tr>
<tr>
<td>Name</td>
<td>Example Photo</td>
<td>Details</td>
</tr>
<tr>
<td>------</td>
<td>---------------</td>
<td>---------</td>
</tr>
</tbody>
</table>
| Blue Star Creeper/ Pratia pedunculata | ![Example Photo](image) | 2”-3” tall  
Full/Part shade  
Moderate water  
Prefers rich soil, good drainage  
Tiny blue star-shaped flowers  
late spring/summer |
| Dwarf Mondo Grass/Ophiopogon japonicas, ‘Kyoto Dwarf’ | ![Example Photo](image) | 4” tall  
Slow grower  
Sun/part shade  
Moderate to regular water  
Easy to divide for more plants |
| Buffalo Grass/Bouteloua dactyloides, ‘UC Verde’ | ![Example Photo](image) | 4” tall (higher w/ regular irrigation  
Native from central Montana to Arizona  
Many cultivars: year-round green  
Up to 75% less water  
Tolerates mowing  
Plant from seed, plugs (shown) or sod |
<table>
<thead>
<tr>
<th>Name</th>
<th>Example Photo</th>
<th>Details</th>
</tr>
</thead>
</table>
| Blue Grama Grass/Bouteloua gracilis | ![Blue Grama Grass/Bouteloua gracilis](image1) | 8”-12” tall (can be kept to 3” w/ mowing)  
Warm-season bunchgrass  
Full sun, good drainage  
No summer water once established  
Grow from seed (1#/1000SF)  
Sow in fall |
# Green Groundcovers

<table>
<thead>
<tr>
<th>Name</th>
<th>Example Photo</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerald Carpet/Arctostaphylos</td>
<td></td>
<td>&lt;1 ft. tall</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full sun</td>
</tr>
<tr>
<td></td>
<td></td>
<td>White flower bloom in winter/spring</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low water&lt;sup&gt;36&lt;/sup&gt;</td>
</tr>
<tr>
<td>Ornamental Strawberry/Fragaria chiloensis</td>
<td></td>
<td>6”-12” tall</td>
</tr>
<tr>
<td></td>
<td></td>
<td>California Native</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full sun/Part shade</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low to moderate water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Good drainage&lt;sup&gt;37&lt;/sup&gt;</td>
</tr>
<tr>
<td>Creeping Raspberry/Rubus pentalobus</td>
<td></td>
<td>&lt;6” tall</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full sun/Part shade</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low to moderate water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>White flower bloom in summer&lt;sup&gt;38&lt;/sup&gt;</td>
</tr>
<tr>
<td>Putah Creek/Myoporum parvifolium</td>
<td></td>
<td>&lt;1 ft. tall</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full sun</td>
</tr>
<tr>
<td></td>
<td></td>
<td>White flower bloom in summer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Native to Australia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low water&lt;sup&gt;39&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>37</sup> http://ucanr.edu/sites/MarinMG/Plant_Guide/Plants_by_Type/?uid=138&ds=451.
APPENDIX B

FINDINGS SUMMARY ON THE INSTALLATION AND USE OF ARTIFICIAL TURF FOR THE CITY OF GLENDALE

August 14, 2015
Background

Located at the juncture of the San Fernando and San Gabriel Valleys, the City of Glendale is the third largest city in Los Angeles County. The City incorporated in 1906 and boasts a rich cultural history with many buildings of historic interest and significance. Residents within the 34 distinct neighborhoods that ultimately formed the City of Glendale enjoy a high quality of life that is reinforced by a city-wide landscaping ordinance enforced as part of the City’s Municipal Code.

The landscaping ordinance currently restricts the use of artificial turf to areas not visible from public streets. With the current drought conditions and water reduction mandates, and with no relief in sight, artificial turf is being proposed as a suitable substitute for existing turf and landscaping in front yards. The City, in response to these requests, recognizes the need for a well-researched technical report that explores all costs and benefits of using artificial turf in the public realm, focusing on single-family dwellings, multi-family buildings and typical land uses in commercial, industrial and mixed use zones. The report will also address how to update the municipal code to guide the design of landscapes with drought tolerant plantings and, if approved by the City Council, artificial turf, while preserving the attractive neighborhood character residents enjoy.

Prior to preparing the Draft Report, the consultant team has prepared the following Findings Summary Report that compiles the current data and literature on artificial turf and summarizes key issues to be considered when evaluating the appropriateness of using artificial turf in various landscape applications. Key issues that are addressed in this report include: aesthetics; proper installation, cost, and maintenance; legislation and city ordinances; and health, safety and environmental concerns.

Aesthetics

The quality and appearance of artificial turf products on the market vary widely, from short-cropped “Astro-turf” or slick, flat blades with shiny surfaces to materials with a more realistic turf color and texture. When artificial turf is placed within view of the public realm, the most desirable aesthetic is the latter.

Key specifications for a more natural appearing turf include:

**Color:** Blades shall be a minimum of three colors: two green (field green/olive green) blades and a straw colored “thatch” blade, to match the natural variation in living turf. Single colored, monochromatic blade materials are not acceptable.

**Texture:** Blades shall be designed to mimic a natural blade appearance with a three-dimensional ridge or spine cross-section and uneven tips on each individual blade, which also increases resiliency and durability. Flat, 2-dimensional blades with squared off tops, as shown on the examples above, are not acceptable.

**Blade Length:** Blade length shall be shall be a minimum of 1½ inches in height, held vertical with granulated sand (or other non-rubber materials as recommended by the manufacturer) infill material graded specifically for “thatch” style artificial turf. Note that there are ongoing environmental and public health concerns with the use of crumb rubber.
There are a wide variety of artificial turf materials and fabrication.

The following photos illustrate some of the characteristics found in various artificial turf materials that are not natural-appearing.

Example of short, flat bladed artificial turf. From a distance, the shorter turf material does not resemble a natural lawn, but a miniature golf course/putting green on a slope.
Installation, Cost and Maintenance

Installation

The installation of artificial turf by qualified installers with a valid D-12 - Synthetic Products Contractor’s license with the California Contractors State License Board is highly recommended to ensure proper base preparation, seam joining and anchoring. The Planning Department may choose to require proof of this license as verification of quality of work. Most, if not all, manufacturers will provide a guarantee on installation as well as materials, which can provide insurance against defective installation.
Key steps to proper installation include:\(^{40}\)

1. Site clearing: Remove 3 - 4 inches of existing sod, plants and/or dirt. Cap and/or remove any sprinklers.

2. Site gradients: Establish a smooth, even finished grade with a minimum of 2 percent slope for surface drainage, compacted to 90 percent. Gradients steeper than 4:1 shall be engineered to be stable prior to application of artificial turf. Consultation with a geotechnical engineer is highly recommended. Install gopher barriers, if required, on top of prepared subgrade.

3. Base material: Proper base preparation is critical for a successful artificial turf installation. Lay 2 - 2 1/2 inches of drain rock, hose down, then using a vibrating plate compactor, compact to 90 percent. Place a 1 - 1 1/2 inch layer of Class II road base or 3/8 inches minus with fines (which is utilized by professional fields for a more stable base) over the drain rock. Install a weed barrier fabric, if used, on top of the base. Hose down and then use a vibrating plate compactor to compact to 90 percent.

4. Compaction: When compacting the base with the plate compactor, constantly water the area with a hose. Repeat the compaction procedure up to ten to twelve times before introducing the sub-base material.

5. Turf installation: Prior to installation, lay turf out under the sun for at least 1-2 hours to allow turf to acclimate. This will make the backing less stiff and the turf easier to be swept. Always stretch and install turf taut. Lay turf onto base and position where needed. Always run grain of turf in the same direction. Using a carpet knife/razor knife, cut off excess turf on the backside (3 stitches in from sides). Cut turf (on backside) to fit area. Fasten one end with 40D or 60D Bright Common nails of 5-6 inches in length, spaced 3-4 inches apart along the edges. Stretch turf using a carpet stretcher and fasten with nails as you move across to the opposite end. Use of a carpet stretcher will keep the material from buckling. Place a nail every 12-24 inches throughout center and every 3-4 inches along the perimeter. Do not overlap seams. Never drive nails too far into the base because this will create a noticeable dip.

6. Headerboards: Use a 2x4 (straight line installation) or 1x2 (curve line installation) wood or recycled metal or plastic bender board around the perimeter of turf area to frame and protect the turf from soil and debris. Note that some plastic benderboards will melt and warp when exposed to the sun for long periods of the day.

7. Seaming: Apply seam tape lengthwise to the bottom side of turf, lining up the turf edges with the guidelines on the seaming tape. Apply hot glue, per manufacturer’s instructions to the seaming tape. Fasten together seams by using 11 gauge 6 inches x 1 inch x 6 inches staples spaced 4 inches apart along the seam. Do not counter sink staples. Be sure the seams are taut and precise, the grain of the turf is facing in the same direction, and the space at the seam is the same as the stitching gauge. Match the blades per blades along the seam to ensure invisible seaming.

8. Finishing and Infill: After turf is installed, power broom before applying infill. Apply infill onto turf using a drop spreader. Spread infill as evenly as possible with a grading rake or broom until infill settles into the base of the turf. Hand or power broom again so that the blades are standing straight up. Use carpet scissors to trim off the excessive turf blades. Clean the surrounding area with a blower or a broom. Use only manufacturer recommended infill materials.

Additonal Considerations with Location and Installation of Artificial Turf

**Backing Material:** Permeable backing shall allow for infiltration of surface water into the base below. Many hole-punched backing materials have openings spaced 12 inches on center, which will not allow sufficient flow of water through the material when rinsing off pet urine.

**Compaction:** A plate compactor is essential to obtaining the proper 90 percent compaction and establishing a firm, stable base for the artificial turf. If not properly compacted, the materials will continue to shift and compress in time, causing ruts in the turf and developing higher or lower areas that eventually will cause buckles and wrinkles in the surface.

**Melting:** Sunlight reflecting off west or south facing windows can create a “magnifying glass effect” on the adjacent turf. This concentrated, reflected sunlight can act very much like a laser and can melt the artificial turf. A coating on the outside of the adjacent windows can prevent this effect.41

**Surface Temperature:** Artificial grass can get hot to the touch during the midday direct sun, resulting in surface temperatures that are too hot to walk on with bare feet and increasing the ambient temperature. This heating effect can be somewhat reduced by hosing off the artificial turf surface in the morning.42

**Pet Smell:** Odors from pet urine will build up if the backing material is not sufficiently permeable allow thorough rinsing. Backing material should provide maximum drainage with perforations throughout. Hole-punched perforations are not recommended.43

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42 Per conversation with staff at Heavenly Greens on 8/8/15. No specific data provided.
43 University of Arkansas; Turfgrass Science. Synthetic (Artificial) Turf vs. Natural Grass Athletic Fields.
Cost

Artificial lawns average between $7 and $17 per square foot installed. For a 1,000-square-foot lawn this equates to between $7,000 and $17,000 for the initial installation. Installation of natural turf, by comparison, can vary between $5.00 and $15.00 per square foot.

Long term potential maintenance costs of artificial turf include irrigation for spraying down weekly, during hot weather, or to rinse off pet waste or food spills, additional infill, chemical disinfectants, and drainage repair and maintenance. Depending on the usage and maintenance schedule, these costs may be close to or above the cost of installation and maintenance on natural turf.

Warranties

Warranties vary with manufacturers and installers but usually cover UV degradation, fiber strength, stability of the backing and tufted yarn integrity are generally covered by the yarn and component manufacturers warranties. Most warranties, in the carpet industry and specific to artificial turf, do not cover "wear and tear."

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Because the fiber and backing, manufacturer's components make up the vast majority of materials used to create the finished product, if something, other than workmanship fails, the manufacturer has to rely upon their warranties, in getting relief for any claims. The component manufacturer's maximum warranty coverage period for lawn and landscape artificial grass yarn fibers and backings is up to eight years.46

**Maintenance**

Most homeowners will need to lightly rinse down their artificial lawns once per week to clean off accumulating dust and dirt. Turf used by outdoor pets or children, or surrounded with ample trees and shrubs, will require more frequent cleaning. Several manufacturers recommend a more thorough artificial grass cleaning, performed by professionals on a monthly basis, to help keep the artificial lawn green, clean and inviting. Large turf areas should be broomed with a power broom 2-3 times a year.

With pets, once any solid waste has been removed, it is then necessary to spray down the area in which any pet waste was located.47 The area may then need to be sanitized and deodorized. Some dog owners with artificial turf have found this to be a concern.48

**Gophers**

One consideration for the City of Glendale residents may be the presence of gophers. According to manufacturers of artificial turf, “Gophers CAN and WILL bore through the base and the turf itself. In order to prevent this, several options are available. A chicken wire or gopher wire must be used, and installed in the proper place. In order to be most effective, the gopher wire must be inserted below the compacted base.”49 A gopher hole effectively destroys the artificial turf lawn, creating a damaged section that cannot be patched, but requires the whole lawn to be replaced. Gopher holes are usually not covered under warranties.

**Additional maintenance concerns include:**

- **Weeds Growing Through or Underneath Turf.** Using a weed barrier will block most of the weeds from growing through, but wind and birds can drop seeds in the area which may sprout if they are not cleaned up periodically.
- **Rotting Organic Material and Debris.** Leaves, dead flowers, and dead weeds will decompose on top of the turf if not removed periodically, providing a perfect medium for weed seeds to sprout.
- **Food, Beverages, and Pet or Bird Waste.** Any time a beverage spills on the turf, or dogs or birds leave feces, it will stick to the turf surface until washed off. A specially treated infill material is often recommended for owners with pets that regularly go on the turf, with frequent reapplication. The composition of this material and potential toxicity is unknown.
- **Weather (Rain, Wind).** The rain and the wind will move the infill or blow some of it away. A shag carpet rake or stiff broom can be used to move the infill back into place; however, infill will need to be added annually.
- **Heavy Use.** The artificial turf is attached to the ground with glue and nails. It may be necessary over time to push the nails back down or to re-glue some of the corners to prevent further damage to the turf. It is also important to use a push broom and sweep the turf in the opposite direction it is laying to restore the upright blade alignment; doing this monthly will greatly improve the turf's appearance as well as the life expectancy.

- Chemical Damage or Burned/Melted Blades. May require replacement.\textsuperscript{50}

- Trees Around or Near the Turf. Tree and shrub roots will grow under the turf and may need to be trimmed to avoid penetrating the surface of the turf. Artificial turf should not be installed under the canopy of existing trees to protect their root zones from compaction.

Property Value Impacts

Opinions vary regarding the effect of artificial lawn installation and property values. The National Association of Realtors does not see a definitive trend on artificial turf impacting home values, but lists the following considerations:

Pros:

- The perceived “green” or “eco” perspective of artificial lawns
- Eliminates need for lawn chemicals and pesticides
- Low maintenance
- Color stays green year-round
- Major improvements in artificial turf look over the last several years

Cons:

- Heat - surface and ambient
- Lead or other harmful chemicals in blades and infill material
- Stigma that artificial lawns are “tacky”
- Increased risk of injury\textsuperscript{51}

Legislative Overview

A number of State Assembly and Senate bills that could influence and increase the installation of artificial turf are under consideration:

AB349: (amended in the Senate) would prohibit HOA fines for replacing lawns with artificial turf.

AB1164: (amended and referred to committee\textsuperscript{55}) would prohibit a city from enacting or enforcing any ordinance or regulation that prohibits the installation of artificial grass or artificial turf on residential property.

SB759: (amended in Senate 2011) provides that a provision of any of the governing documents of a common interest development shall be void and unenforceable if it prohibits, or includes conditions that have the effect of prohibiting, the use of artificial turf or any other artificial surface that resembles grass. This prohibition would not prohibit an association from applying landscape rules and regulations established in governing documents that establish design standards and quality standards for the installation of artificial turf, or any other artificial surface that resembles grass, to the extent the rules and regulations do not prohibit the use of artificial turf or any other artificial surface that resembles grass.

SB47: (currently held in committee) would require the Office of Environmental Health Hazard Assessment, by July 1, 2017, in consultation with the Department of Resources Recycling and Recovery, the State Department of Public Health, and the Department of Toxic Substances Control, to prepare and provide to the Legislature and post on the office's Internet Web site a study analyzing artificial turf, as defined, for potential adverse health impacts.

\textsuperscript{50} http://www.simplerturf.com/artificial-lawn-turf-maintenance-warranty/.

\textsuperscript{51} http://infocentral.blogs.realtor.org/2013/04/12/do-artificial-lawns-impact-home-values/.

\textsuperscript{55} https://legiscan.com/CA/text/AB1164/id/1250798.
Chapter 30.32.160 Landscaping of Parking and Loading Areas

Artificial

Chapter 30.31 Landscaping

Glendale’s plans, ordinances and guidelines define the multiple goals and objectives for City growth and change, while also listing specific requirements for new construction and renovations. Documents that provide guidance and perspective on the use of artificial turf in the landscape include:

Glendale Municipal Code

Chapter 12.40 City Street Trees

This chapter establishes regulations and standards to promote the benefits of a healthy urban forest. Section 12.40.030 Duties and Prohibitions states that it is unlawful for any person to cause or allow damage or interference with the roots systems of any city street tree with the application of any paving materials. Installation of artificial turf requires removal of the top four inches of soil and compaction of base materials to 90 percent, which is equivalent to pavement installation. In addition, this compacted base layer prohibits percolation of surface water down to the established root system.

Chapter 16.08 Subdivision Design Standards

This chapter focuses on the preservation of primary and secondary undeveloped ridgeline areas within the City as a “precious scenic resource.” Slope revegetation must use a “naturalizing plant palette,” as defined in the hillside development landscape guidelines. Section 16.08.270 Passive Heating or Cooling states that the subdivision shall provide to the extent feasible for future passive or natural heating or cooling opportunities. As described elsewhere in this document, artificial turf has been documented to increase ambient temperatures significantly.

Chapter 30.31 Landscaping

Artificial turf is specifically prohibited in this chapter in ROS and R1R zones and may not be installed in R1 zones where it would be visible from the public street immediately adjacent to the property. Artificial turf is also not allowed under tree canopies and is not considered as a live plant material. The code requires that 40 percent of the total lot areas be permanently landscaped open space and more than 50 percent of that areas must be live plant material. In all multi-family, commercial, industrial, mixed use, CE and MS zones, artificial turf may not be installed where it would be visible from the public street immediately adjacent to the property.

Chapter 30.32.160 Landscaping of Parking and Loading Areas

Artificial turf is not permitted in any landscaped areas adjoining the street right-of-way nor within the interior parking lot landscaping.

Greener Glendale Plan: The City of Glendale’s Sustainability Plan

The Greener Glendale Plan, adopted by the City Council in 2012, outlines a comprehensive framework for a more sustainable City and adapting to climate change while also addressing State legal requirements, per AB 32, to reduce greenhouse gas (GHG) emissions to 1990 levels by the year 2020.

The report includes two volumes: Municipal Operations and Community Activities. The latter volume acknowledges that the community’s actions will play a much larger role in achieving the City’s sustainability and GHG reduction goals and defines a comprehensive set of goals and objectives organized within the seven key topic areas described in the United Nations Urban

Within each of these topic areas, numerous objectives were defined, with several strategies for implementation. As shown on Table B-1, objectives and strategies described in the Greener Glendale Plan (GGP) that are not supported by the installation of artificial turf include:

<table>
<thead>
<tr>
<th>Table B-1</th>
<th>Summary of Greener Glendale Plan Goals and Strategies Related to Artificial Turf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal/Strategy</td>
<td>Comments</td>
</tr>
<tr>
<td><strong>ECONOMIC DEVELOPMENT</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Objective ED 4 – Raise Glendale’s profile as a forward thinking, “green” city.</strong></td>
<td></td>
</tr>
<tr>
<td>Strategy ED 4 – A: Expand promotion of Glendale’s sustainability initiative brand, “Greener Glendale.”</td>
<td>Per environmental data and other &quot;Greener Glendale&quot; goals, artificial turf does not promote this Objective.</td>
</tr>
<tr>
<td><strong>URBAN DESIGN</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Objective UD3 – Consider expansion of the City’s Green Building Standards.</strong></td>
<td></td>
</tr>
<tr>
<td>Strategy UD3-C: Increase requirements for utilization of cool paving and cool roofing.</td>
<td>Artificial turf is not a cool surfacing and can reach temperatures in excess of asphalt.</td>
</tr>
<tr>
<td>Strategy UD3-D: Increase requirements for utilization of permeable and natural landscaping.</td>
<td>Artificial turf compacts soil, preventing or highly limiting infiltration.</td>
</tr>
<tr>
<td><strong>Objective UD5 – Incorporate Greener Glendale sustainability concepts into Community Plans and other General Plan documents.</strong></td>
<td></td>
</tr>
<tr>
<td>Two items that relate to landscaping:</td>
<td></td>
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<tr>
<td>4. Encourage the retrofit of existing development to increase energy and water efficiency, reduce waste, reduce use of toxics, and increase the use of natural landscaping including native trees and plants. Encourage new development to build to these standards.</td>
<td>Artificial turf does not support these goals.</td>
</tr>
<tr>
<td><strong>WASTE</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Objective WS1 – Promote Zero Waste through community education and outreach.</strong></td>
<td></td>
</tr>
<tr>
<td>Strategy WS1-B: Promote “deconstruction”/salvaging of materials in all remodeling projects.</td>
<td>Limited ability to reuse artificial turf once installed in place.</td>
</tr>
<tr>
<td>Strategy WS1-C: Work with developers and builders to incorporate materials and furnishings made from recycled content.</td>
<td>Limited availability of artificial turf with recycled content. Artificial turf is not renewable.</td>
</tr>
<tr>
<td><strong>Objective WS2 – Reduce use of disposable, non-renewable product</strong></td>
<td></td>
</tr>
<tr>
<td><strong>URBAN NATURE</strong></td>
<td></td>
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<tr>
<td><strong>Objective UN2 – Increase Glendale’s tree canopy coverage by 20,000 trees by 2035.</strong></td>
<td></td>
</tr>
<tr>
<td>Strategy UN2 - B: Ensure trees are planted in at least 50 percent of all sidewalk planting sites.</td>
<td>Artificial turf is not recommended under trees.</td>
</tr>
<tr>
<td><strong>Objective UN3– Implement programs to increase biodiversity in Glendale.</strong></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Goal/Strategy</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategy UN3 - B: Encourage and promote diverse landscaping palettes instead of monoculture.</td>
<td>Artificial turf does not enhance biodiversity.</td>
</tr>
<tr>
<td>Strategy UN3 - D: Encourage citizens to provide habitat for wildlife in their yards and gardens.</td>
<td>Artificial turf does not provide habitat.</td>
</tr>
</tbody>
</table>

**WATER**

**Objective WT1- Reduce community water consumption through promotion, education, and outreach campaigns.**

| Strategy WT1-B: Encourage natural, low-water use landscaping in yards and parkways – natural landscape supports urban nature, reduces urban heat island effect, helps clean water runoff, and has a cleaner life-cycle (e.g. reduced or no fossil fuel based energy or materials to produce, does not emit artificial toxins, creates a biodegradable waste product, etc.) than artificial landscaping. | Artificial lawn does not support this strategy. |

**Objective WT4- Facilitate and coordinate community water conservation projects.**

| Strategy WT4-A: Replace lawns in any public parkways (parkways adjacent to private property are the responsibility of the property owner) with native and low-water use plants. | Artificial lawn does not support this strategy. |
| Strategy WT4-B: Utilize low-water use landscaping in public works projects and on public rights-of-way. | Artificial lawn does not support this strategy. |

**Objective WT5- Implement stormwater runoff management practices to protect water quality and replenish local groundwater supplies.**

The following measures also have the potential to reduce greenhouse gas emissions by reducing the energy required to import water and by increasing urban nature (which absorbs GHGs and reduces heat):

| Strategy WT5-B: Promote and encourage the use of permeable paving. | Artificial turf compacts soil, preventing infiltration. |

**ENVIRONMENTAL HEALTH**

**Objective EH1 – Reduce use of toxics city-wide**

| Strategy EH1 - B: Implement an education and outreach program to curb the use of toxic products in gardening and landscaping. | Toxicity of some artificial turf requires more research. |

**Health, Safety, and Environmental Findings**

Environmental and public health concerns over the installation of artificial or synthetic turf (ST) continue to be discussed and reviewed. Meanwhile, there is a need for further data and research to verify and validate claims that artificial turf is not hazardous. Issues of concern are discussed below and include chemical exposure, thermal effects, microbial exposure, climate change, urban heat island effect, and water quality. A summary of these concerns are listed on Table B-2.

**Chemical Exposure**

Although numerous studies concerning the health and safety of artificial turf use have been conducted, most represent only partial assessments of the environmental and human health risk potential. Review of the literature found no long-term health or environmental risk studies of chemical exposure levels associated with artificial turf. The lack of long-term exposure information in the available literature leaves significant gaps in knowledge of the true
and full effects of artificial turf use.\textsuperscript{54} Adding to the confusion over the safety of artificial turf products are manufacturers who use coconut fiber and cork claimed to be environmental friendly and without health risks but lack the rigorous scientific studies to support these claims.

To illustrate the need for caution, results from an investigation conducted by the Connecticut Agricultural Experiment Station reported by Environment & Human Health, Inc. (EHHI)\textsuperscript{55} – the most complete report on the topic identified in the preparation of this report found that in-fill recycled rubber tire crumb used in the manufacture of artificial turf resulted in repeat confirmatory exposure to benzothiazole, butylated hydroxyanisole, n-hexadecane, and 4-(t-octyl) phenol. All four of the chemicals have recorded health effects including acute and chronic irritation of the lungs, skin, and eyes. The same study reported the presence of measurable levels of metals including selenium, lead, cadmium, and most notably high concentrations of zinc in artificial turf.\textsuperscript{54}

Investigation of reported allergic reactions, thyroid, liver, kidney, respiratory, endocrine, neurologic and developmental disorders as well as cancer associated with artificial turf exposure need to be researched comprehensively to determine whether a causal relationship exists. Health assessments that indicate \textit{de minimis} risk should not be applied to artificial turf.\textsuperscript{54}

In short, as noted by EHII, none of the available artificial turf studies are sufficiently robust to be used in a public health safety evaluation.\textsuperscript{54}

In addition, lead exposure from contact with artificial turf has been an ongoing concern. Manufacturers agreed to reduce the amount of lead in artificial turf after the California Attorney General’s office filed a suit alleging that the companies failed to provide adequate warning about potentially harmful substances. Attorneys are continuing to investigate possible suits for people who have been regularly exposed to artificial turf (such as on a soccer field or playground) and were diagnosed with cancer.\textsuperscript{55,56}

Given the limited state of our artificial turf environmental and health risk knowledge, particularly related to long-term exposure effects, application of the “Precautionary Principle”\textsuperscript{57} should be given utmost consideration in policy-making decisions about its widespread use in the landscape.


\textsuperscript{55} http://www.classaction.org/artificial-turf-lawsuit.

\textsuperscript{56} http://www.artificialturflawsuit.com/.

\textsuperscript{57} https://en.wikipedia.org/wiki/Precautionary_principle.
<table>
<thead>
<tr>
<th>Concern</th>
<th>Summary Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health &amp; Safety</strong> &lt;br&gt;Thermal Effects</td>
<td>Increased surface temperature associated with artificial turf is an ongoing concern. Methods to mitigate high temperatures, including irrigation, are temporary. &lt;sup&gt;25,58,59&lt;/sup&gt; No prolonged temperature mitigation (sustained lower temperatures of 20-30°F) has been substantiated by scientific investigation. &lt;sup&gt;12,13,14&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Health &amp; Safety</strong> &lt;br&gt;Chemical, Particulate Exposure &amp; Flammability</td>
<td>Acute and chronic irritation of lungs, skin, and eyes from Volatile Organic Compounds (VOC) off-gassing has been documented by confirmatory studies. &lt;sup&gt;28&lt;/sup&gt; Measurement of PM&lt;sub&gt;10&lt;/sub&gt;, PM&lt;sub&gt;2.5&lt;/sub&gt;, and ultra-fine particles are needed to determine inhalation and ingestion risk. &lt;sup&gt;25&lt;/sup&gt; A complete review of flammability is needed including an analysis of smoke produced from burning. Artificial turf should be considered potentially flammable. &lt;sup&gt;25&lt;/sup&gt; Zinc has been documented as a metal concern. &lt;sup&gt;28,25,60&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Health &amp; Safety</strong> &lt;br&gt;Exposure to Infectious Agents</td>
<td>Increased skin cuts and abrasions resulting from artificial turf pose an opportunity for infection. &lt;sup&gt;28,29&lt;/sup&gt; The presence of feces, blood, and other bodily fluids represent a health risk that needs additional investigation. Increased exposure to <em>S. aureus</em> and other infectious bacterial agents has not been conclusively linked to artificial turf. &lt;sup&gt;29,25&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Environment</strong> &lt;br&gt;Climate Change/Heat Island Effect</td>
<td>The Athena Institute CO&lt;sub&gt;2&lt;/sub&gt; impact model suggests that use of artificial turf should be minimized and confined, and that artificial turf be recycled when replacement is needed. &lt;sup&gt;25&lt;/sup&gt; Extended periods of intense sunlight could raise artificial turf temperatures to urban heat island levels. &lt;sup&gt;25&lt;/sup&gt; Artificial turf increases CO&lt;sub&gt;2&lt;/sub&gt; emissions and heat absorption. &lt;sup&gt;25&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Environment</strong> &lt;br&gt;Water Quality &amp; Ecosystem Health</td>
<td>Zinc in artificial turf leachate entering stormwater repeatedly violated the CT acute aquatic toxicity concentration of 65ug/l. &lt;sup&gt;25,61&lt;/sup&gt; No relevant studies of ecosystem effects related to artificial turf were identified, except for recognition of ecosystem factors to consider when evaluating artificial turf including soil carbon sequestration, soil health, stormwater infiltration, partitioning and solute flow in soil, biodiversity, and habitat fragmentation. &lt;sup&gt;25&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

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**Thermal Effects**

Surface temperatures can reach up to 200°F\(^6^2\) on most artificial turf during peak heating hours. While turf can be watered to reduce the surface temperatures, they quickly rebound to near pre-irrigation levels.\(^6^3\) Alternatives to the standard crumb rubber can mitigate this to some extent, but temperatures can still reach 167.3.\(^6^4\)

The thermal effects associated with artificial turf artificial turf are arguably the most significant and best documented in the scientific literature. Although debate exists over the extent of thermal effects, there is recognition by the artificial turf industry that use of the product does result in an increase in surface temperature. With tested temperatures reported in excess of 150°F (and up to as high as 200°F), the safety of people and pets exposed to artificial turf in the landscape is a major concern.\(^2\) According to Joel Forman, medical director of the Pediatric Environmental Health Specialty Unit at Mount Sinai School of Medicine, “Exposures of ten minutes or longer to surface temperatures above 122°F can cause skin injuries, so this is a real concern.”\(^6^5\)

While mitigation of surface temperature increases has been a focus of manufacturers, with considerable marketing attention given to product design features aimed at reducing this effect, no scientific reports exist to substantiate such claims.\(^6^6\) Until temperatures can be reduced by at least twenty or thirty degrees Fahrenheit for an extended period of time, surface temperature will remain a major health, safety, and environmental issue on artificial turf fields.\(^6^7\)

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\(^6^3\) McNitt et al., 2008.
\(^6^5\) http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2265067/.
\(^6^7\) http://ecologyartisans.com/artificial-grass/. Photo L.B. McCarty, Clemson University.
Microbial Exposure

The presence of microbes is ubiquitous both in individuals and the environment. While it has been suggested that artificial turf increases exposure to bacterial/staph infection, a well-researched Study Group report prepared for the San Francisco Recreation and Park Commission on artificial turf playfields found no evidence to support the greater staph infection risk claim. Not discussed however, and open to debate given the limited literature available, is whether feces, blood and other bodily fluids (human and animal) may persist in artificial turf and pose a potential public health hazard. Investigations of human pathogens other than staph bacteria, particularly molds and fungi, need to be conducted to determine if artificial turf is a vector for disease transmission of this type.

Climate Change

As stated earlier, the Greener Glendale Plan outlines an aggressive strategy for achieving the required GHG reductions by 2020 and other adaptations to climate change. The debate over the use of natural versus artificial turf can be evaluated by the accumulative contributions to GHG emissions. The Study Group report prepared for the San Francisco Recreation and Park Commission concluded that if the Athena Institute model is correct and broadly applicable to artificial turf, it strongly suggests that the use of artificial turf should be minimized and confined to the sites where its other benefits are maximized. It also highlights the need to recycle artificial turf when it needs to be replaced.

Other factors to consider in looking at climate impacts of artificial turf versus irrigated lawn scenario when applied to residential, commercial or industrial uses include:

Emissions associated with fuel used in mowing/maintenance equipment.

1. Water usage and associated energy used for pumping.
2. Loss of the soil carbon sequestration benefit in the artificial turf scenario.
3. Emissions associated with pesticides and fertilizers in the grass scenario.
4. Any emissions associated with disposal of waste in either scenario (presumably the grass clippings are being composted which would address this in that scenario).
5. On the adaptation to climate change impacts side - ability to absorb stormwater.

Urban Heat Island Effect

Urban heat islands are created, in part, when natural areas are replaced by impervious surfaces such as rooftops and asphalt, which absorb heat during the day, and then re-release this stored heat at night, contributing to warmer urban temperatures. Artificial turf materials are also impervious, and surface temperatures are higher than natural grass. These increased temperatures from artificial turf can significantly raise the ambient temperature around the home or building. According to Stuart Gaffin, Research Scientist at the Center for Climate Systems Research at Columbia University, the effect is the equivalent of “putting a parking lot around your house.”

Urban heat islands are identified as a concern because they can lead to an increase in the demand for energy for air conditioning, intensify air pollution due to increased heat, and increase heat-related health problems. In recent years

68 http://www.athenasmi.org/
there has been a popular movement to create “living roofs” such as the one on the California Academy of Sciences museum in Golden Gate Park, to lessen the heat island effect caused by standard roofing material.25

Due to increased carbon dioxide emissions and heat absorption of artificial turf when compared to natural grass, the use of artificial turf should be balanced against the benefits, criteria should be developed for selecting suitable installation sites, impacts can be reduced through offsets, site selection should maximize its benefits, and, if possible, artificial turf made with recycled materials should be used to reduce overall emissions compared to virgin material.25

**Water Quality**

Studies reviewed show that concentrations of heavy metals in leachate from artificial turf and/or materials used in artificial turf (i.e. crumb rubber from recycled tires, tire shreds, etc.) can exceed national and state water quality standards 25 (zinc up to 14x the national standard in one test), however the concentrations decreased to safe standards after a few months.25

Additional studies found that toxic substances that leached were very localized and did not affect a large area.25 It was emphasized that, while there may be some water quality impairment from metals, PAHs, and toxics, these impacts pale in comparison to the leaching of tire scrap storage in landfills.25

The Study Group found that more evidence is needed about the resultant environmental effects of artificial turf leachate. Because of this unknown, the Study Group found that turf leachate risks could be lessened by locating artificial fields in locations that do not flood and by lining the fields so that leachate could be collected and diverted into the wastewater system, allowing it to be processed by the City’s wastewater treatment facilities. The Study Group also discussed the possibility of installing turf only after leachate concentrations have declined to lower levels.25

The only potential risk to surface waters identified in the stormwater collected from the artificial turf fields is zinc, since it was the only chemical parameter that was detected above the acute aquatic life criteria of 65 ug/l. Acute toxicity is assumed to occur when the zinc concentration in-stream exceeds 65ug/l for one hour in any three year period. In three of the eight stormwater samples analyzed, zinc concentrations were detected at 130, 150 and 260 ug/l, well above the acute aquatic life criteria. It is important to note, that the three stormwater samples with acutely toxic levels of zinc were also determined to exhibit aquatic toxicity (<90 percent survivorship) for both species PimeTabphalespromelas and Daphnia pulex in the whole effluent toxicity testing.27 This would be of concern for any nearby by waters covered under the Clean Water Act.

**Conclusion**

The installation and use of artificial turf has drawn mixed and at times polarized opinions from the public. While there are potential benefits to property owners installing artificial turf, many of the environmental and public health concerns are not sufficiently addressed in current literature to ensure the positives outweigh the negative impacts. Both are summarized below.

**Potential Benefits to Property Owners**

- No need to mow.
- Consistent manicured appearance.
- Reduced water use – water is required to wash off regularly for cleaning and cooling.
- Reduced chemical use – chemicals may be required to eliminate biohazards from pet feces.

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27 FINAL REPORT Artificial Turf Study Leachate and Stormwater Characteristics; Connecticut Department of Environmental Protection.
Environmental and Public Health Concerns

- Heat gain contributes to the urban heat island effect; potential injury from skin exposure.
- Off-gassing of Volatile Organic Compounds (VOC) and related health and air quality concerns.
- Sanitation.
- Disposal of excavated turf at landfills and artificial turf at the end of its useful life.
- Compaction of soil eliminates the carbon sequestration capacity of living soils and prevents.

Living Lawns, Drought Tolerant Landscapes, and Artificial Turf Comparison

When comparing artificial turf to natural turf, the economic and environmental benefits of a living lawn appear to outweigh the advantages of installing artificial turf. A living lawn is not inherently water wasting and is still a possible landscape solution within the latest State regulations. Per the July 2015 State Model Water Efficient Ordinance (MWELO), residential landscapes can have 25 percent to 49 percent of the landscape in turf with low or very low water use for the remaining plantings. Nonresidential landscapes can have 10 percent to 37 percent of the landscape in turf with low or very low water use for the remaining. Unlimited amount of recreational lawns are also allowed.34 Lawns have traditionally wasted water due to overspray, runoff and poor spray head distribution that requires overwatering to cover the entire area.

Water savings can significantly increase when switching to a climate appropriate landscape. A drought tolerant landscape irrigated with a drip system operating at .81 irrigation efficiency, which is the measurement of the amount of water beneficially used divided by the amount of water applied,73 can use less than one-third the amount of water needed for an efficiently irrigated lawn. In addition, there are many green groundcovers and turf alternatives that require less water than a standard lawn.

The multiple benefits of a living landscape include cooler temperatures, potential urban wildlife habitat, healthy soils that can sequester carbon, stormwater infiltration, and much lower installation costs. Maintaining a lawn organically will also eliminate concerns for contaminated runoff from pesticides and fertilizers.

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