FIELD GOALS: A FRAMEWORK FOR INTEGRATING SUSTAINABLE DESIGN METHODS TO RETROFIT EXISTING SPORTS PARK INFRASTRUCTURE

Basil Khalid | Master of Landscape Architecture | 2024

PATH TO LANDSCAPE ARCHITECTURE & PROJECT


APRU

CERTIFICATE OF PARTICIPATION

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University of Oregon

completed

APRU Course on Global Sustainability: Waste & The City

November 2023

My path to landscape architecture and eventually, my project topic, began during the pandemic in 2020. Working as a Marketing Specialist for FedEx Canada, I began questioning whether I wanted to spend the rest of my career in marketing as I was searching for something more fulfilling in a career that would provide a greater sense of accomplishment, and an opportunity to explore a more creative outlet. At the time, I was also working part time in the parks and recreation department for the Town of Oakville, just outside of Toronto. One of my favorite things about that job was that I got to drive the Zamboni and resurface ice rinks, which I enjoyed because I grew up playing hockey and was able to stay connected to the sport. During my time working in parks and recreation, I started questioning who was responsible for designing public spaces, specifically parks and sports facilities, which led me to learn about landscape architecture. I began looking into landscape architecture as a career path, and the more I investigated, the more I found out it aligned with the things I was looking for in a career and as a professional. I started looking into master's programs in the United States and applied to the University of Oregon, got accepted, and started my MLA in the summer of 2021. While at the University of Oregon, I took several courses on sustainable design and really enjoyed learning about the concept of sustainable design and how it can apply to landscape architecture. As a result, my master's project seeks to combine my passion and interest in sports park design with the knowledge gained through courses centered around sustainability.

TABLE OF CONTENTS

Abstract

As climate change and its impact on heat island effects, water scarcity, and loss of biodiversity all become increasingly more pressing from year to year, designers and planners play an integral role in managing the effects of these impacts to provide a more sustainable way forward for future generations. One of the ways in which designers and planners can contribute to more sustainable design solutions is through improved land use management practices. While occupying large footprints in regard to land use, sports parks and fields have long been considered an essential feature for communities. Sports parks can be defined as public outdoor spaces that serve the primary function of providing organized physical activity and sports opportunities to a wide variety of users[1]. Ranging from rural to urban centers, sports parks promote health and wellness through exercise and physical activity, stimulating economic development and benefits, as well as supporting social inclusion and cohesion.

Although the health, economic, and social benefits may be apparent through sports parks and fields, what is often a challenge to incorporate into the design of these spaces is an environmental and multi-functional benefit to the land they encompass. This project seeks to integrate sustainable design principles and practices into the planning of sports parks and fields. Incorporating a multifunctional landscape approach to the design of sports parks and fields can allow planners and designers to employ innovative methods to addressing specific sustainability challenges related to land use efficiency, along with storm water management, renewable energy sources, and habitat restoration, while promoting social and health benefits for communities.

1 Barnum, 2016

CHAPTER 1:
PROJECT FRAMEWORK

Sports parks can be defined as constructed outdoor spaces offering a variety of physical exercise and recreational activities, while providing the comforts of a neighborhood park.

Sustainable design is centered around the of use efficient processes to mitigate negative impacts on the environment while optimizing site performance.

Sports parks can be defined as constructed outdoor spaces offering a variety of physical exercise and recreational activities, while providing the comforts of a neighborhood park. The various health and social benefits from exercise and physical activity such as playing sports have been well documented, and it comes as no surprise that areas and outdoor spaces for sports and physical activity are becoming increasingly more popular[2]. The impacts of the pandemic and rise in sedentary lifestyles have further highlighted the importance of spaces such as sports parks for addressing both physical and mental health related issues[3]. Although there are many social and health benefits associated with sports parks, they also come at a cost due to the lack of consideration in how these large amounts of land are managed. This often results in the environmental impacts of sports parks being overlooked. Sustainable design is centered around the use of efficient processes to mitigate negative impacts on the environment while optimizing site performance. With the growing concern for climate change and its impacts on local communities, the need to consider the environmental effects at all levels of land use planning has never been more important.

2 Raiola & Di Domenico, 2021
3 Raiola & Di Domenico, 2021

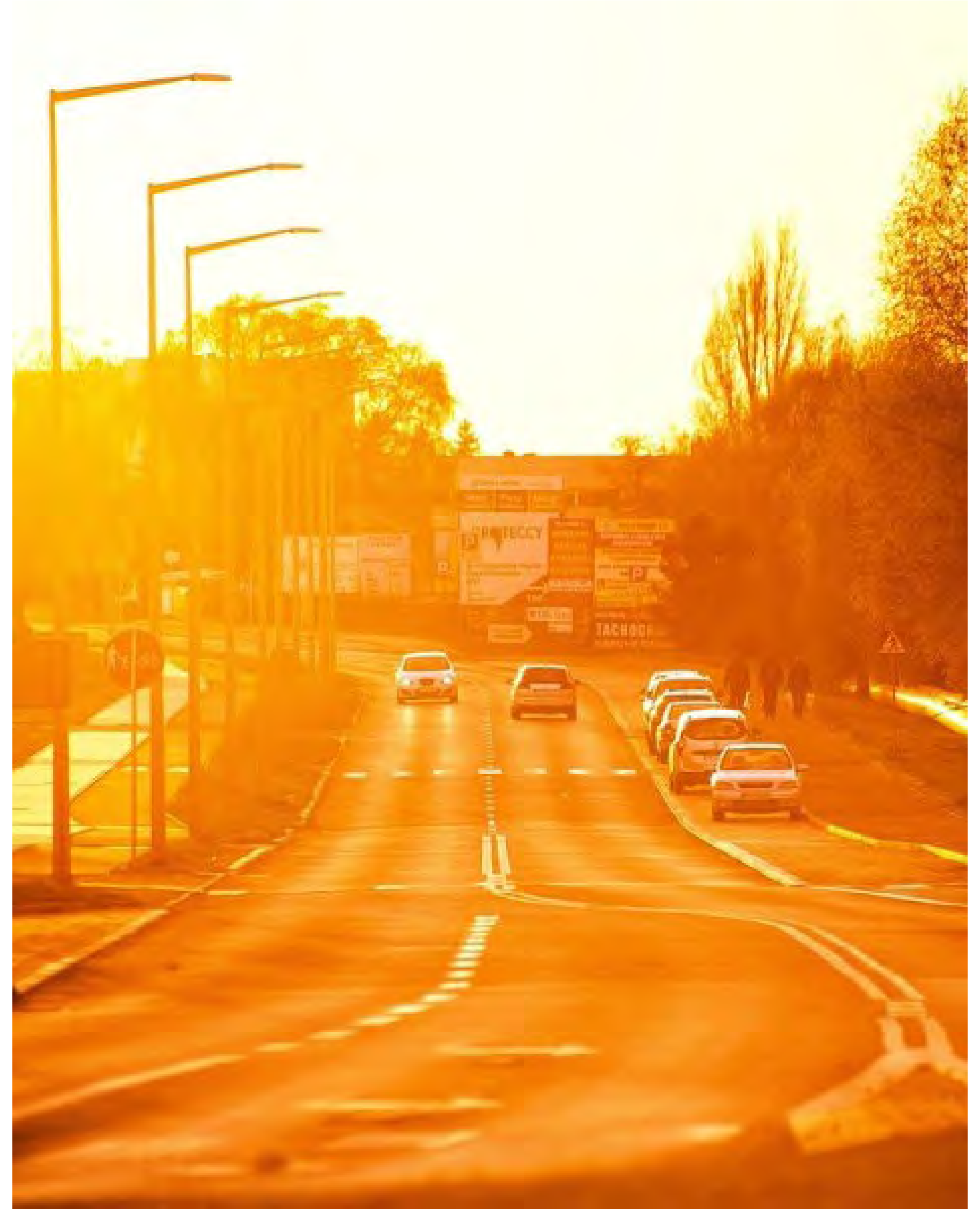
PROJECT GOAL

- *MULTIFUNCTIONALITY & COLOCATION*
- *MANAGE ENVIRONMENTAL IMPACTS*
- *ESTABLISH PRECEDENT FOR PUBLIC SPACE DESIGN*

The goal of my research is to determine those aspects of sports park planning and design that can be reconfigured to employ more sustainable approaches that consider multifunctionality and consolidation of resources, while managing the environmental impacts of a site. Through this approach, the hope is that sports parks can better incorporate sustainable design and establish a precedent for designing other outdoor spaces that require substantial amounts of land.

RESOURCE SCARCITY

Water & Irrigation



CLIMATE CHANGE

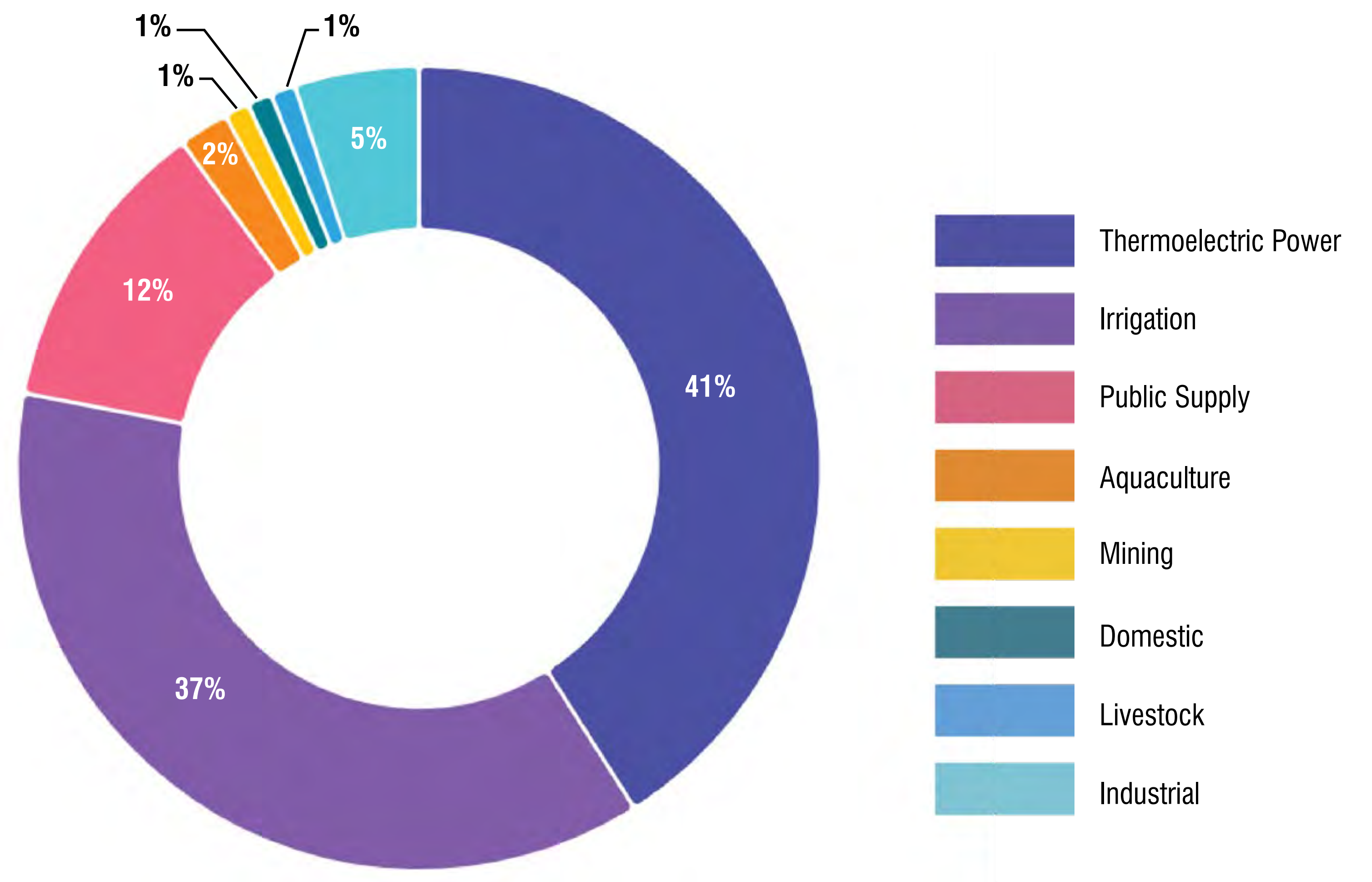
Heat Island Effect

HABITAT FRAGMENTATION

Loss of Biodiversity

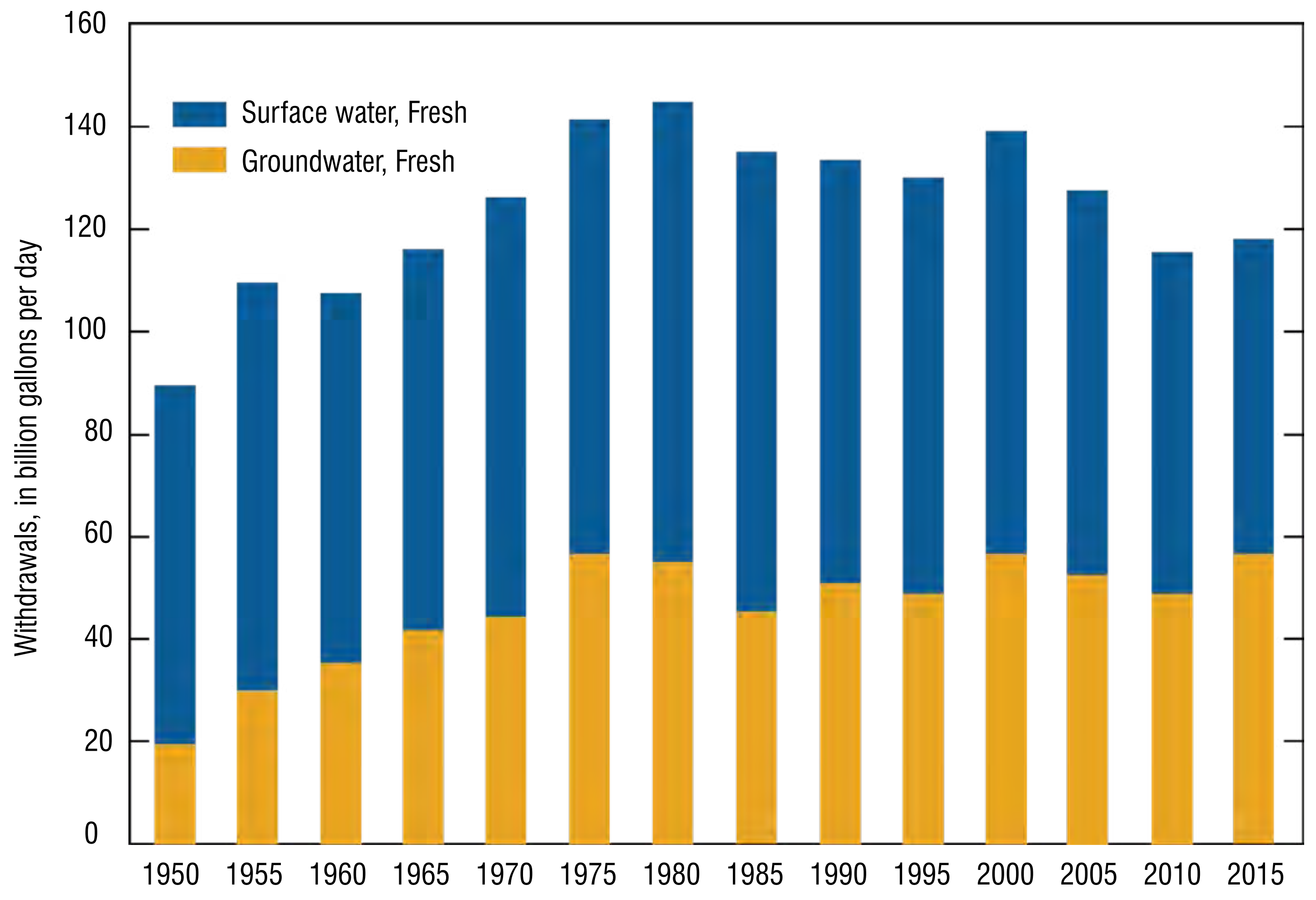
Looking into some of the challenges facing sports parks has helped me develop a framework for my project, and I have narrowed in on these three specific challenges that have the potential to be addressed through sustainable design. The first challenge is resource scarcity, specifically, water and irrigation. Sports parks and fields require large amounts of water to maintain through irrigation, which is especially the case for natural grass versus turf fields. The next pressing challenge is climate change and the heat island effect. Climate change and the heat island effect can have adverse impacts on field surface temperatures, human health, and performance. The third challenge is habitat fragmentation and the loss of biodiversity. Sports parks require large amounts of land to house a variety of recreational activities and playing surfaces, which can contribute to habitat degradation and loss of biodiversity.

Estimated Use of Water in United States (2015)



Source: Dieter et al., 2018

Water Withdrawal Trends in United States (1950-2015)



Source: Dieter et al., 2018

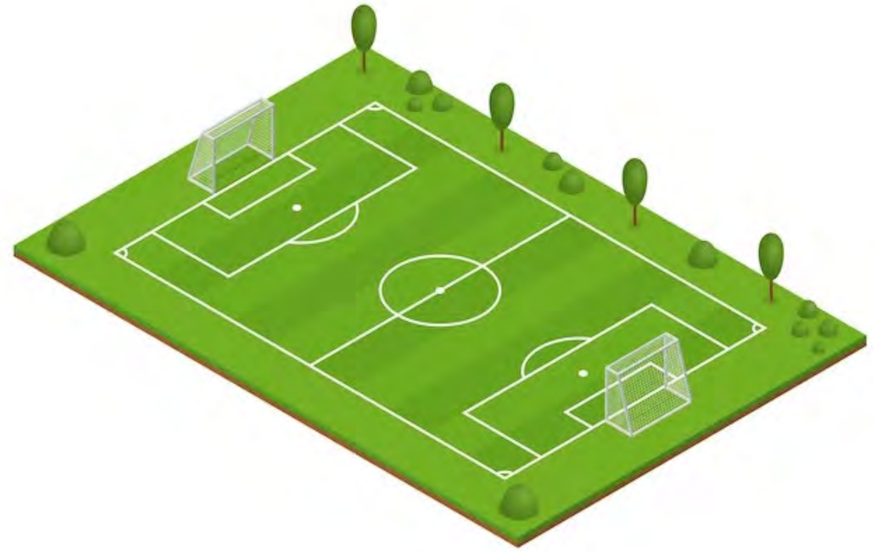
The chart on the left provides a breakdown of water usage in the United States based on some key categories as provided by USGS data. Irrigation, which includes irrigation for agricultural and horticultural practices, as well as irrigation for parks and fields, is the second largest contributor to water usage, only after water used for thermoelectric power. The chart on the right provides a more detailed breakdown of the water withdrawals in billion gallons per day from 1950 to 2015. As drought becomes more prevalent due to climate change, groundwater withdrawals have increased as a result of limited surface water resources, causing a more balanced proportion of overall water withdrawals[4]. More efficient irrigation systems could also contribute to an overall decrease of total water withdrawals.

4 Dieter et al., 2018

• Typical natural grass field requires 500,000 to 1,000,000 gallons of water per year

X

• Portland Parks & Recreation (PP&R) has over 200 athletic fields



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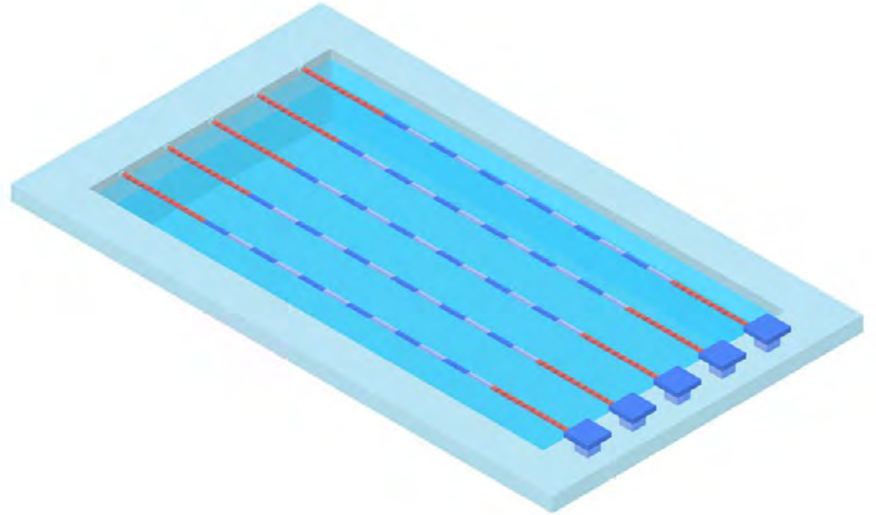
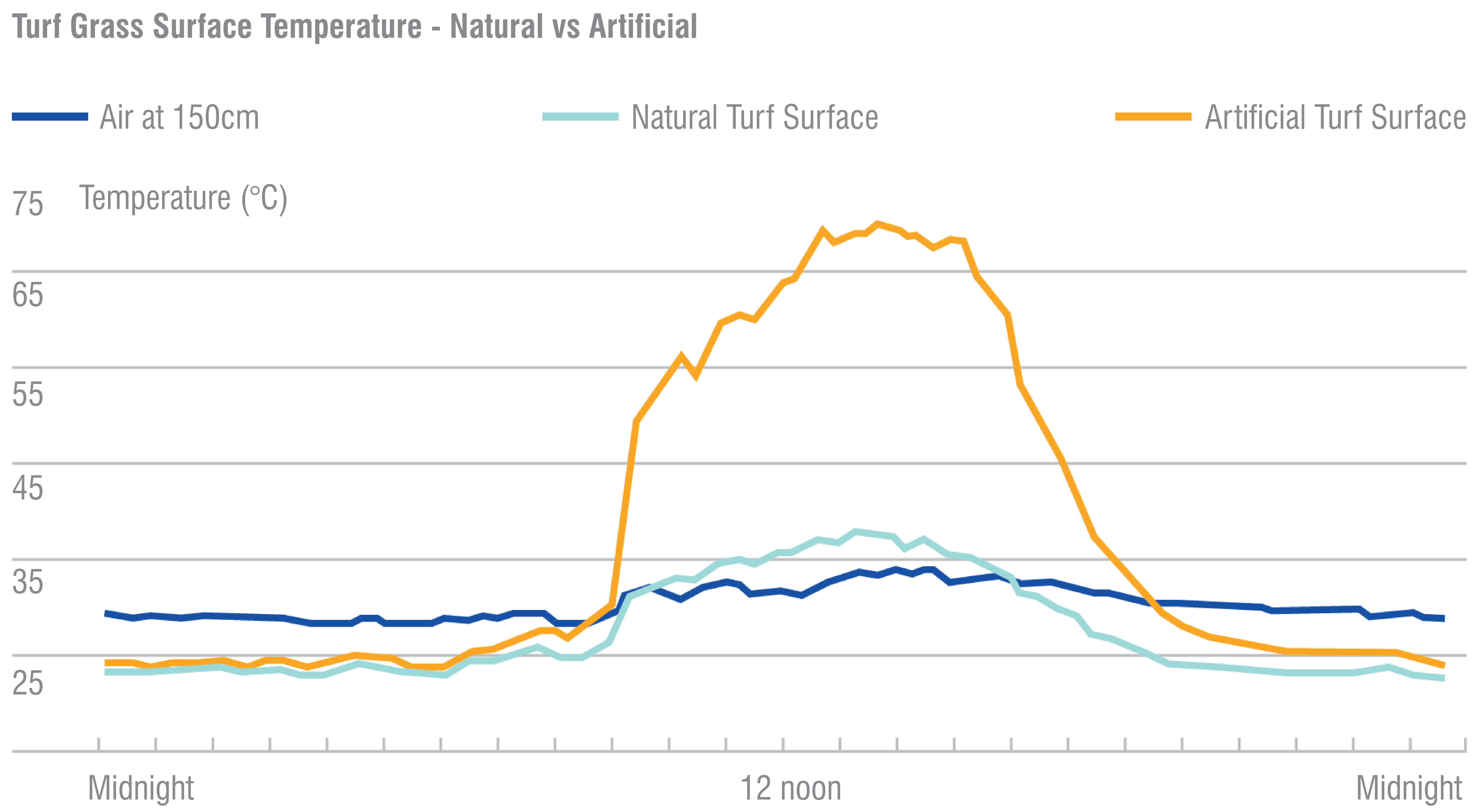


• 100 to 200 million gallons of water per year (~150 to 300 Olympic swimming pools)

The amount of water a typical sports field uses in a year is around 500,000 to 1 million gallons[5]. Multiplying this amount by the number of athletic fields in a given area can provide some context to the amount of water required for sports field irrigation. In this case we can use Portland, OR as an example. Portland has around 200 athletic fields[6], meaning that the total amount of water required for sports field irrigation is approximately between 100 and 200 million gallons per year, enough to fill 150 to 300 Olympic swimming pools.

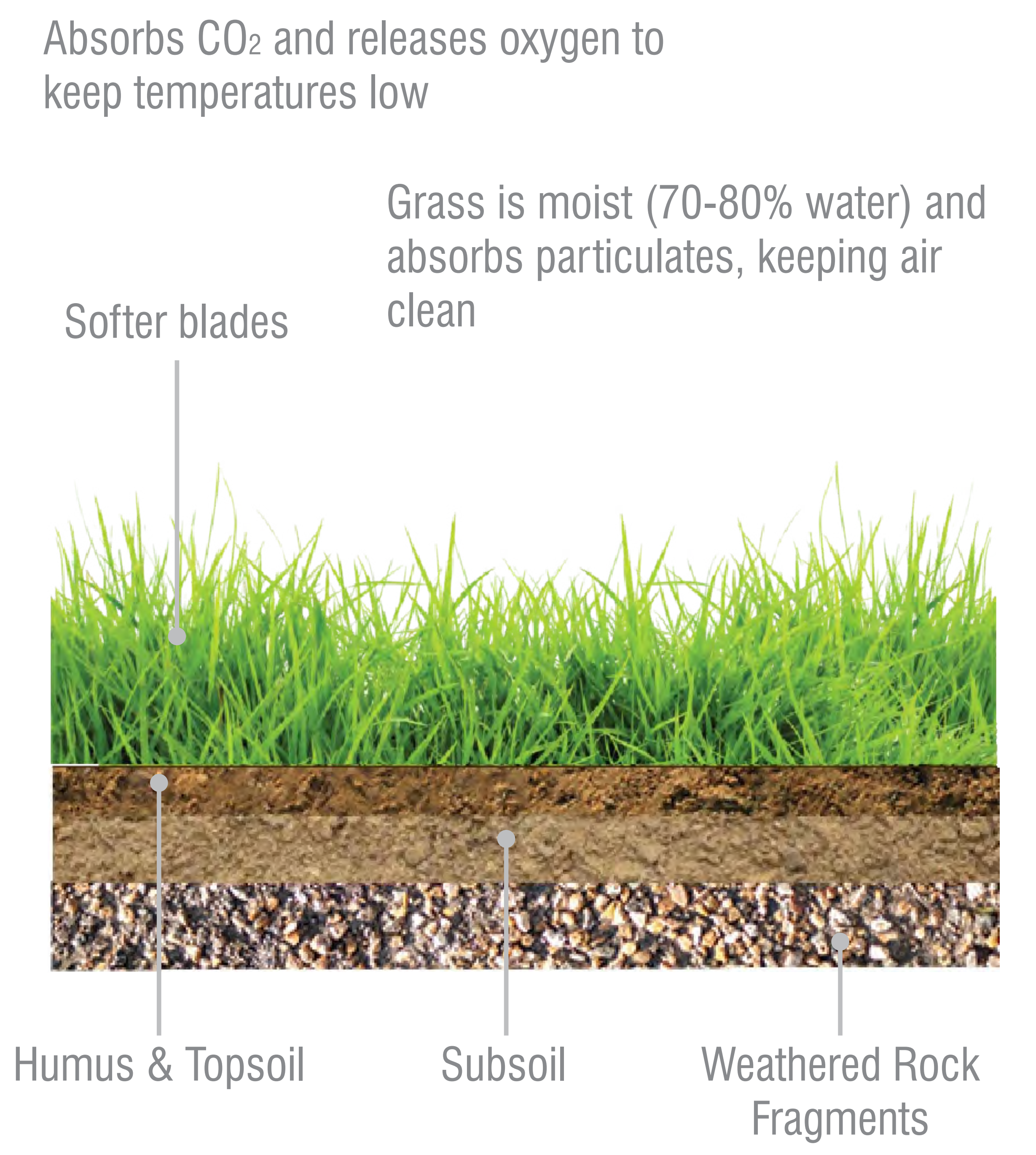
5 *Sports Field Irrigation & Sprinkler System Cost and Funding Guide*, n.d.
6 *Athletic Field Rental*, n.d.



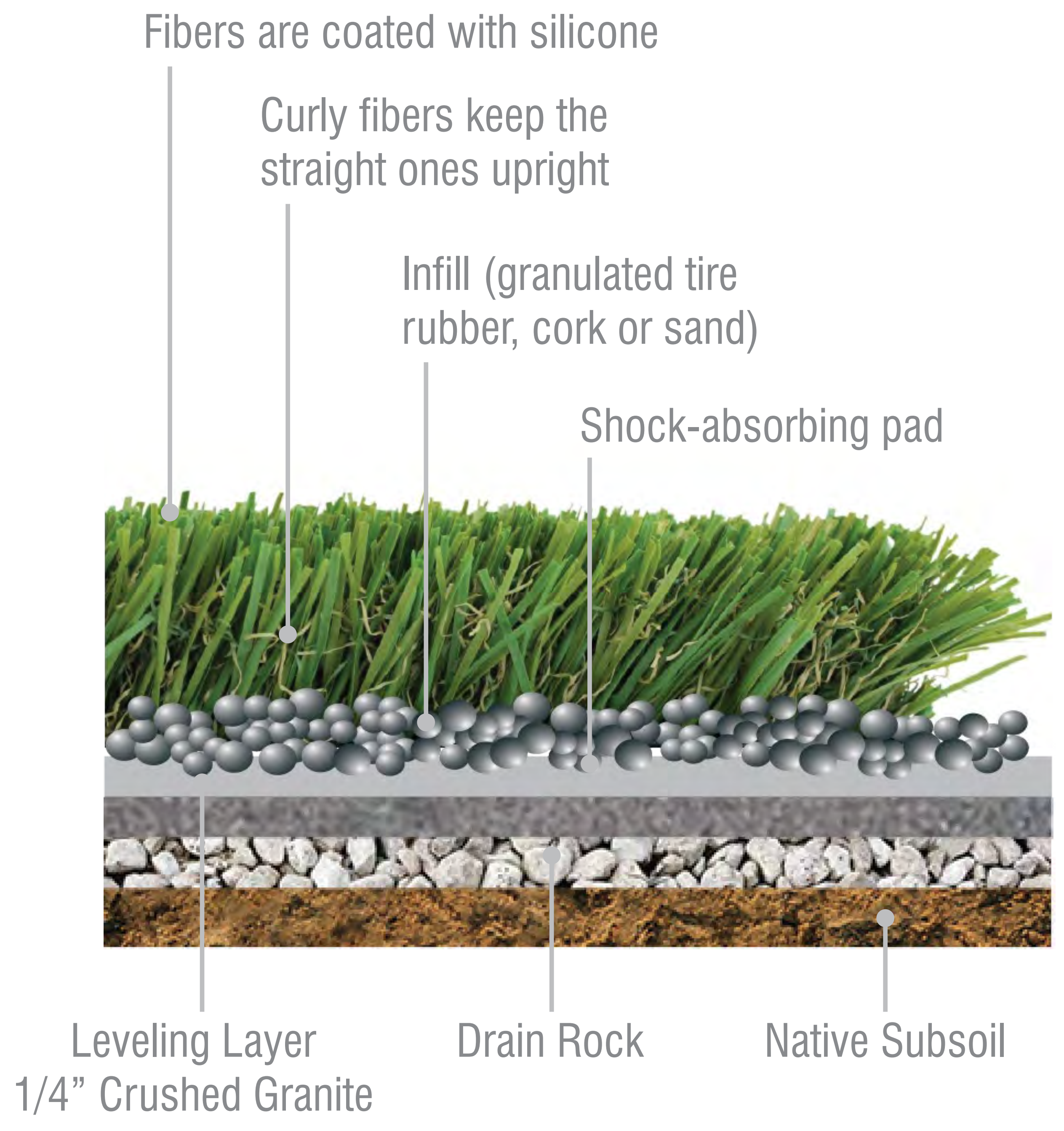
Source: Kao, 2015

The issue of climate change and the urban heat island effect has a direct relationship to the surface temperature of sports fields. This chart provides a compelling visual of how much hotter the artificial turf gets compared to natural turf grass, with a difference of 30 degrees Celsius or 85 degrees Fahrenheit during peak afternoon hours. With the trends in climate change creating more difficult playing conditions in sports parks, we as landscape designers and planners should start considering ways to combat this challenge so that users can continue to enjoy the various health benefits that sports parks offer.

Natural Turf Grass



Artificial Turf Grass

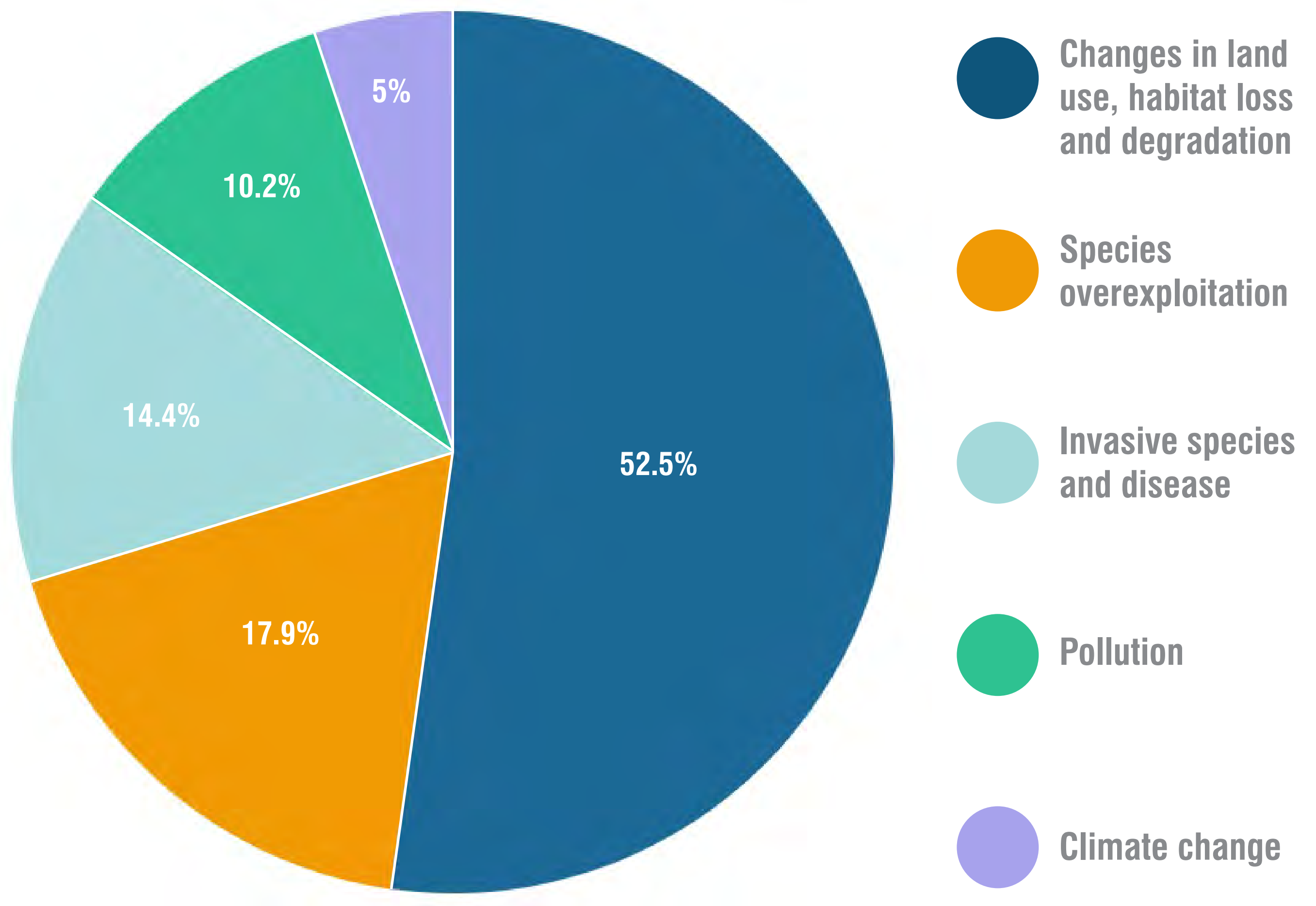


Source: Kao, 2015

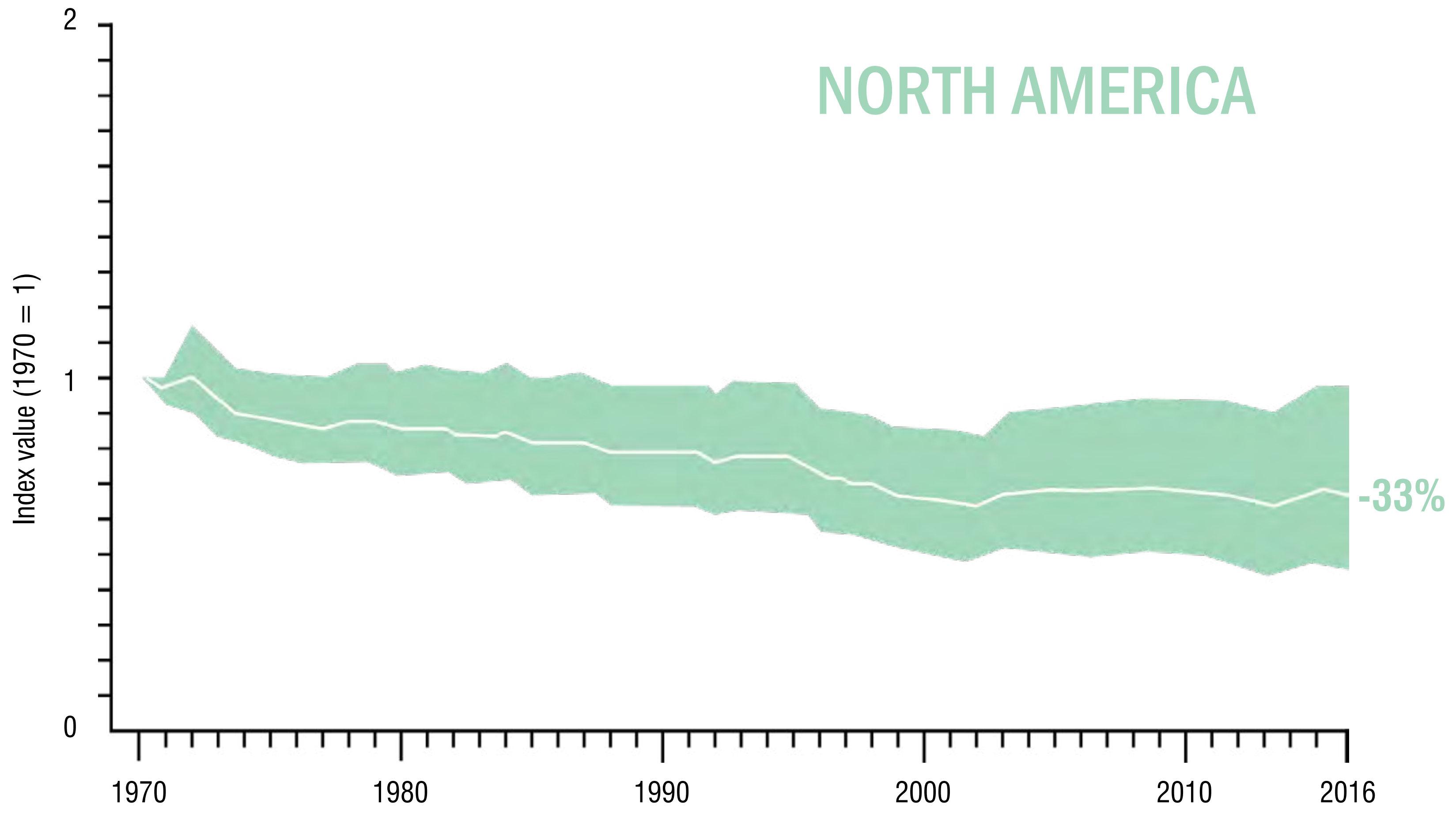
Research has also reported potential health risks of artificial turf due to chemicals such as polyaromatic hydrocarbons (PAHs), phthalates, and volatile organic compounds (VOCs) to be found in certain infill materials where recycled crumb rubber is used[7]. Though artificial turf is often associated with being more sustainable since it requires less irrigation, the drawbacks of artificial turf such as significantly higher surface temperatures and toxicity levels in the materials used, appear to outweigh the benefits. Natural grass may be a more sustainable option from a long term environmental and health perspective.

7 Luz, 2008

CAUSES OF BIODIVERSITY LOSS



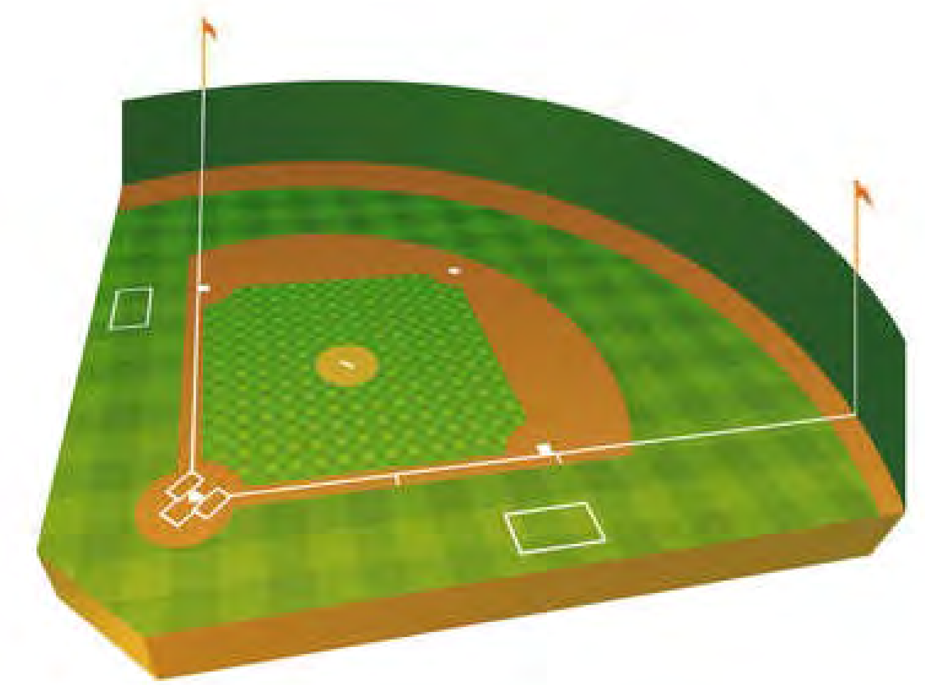
The Living Planet Index (LPI) tracks the abundance of mammals, birds, fish, reptiles, and amphibians across the globe.



Source: WWF (2020) *Living Planet Report 2020 - Bending the Curve of Biodiversity Loss*, 2020

This pie chart shows how changes in land use are the largest contributor to the loss of biodiversity at 52.5% of the total loss. The chart on the right presents the Living Planet Index (LPI), which tracks the abundance of mammals, birds, fish, reptiles, and amphibians across the globe[8]. The green shaded area represents the statistical certainty of the trend at 95% confidence, while the white line represents the index values, which shows a 33% decline in the biodiversity of North America from the period of 1970 to 2016 These graphics paint a compelling picture of the realities of land use and habitat degradation, and the importance of incorporating more ecological function into landscapes, including sports parks.

8 WWF (2020) *Living Planet Report 2020 - Bending the Curve of Biodiversity Loss*, 2020



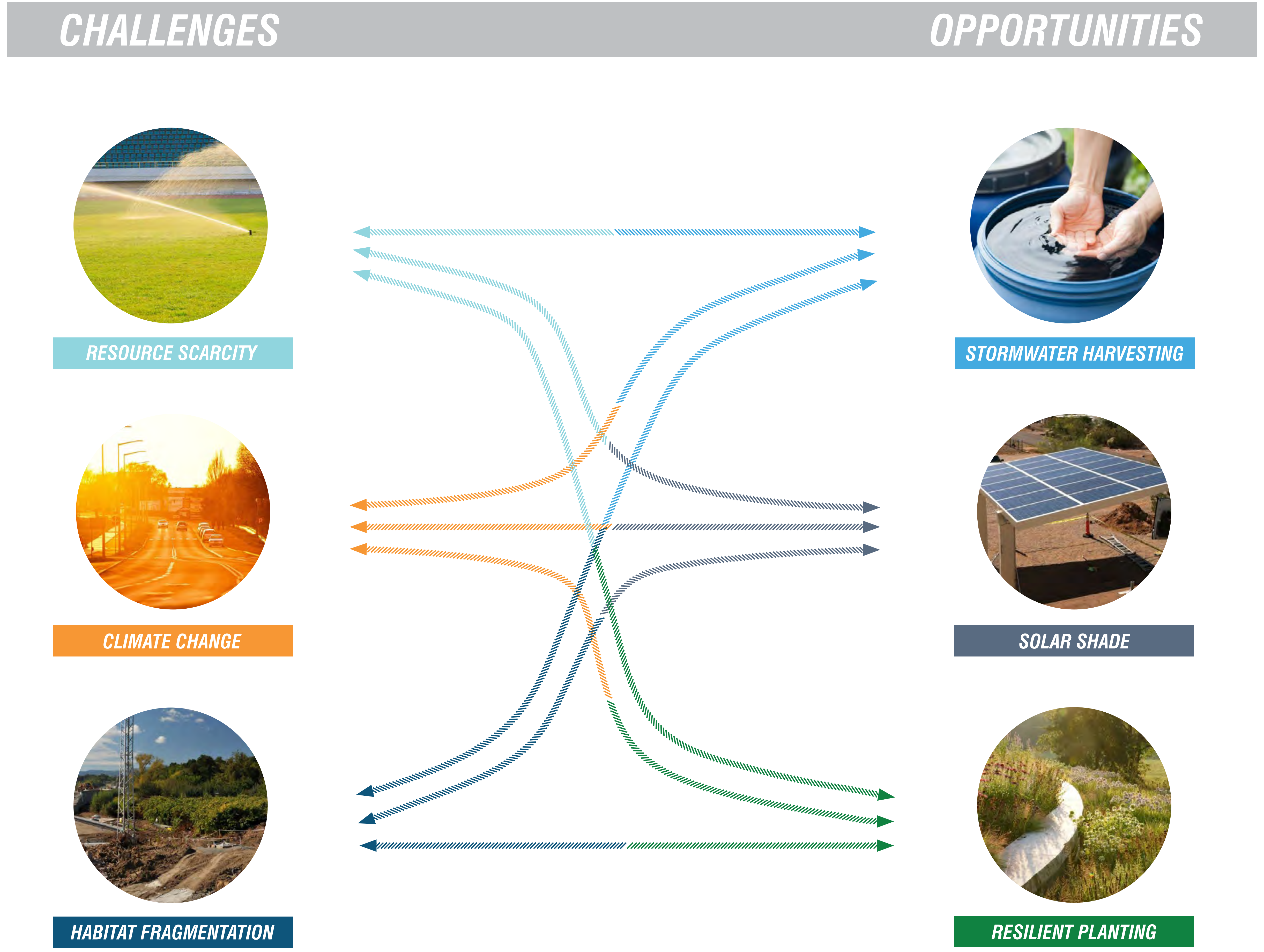
- Over 200 athletic fields in Portland, OR
- Average athletic field size: 1.5 - 1.75 acres
- ~350 acres of sports fields (UO is 295 acres)

- Sports fields typically developed on land not suited for other types of development
- Land with compressible soils, floodplains, wetlands, steep slopes

To get a sense of how much sports parks contribute to overall habitat fragmentation and a loss of biodiversity in communities, we can consider the number of athletic fields in Portland, OR as an example. Portland has over 200 athletic fields, with an average field size ranging from 1.5 to 1.75 acres[9]. This equates to approximately 350 acres of athletic fields alone, not including the additional space required for parking and other amenities within sports parks. For some context, the University of Oregon campus sits on 295 acres.

Additionally, sports parks are often constructed on lands that are not suitable for other types of development, and often include lands with compressible soils, floodplains, wetlands, and steep slopes[10]. Given the environmental sensitivity of areas such as floodplains and wetlands, it becomes even more crucial for sports parks to take a sustainable approach to land management in order to protect the surrounding environment.

9 *Athletic Field Sizes*, n.d.
10 Shay, 2016

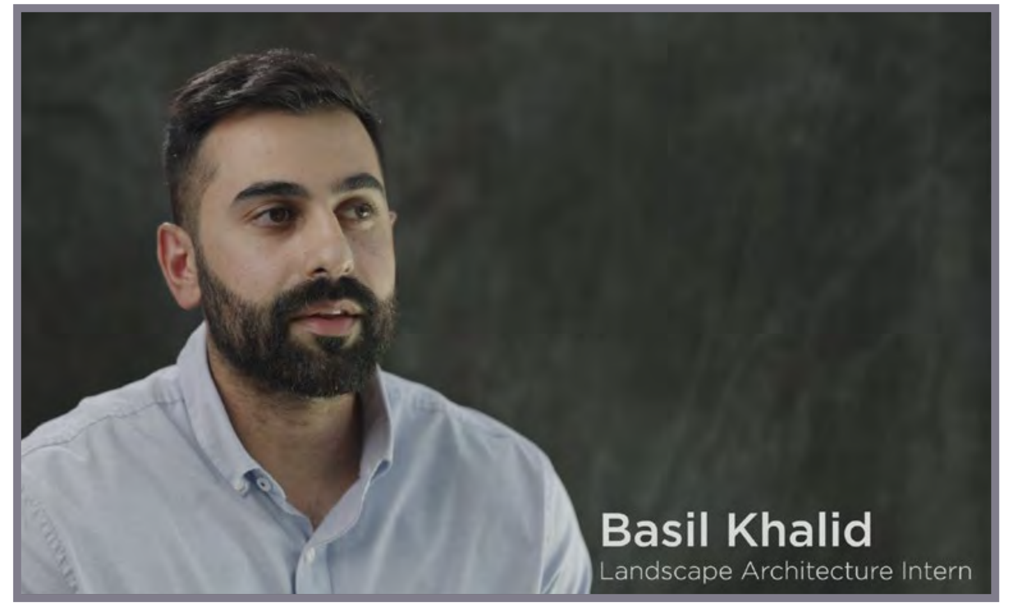


Having touched on some of the challenges that are exacerbated by the presence of sports parks, what are some of the potential opportunities that could be explored through targeted design interventions? As shown in this diagram, my project explores how each of the challenges presented may be addressed by three potential design opportunities: stormwater harvesting, solar shade, and resilient planting.

CHAPTER 2:
SITE SELECTION, CONTEXT & ANALYSIS

Landscape Architecture Intern | Summer 2023 - Portland, OR

MACKENZIE.



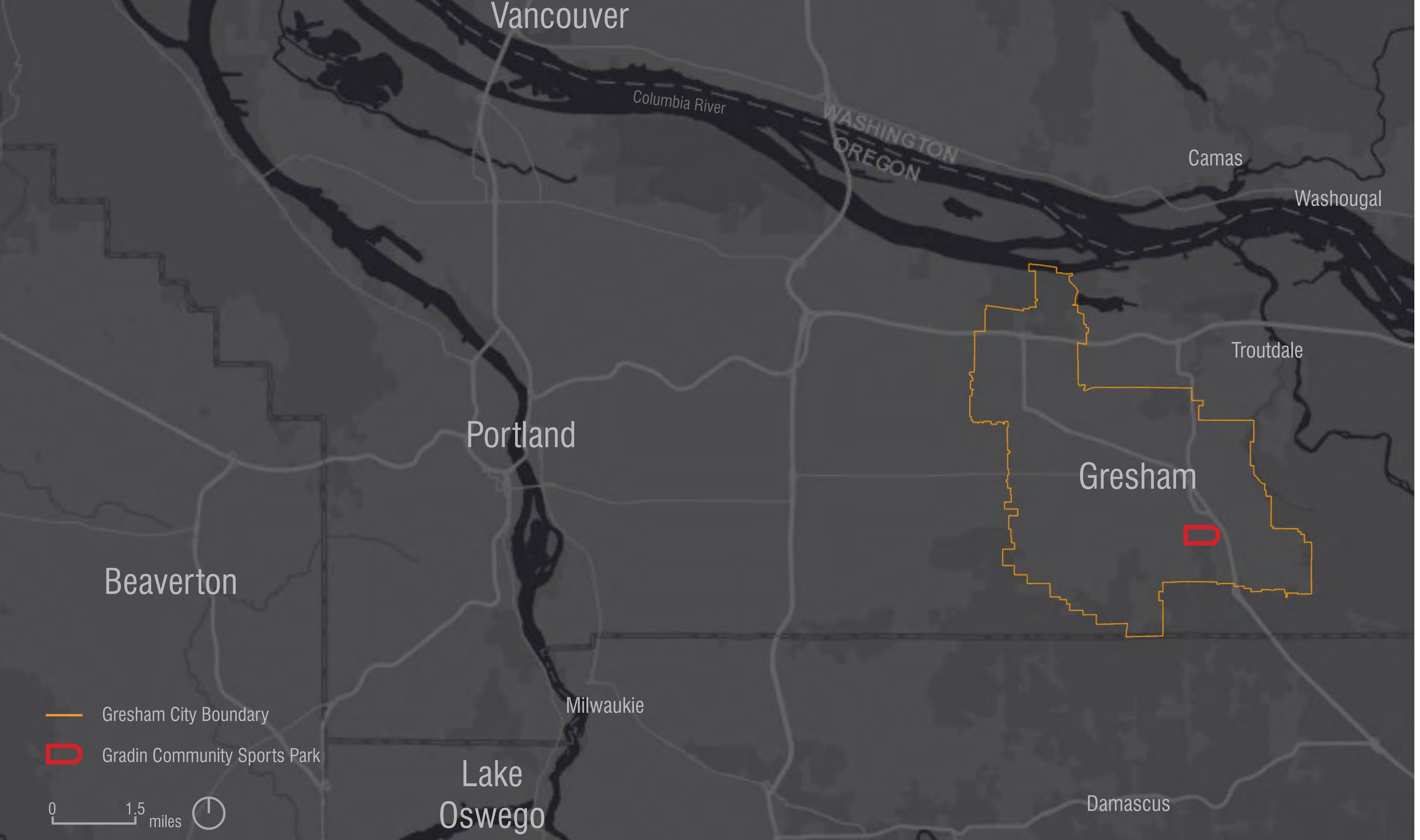
The process for my site selection started during the summer of 2023, while interning at Mackenzie in Portland, OR. Mackenzie is a multidisciplinary firm that works on a wide range of projects from large industrial centers and corporate campuses to smaller community parks.

SITE SELECTION - MACKENZIE CONCEPT PLAN

Source: Bourgeois (Courtesy Mackenzie, Inc.), 2023

One of the projects Mackenzie was involved in during the early conceptual design phase was Gradin Community Sports Park in Gresham, OR. Based on criteria set by the City of Gresham, Mackenzie had developed a concept plan that included two additional softball and soccer fields, restrooms, an all abilities playground, and additional parking. The idea for my project was to build on this existing plan, but integrate features of sustainable design that could optimize the environmental performance and community enjoyment of the site.

SITE SELECTION - LOCATION



Gradin Community Sports Park is located in Gresham, OR, within Multnomah County, approximately 20 miles east of downtown Portland.

SITE SELECTION - DEMOGRAPHICS & TREE EQUITY

67
Tree Equity Score

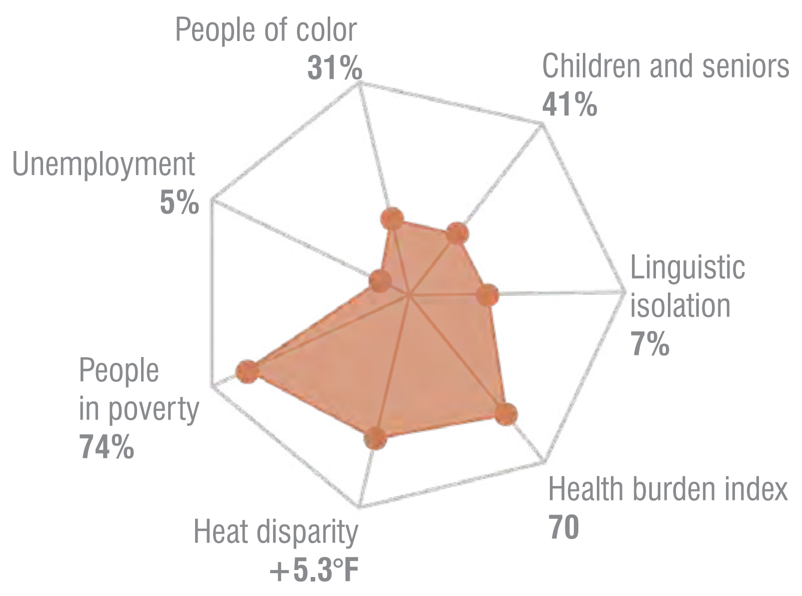
Ranked 64th of 65 block groups in Gresham

Priority: HIGHEST

Current canopy cover: 13%

Canopy cover goal: 40%

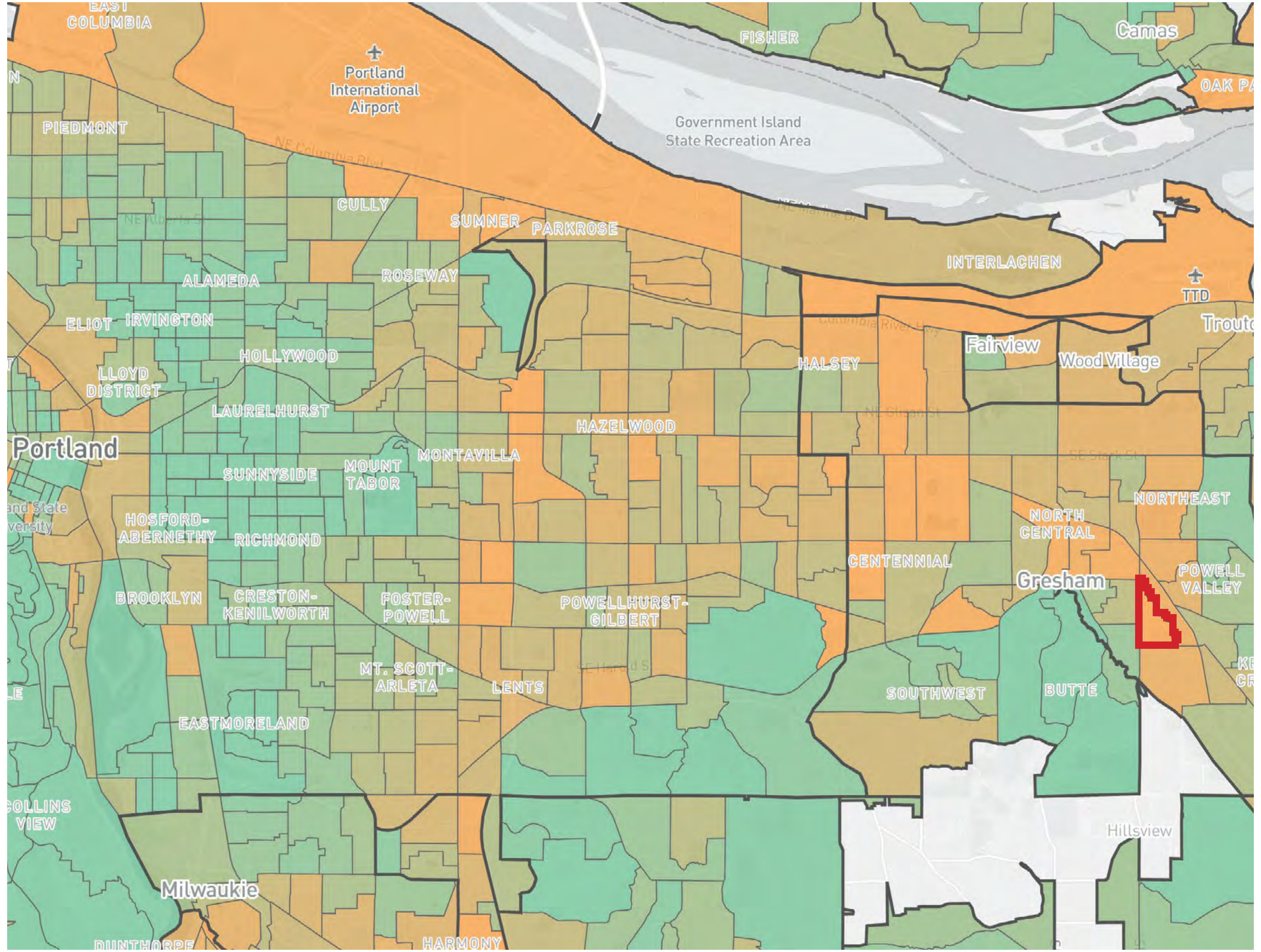
Score indicators
Priority index



Tree Equity Score

<70 — 100

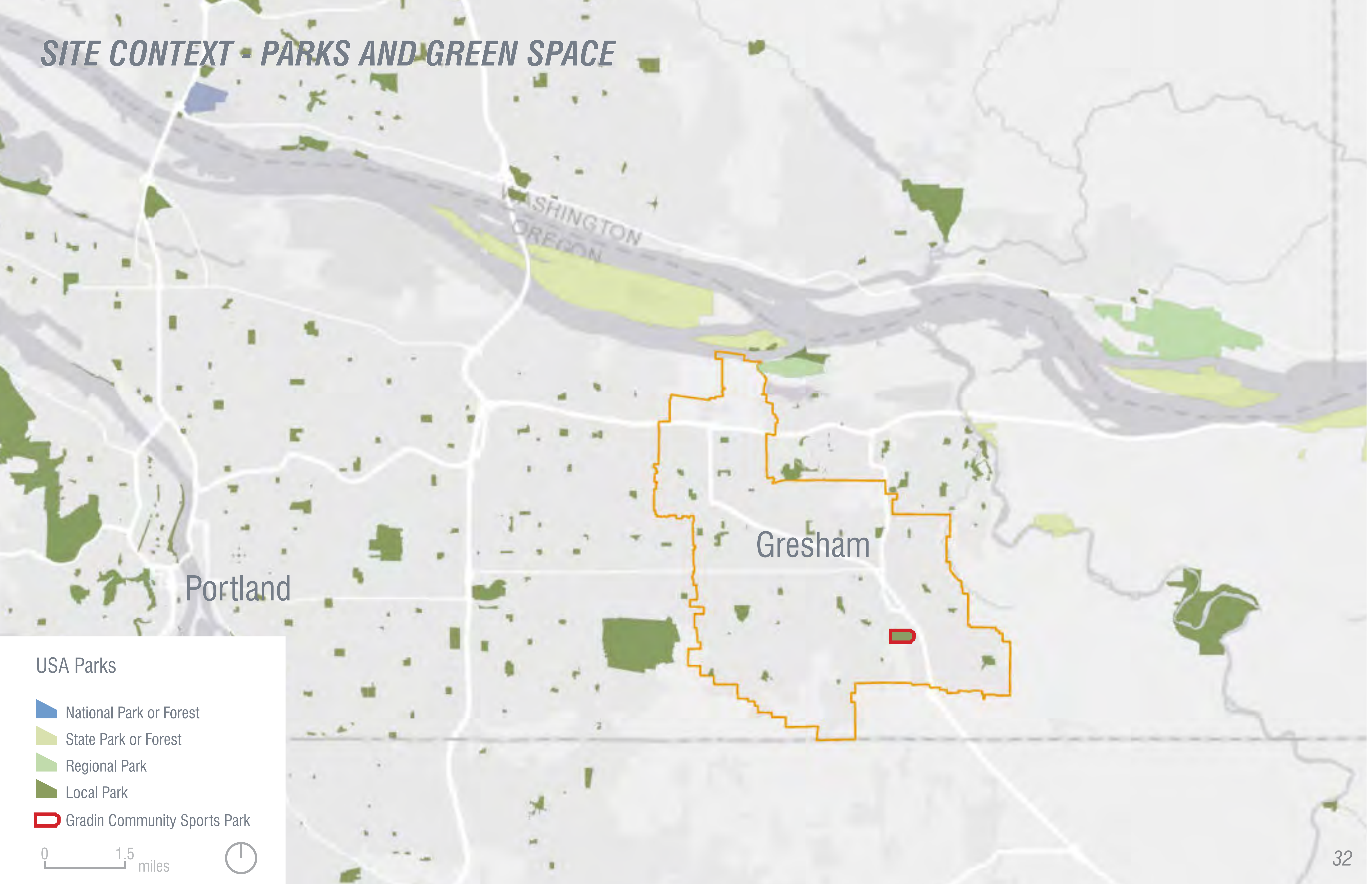
Source: *Tree Equity Score National Explorer*, n.d.



Equity was another contributing factor in selecting Gradin Community Sports Park as my site. With a tree equity score of 67, Gradin ranks 64th out of 65 census block groups in Gresham, making it one of the highest priority areas for canopy cover in Gresham. The tree equity score measures the equitable distribution of canopy cover for residents[11]. The current canopy coverage of 13 percent sits well below the canopy cover goal, which is 40 percent. The lack of canopy cover further exacerbates the heat island effect and puts marginalized groups at further risk. With children and seniors making up 41 percent of the population in the area and a whopping 74 percent living in poverty, it is clear that the community surrounding Gradin is one that is severely underserved and in need.

11 *Tree Equity Score National Explorer*, n.d.

SITE CONTEXT - PARKS AND GREEN SPACE



Considering the site context, it is important to note the distribution of surrounding parks and green space and why the idea of sustainable design is significant to these spaces. We can see just how many patches of green space and parks exist in this corridor between Portland and Gresham. Integrating sustainable design methods to improve the overall network of parks and green space to combat challenges like managing stormwater, mitigating the heat island effect, and preventing biodiversity loss, could have a broader, longer term impact at a much larger scale.

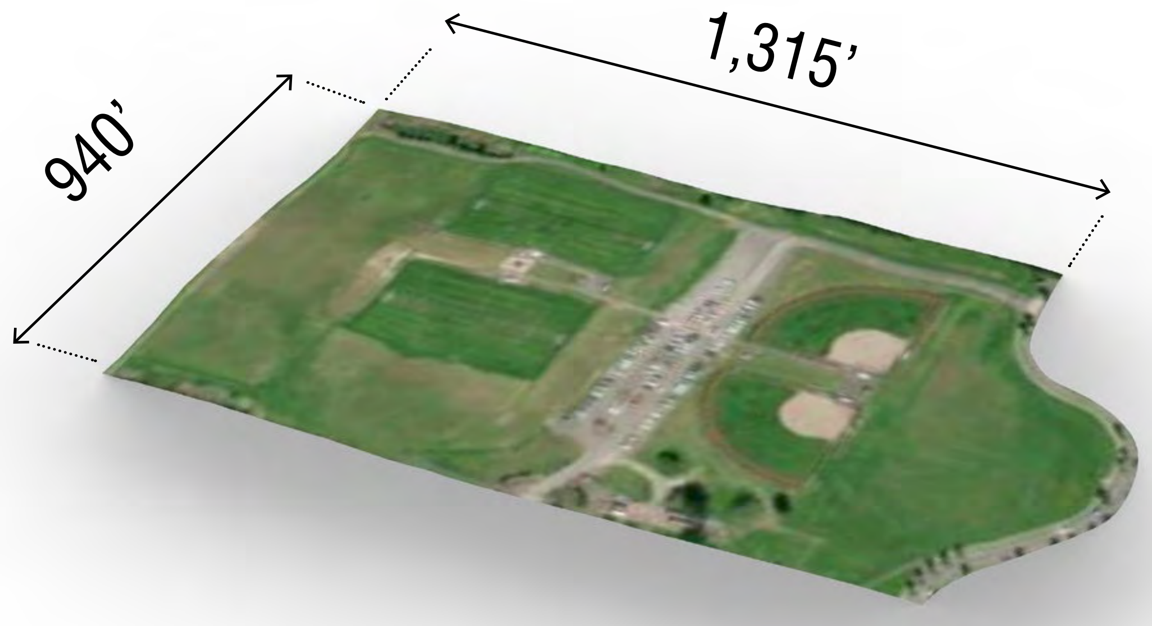
SITE CONTEXT - PARKS AND GREEN SPACE

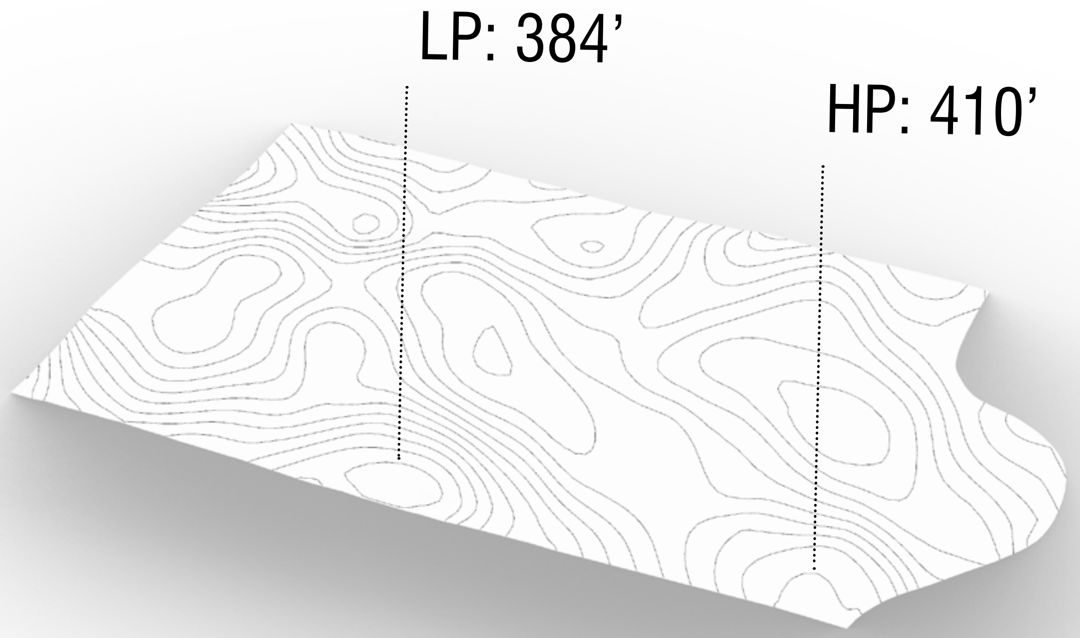
Zooming into the area around Gradin Community Sports Parks, we can see how it is situated between two larger natural green spaces, Johnson Creek to the west, which is part of the larger Johnson Creek Watershed, and Kelly Creek and trail to the east. Some of the notable vegetation within Johnson Creek include trees such as Western Red Cedar (*Thuja plicata*), Black Cottonwood (*Populus balsamifera trichocarpa*), and Red Alder (*Alnus rubra*), with shrub habitats including Red Osier Dogwood (Cornus sericea), Western Spirea (*Douglas spiraea*), and Red Elderberry (*Sambucus racemosa*)[12]. At Kelly Creek, Western Red Cedar (*Thuja plicata*) and Bigleaf Maple (*Acer macrophyllum*) can be found in the woodland forest areas, with Red Osier Dogwood (*Cornus sericea*), Red Alder (*Alnus rubra*), and Willow (*Salix sp.*) surrounding the wetland and pond areas[13]. By gaining a better understanding of the environmental context of a site, the hope is that when planning and designing community spaces, areas like Gradin Community Sports Park can integrate planting that create stronger networks of connectivity that support biodiversity in adjacent natural areas.

12 *Johnson Creek Watershed Action Plan - An Adaptive Approach*, 2003
13 *OregonHikers.org*, n.d.

SITE ANALYSIS - EXISTING CONDITIONS

Upon visiting the site, I did a full walk through and documented the current state of the park through photographs. What really stood out to me was the overall crumbling, deteriorating infrastructure, including the concrete curbs and asphalt surface in the parking lot. The vegetation and planting were poorly maintained and dying. There were limited areas for spectator seating and the metal bleachers seemed to be a poor choice as they could get uncomfortably hot during severe heat events. Overall, there was lots of open and underutilized space with minimal shade and planting.

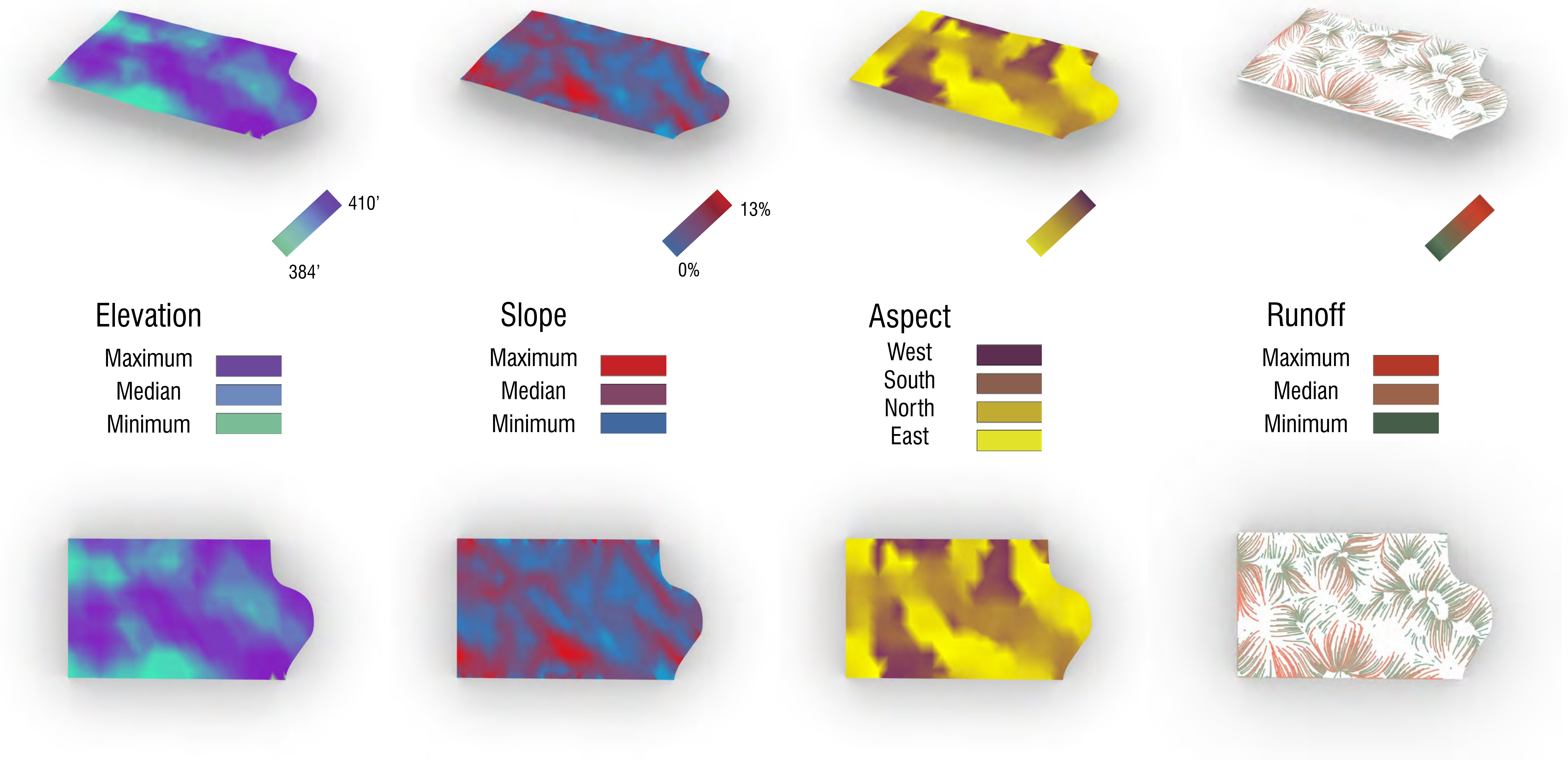




Total Area: 1,370,625 square feet
(31.46 acres)

The Gradin Community Sports Park site runs 940 feet by 1,315 feet for a total of 1,370,625 square feet or 31.46 acres. The site is relatively flat, with a low point of 384 feet and high point of 410 feet.

SITE ANALYSIS - ENVIRONMENTAL



Using Rhino and Grasshopper analysis tools, I conducted an environmental analysis of the current state of the site by evaluating elevation, slope, aspect, and runoff. Slopes are relatively gentle in order to comply with existing ADA and sports field requirements. The results of the aspect and runoff analysis, however, do provide some useful insights on how to best orient solar shade structures and situate storm water management features to treat site runoff.

CHAPTER 3: DESIGN

This image depicts the existing plan view of the site. Currently, there are two soccer fields and two softball fields with a parking lot and maintenance yard at the south end of the site. This plan view clearly presents a site with a vast amount of open, underutilized space, with minimal planting, specifically around the perimeter of the site.

My proposed site plan aims to integrate the criteria laid out by the City of Gresham which includes two additional softball and soccer fields, restrooms, an all-abilities playground, and additional parking. However, the overall theme of my design at Gradin is centered around three key sustainable design opportunities. The first is stormwater harvesting, which is addressed through the sunken basketball court and permeable parking lot, which both double as detention ponds. The natural grass fields also absorb storm water which then drains to an underground storage system. The second design intervention focuses on solar shade, addressed through photovoltaic panels on shade canopies and tensile shade structures located around spectator viewing areas along the playing fields. The third design intervention seeks to incorporate resilient planting through native, drought tolerant plant species that could also provide habitat or food for wildlife. The primary planting areas include a woodland buffer, swales, and interior plantings. In keeping with the theme of sustainable design, the grass berm seating areas make use of the fill from the cut of the sunken basketball court, and provide a more natural seating experience compared to metal or concrete bleachers.

STORMWATER HARVESTING

Stormwater harvesting addresses the issue of resource scarcity by providing an alternative water source for landscape irrigation and toilets, reducing the demand on primary water sources from the city system. It can also help to relieve pressure on the city stormwater infrastructure by treating more stormwater on-site.

Stormwater harvesting can also address climate change and the heat island effect using a more sustainable approach. Capturing, storing, and reusing stormwater for field and landscape irrigation promotes a cooling effect, thereby lowering the surface temperature of sports fields, while reducing the dependance on the municipal water supply for irrigation. Additionally, climate change will result in more extreme weather events and having more stormwater management on-site will help to mitigate flooding by slowing the flow of water into local waterways.

Finally, stormwater harvesting can address the challenge of habitat fragmentation through planting and vegetation of stormwater facilities that in turn, enhance biodiversity and provide habitat.

STORMWATER HARVESTING - Watersquare Benthemplein (Rotterdam, Netherlands)

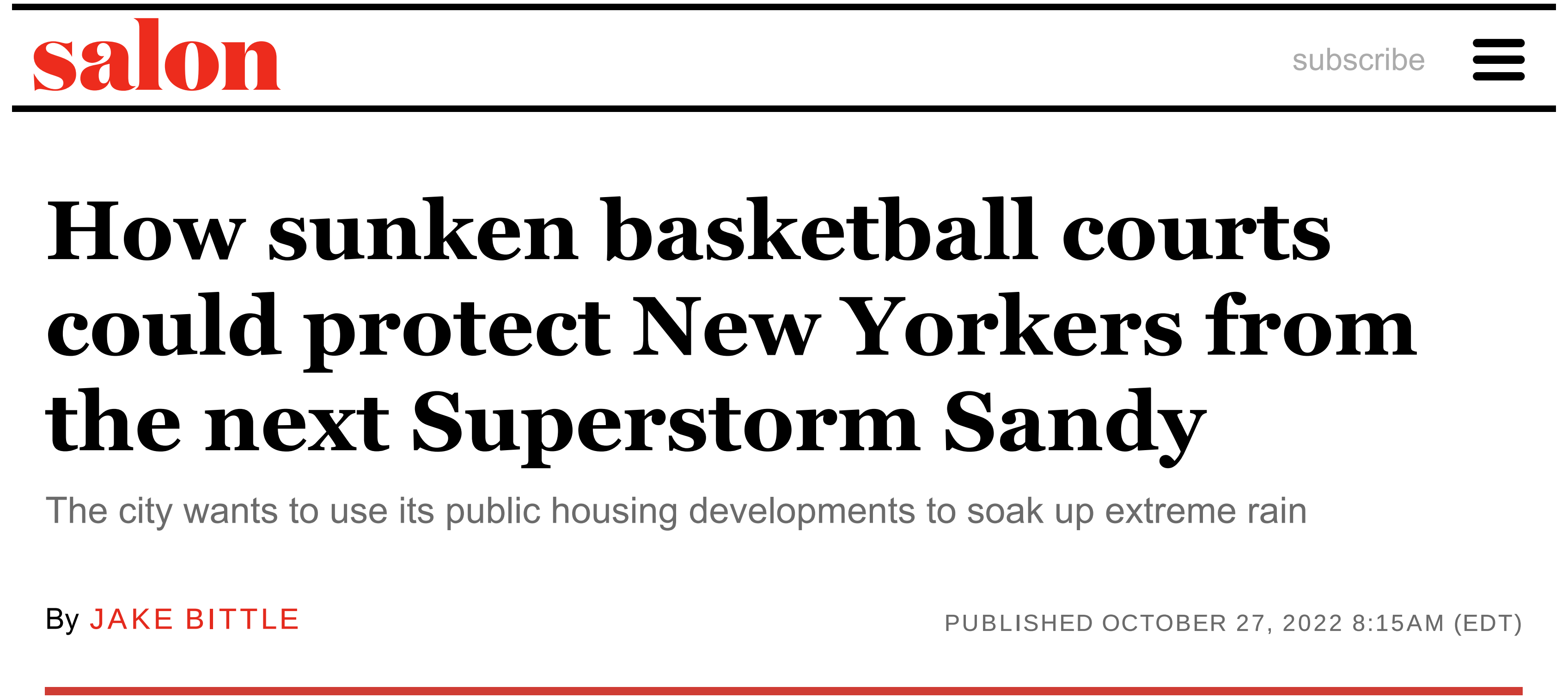
Source: *De Urbanisten*, n.d.

Source: *Water and Urban - Global Center on Adaptation*, n.d.

Source: *"Water Square" in Benthemplein*, n.d

One of the precedents that helped inform my stormwater design interventions at Gradin is the Watersquare Benthemplein in Rotterdam, Netherlands. This project uses a sunken basketball court to mitigate flooding in the area, but also to provide an educational experience for visitors to learn how stormwater management can integrate into public space within an urban setting[14].

14 *"Water Square" in Benthemplein, n.d*


salon

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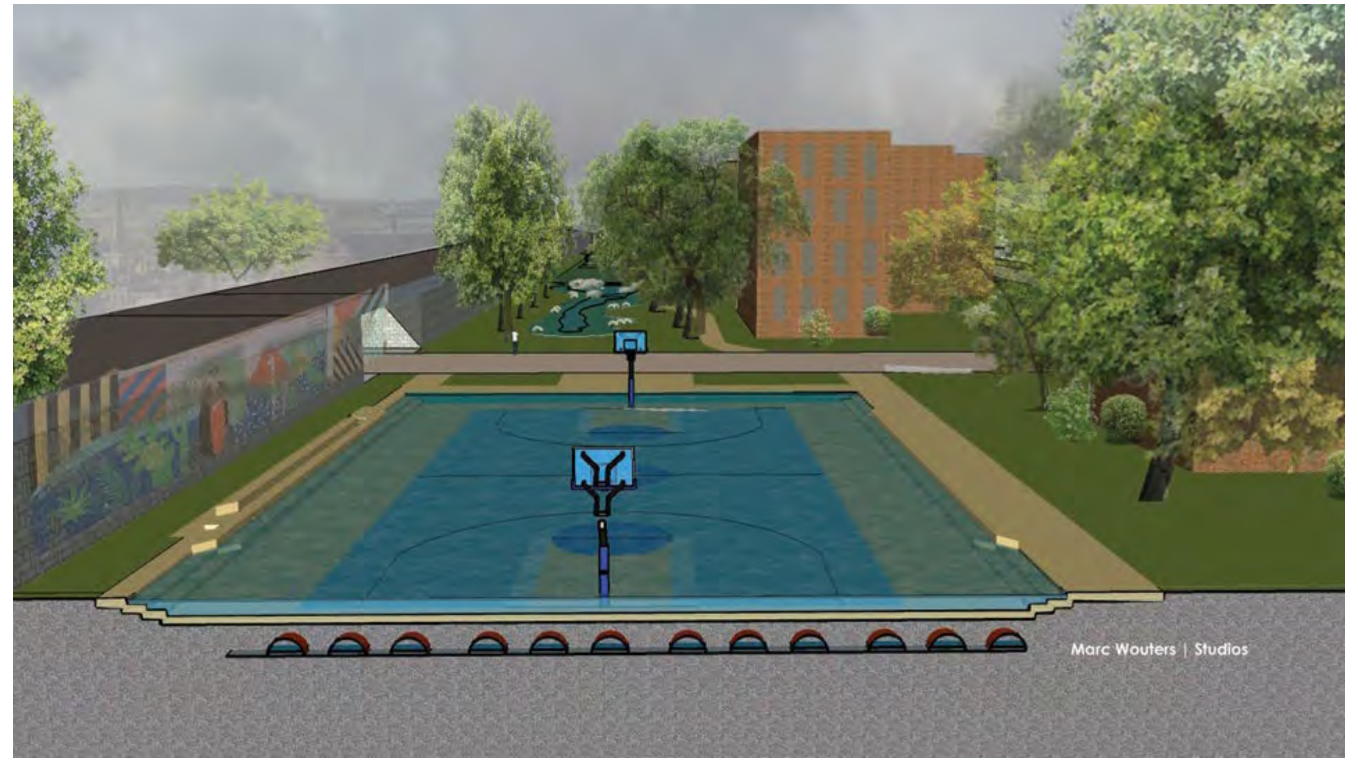
How sunken basketball courts could protect New Yorkers from the next Superstorm Sandy

The city wants to use its public housing developments to soak up extreme rain

By JAKE BITTLE

PUBLISHED OCTOBER 27, 2022 8:15AM (EDT)


Source: Bittle, 2022

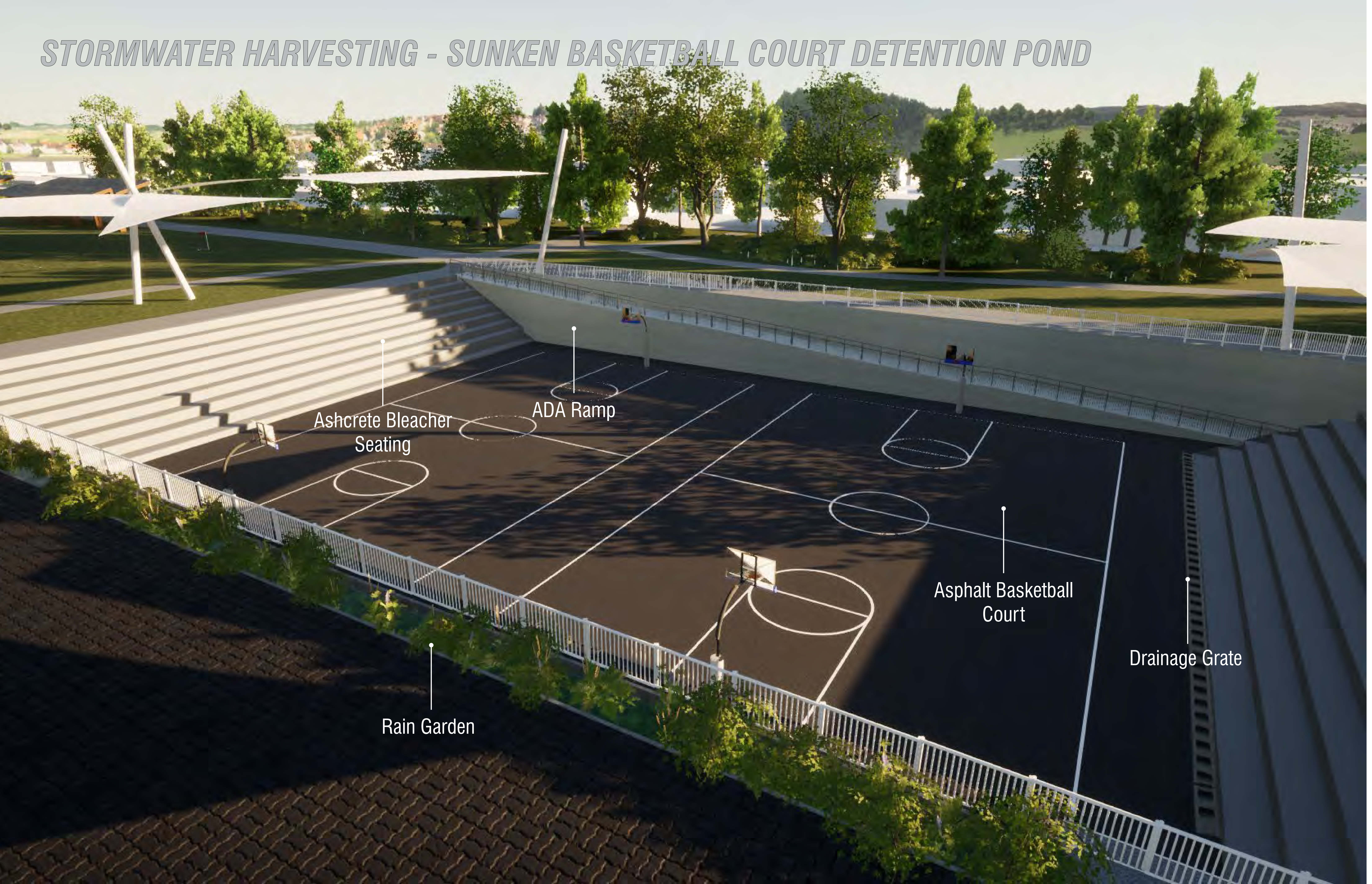


Source: *South Jamaica Houses Cloudburst Conceptual Plan*, 2018

Source: *South Jamaica Houses Cloudburst Conceptual Plan*, 2018

This type of multifunctionality appears to be a growing trend, represented in projects such as the South Jamaica Houses Cloudburst Master Plan. Designed by Marc Wouters Studios for the New York City Housing Authority, the project presents the idea of utilizing sunken basketball courts to manage neighborhood flooding in the South Jamaica, Queens community of New York City[15].

15 *South Jamaica Houses Cloudburst Conceptual Plan*, 2018



The design concept for Gradin Community Sports Park features a large sunken area, about 13 feet in depth, with two full size basketball courts and bleacher style seating for spectators and community gathering for events. An ADA ramp also provides universal access down to the courts. Stormwater from the site would be directed to the sunken court detention area through a series of rain gardens and swales which would serve to treat pollutants before entering the basin.

STORMWATER HARVESTING - SUNKEN BASKETBALL COURT DETENTION POND

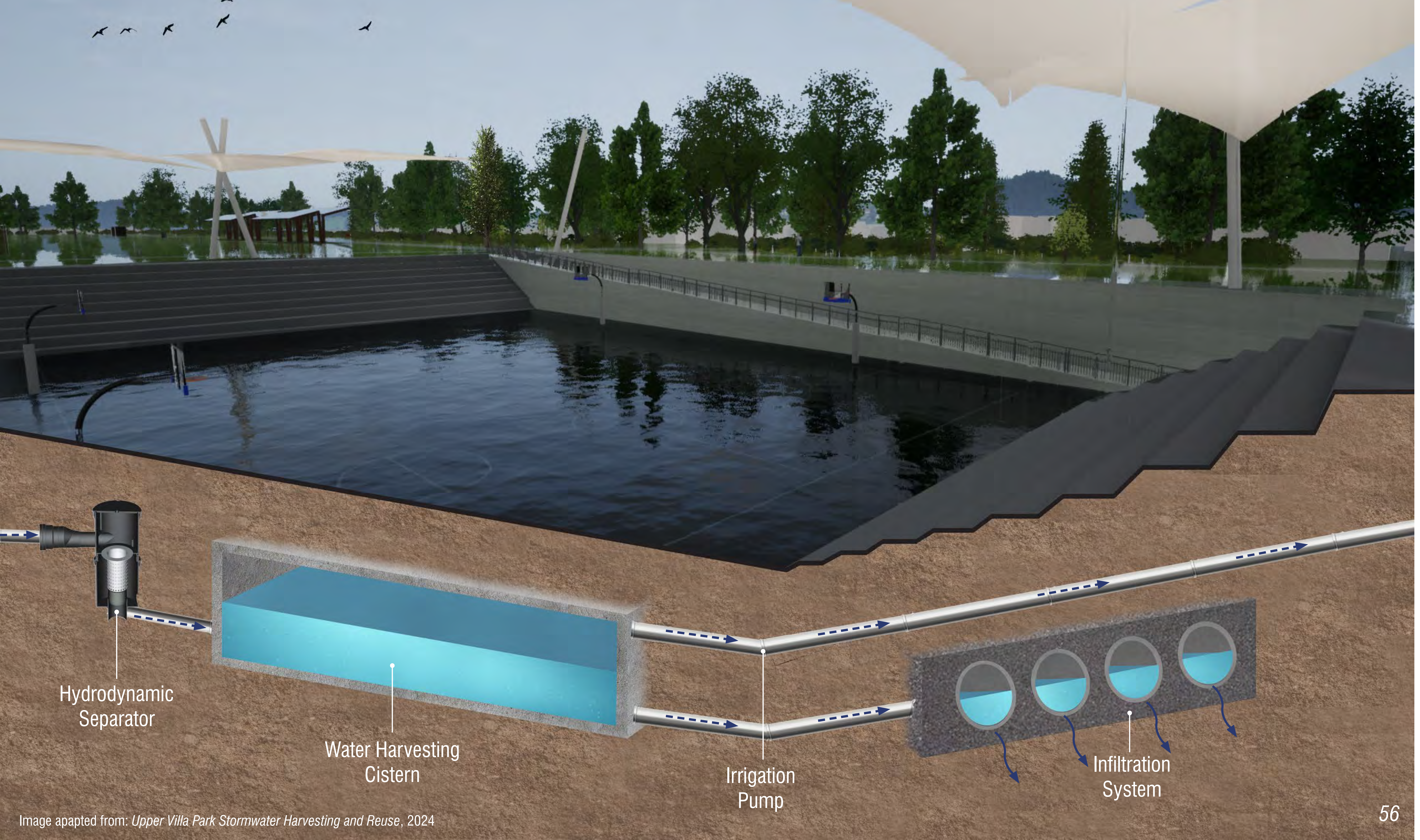
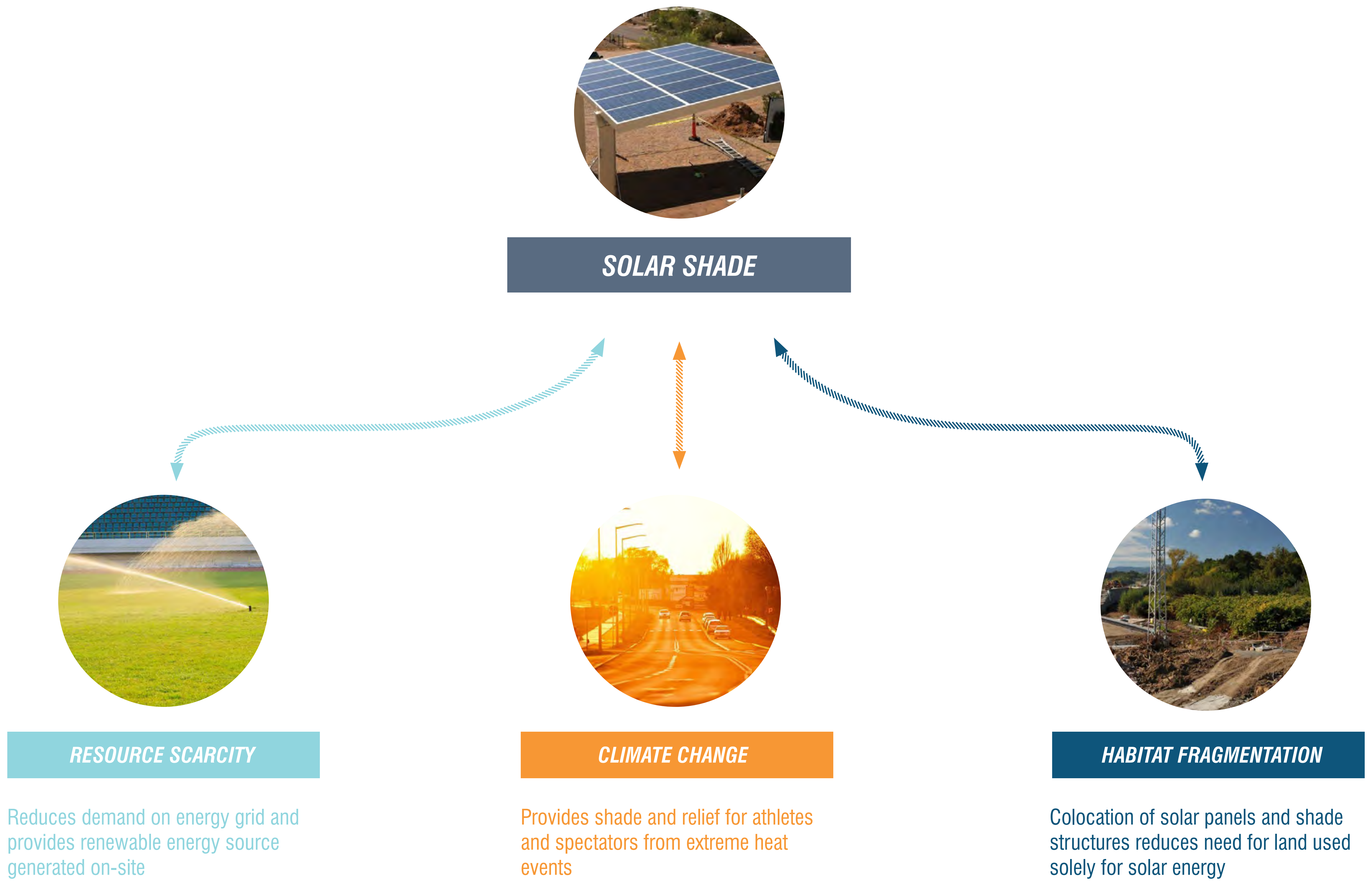


Image apapted from: *Upper Villa Park Stormwater Harvesting and Reuse*, 2024

As the sunken basketball court detention pond captures stormwater, the water gradually drains and is filtered through a hydrodynamic separator, which treats stormwater runoff for pollutants and sediments, before being stored in a harvesting cistern. The stored water can then be used to irrigate the sports fields and plants on-site, while overflow is directed to an infiltration system.

The parking lot is another area that is designed to capture and treat stormwater from the site. The rain gardens along the perimeter of the parking lot will help to treat pollutants from site runoff, while the permeable pavers and vegetated parking lot islands help to absorb stormwater directly. A similar system as that under the sunken court would be located below the parking lot to help treat and store storm water, while allowing the opportunity for reuse for field irrigation or toilet flushing for the park restrooms.

SOLAR SHADE



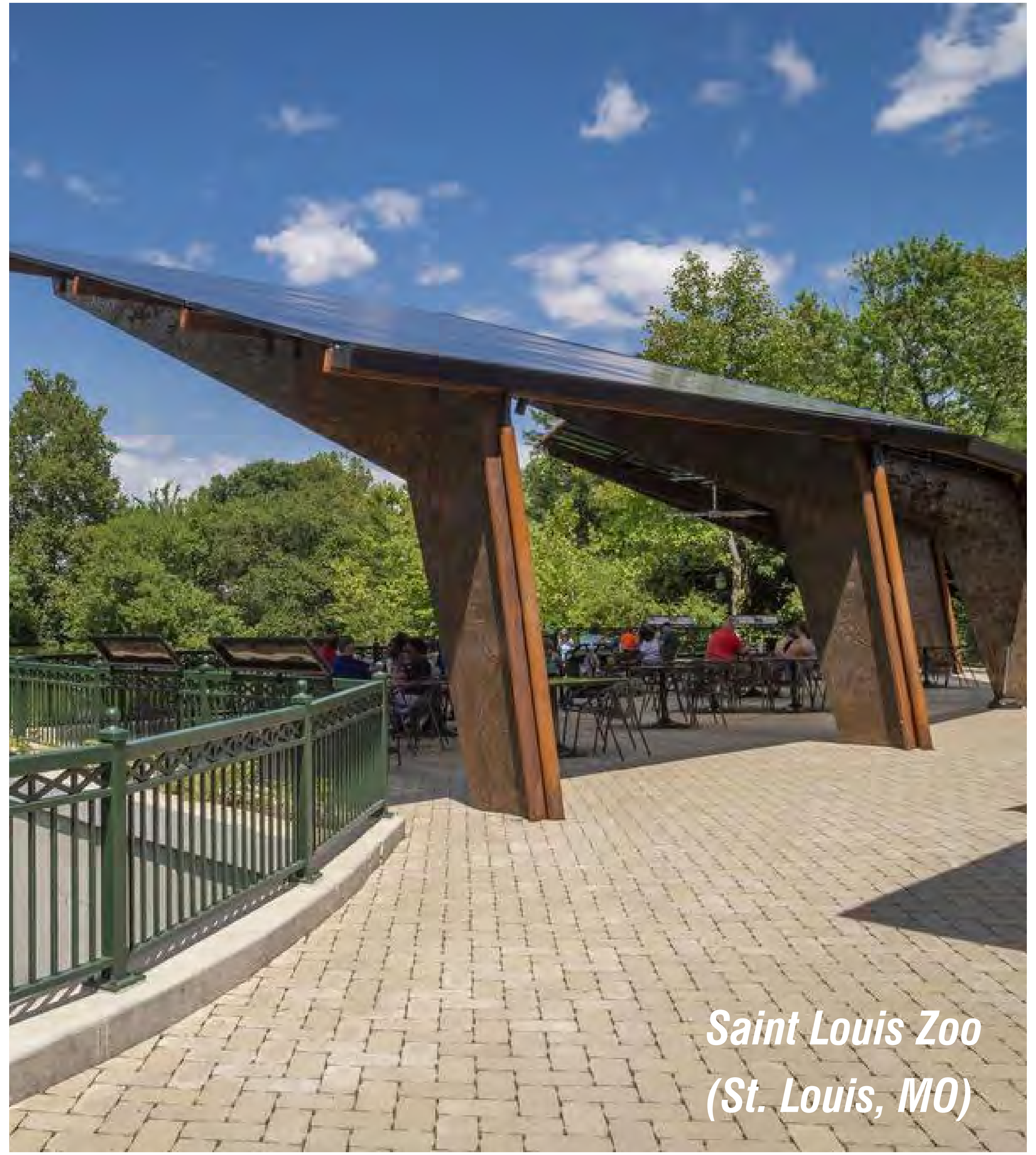
The next sustainable design intervention is focused on solar shade. Solar shade can have an impact in dealing with resource scarcity by providing a renewable energy source on-site, thereby reducing the demand on the existing energy grid.

In response to climate change and the heat island effect as it relates directly to sports parks, solar shade can provide relief for participants and spectators from extreme heat events. Providing areas of respite through shade structures can allow both athletes and spectators to withstand the full length of matches and games while reducing the risk of heat related illnesses and injuries.

Lastly, in perhaps a more indirect, yet equally important method, solar shade can work towards addressing habitat fragmentation through the colocation of solar panels and shade structures, which could reduce the need for land used solely for energy generation, such as solar farms.

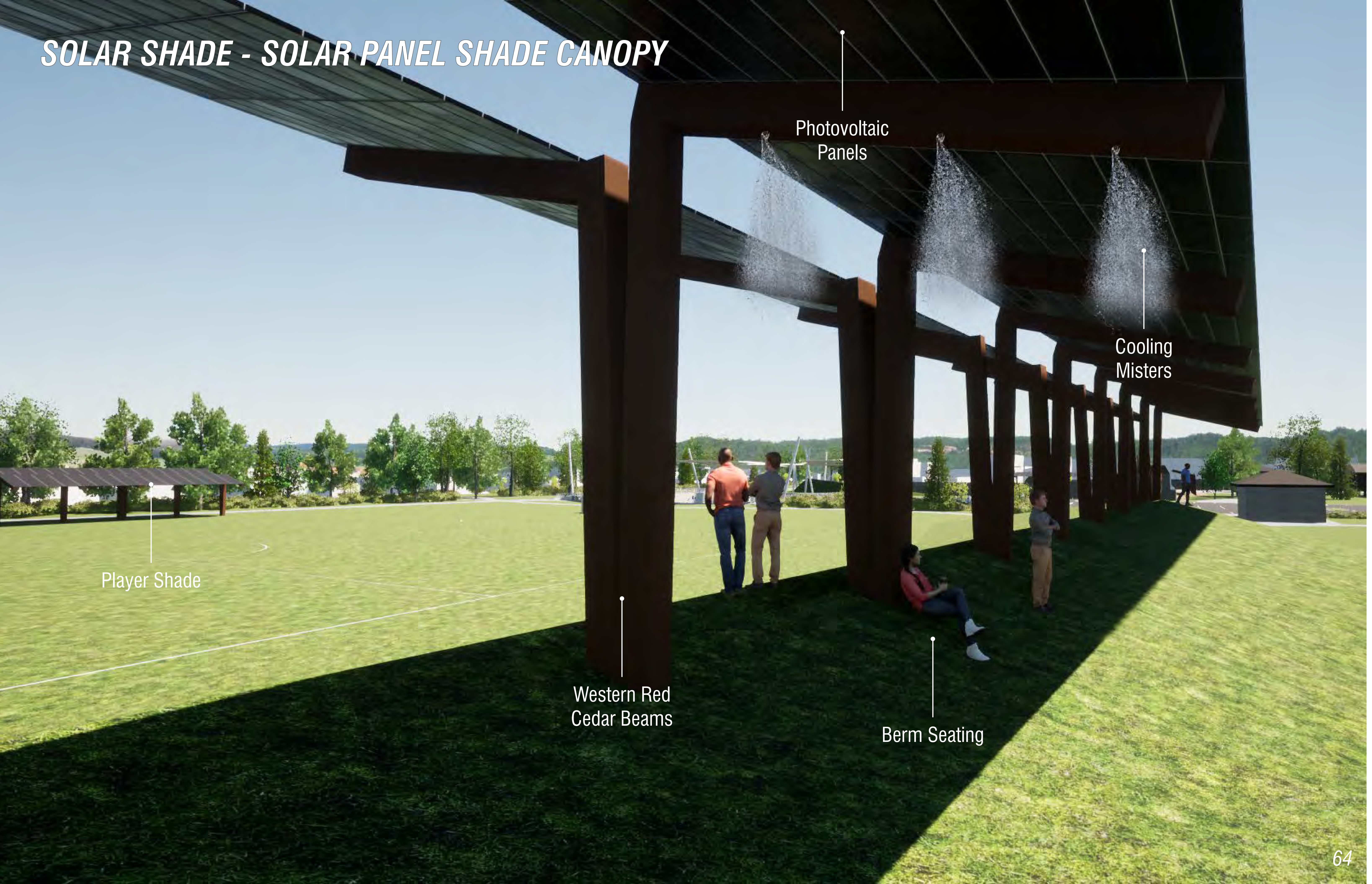
SOLAR SHADE - Jefferson Park (Seattle, WA) & Saint Louis Zoo (St. Louis, MO)

Source: Frothingham, 2012



Source: Rizvic, 2019

Solar shade canopies at Jefferson Park in Seattle, WA, and at Saint Louis Zoo in St. Louis, MO have provided some inspiration on design concepts for the collocation of photovoltaic panels and shade canopy structures. The idea in both precedents is to provide adequate shade for visitors along fields and seating areas, while incorporating photovoltaic panels to provide a renewable source of energy.

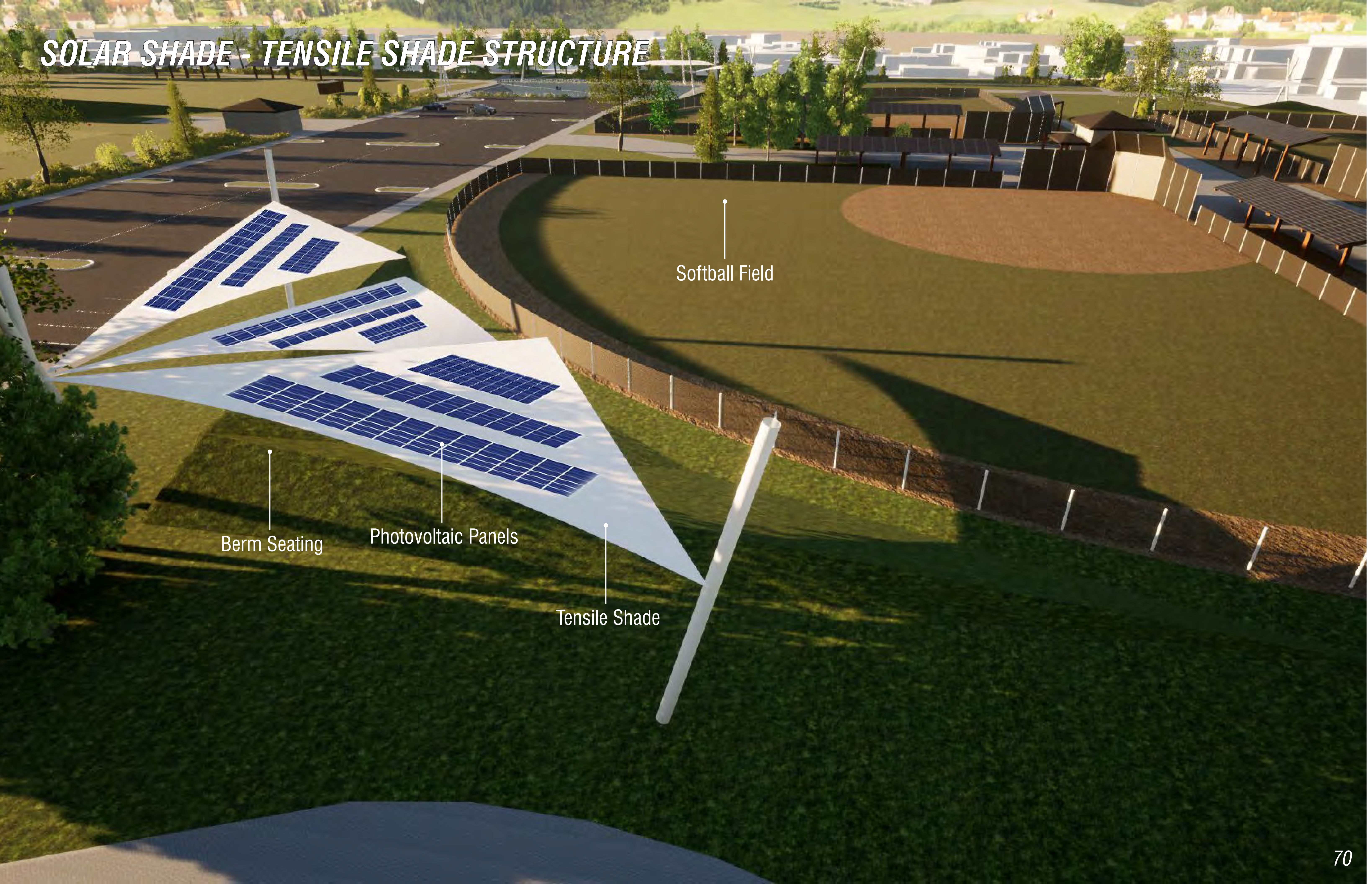


The design concept for the solar panel shade canopy structures provides an area for respite for spectators along the berm seating area, as well as for the players along the soccer field sidelines. Cooling misters, attached to the Western Red Cedar beams and structure could provide additional relief from extreme heat events. Photovoltaic panels placed atop the shade structures are tilted to face south or west in order to receive maximum sun exposure.

Additional solar shade concepts are presented in the concessions and central plaza area at Gradin. Shade structures with solar panels provide respite in the softball dugouts, while a concession stand and shade trees provide additional relief for spectators in the area.

Another view from the spectator corridor where we can see how benches, shade trees and the concession stand offer opportunities for respite and relaxation during sporting events.

SOLAR SHADE - TENSILE SHADE STRUCTURE



Tensile shade structures with photovoltaic panels provide shade for spectators along the four softball fields, while the berm seating offers elevated views over the fence and on to the fields.

RESILIENT PLANTING

The third and final sustainable design intervention applied to Gradin Community Sports Park is resilient planting. By incorporating resilient and drought tolerant planting within sports parks, we can address water scarcity by reducing the demand for irrigation and maintenance for landscaped areas.

Resilient planting can also address climate change and heat related challenges through its contribution to additional green space and shade trees, which can help to alleviate the urban heat island effect within sports parks.

Finally, resilient planting plays a crucial role in addressing challenges related to habitat fragmentation through its ability to enhance biodiversity and the overall ecological function within sports parks.

RESILIENT PLANTING - PLANT LIST

Woodland Buffer


Calocedrus decurrens
California Incense Cedar


Acer circinatum
Vine Maple


Garrya elliptica
Coast Silktassel


Philadelphus lewisii
Mock Orange


Dicentra formosa
Bleeding Heart


Vaccinium ovatum
Evergreen Huckleberry

Swale & Rain Garden


Juncus effusus
Soft Rush


Camassia quamash
Common Camas


Spiraea douglasii
Western Spirea


Arctostaphylos uva-ursi
Kinnickinnick


Cornus sericea
Redosier Dogwood


Polystichum munitum
Western Sword Fern

Parking Lot & Interior


Carpinus betulus
European Hornbeam


Ginkgo biloba
Ginkgo Tree


Parrotia persica
Persian Parrotia

The plant list for Gradin incorporates mainly native, drought tolerant planting such as Vine Maple and Mock Orange in the woodland buffer, Rush and Camas in the swales and rain gardens, with Hornbeam, Ginkgo Tree and Persian Parrotia in the parking lot and interior areas throughout the site.

RESILIENT PLANTING - TURF GRASS TYPES

Fair	●○○○
Medium	●●○○
Good	●●●○
Excellent	●●●●

	Characteristics	Kentucky Bluegrass	Perennial Ryegrass	Tall Fescue
	Quality	●●●○	●●●○	●●○○
	Establishment Speed	●○○○	●●●●	●●○○
Resilient	*Wear Tolerance*	●●◐○	●●●○	●●●○
Resilient	*Drought Tolerance*	●◐○○	●●●○	●●●○
Resilient	*Disease Tolerance*	●●○○	●○○○	●◐○○
Resilient	*Shade Tolerance*	●○○○	●○○○	●●●○

Source: *Grasses for Sports Fields*, n.d.

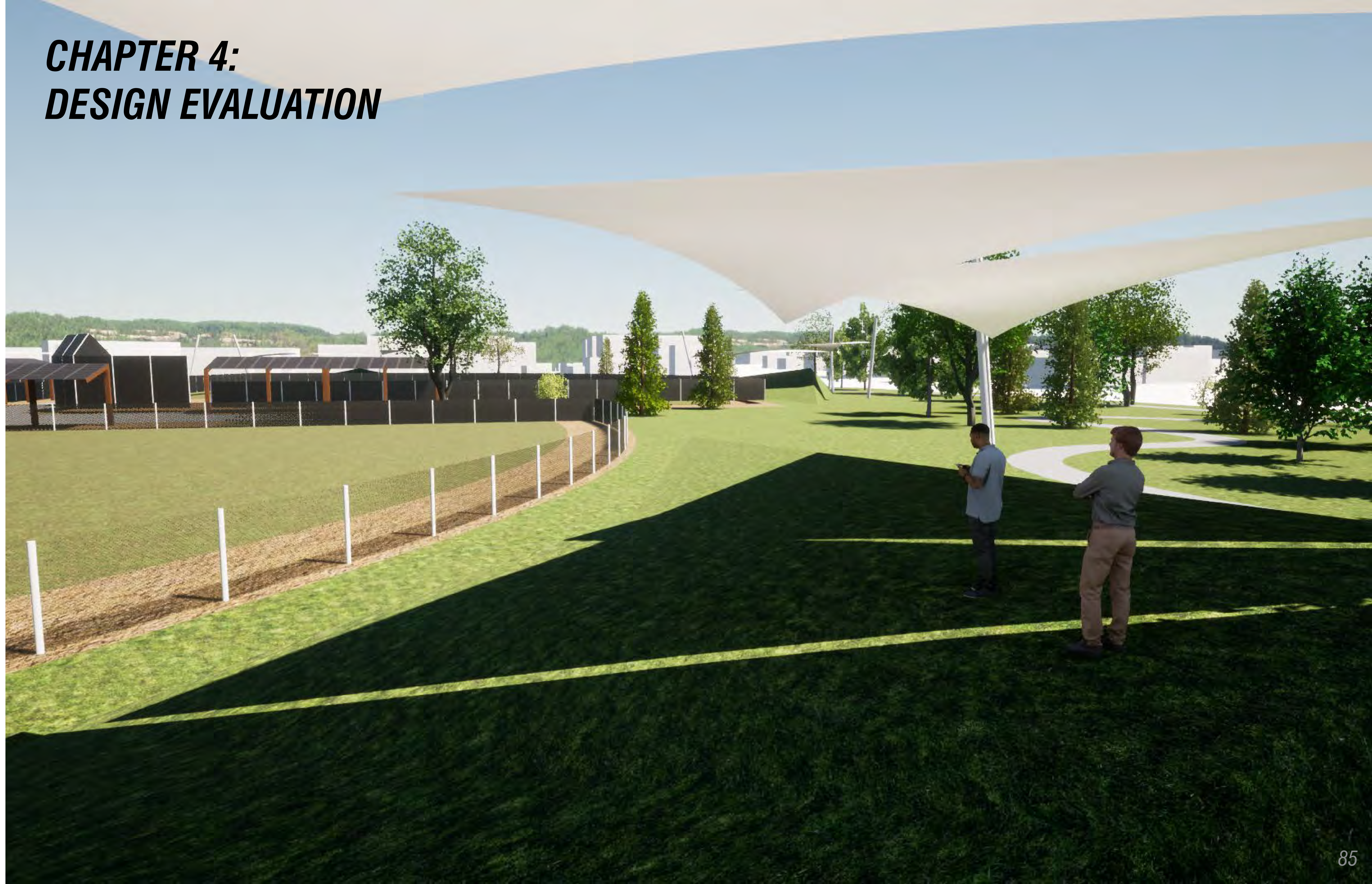
This slide presents the ratings of some of the most commonly used grass seed used for sports fields in Oregon, as well as across the United States. Kentucky Bluegrass, Perennial Ryegrass, and Tall Fescue are all popular options for sports fields with their ratings ranging from fair to excellent in categories such as establishments speed to drought tolerance. For Western Oregon, a mix of Perennial Ryegrass and Fescue has been described as an effective blend that is fairly quick to establish, durable and fairly drought and shade tolerant[16]. So, this is the blend I am proposing for the fields at Gradin Community Sports Park.

16 Pokorny, 2023

The rain gardens around the site play an important role in treating pollutants from the site's stormwater runoff. Using native, drought tolerant species such as Camas, Western Spirea, and Western Sword Fern can provide functionality for stormwater treatment as well as potential habitat provision for local species.

The swale planting provides a similar function to the rain gardens and even more ecological benefit to potential wildlife due to their size and greater diversity of plants. Native species such as Redosier Dogwood provide great versatility in terms of tolerating both standing water and drought, while plants like Kinnikinnick provide a good option for the dryer zones near the top of the swale.

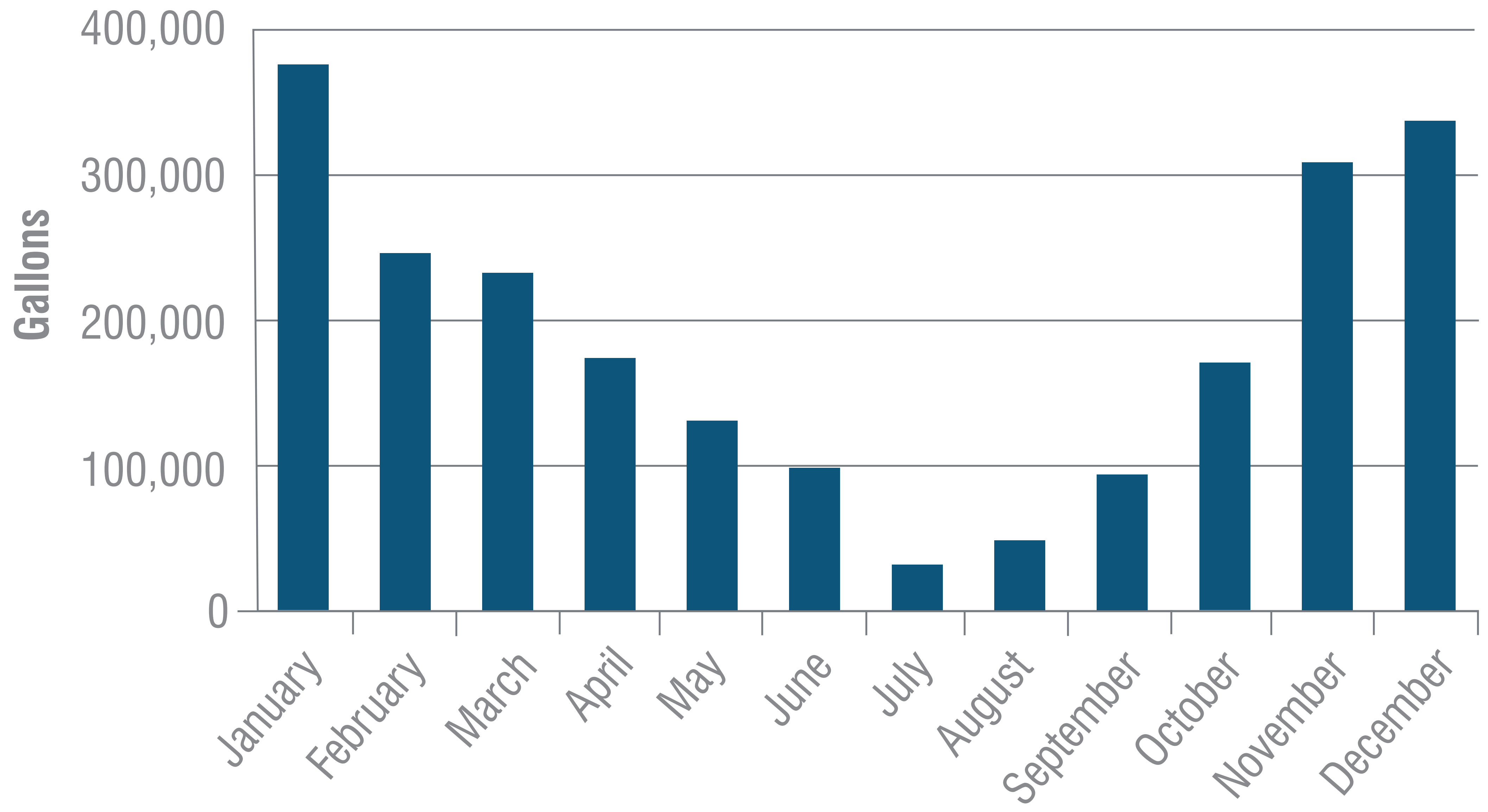
Finally, the woodland buffer enhances biodiversity by increasing habitat diversity along the site perimeter and supporting increased connectivity to nearby natural areas. The woodland buffer would include large conifers such as California Incense Cedar (*Calocedrus decurrens*), along with other native and drought tolerant species such as Mock Orange (*Philadelphus lewisii*) that can provide food and cover for wildlife.



CHAPTER 4: DESIGN EVALUATION

Monthly Estimated Gallons of Harvested Rainfall

=Catchment Area (74,400 sqft) x Monthly Rainfall (inches) x Collection Efficiency (0.8) x Conversion Factor (0.62)



Source: *Federal Energy Management Program - Rainwater Harvesting Calculator*, 2022

Potential to harvest 25-50% of irrigation needs

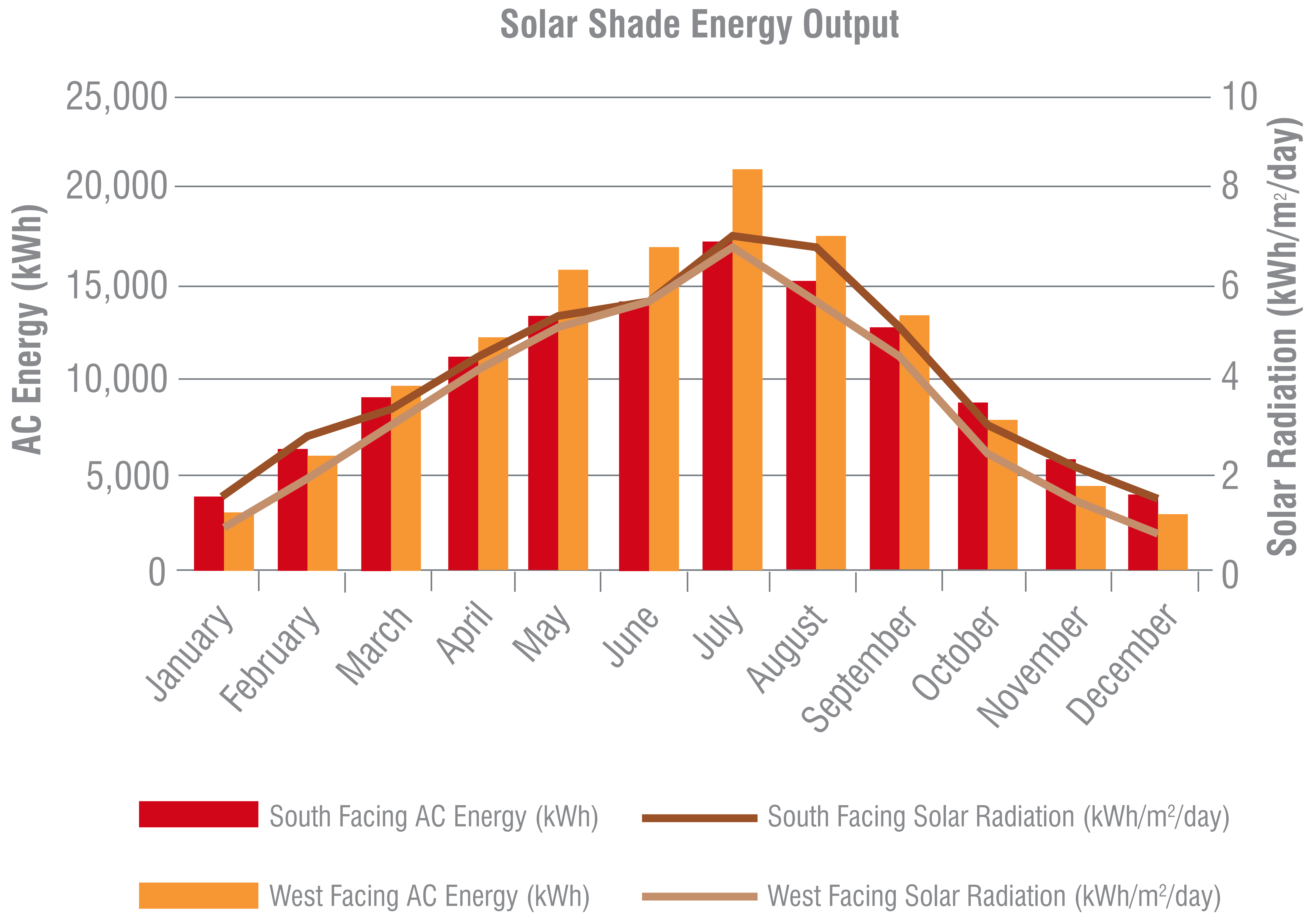
Annual Rainfall Harvested (gal)
=2,229,261

***Remember**
Typical grass field: 500,000 to 1 million gallons of water per year
x 8 (athletic fields at Gradin)
=4 to 8 million gallons per year

To get a sense of how much stormwater or rainfall could be captured on-site and potentially reused for irrigation and other non-potable water uses, I used the Rainwater Harvesting Calculator from the Federal Energy Management Program website. I was able to input information on the total catchment area of 74,400 square feet and the zip code for Gradin Community Sports Park which provides monthly inches of rainfall data. The calculator then uses default figures of 0.8 for collection efficiency which is a factor applied to account for losses in the system, and a conversion factor of 0.62 used to covert inches of rain that fall onto the catchment area[17]. As we can see from the bar graph, the highest rainfall harvest potential occurs from November to January, with the harvesting potential dropping significantly in the peak summer months.

On an annual basis, Gradin has the potential to harvest 2.2 million gallons of rainwater. With the typical natural grass sports field using between 500,000 to 1 million gallons of water per year, the total water needs for Gradin and its 8 athletic fields, is anywhere between 4 to 8 million gallons per year. So, the amount of stormwater harvested on-site could potentially provide anywhere from 25 to 50 percent of the irrigation needs for its athletic fields, thereby reducing the amount of water and expenditure from the municipal water system.

17 *Federal Energy Management Program - Rainwater Harvesting Calculator*, 2022



Source: *PVWatts Calculator*, n.d.

Generates up to 100% of energy used for irrigation

256 South Facing Panels
123,214 kWh
+
320 West Facing Panels
134,341 kWh

=Total Annual AC Energy (kWh): 257,555

***Average 18 hole golf course (30 acres) uses ~225,000 kWh per year**

Similar to the evaluation of the stormwater harvesting potential at the site, I wanted to provide some insights on how much energy could be generated on-site through the solar panel shade canopies, which would likely consist of the 72-cell commercial style solar panels. Using the PVWatts Calculator from the National Renewable Energy Laboratory website, I input the required information such as system size, number of panels, tilt angle, and azimuth. The calculator then provides a monthly breakdown and annual average for the solar radiation, as well as a monthly breakdown and annual total of the alternating current energy output. In this chart, we can see the inverse of the patterns shown in the stormwater harvest chart, where the highest potential for solar radiation and energy output occurs during the summer months, and the lowest potential occurring during the peak winter months.

Based on the 256 south facing panels and 320 west facing panels, there is a potential to generate around 257,000 kWh of energy to be used for the irrigation pump system, lighting, and more. To provide some context for what this number means for Gradin, the average 18-hole golf course, which is around the same size as Gradin at 30 acres, uses approximately 225,000 kWh per year for irrigation systems[18]. So, Gradin could generate enough solar power to provide 100 percent of the energy needs for its irrigation system. The ability to provide a self-sustaining source of renewable energy on-site and possible energy credits for excess power generated can present financial benefits that make the best of the impacts of climate change.

18 *PVWatts Calculator, n.d.*

RESILIENT PLANTING

			Resource Scarcity	Climate Change	Habitat Fragmentation
PLANT SPECIES	**NATIVE**	**H/W**	**WATER**	**SUN**	**WILDLIFE**
Woodland Buffer					
California Incense Cedar *(Calocedrus decurrens)*	Y	135'/50'			
Vine Maple *(Acer circinatum)*	Y	20-30'/20'			
Coast Silktassel *(Garrya elliptica)*	N	8'/8'			
Mock Orange *(Philadelphus lewisii)*	Y	9-12'/8'			
Bleeding Heart *(Dicentra formosa)*	Y	18"/3'			
Evergreen Huckleberry *(Vaccinium ovatum)*	Y	3-15'/3'			
Swale Planting					
Common Rush *(Juncus effusus)*	Y	1'/1'			
Common Camas *(Cammasia quamash)*	Y	1-3'/1'			
Western Spirea *(Spiraea douglasii)*	Y	8-10'/5'			
Kinnickinnick *(Arctostaphylos uva-ursi)*	Y	<1'/15'			
Redosier Dogwood *(Cornus sericea)*	Y	15-20'/10'			
Western Sword Fern *(Polystichum munitum)*	Y	2-4'/3-4'			
Parking Lot & Interior					
European Hornbeam *(Carpinus betulus)*	N	60'/40'			
Ginkgo Tree *(Ginkgo biloba)*	N	80-120'/40-60'			
Persian Parrotia *(Parrotia persica)*	N	20-40'/30'			

Source: McMahan et al., 2022

The final design intervention at Gradin involves resilient planting, focusing on native, drought tolerant species with the potential to provide food and habitat for wildlife. Having presented the plant list earlier, I wanted to provide a more detailed breakdown of the proposed plant species and their relationship to the challenges of resource scarcity through water use, climate change through sun exposure, and habitat fragmentation through provision for wildlife. Overall, we can see from the chart that most of the plant species require low to moderate water levels, can tolerate full sun exposure, while providing food and habitat for wildlife such as butterflies, bees, and bird species.

Key Takeaways	Considerations
 Multifunctional design creates mutually beneficial outcomes for users and the environment	Designs should be tailored to the environment of specific climate regions (Not a one-size-fits-all solution) 
 Climate change impacts elicit the need for innovative design solutions	Cross-functional collaboration between disciplines to better inform design decisions 
 Existing inequity in distribution of resources and quality of public space	Promote self-sustaining systems to reduce dependency on external resources 

To wrap up my presentation, I wanted to summarize some key takeaways and considerations relating to the impacts of sustainable design on sports parks. First, multifunctional approaches to the design of sports parks can create mutually beneficial outcomes for users and the environment. However, it is important to consider that the methods I discussed are not a one size fits all solution and designs should be tailored to the environment of specific climate regions.

Next, climate change and its associated impact on the environment and playing conditions of sports parks can bring about more innovative design solutions. By embracing cross-functional collaboration between landscape architects, planners, engineers and scientists, the diversity of perspectives across disciplines can better inform design decisions aimed at addressing climate change challenges.

Finally, existing inequities in the distribution of resources create disparities between the quality of public space among different socioeconomic groups. So, the sustainable design of public spaces such as sports parks could help to promote more self-sustaining systems that reduce the dependency on costly external resources such as electricity and water.

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