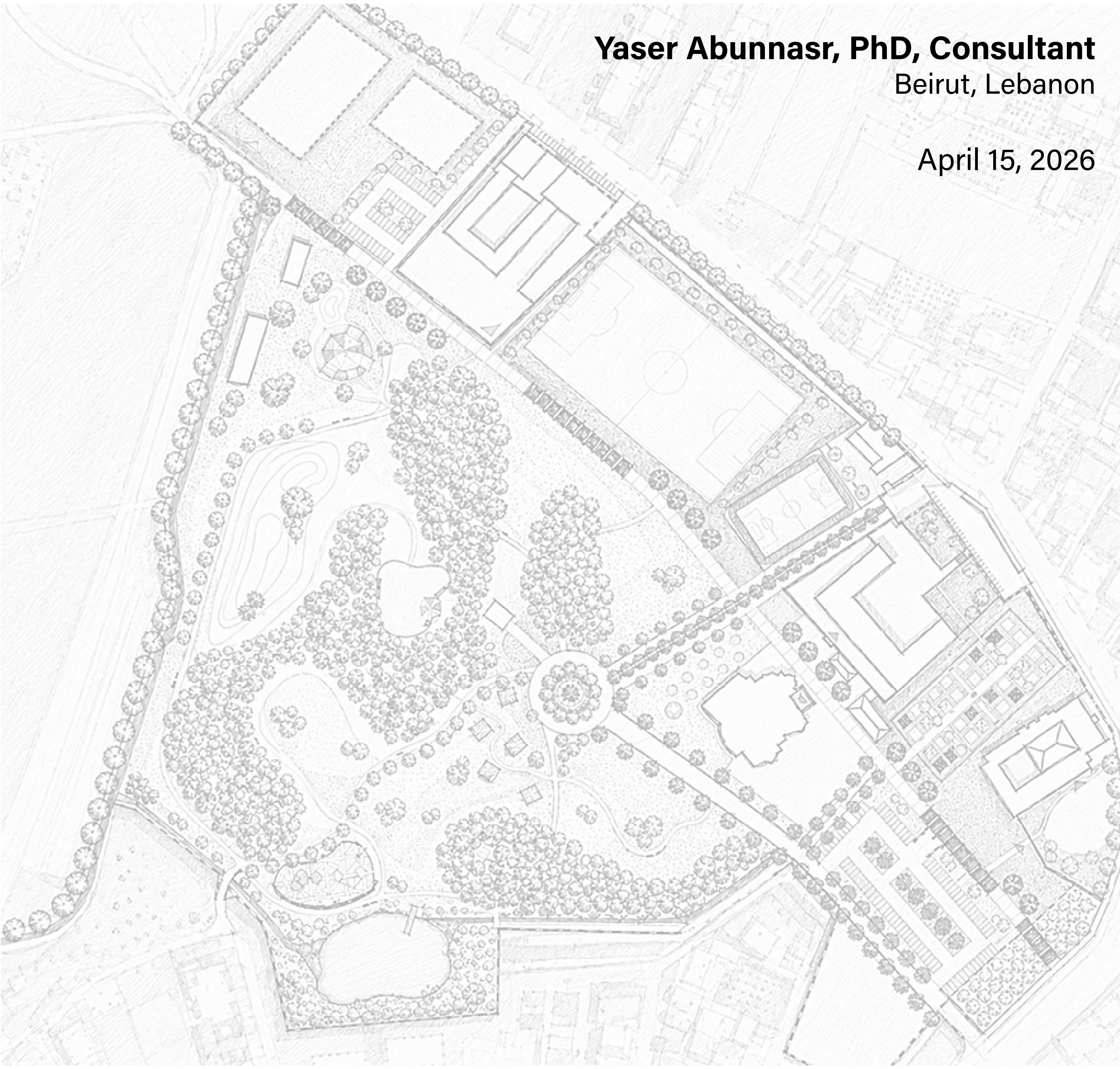
Green Urban Places: Design Guidelines for Arid and Semi-Arid Climates



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Executive Summary: Ten Key Takeaways

This booklet provides a practical and applied guidelines for the development of Green urban Places in arid and semi-arid climates. Key takeaways for municipalities are summarized below and provide the basis for what needs to be done to transform open spaces in cities into ecologically, environmentally and socially viable places.

1. **Green Urban Ppaces in arid cities are climate infrastructure – not a luxury.** They require the same planning, investment, and maintenance as roads or water supply.
2. **Failure is usually institutional, not design-related.** Fragmented governance, short-term budgets, and limited maintenance capacity are the real barriers. Address these first.
3. **Shade is the priority.** In hot, dry climates, shade reduces heat stress more effectively than water features. Always plan shade before water.
4. **Base decisions on data, not aesthetics.** Site inventory (climate, soil, water, vegetation, use patterns) and community input must drive design.
5. **Involve the community as partners.** Residents are "living sensors" who know where it's hot, unsafe, or pleasant. Their knowledge is essential.
6. **Choose the right typology.** Match your site conditions and priorities to proven GUS types – shade-first parks, street trees, bioswales, urban forests, etc.
7. **Select materials and plants for performance.** Prioritise durability, cool surfaces, low water demand, and local adaptability over decoration, while maintain the aesthetic value.
8. **Integrate nature-based solutions.** Use micro-catchments, bioswales, rain gardens, and shade groves to manage water and improve comfort naturally.
9. **Design for maintenance.** If your maintenance team can't sustain it, it will fail. Keep it simple, robust, and matched to local capacity.
10. **Start small, learn, and scale up.** A well-placed shaded bench, a single bioswale, or a cluster of trees can demonstrate success and build momentum.

Introduction

This document represents a preliminary set of guidelines for the design of Urban Open Places in arid and semi-arid contexts. Green urban places are defined as open spaces that enhance ecological and climatic performance of open spaces through vegetated cover and transforming spaces into natural areas within cities. In arid and semi-arid contexts, this definition is adjusted to mean the following: A climate responsive public or semi public space that strategically combines vegetation, shade, soil, and water sensitive systems to improve thermal comfort, ecological function, and social usability under extreme heat and water scarcity.

With this definition, an online training workshop was conducted during January 2026 to five Libyan Municipalities to introduce the concept and provide guidelines on defining design priorities that enhance the ecological, climatic, and social functioning of these open spaces. The five municipalities are: Garabulli, Tawerga, Zliten, Zweillah, and Janzour. These five municipalities are distributed across desert (arid) climate and some closer to the Mediterranean coast (semi-arid). The definition above has provided the basis for the training workshop. The workshop focused on building local capacities in planning and design of GUP in these municipalities with the support of the Ministry of Local Governance (MoLG). This work is funded and supported by GIZ (Germany) and MEDCITIES (Spain).

This booklet presents clear guidelines that can be used by municipalities in Libya and other regions with similar climatic contexts. It is a result of this training workshop and the interactions with the local municipality members.

The booklet is organized in five sections as follows:

Section 1: Green Urban Places in arid and semi-arid contexts
Section 2: green Urban Place Design and Process
Section 3: Site Inventory and Analysis
Section 4: Community Participation
Section 5: Landscape Plant and Materials and Nature-Based Solutions

While the booklet is compiled to assist Libyan municipalities in GUP design, it can be used in other similar climatic and cultural contexts.

Section 1: Green Urban Spaces in arid and semi-arid contexts

1.1 Defining Green Urban Places (GUP)

A Green Urban Place in arid and semi-arid contexts is defined as a climate responsive public or semi public space that strategically combines vegetation, shade, soil, materials and water sensitive systems to improve thermal comfort, ecological function, and social usability under extreme heat and water scarcity.

In simple terms: a GUP is designed to perform in hot, dry conditions and not just to look green. Performing systems means that, in addition to aesthetics and spatial quality, GUP should be efficient in water use, provide biodiversity, use native or climatically adapted plants, respond to local ecological specificities, be contextual, and responsive to social needs of surrounding communities.

1.2 What GUP Is Not

As the definition clearly states, GUP are not spaces that include lawns, or decorative planting nor the use of green for “greenwashing” purposes. What GUP is not is equally important to what GUP is. Below are three key concepts that should be avoided to ensure a performing GUP.

Not to do	Impact if done
Lawn-Based Parks Copied from Temperate Climates	High water demand, wrong species, no local adaptation
High-Maintenance Decorative Planting	Dependent on intensive irrigation, fertilization, frequent replacement
Greenwashing Without Performance Outcomes	“Green” label without measurable cooling, shade, or usage benefits

1.3 Challenges for GUP design in arid and semi-arid climates

There are three key challenges for GUP design and implementation in arid and semi arid contexts, especially in low to middle income countries. The design guidelines address most of these challenges and provide clear and pragmatic measures. These challenges are environmental, urban, and institutional.

1.3.1 Environmental Stressors

Stressor	Impact
Extreme heat and heat waves	• Reduces outdoor liveability and use of public spaces, especially for vulnerable populations. • Increases health risks (heat exhaustion, dehydration, mortality). • Accelerates degradation of vegetation and materials leading to higher irrigation, plant death, higher maintenance costs.
High solar exposure	• Intensifies surface/air temperatures and urban heat island effects. • Limits daytime use of open spaces due to lack of shade and glare. • Increases water stress on plants (higher evapotranspiration exceeds soil moisture).
Low and unpredictable rainfall	• Creates chronic water scarcity → constrains irrigation, plant selection, long-term viability • Causes unreliable soil moisture → poor plant establishment, shallow roots, higher failure rates. • Increases dependence on non-conventional water sources (treated wastewater, harvested rainwater) → adds infrastructure and management complexity.

1.3.2 Urban Conditions

Condition	Impact
Dense built form	• Restricted airflow → heat accumulation • Limited shade diversity, heat trapping buildings • Less flexibility for trees, soil systems, cooling corridors
Heat absorbing materials	• Dark pavements, roofs, façades absorb and re radiate heat • Amplified urban heat island effect • Higher cooling energy demand
Limited per capita open space	• Reduced access to cooling and recreation • Overuse and degradation of existing green spaces • Unequal distribution of benefits

1.3.4 Institutional Realities

Reality	Impact
Fragmented governance	• Weak coordination → inconsistent policies, delays • No long term vision → limits scalability • Unclear mandates, poor data sharing
Short term budgets	• Emphasis on quick win projects → undermines sustainability • Unstable funding disrupts continuity • Low return on investment
Low return on investment	• Low return on investment Insufficient routine maintenance → rapid deterioration • Limited technical expertise → high vegetation failure • Loss of public confidence

1.4 Benefits of GUP

GUP provide several benefits. These benefits become extremely critical in arid and semi-arid climates providing ecological, social and economic benefits. These can be achieved by following the design principles and recommendations provided in this booklet. Extensive literature is available for detailed understanding of these benefits. The following table provides a very brief summary of possible benefits, depending on context, location, institutions, and local capacities.

Ecological Benefits	Social benefits	Economic benefits
Supports native biodiversity	Increases use of public space	Reduces cooling energy demand
Captures dust, improves air quality	Reduces heat stress, improves mental health	Lowers heat related health costs
Stabilizes soil, controls runoff	Reduces heat stress, improves mental health	Raises land and property values
Stabilizes soil, controls runoff	Delivers heat equity to vulnerable groups	High return climate adaptation

1.5 Why GUP fail in arid and semi-arid cities

Failure of GUP in arid and semi-arid contexts is usually not design failure but rather institutional and / or climatic. To achieve meaningful and responsive design of GUP to climate and society, the following 'business as usual' design processes should be avoided and replaced by what is provided in this booklet. The following table summarizes what are the common mistakes and it should be replaced with.

Common Mistake	What Is Really Needed
Decisions based on aesthetics	Decisions based on performance (shade, cooling, water use)
Environmental factors considered too late	Environmental analysis before design
No feasibility check of resources	Proper pre-design assessment
GUS treated as an "afterthought"	GUS treated as core infrastructure (like roads)

Key insight: Green spaces in arid cities require the same level of investment and planning as any other infrastructure – they are not an afterthought but a fundamental part of the urban fabric.

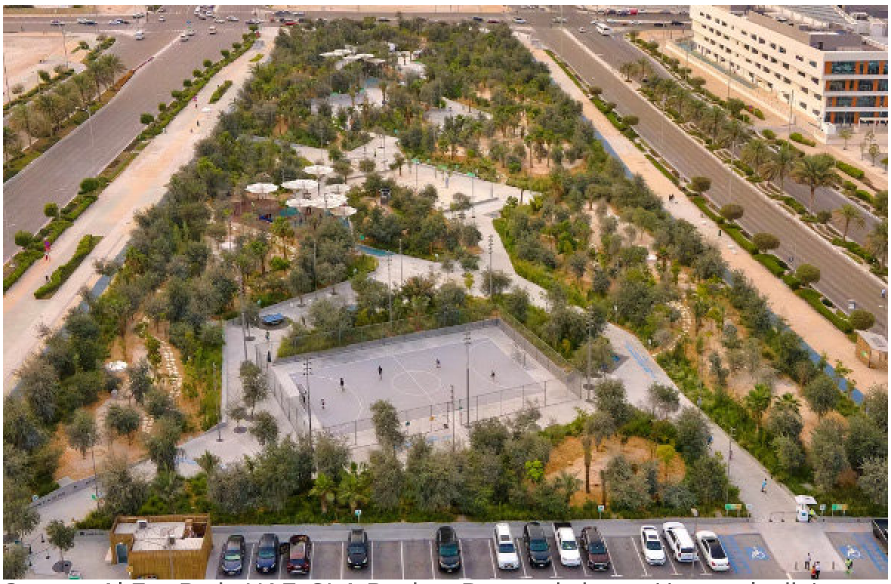
1.6 Examples of GUP relevant to arid and semi-arid climate

The following examples of GUP provide examples that connect project design, benefits and landscape elements. The design principals that result in such projects or typologies are explained in this booklet.

Example:
Shade first urban park (non lawn)

Description:
Tree canopy, pergolas, gravel/mulch, minimal turf

Primary Benefit:
Reduces surface temperatures / UHI with low irrigation



Source: Al Fay Park, UAE. SLA Design, Denmark. https://www.sla.dk/

Example:
Street tree corridor

Description:
Continuous trees integrated with sidewalks, bike lanes, transit stops

Primary Benefit:
Cooler pedestrian corridors; less asphalt heat

Source: ChatGPt render

Example:
Bioswale / rain garden (arid adapted)

Description:
Shallow planted basin, episodic storms, tolerant species, engineered soil

Primary Benefit:
Improves infiltration; reduces flooding / polluted runoff

Source: NAWAMED Project https://www.enicbcmed.eu

Example:
Urban forest patch (cluster planting)

Description:
Dense native/adapted trees

Primary Benefit:
High cooling effect + biodiversity support

Source: Beirut Central Park, The Horsh, https://ejatlas.org/conflict/horsh-beirut

Example:
Green roof (extensive, drought tolerant)

Description:
Lightweight system, succulents/natives, efficient irrigation if needed

Primary Benefit:
Reduces building heat gain; lowers roof temperature

Source: Stavros Niarchos Center,
https://zinco-greenroof.co.uk/press-releases?page=2

Example:
Green wall / shaded façade

Description:
Vertical greenery or trellised vines shading building envelopes

Primary Benefit:
Lowers wall temperatures; improves street micro climate

Source: NAWAMED Project https://www.enicbcmed.eu

Section 2: Green urban place design principles and process

This section provides guidance on the process and principles of designing green urban places along with practical tools, references to other sections and a GUP design checklist to ensure that municipalities and their teams can integrate these principles into their planning processes.

This section should be read in conjunction with other sections of this booklet.

2.1 GUP design process

The steps for a GUP design process are very similar to any other open space design process (Figure 1). The usual steps include the decision to start a project until implementation and handing over. The typical design process includes thirteen general steps. These steps my vary slightly, depending on design approach.

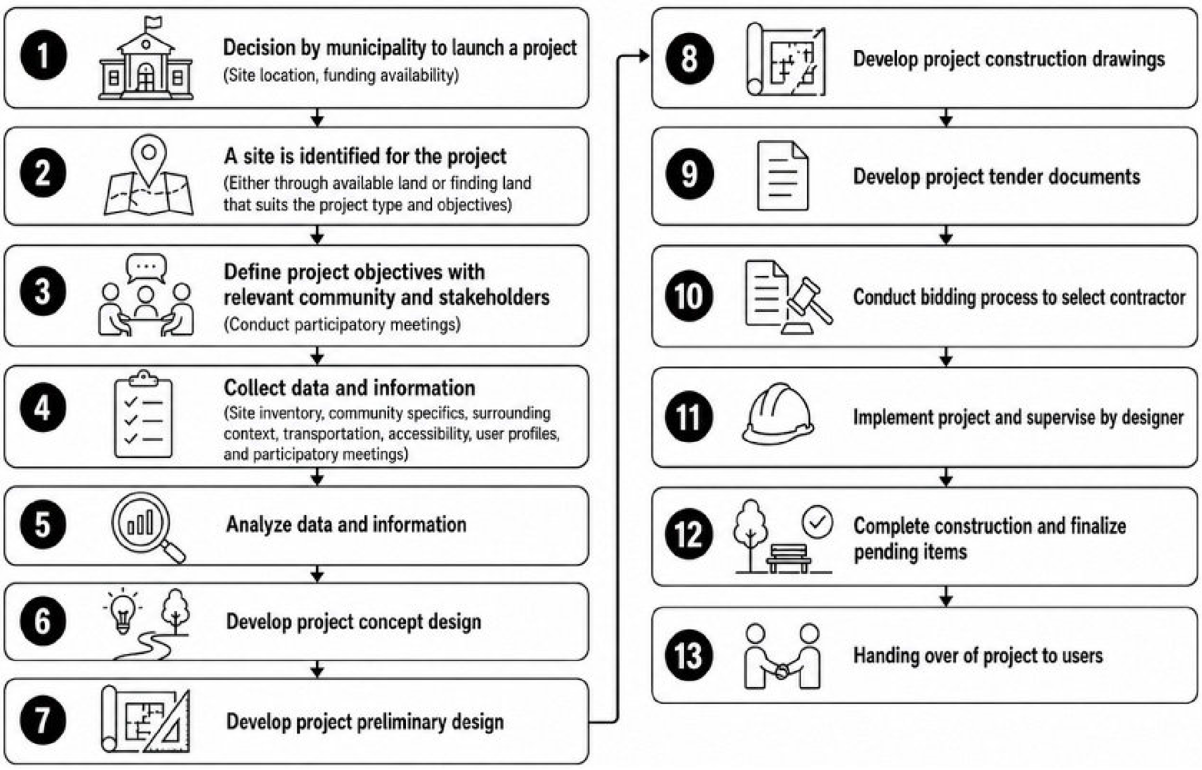


Figure 1: Typical design process for an open space project

To transform this process into a GUP design process for arid and semi-arid contexts, several of these steps will need to be adjusted to ensure a responsive design to the climatic, social, and environmental context of arid and semi-arid contexts. The flow diagram in Figure 2 shows where several interventions will, be required to ensure aligning with GUP design principles. These interventions include specific data gathering, analysis and decision taking.

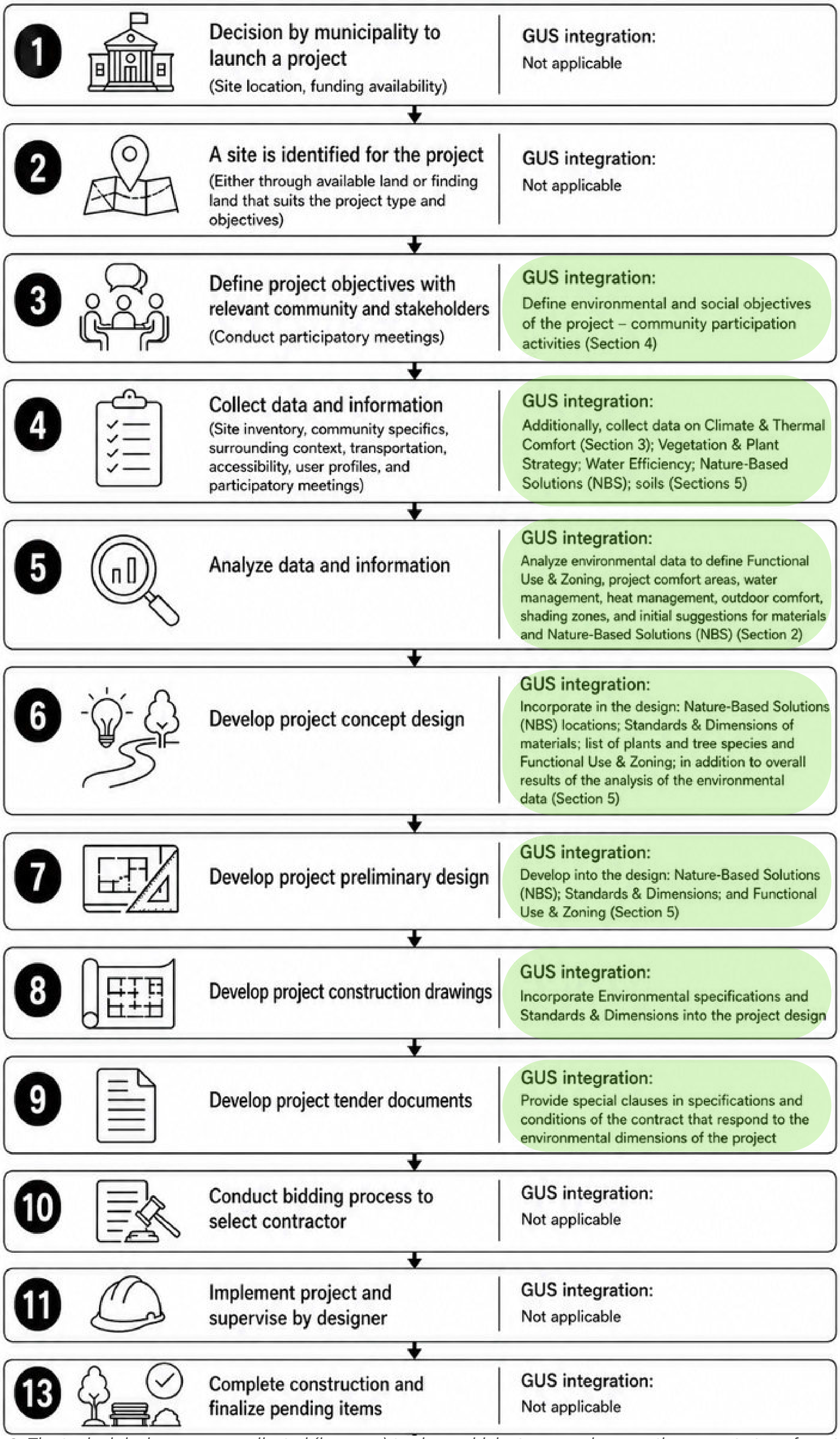


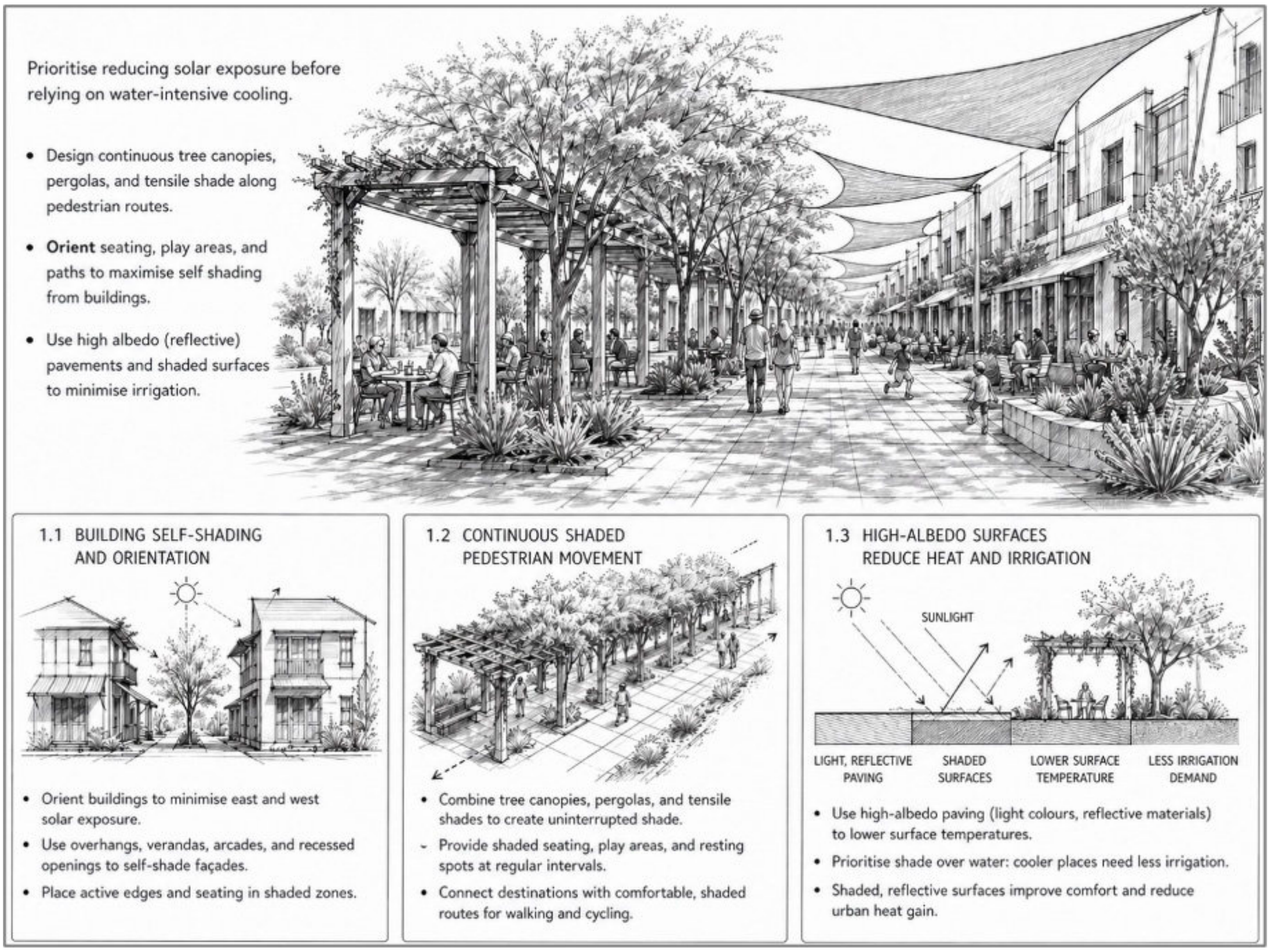
Figure 2: The typical design process adjusted (in green) to show which steps need new action so as to transform the process for a GUS design process for arid and semi-arid climates. These are steps 4 to 9 indicated in light green

2.2 Four GUP core design guidelines

2.2.1 First Guideline: Shade First, Water Second

Water is a valuable resource in arid and semi-arid climates. Ensuring that areas and locations are shaded first creating micro-climates ensures that irrigation water use is reduced. This can be achieved by:

- Design continuous tree canopies, pergolas, tensile shade along pedestrian routes.
- Orient seating, play areas, paths to maximize self shading from buildings.
- Use high albedo (reflective) pavements and shaded surfaces will contribute to minimizing irrigation.

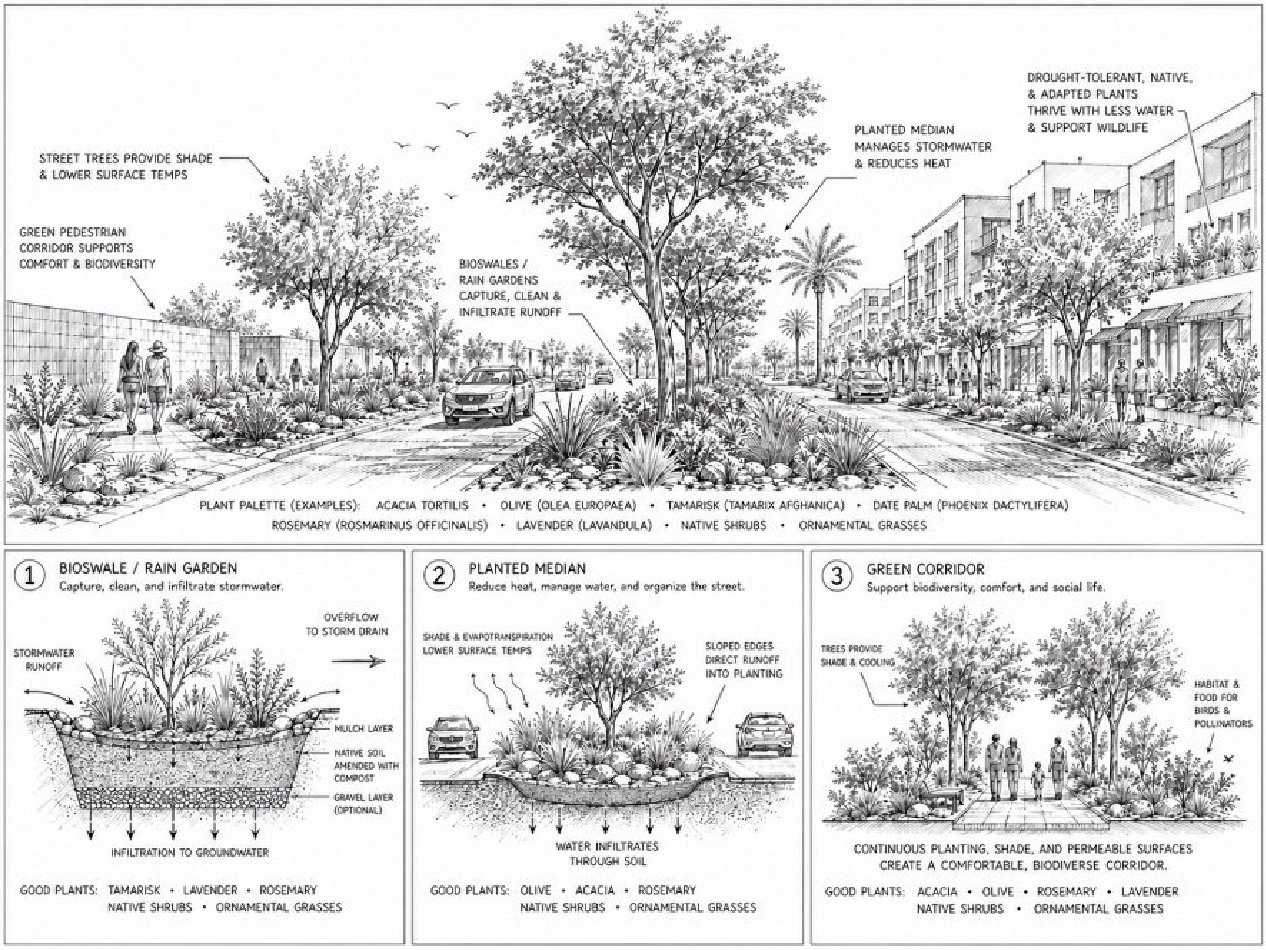


Key insight 1: Prioritize reducing solar exposure before relying on water intensive cooling.

2.2.2 Second Guideline: Vegetation as Infrastructure, Not Decoration

Balancing between the functional and aesthetic values of vegetation is critical in arid and semi arid contexts. By leveraging the ecosystem services of plants and their biological system, temperatures can be reduced, outdoor comfort can be mitigated, better social spaces can be created, and water can be captured and reused. This can be achieved while ensuring a beautiful alignment of pants that bring life seasonally while performing its role as infrastructure. The following are some examples of infrastructural performance of plants (see also section 5, Nature based solutions).

- Street trees as heat mitigation infrastructure → lower surface temps, extend pavement life.
- Bioswales, planted medians, rain gardens → manage stormwater, improve infiltration.
- Urban green corridors → support biodiversity and pedestrian comfort.

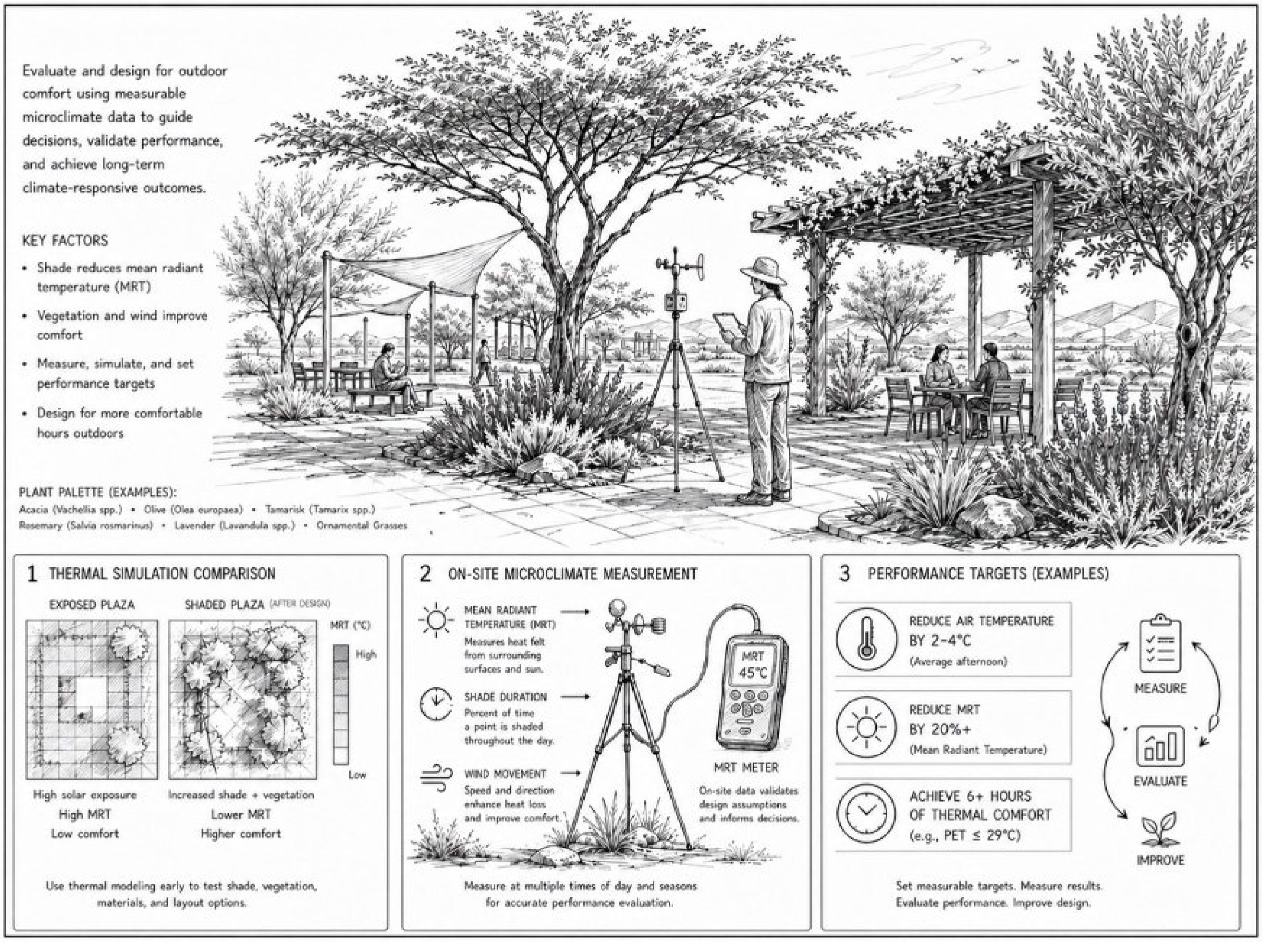


Key insight 2: Treat plants as functional systems that deliver climate, ecological, and social services.

2.2.3 Third Guideline: Microclimate Performance as a Design Metric

In arid and semi-arid climates, generating micro-climates that provide shade, cooler temperatures, and safe places is critical to the use and performance of GUS. This is connected to the surface and ambient temperatures in GUS spaces. Therefore it is important to set targets to reduce temperatures by using field measurements and monitoring locations within the site to ensure matching uses with shading levels. Designers should:

- Design/assess using mean radiant temperature (MRT), shade duration, wind movement.
- Compare options with thermal simulations or on site measurements.
- Set performance targets (e.g., temperature reduction, hours of thermal comfort).

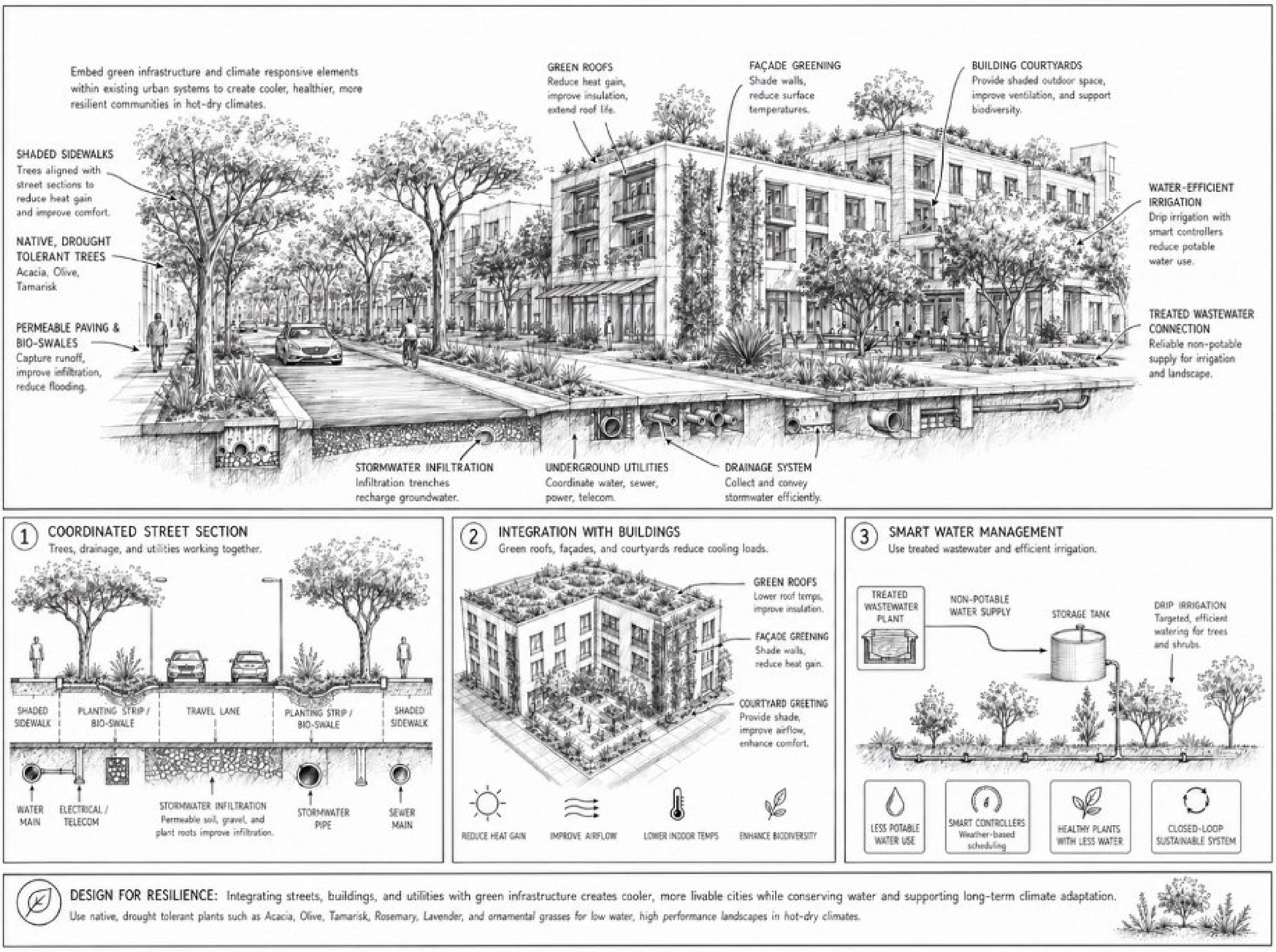


Key insight 3: Evaluate success based on measurable thermal and comfort outcomes – not aesthetics alone

2.2.4 Fourth Guideline: Integration with Streets, Buildings, and Utilities

Thinks of Gus as an urban system that goes beyond the location of the space. By integrating GUS systems with planting an vegetation in streets and buildings provides the connectivity required for performance: water can be captured in multiple locations, shading is connected provides continuous cooler walking and activity spaces, and this integration will reduce the urban heat island within the city. Key ideas to consider:

- Coordinate tree planting with street sections, underground utilities, drainage.
- Integrate green roofs, façades, courtyards with building design → reduce cooling loads.
- Align irrigation with treated wastewater or smart water management.



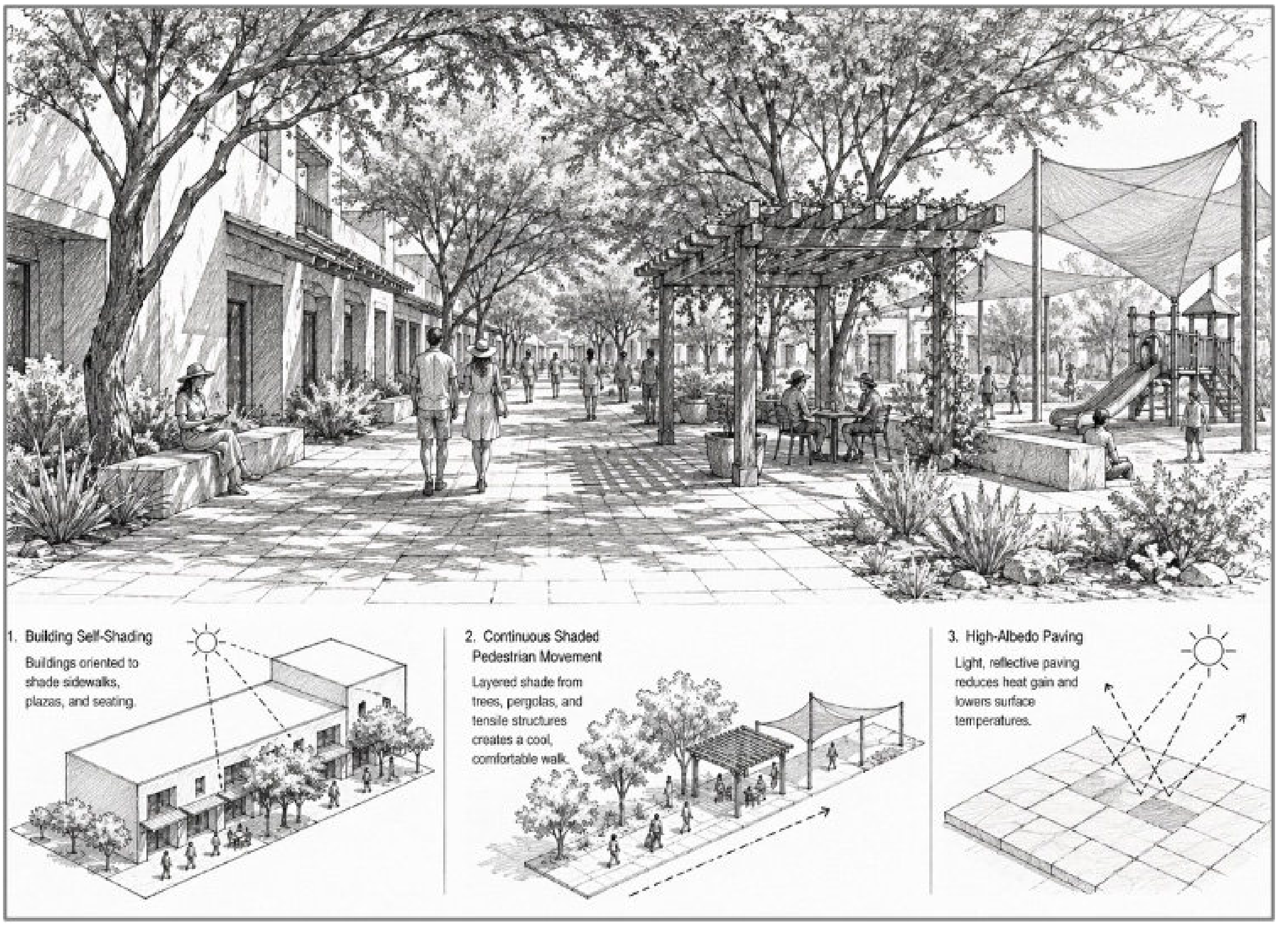
Key insight 4: Embed green, climate responsive elements within existing urban systems.

2.3 15 Arid & Semi-Arid Responsive Design Techniques

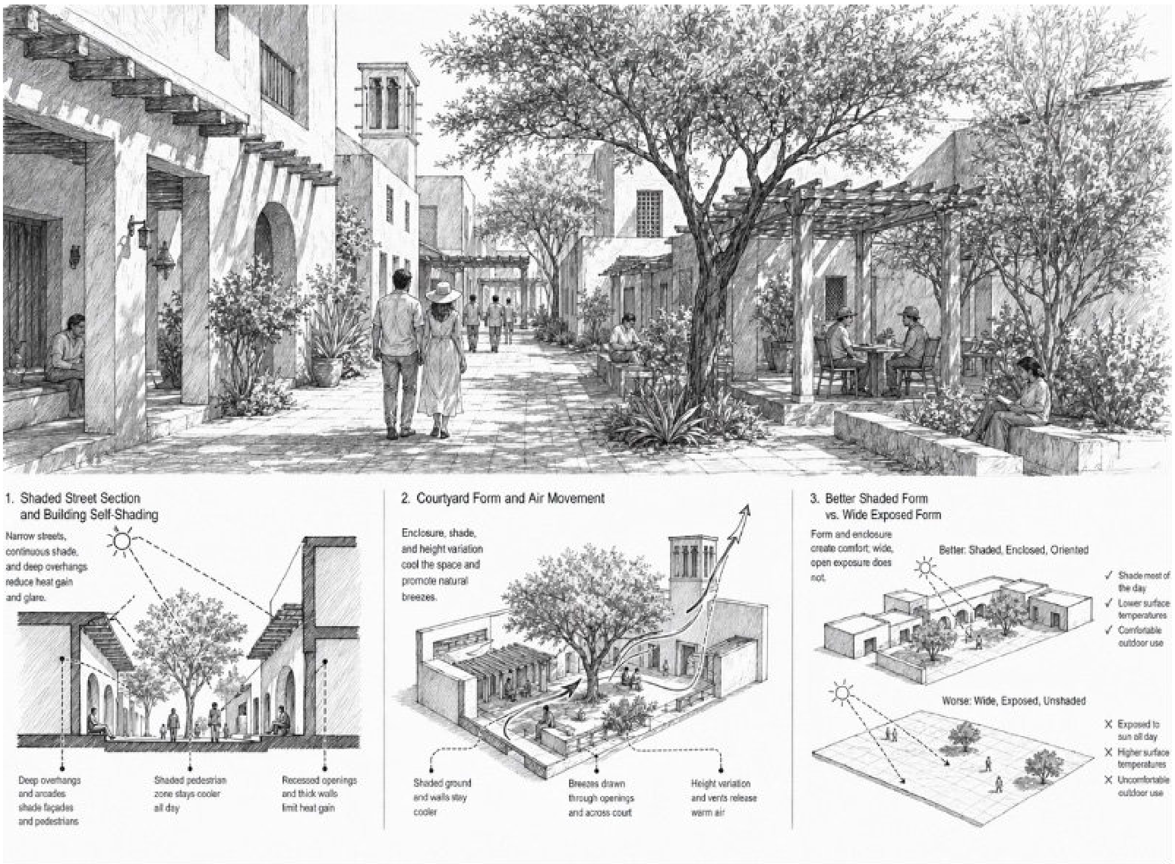
The fifteen design principles are the key practical ideas and techniques to develop summarized approach to what needs to be done to ensure that the design of open spaces are environmentally, socially, and ecologically viable while providing the benefits of use and function. These principles are achieved by ensuring that materials, plants and community participation are incorporated in the design. These elements are explained and referenced in relevant sections in this booklet.

These principles are interconnected – shade, moisture, soil, comfort, and governance work together to deliver equitable, climate resilient GUP.

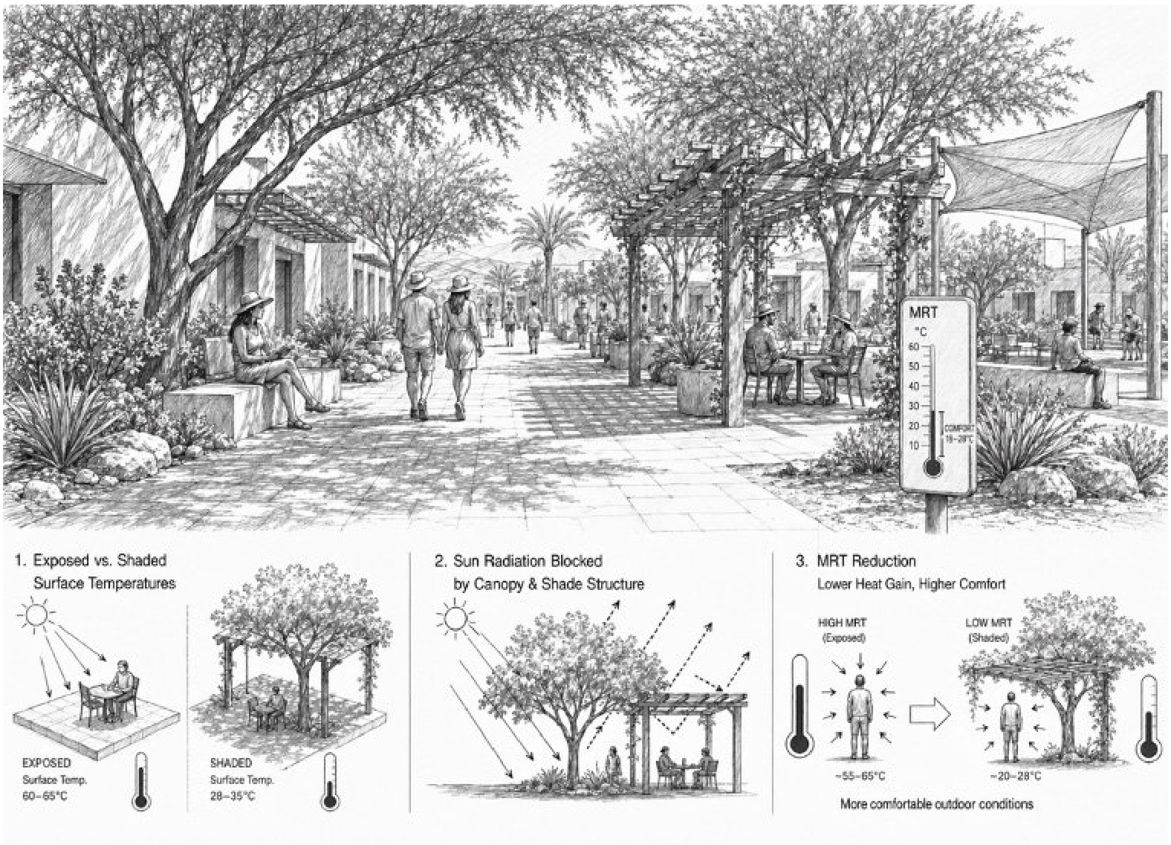
2.3.1 Shade first spatial planning



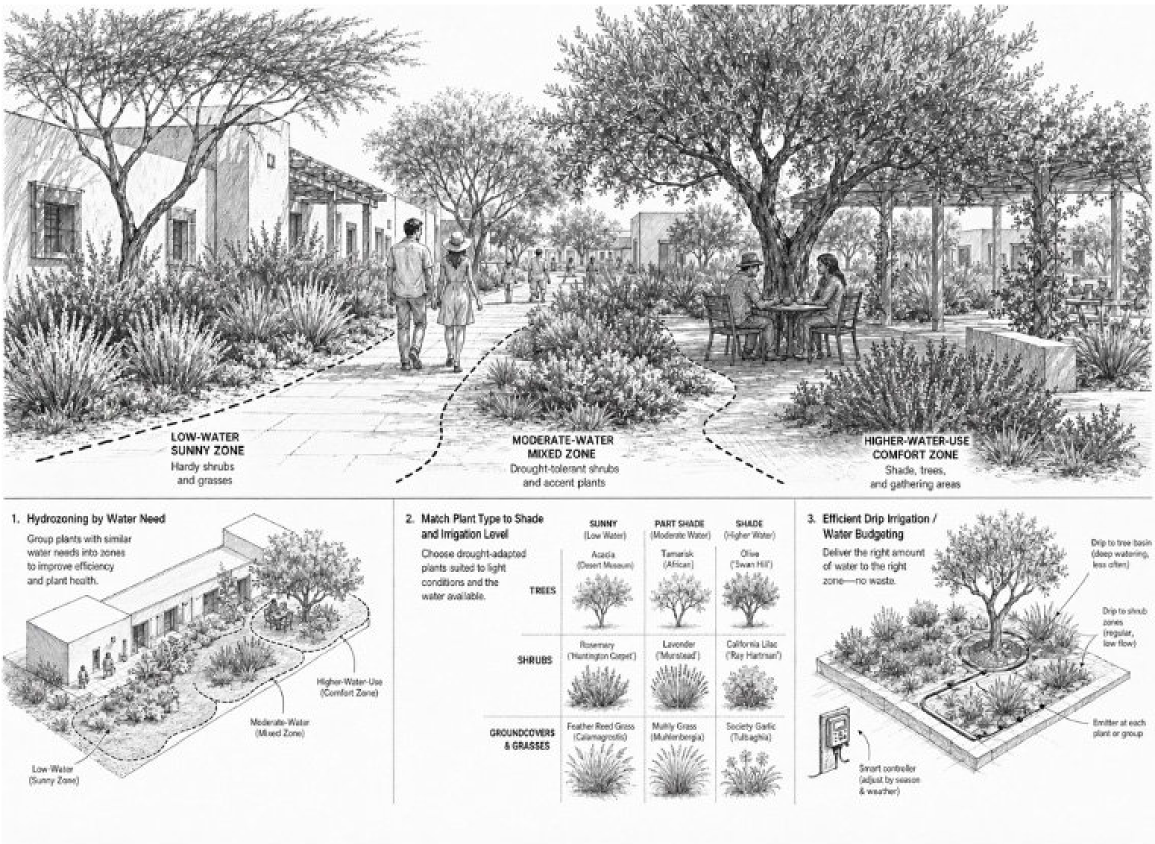
2.3.2 Thermal comfort by form, not only by planting



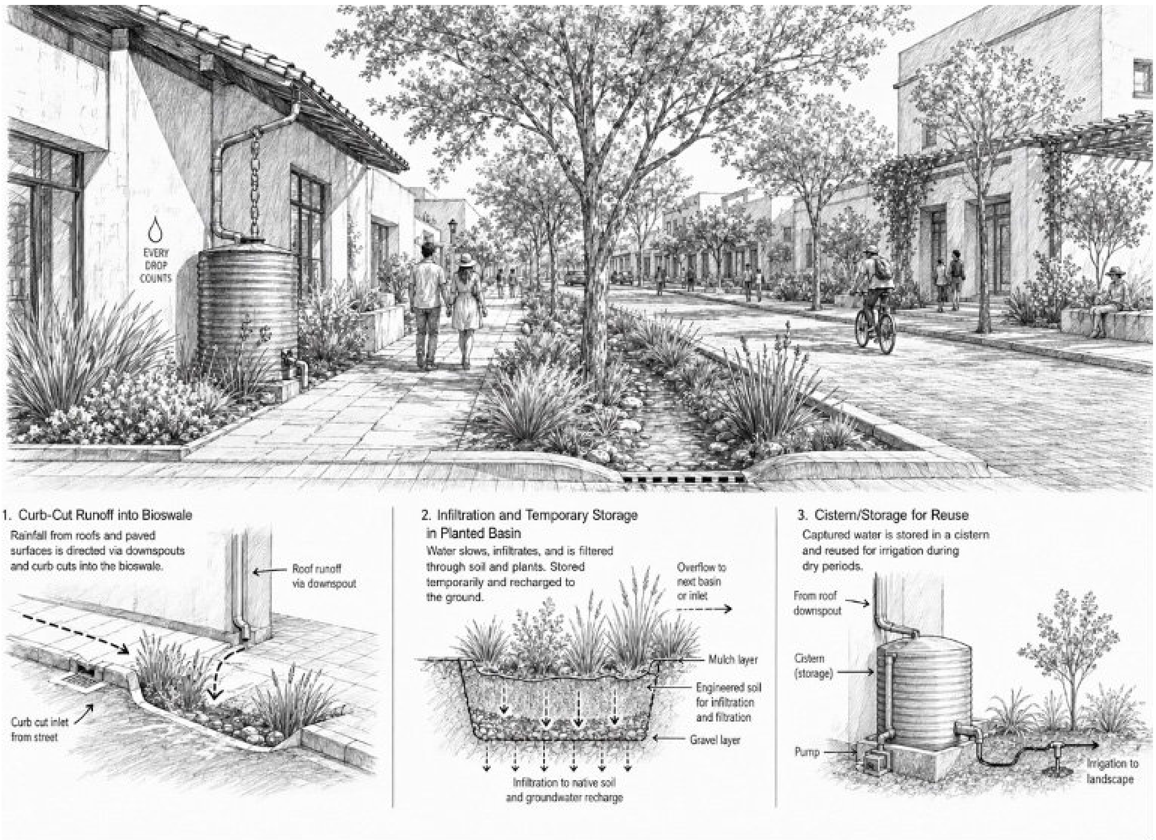
2.3.3 Reduce mean radiant temperature (MRT)



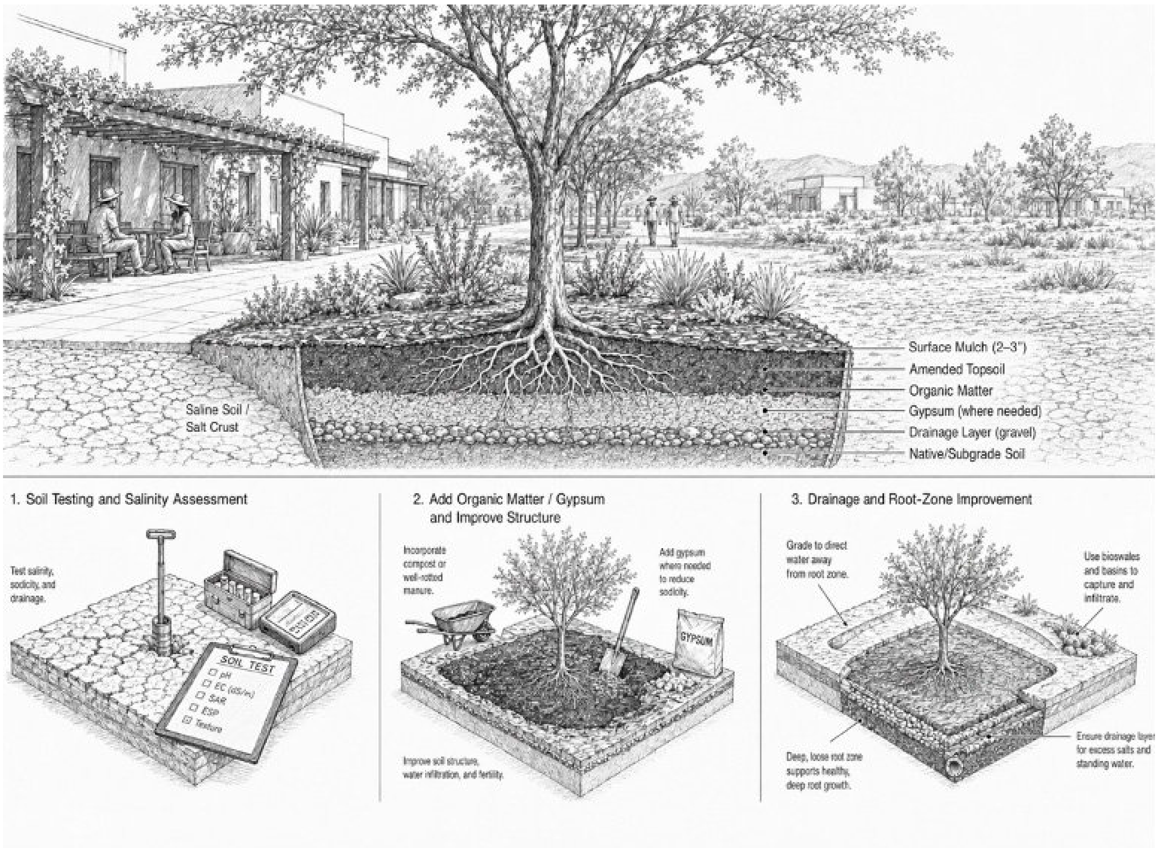
2.3.4 Water budgeting and “right plant, right place”



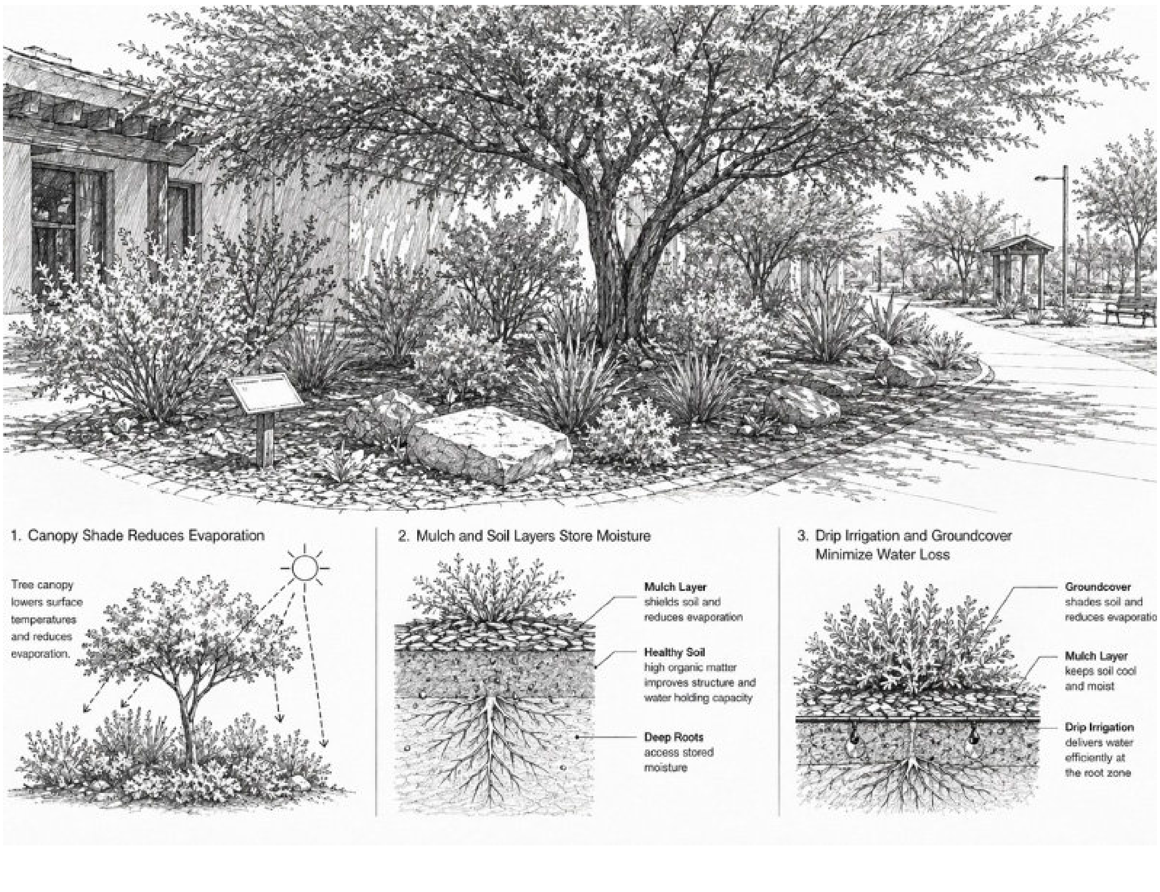
2.3.5 Capture, slow, and use water (blue green integration)



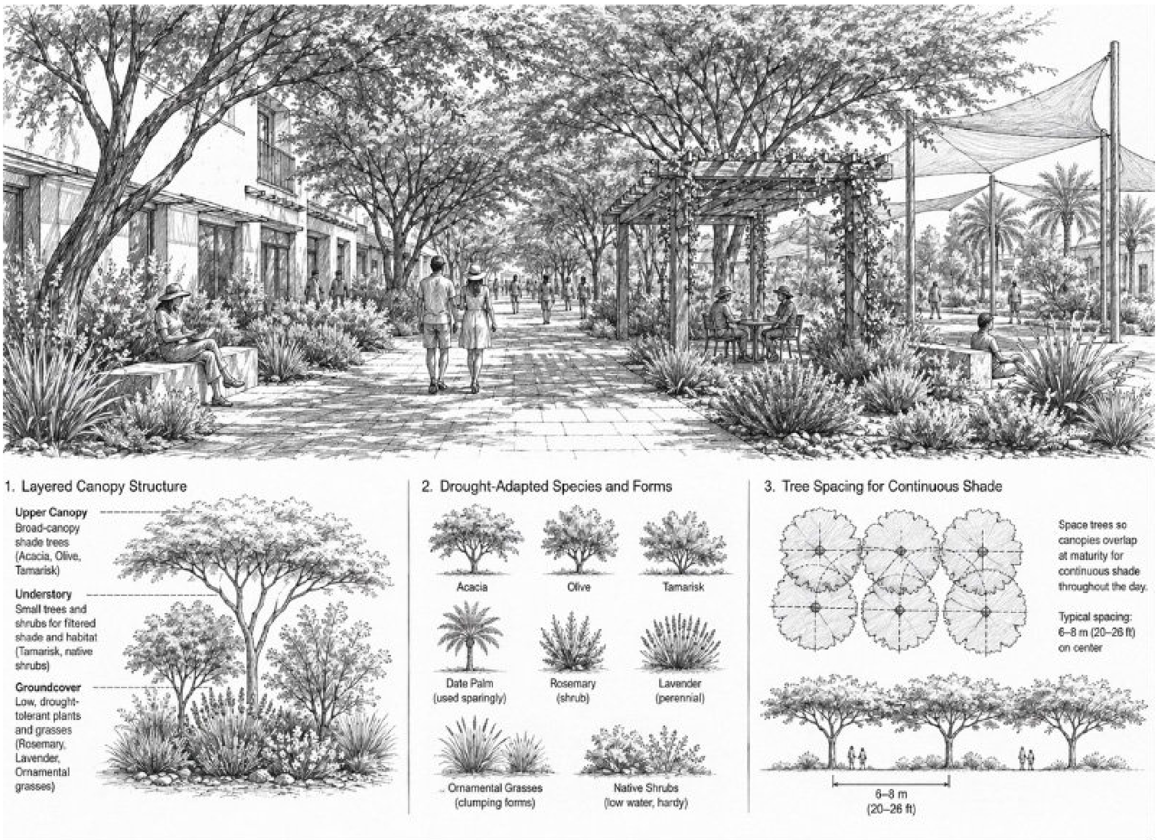
2.3.6 Soil first design (especially in saline contexts)



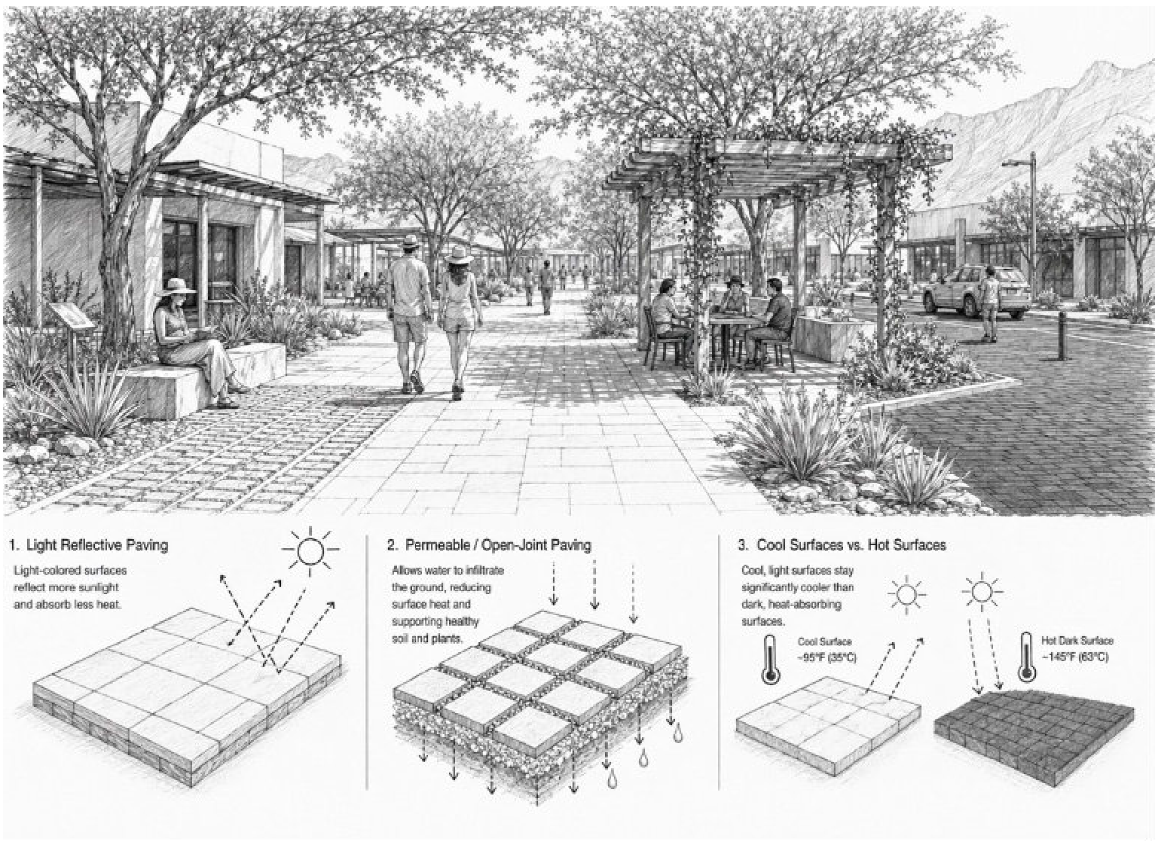
2.3.7 Evaporation control at every layer



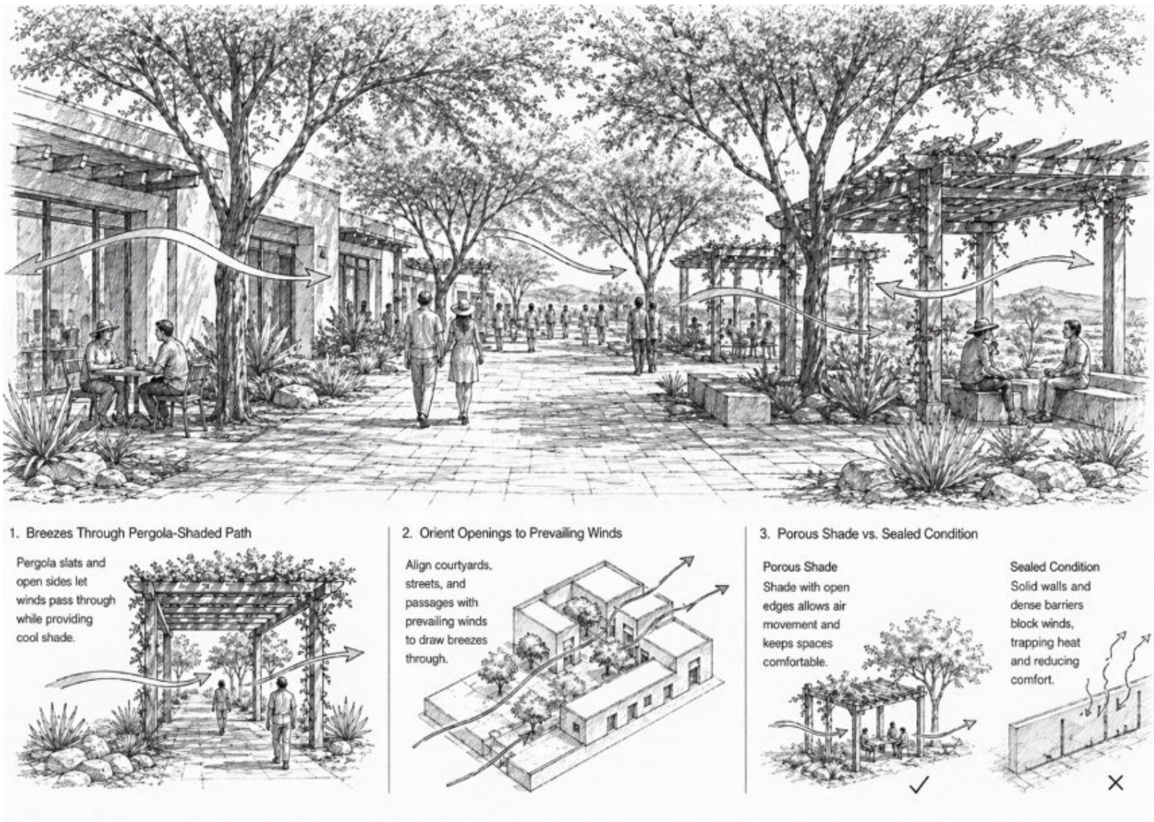
2.3.8 Climate adapted plant palettes and canopy strategy



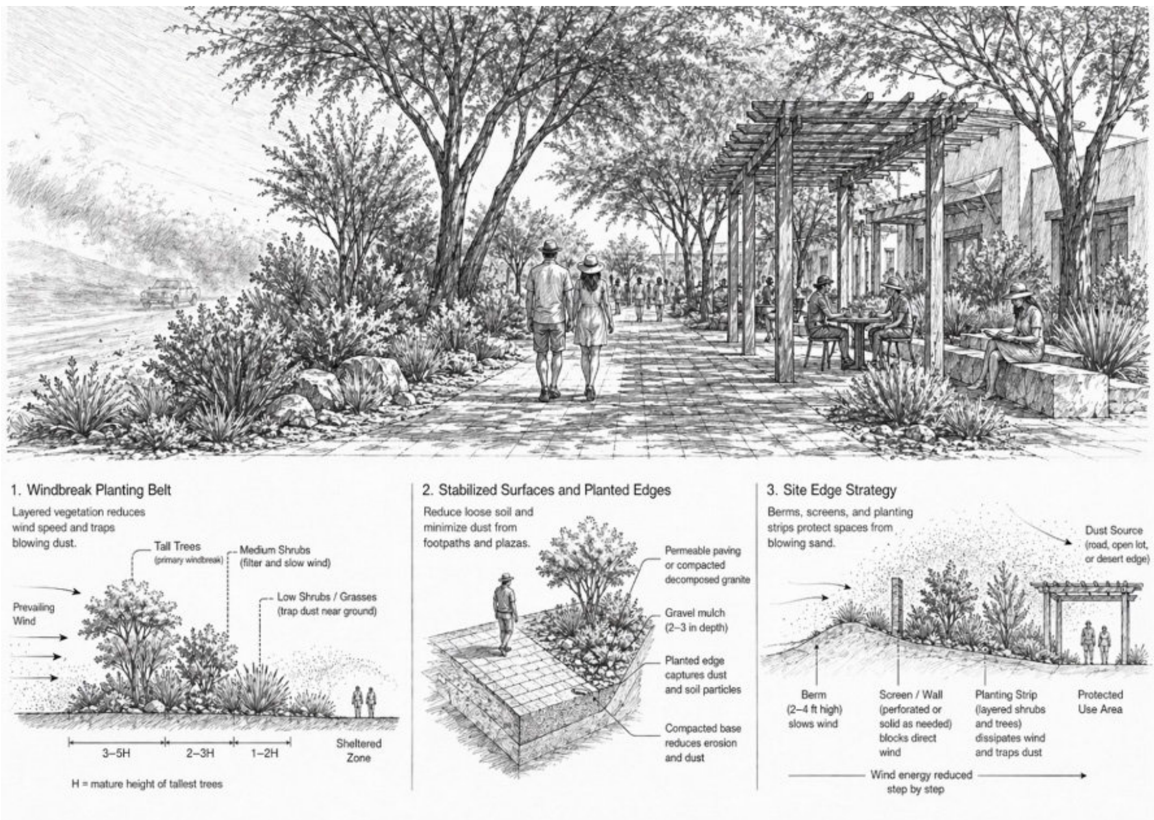
2.3.9 Materials and surfaces that stay cooler



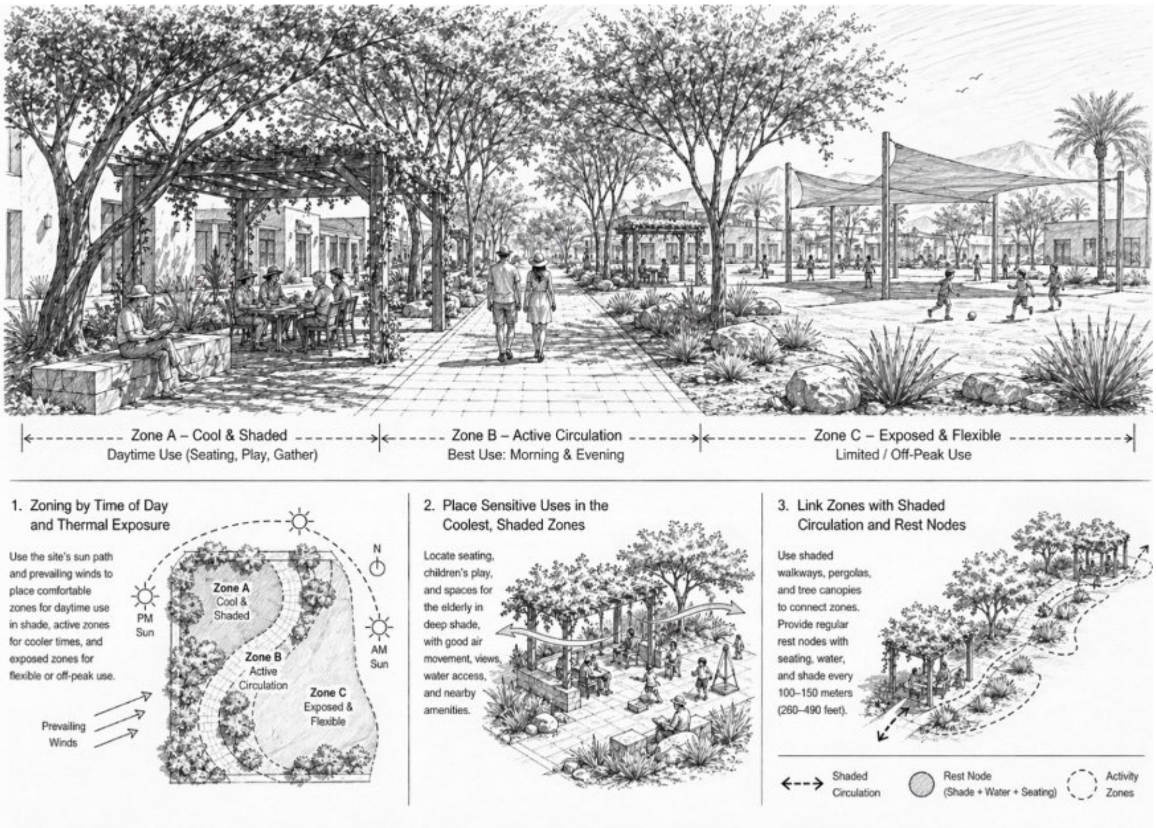
2.3.10 Balance ventilation and shade (don’t “seal” the site)



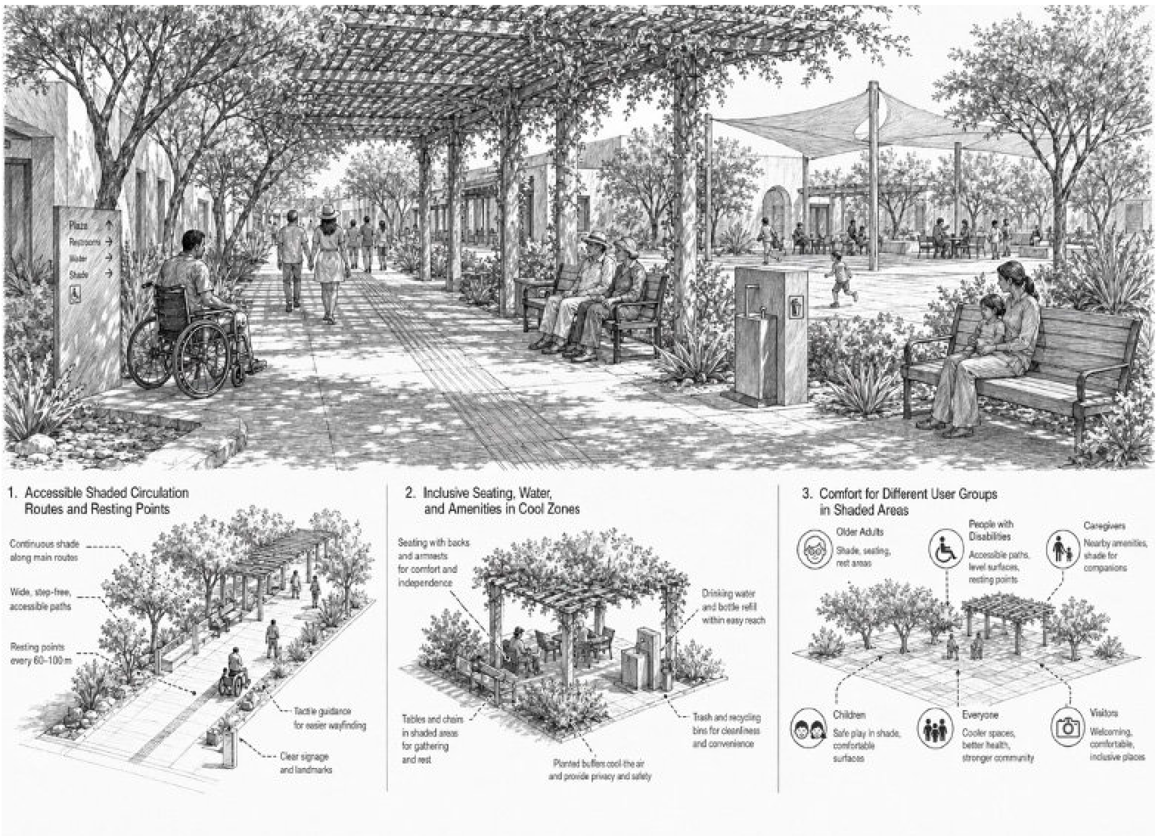
2.3.11 Dust and sand management



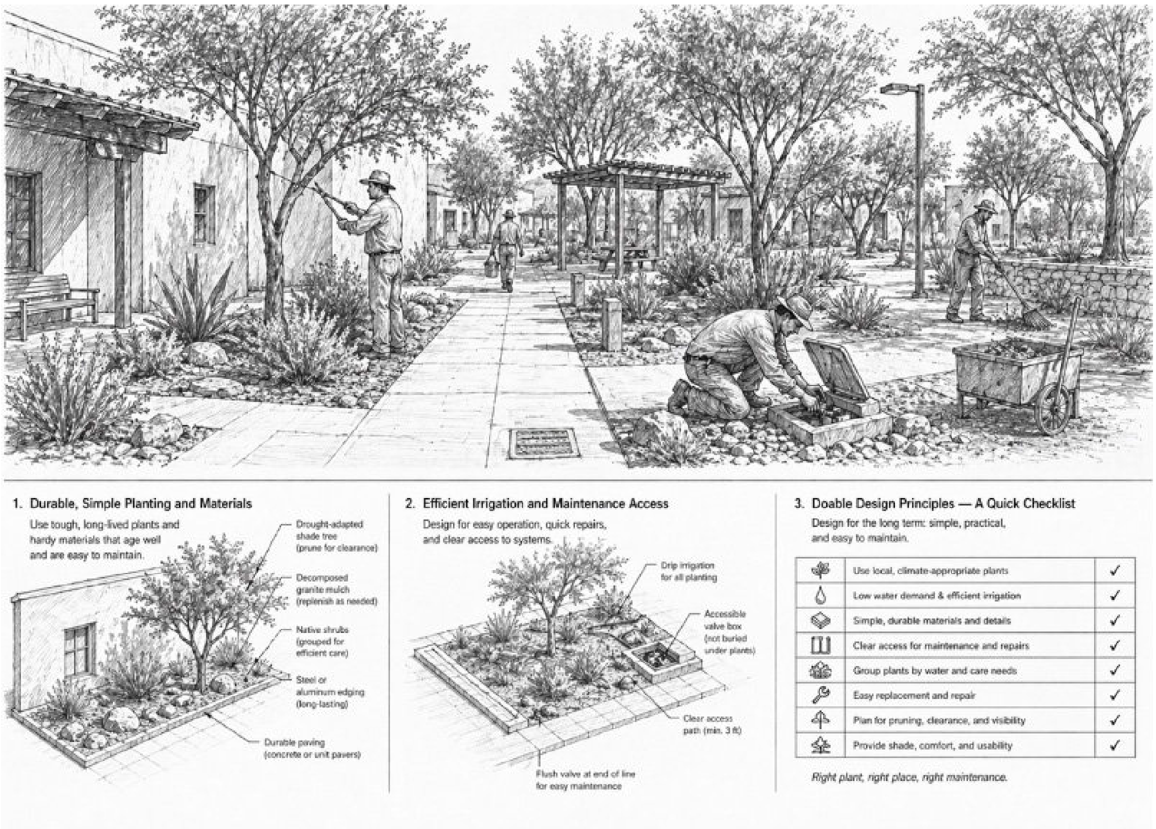
2.3.12 Functional zoning for heat safe use



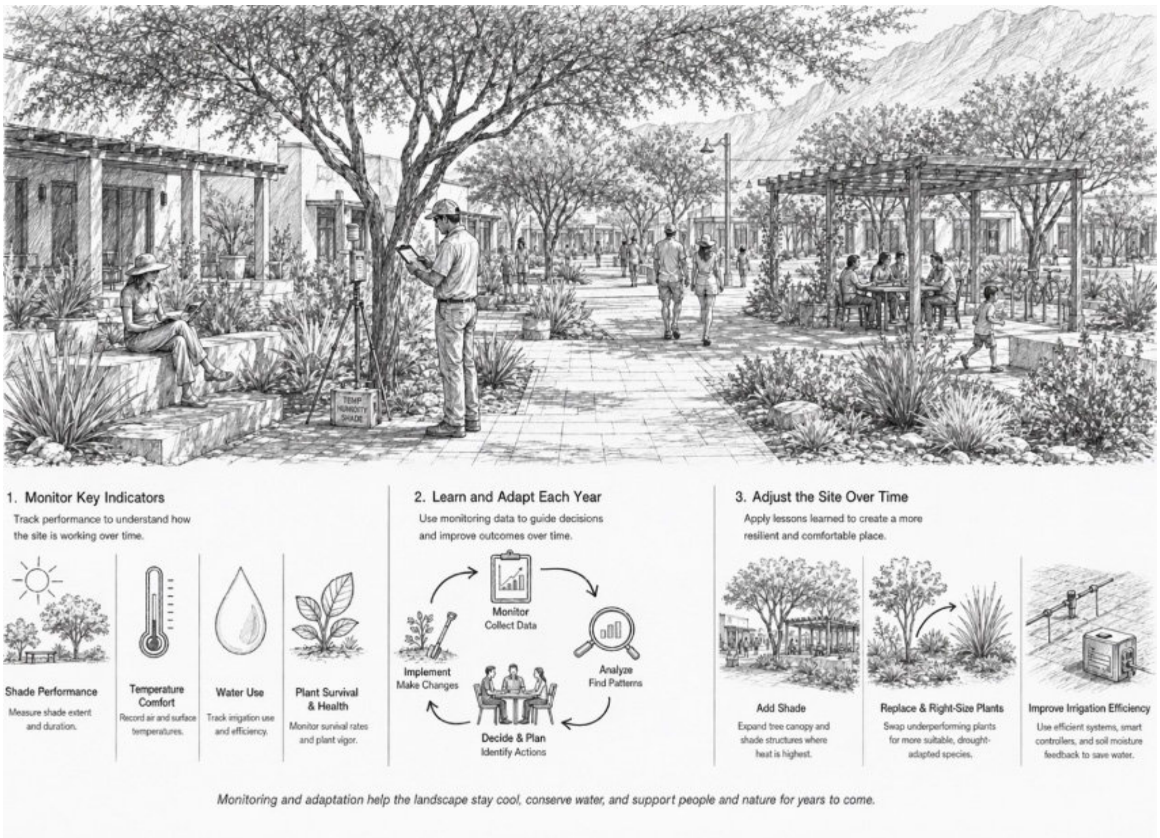
2.3.13 Equity and comfort for all users



2.3.14 Operations, maintenance, and "doable" design



2.3.15 Monitor and adapt over time



2.4 Functional Zoning for Outdoor Comfort

Functional zoning is a design approach for open space design that is very relevant to arid and semi-arid climates. It is the deliberate organization of a GUP into use areas (functions) based on:

- Who uses them (children, elderly, commuters, vendors, families, sports users),
- When they are used (morning / midday / evening / seasonal),
- How heat affects safety and comfort (sun exposure, radiant heat, hot winds, surface temperatures)
- what level of cooling support is needed (shade, breeze, water access, rest points).

In hot climates, zoning is not only "program planning"—it's heat-risk planning. You are essentially designing a comfort gradient across the site so that people can move, pause, recover, and socialize without dangerous heat stress while also ensuring lower environmental and ecological impact.

Key Insight: Put the most heat sensitive uses in the coolest microclimates, and the most heat tolerant uses in the hottest zones – while providing shaded connections between them.

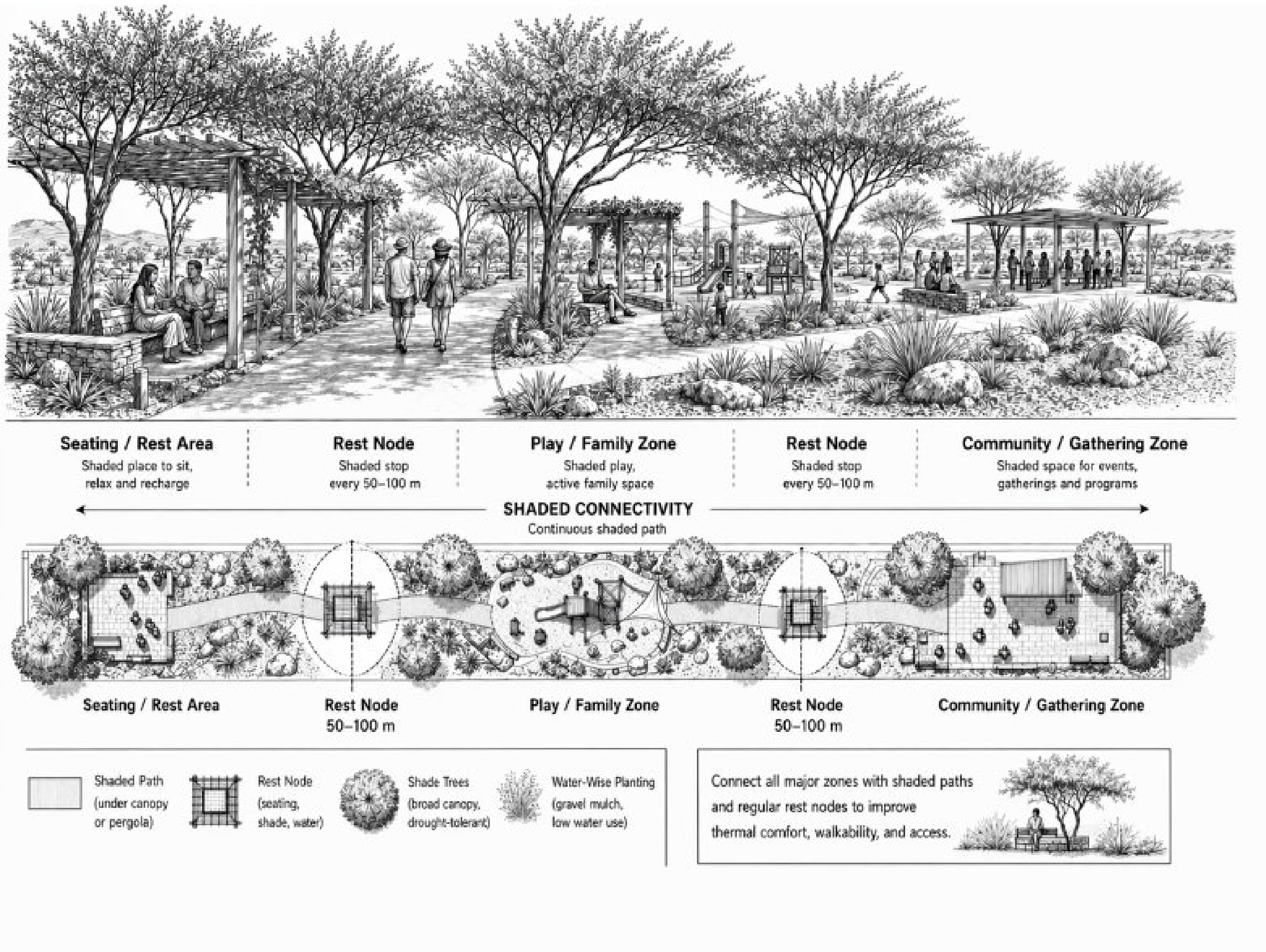
2.4.1 Match Function to Heat Sensitivity

The key principle of functional zoning is to match different activities on site to the relative vulnerability to heat. Usually, different activities have different levels of vulnerability to heat. Therefore, ensuring that activities are aligned with the measures that address different heat vulnerability levels allows for a better use and programing of the GUS. In other words, **functional zoning is a risk-based** arrangement on the site. The following table matches the different levels of heat sensitivity to uses and location to ensure better space use.

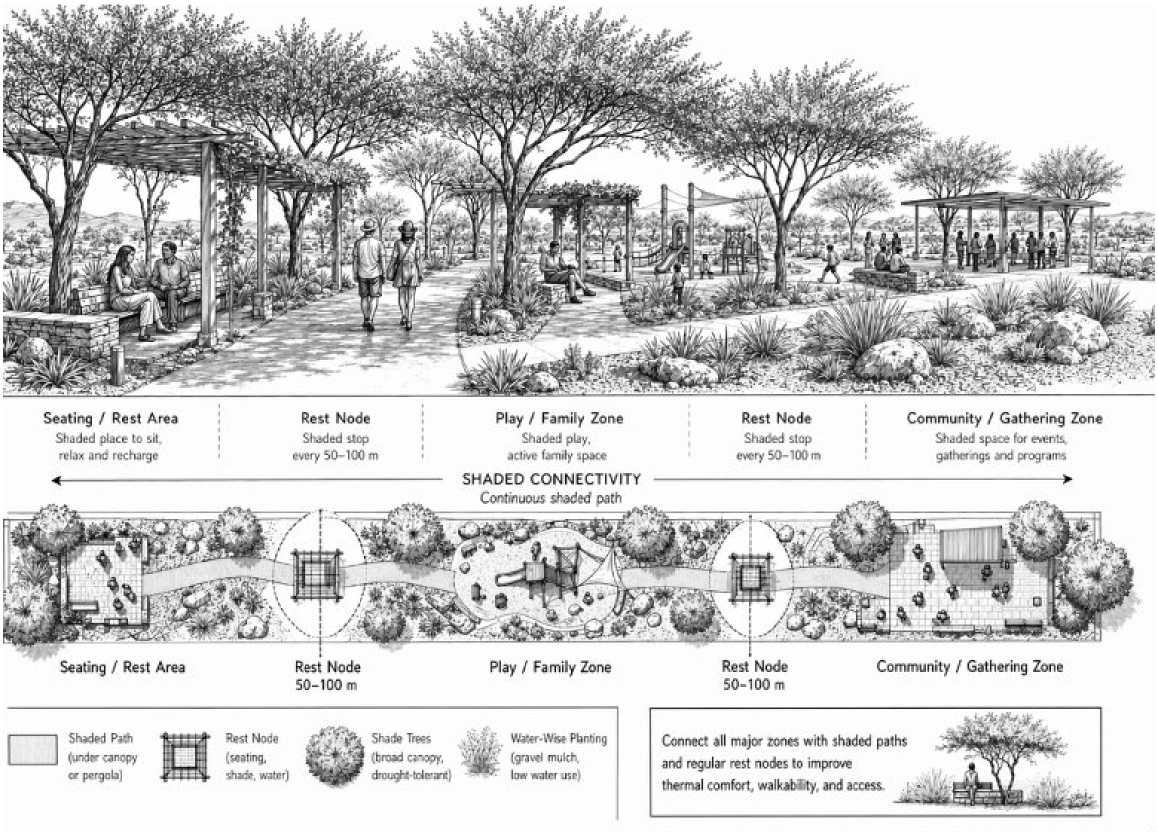
Sensitivity	Uses	Placement
High (must be in coolest zone)	Seating/waiting, children's play, elderly gathering, kiosks, entrances, transit, outdoor learning	Deep shade, cool surfaces, good airflow
Moderate (needs shade + breaks)	Walking paths, strolling, informal play, markets, exercise with shade intervals	Shaded connectors, rest nodes
Lower (can be warmer with controls)	Sports courts (best evening), event lawns (night use), flexible overflow spaces	Partial shade, night use emphasis

2.4.2 Functional Zoning Rules

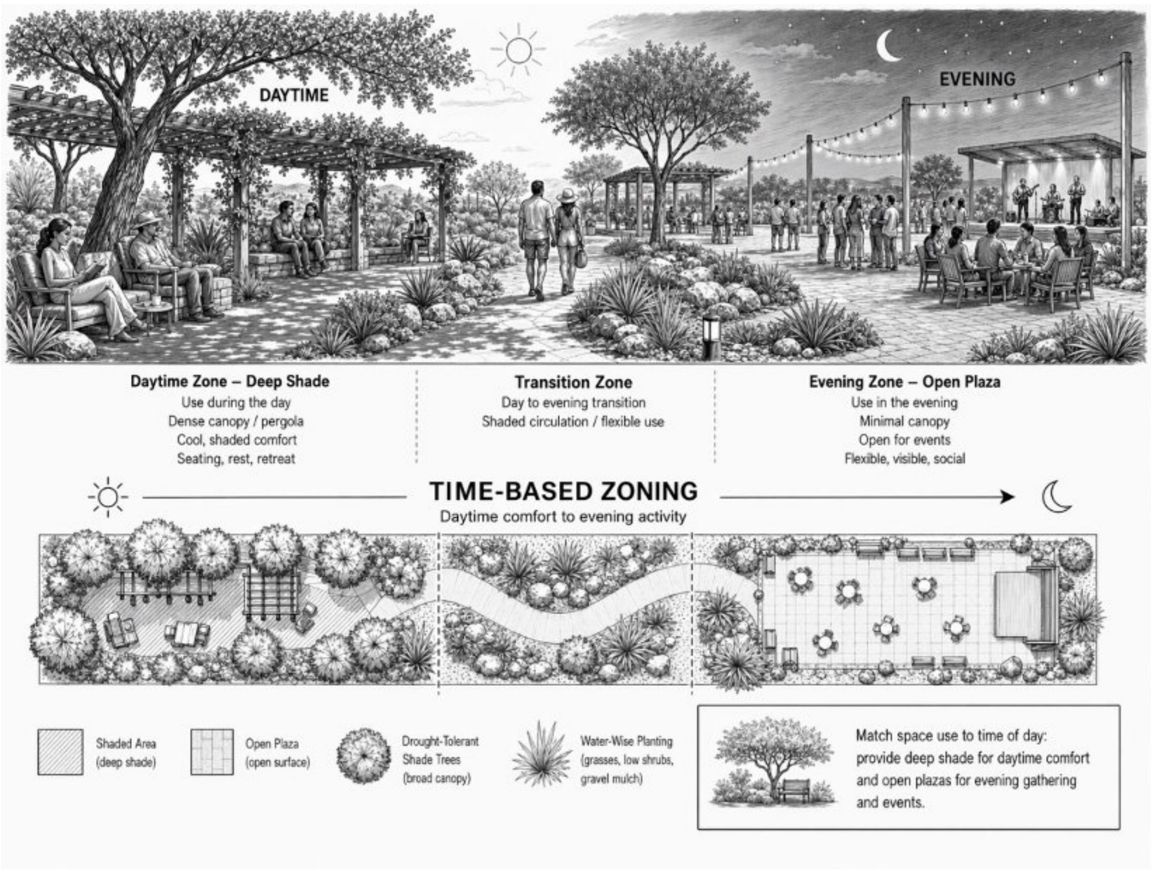
2.4.2.1 *Design comfort as a gradient –* provide deep shade, dappled shade, and night use open zones.



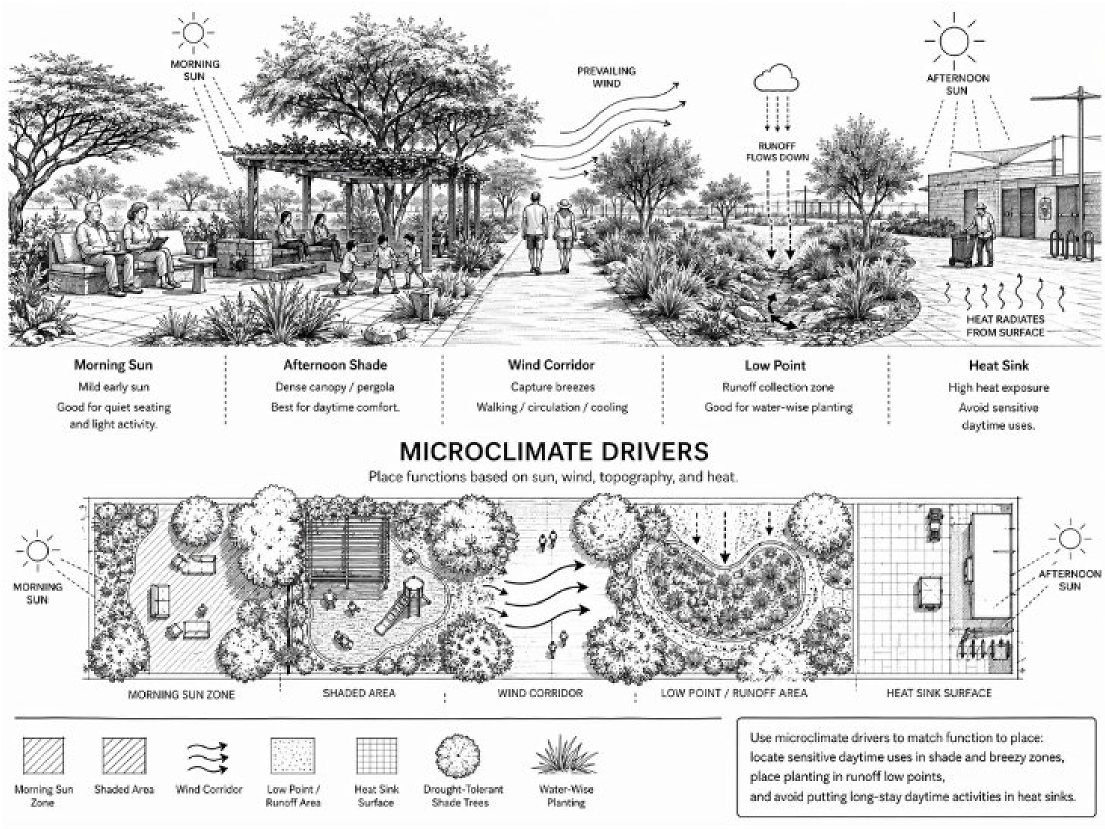
2.4.2.2 ***Provide shaded connectivity –*** connect all major zones with shaded paths and rest nodes every 50–100 m.



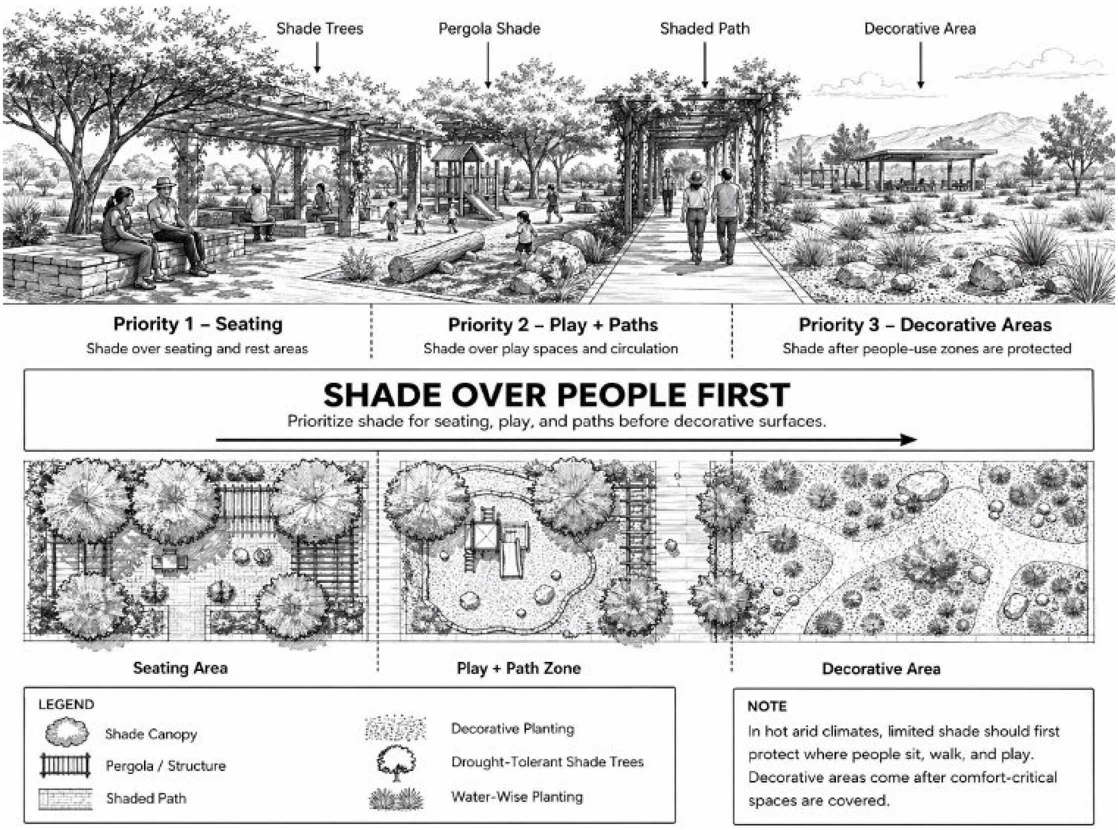
2.4.2.3 ***Time based zoning –*** daytime zones (deep shade) vs evening zones (open plazas, events).



2.4.2.4 ***Use microclimate drivers –*** place functions based on morning sun, afternoon sun, wind corridors, low points, heat sinks.



2.4.2.5 ***"Shade over people first, then over surfaces" –*** prioritize shade for seating, play, paths before decorative areas.



2.5 GUP design checklist

The GUP checklist provides a reference list to ensure that all components of the GUP design process are incorporated in the project design. The checklist **(Appendix 1)** is organized under eight key headings (listed below). Each heading includes several points to be accomplished to ensure that GUP design guidelines are followed and integrated into the design process. Once these points are completed it means that the designer has completed all necessary steps to achieve a GUP.

The full checklist is provided in **Appendix 1** and covers the followings headings. Each heading is referenced to its corresponding section in this booklet.

- Climate & Thermal Comfort (sections 2 and 3)
- Vegetation & Plant Strategy (Sections, 2, 3 & 5)
- Water Efficiency (Section 2, 3 & 5)
- Materials & Surfaces (Section 5)
- Nature-Based Solutions (Section 5)
- Functional Use & Zoning (Section 2 & 3)
- Community Participation (Section 4)
- Standards & Dimensions (Section 5)

Section 3: Site inventory and analysis

Site inventory is the process of collecting data and information about the current conditions of a site of location. The collected data can be obtained through visual observation, surveying, photography and/or measurement using specific digital or manual tools. This data is usually presented in map form to allow overlay analysis.

Site inventory is a decision-support tool. Its not meant to "collect everything," but to gather only what reduces uncertainty and improves choices (i.e. what to shade first, where to place water, which areas must be protected, what can be transformed). Inventory is evidence for trade-offs. Every GUP involves trade-offs (shade vs. visibility, trees vs. water budget, access vs. habitat). Inventory data helps justify priorities and defend them to stakeholders. It is a risk management tool that identifies constraints early (heat exposure, saline soils, utilities, social conflict, maintenance limits). Doing this prevents the design from failing during implementation or operation. Inventory analysis outputs should be "actionable". Each dataset should end in a clear implication: to do, to avoid, to prioritize, to phase, or to monitor.

3.1 Why site inventory matters for GUS Success?

Taking decisions that are responsive to site conditions and context avoids multiple missteps and ensures buy-in from different stakeholders. The following explains why a site inventory and analysis are critical for GUP design.

	Prevents climate-blind design	Without heat/shade/wind understanding, you can end up creating “green” spaces people avoid in summer.
	Improves long-term performance (not just opening-day aesthetics)	Inventory helps match planting, materials, and water systems to real conditions so the space thrives after year 1–3.
	Aligns design with operations and maintenance capacity	It reveals what can realistically be maintained (irrigation complexity, pruning frequency, litter loads, security needs).
	Builds credibility and buy-in	When community priorities and observed patterns are documented, design choices feel justified rather than imposed.
	Avoids costly redesign	Discovering utilities, drainage problems, or soil issues late triggers expensive changes; inventory reduces surprises.
	Supports equitable outcomes	It highlights who is currently excluded (lack of access, unsafe edges, heat exposure) and where benefits should be targeted first.

3.2 The "Decision Chain" from goals to design

The following provides a step-by-step process to ensure the usability and impact of a site inventory. The inventory and what to collect is tied to the objectives of the GUP project and final design outcome.

	Define the goal in measurable terms	Example goals: “reduce peak heat exposure,” “increase usable hours,” “cut irrigation demand,” “increase tree survival.”
	Convert goals into key questions	“Where is heat worst?” “When are people present?” “Where does water collect?” “Which soils can support trees?”
	Identify only the data that answers those questions	Collect minimum sufficient data (targeted, not exhaustive): shade gaps, wind corridors, surface materials, water sources, user flows.
	Translate data into design implications	Each finding becomes a design rule: “High heat zone” → prioritize shade-first canopy + cool paving “High heat zone” → prioritize shade-first canopy + cool paving “Low water budget” → non-lawn typology + drought-adapted palette
	Make decisions visible through maps and priorities	Heat maps, shade gap maps, conflict/opportunity maps turn information into clear spatial choices.
	Validate with stakeholders	Quick review sessions ensure the design logic matches lived experience and reduces implementation conflict.

3.3 Typical Objectives of Site Inventory

Objectives for a project depend on several components and include finance, convenience, capacities, climate and environment. The following table provides some examples of objectives for GUP.

Objective	What It Addresses
Climate responsiveness	Microclimate: heat, shade, wind – place shade, seating, paths to reduce heat stress.
Water efficiency	Match planting, soils, irrigation to available water and drainage – minimise demand, enable harvesting.
Social use & equity	Who uses the site, when, barriers – design for diverse users fairly.
Ecological performance	Existing vegetation, habitat value, soil health – protect assets, enhance biodiversity.
Quality of spatial design	Circulation, edges, visibility, spatial structure – create legible, safe, attractive places.

3.4 Site Inventory information checklist

To be able to develop GUP designs in arid and semi-arid contexts, several layers of information and data are required to develop informed decisions on site. These include data and information layers that relate to Climate responsiveness; water efficiency; social use and equity; and Quality of spatial design.

These layers are proposed for any project to support design decisions for GUP, but some layers may not apply to the specific context and site location proposed for any project. Keep inventory lean, relevant, and implementation-oriented and only select relevant layers that support decision making for your design. If it doesn't change a decision, don't collect the information.

The following table provides a summary of the data layers that need to be collected for each project **Appendix 3** provides a detailed listing, purpose, and tools to collect the data in map format.

Theme	Data Layers & information	Why it matters
A) Climate responsiveness (heat, shade, wind) **Purpose:** Guides where comfort interventions matter most and how to harness/block wind. **Design implications (examples):** Shade-first zoning, canopy targets, pergolas/trellises, windbreak placement.	**A.1** Identify hot spots & cool opportunities	Finds shade gaps, heat-storing surfaces, quick wins for microclimate.
	A.2 Map shade by time/day/season	Places seating/paths/play where shade is needed most.
	A.3 Understand wind exposure & comfort	Uses wind for cooling when helpful; blocks dust/gusts where harmful.
	A.4 Assess solar orientation & radiation load	Determines where shade-first structures/trees are essential.
B) Water efficiency **Purpose:** Ensures GUS works within water budgets and soil constraints; reduces failure and O&M burden. **Design implications (examples):** Hydro-zoning, efficient irrigation layout, capture runoff to basins, minimize turf/mulch use.	**B.1** Assess water sources & reliability	Confirms availability (potable/non-potable), interruptions, storage/pumping constraints.
	B.2 Understand runoff, drainage, infiltration	Identifies where bioswales/rain gardens/permeable surfaces will work.
	B.3 Evaluate soil moisture capacity & salinity risk	Prevents plant mortality from poor soils/salt stress and over-irrigation.
	B.4 Estimate irrigation demand & maintenance intensity	Drives typology selection (non-lawn, hydro-zones) and "high-care" placement.
C) Social use & equity **Purpose:** Ensures the space serves real users fairly (comfort, safety, access), not an imagined population. **Design implications (examples):** Shaded nodes near edges, inclusive seating, shaded walking loop, equitable distribution of shade/services.	**C.1** Document users, times, activities	Prevents misalignment between design and actual behaviour.
	C.2 Identify barriers to access	Captures heat exposure on routes, unsafe crossings, lack of ramps, exclusion patterns.
	C.3 Map comfort & conflict zones	Reveals avoidance areas and points of crowding/conflict for design fixes.
	C.4 Understand gender/age-sensitive needs	Supports inclusive amenities (visibility, safety, seating, toilets, stroller access, quiet areas).
D) Ecological performance **Purpose:** Protects functioning ecology, improves resilience, and reduces long-term resource inputs. **Design implications (examples):** Native/climate-adapted species, layered habitat	**D.1** Baseline vegetation & habitat value	Identifies what to protect/enhance/replace; avoids unnecessary loss.
	D.2 Connectivity potential	Links site to corridors (river edges, street trees) to extend benefits beyond boundaries.
	D.3 Soil health & compaction	Prevents planting failure and reduces watering demand by addressing soil limits.
	D.4 Invasive species/pest risks	Avoids palettes that increase ecological harm and management load.
E) Quality of spatial design **Purpose:** Improves legibility, comfort, safety, and usability through human-scale and performance-informed layout/materials. **Design implications (examples):** Re-align paths to desire lines, shade at pause points, cooler paving, reduce glare, clarify thresholds (entry →core).	**E.1** Spatial structure & legibility	Maps desire lines, gateways, edges, dead zones to guide layout improvements.
	E.2 Functional relationships	Ensures circulation connects logically to shade, seating, play, services, and adjacent uses.
	E.3 Human-scale comfort	Addresses enclosure, shade continuity, lighting, visibility to encourage staying.
	E.4 Materials & surface performance	Controls heat storage, glare, slip risk, dust, reflectivity for comfort and safety.

3.5 Site Diagnosis Sheet

The site diagnosis sheet is designed to allow any municipality team to ask the right questions in regards to their planned project. It allows the user to define key objectives and have a very initial and preliminary assessment for the feasibility of any GUS project that may be planned.

The diagnosis sheet includes five key sections:

- Purpose and instructions pages
- Project Brief
- Existing Conditions
- Environmental Dimensions
- Implementation Considerations.

The diagnosis sheet is not meant to be comprehensive or replace the detailed collection of information on site and from the community. But rather, and after filling out, it is intended to give the municipality a good idea if the project is feasible and will deliver sufficient benefits. Some of the information can be collected by visits to the site, others may require meetings with the community or official offices and departments. The Diagnosis sheet is provided in **Appendix 2** of this document in English and Arabic.

Section 4: Community participation

4.1 Importance of Participation

Community participation is an important step in a GUP project development. Participation highlights people as data sources and communities as co-designers. Local community members are "living sensors" who hold day-to-day knowledge such as hot or comfortable locations, safe zones and access points.

Co-designed spaces tend to be used more, maintained better, and adapted over time because community members understand the logic of the design and that leads to long term sustainability. The following eight points explain the relevance of community participation.

Reveals invisible needs and patterns: Residents know when and where the space is usable (e.g., morning vs. evening use, women/children's comfort, unsafe corners, informal paths).

Improves climate performance: Users point out actual hot spots, glare zones, wind corridors, dust issues, and shade deficits—critical for "shade-first" planning.

Aligns design with water reality: Community and maintenance teams clarify irrigation feasibility, water interruptions, acceptable planting types, and what will be maintained.

Builds ownership and reduces conflict: When people help define priorities, they're more likely to protect the space, accept trade-offs, and reduce vandalism or misuse.

Increases equity and access: Participation highlights who is excluded (elderly, people with disabilities, low-income users) and what barriers exist (distance, fear, lack of shade/seating).

Strengthens safety and comfort: Local knowledge identifies unsafe areas, poor lighting, harassment risks, and visibility needs—often missed in technical surveys.

Creates better long-term governance: It helps define roles: who manages, who reports problems, what rules are acceptable, and what community stewardship is realistic.

Makes decisions defensible: Documented community input supports municipal approvals, funding arguments, and transparent prioritization.

4.2 Preparation essentials

Preparation is a key for successful participatory activities. The following are key points to consider in the preparation process.

- Understand your audience
- Have clear objectives for the participatory activity such as define uses, identify conflict, or test ideas
- Ensure to have a diversity of age groups and stakeholders
- Conduct exercise in different formats to ensure that pattern emerge from different groups
- Use several activities for verification of data.
- Engage stakeholders as they are part of the discussion

4.3 Tools Introduced

While there is a plethora of participatory tools the four introduced here are relevant to the Libyan context. They are listed in the table below and explained in the following sub-sections

Tool	Purpose
Participatory Mapping	Community identifies hot spots, unsafe areas, favorite spaces
Games & Visual Tools	Priority ranking
Focus Groups	Women, youth, elderly, vendors
Community Meetings	Validation of findings

4.3.1 Participatory Mapping

Definition: A structured mapping activity where community members locate experiences on a map (heat, comfort, safety, use patterns). It turns "opinions" into spatial evidence.

Best used for (what it captures well)

- Heat/comfort hotspots: where people avoid staying, where shade is missing, where surfaces feel hottest
- Safety & fear geography: poorly lit corners, conflict points, harassment zones, blind spots
- Favorite places & social anchors: where people naturally gather, sit, play, wait, sell
- Movement patterns: desire lines, shortcuts, bottlenecks, key crossings, queues
- Equity gaps: who uses what spaces, and who avoids them (women, elderly, youth)

Outputs you can use immediately in design

- A "priority heat map" of where shade-first interventions should start
- A "safety risk map" to guide lighting, visibility, and edge activation
- A shortlist of quick-win sites (shade at entrances, crossings, queue areas)

Tools (what to use and when)

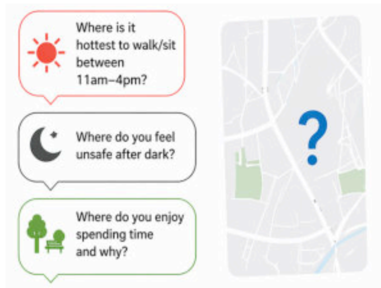
- Best low-tech: large printed map + stickers + markers + camera to document
- Best digital (fast): Google My Maps (pins + comments + photos)
- Best structured field platform: KoboToolbox / ArcGIS Survey123 (geotagged forms + photos)
- Best analysis: QGIS/ArcGIS to digitize and overlay results with site data (shade, LST, land use)

How to use participatory mapping (practical steps)

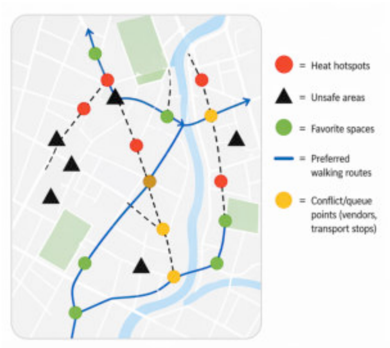
1 Prepare a base map (choose one)

- A0/A1 printed aerial photo OR a simplified line map with landmarks
- Make sure it has north arrow, scale, and key reference points (mosque, school, bus stop)

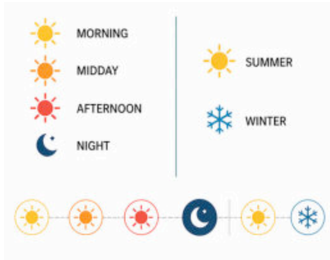
2 Set clear mappping questions (keep to 3-5)



3 Use a simple legend (color + shape)

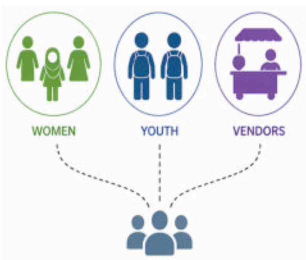


4 Add the time dimesion



Ask people to label: morning / midday / afternoon / night and summer vs winter

5 Triangulate quickly (reduce bias)



Repeat with atleast 2-3 differnt groups

6 Convert to design "priority zones"

Count frequency: hotspots mentioned by many participants become priority interventions

4.3.2 Games & Visual Tools: Priority Ranking

What is it?

A quick voting exercise where participants allocate limited "votes" to interventions or needs.

Best used for (what it captures well)

- Deciding what to do first (shade vs seating vs lighting vs water)
- Comparing priorities across groups (women vs youth vs vendors)
- Building transparent justification for municipal decisions

Outputs you can use immediately in design

- Ranked list of interventions + group differences (useful for equity and phasing)
- Best tools
- Manual: Stickers/dots + cards (most reliable in low-tech settings)
- Digital: Mentimeter / Slido (useful in larger meetings, if connectivity is stable)

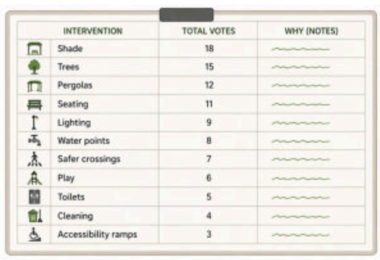
How to use Games & Visual Tools (practical steps)

1 Prepare cards with interventions

2 Give each participant 5 dots (or 10 points).

3 Ask them to vote twice

4 Record results on a simple chart



INTERVENTION	TOTAL VOTES	WHY (NOTES)
Shade	18	
Trees	15	
Pergolas	12	
Seating	11	
Lighting	9	
Water points	8	
Safer crossings	7	
Play	6	
Toilets	5	
Cleaning	4	
Accessibility ramps	3	

4.3.3 Focus Groups (Women, Youth, Elderly, Vendors)

What it is

Small group sessions (6–10 people) designed to elicit detailed needs from specific user groups.

Best used for

- Understanding barriers to use (fear, harassment, mobility limits, cultural norms)
- Capturing time-specific use (women evenings, vendors mornings, youth afternoons)
- Identifying design details that matter (visibility, seating type, shade quality, toilets)

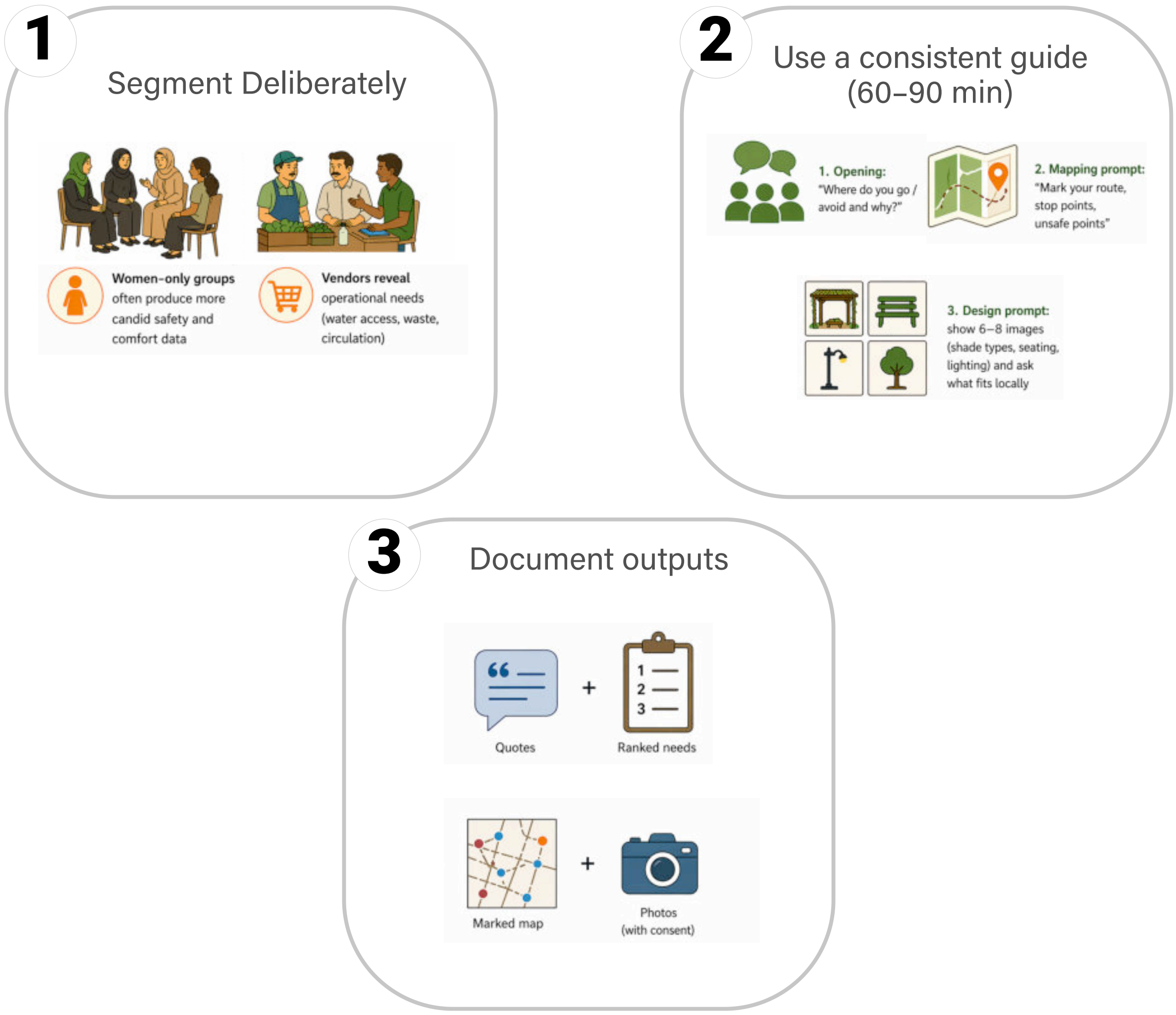
Outputs

- Group-specific requirements (e.g., elderly: seating every 50–70m in shade; women: lighting + clear sightlines; vendors: service access + waste)

Best tools

- Printed maps + photo prompts + simple ranking sheet
- Audio recording (only if culturally appropriate and with consent)

How to use Focus Groups (practical steps)



4.3.4 Community Meetings (Validation of Findings)

What it is

A broader public forum to present what was learned and confirm it is accurate before final design.

Best used for

- Validating the participatory findings ("Did we get this right?")
- Reducing resistance by showing decisions are evidence-based
- Agreeing on phasing and roles (municipality, community, maintenance)

Outputs

- Validated priority maps and accepted phasing
- A documented "decision trail" (important for donors and governance)

Best tools

- Posters (maps + options) + dot voting
- QR form (Google Forms) for fast, trackable feedback

Community Meetings (practical steps)

4.3.5 Photo Page

Participatory Mapping

Visual Tools

Focus Group and Comity

Section 5: Landscape plant, materials and Nature-based solutions examples

5.1 Landscape Hard Materials

This section provides practical and applicable application of landscape hard and plant material and present some applicable Nature-based Solutions (NbS). These guidelines are specific of GUP for arid and semi-arid climates.

The three sections provide on the importance of each theme, best options to apply, how to use and what to avoid. This is specifically applicable to plant and surface matherials. NbS are presented as examples that integrate all the above with a special focus on sustanable water management practices, protection against natural elements and integration into GUPs.

Surface materials play a critical role in outdoor thermal comfort, particularly in hot climates affected by the urban heat island (UHI) effect. Dark, impervious surfaces absorb and store heat during the day and re-radiate it later, increasing surface and air temperatures and reducing usability of public spaces. In contrast, light-colored, permeable, and vegetated materials reflect solar radiation, reduce heat storage, and support cooling through evaporation. These choices directly influence mean radiant temperature (MRT), a key driver of human comfort. When integrated with shade and planting strategies, appropriate surface materials can significantly mitigate heat stress and improve the performance and usability of Green Urban Places.

5.1.1 Why special consideration of materials

- **Thermal comfort and safety:** In hot climates, materials can reach dangerous surface temperatures and increase mean radiant temperature (MRT). Choosing cooler, non-glare, shaded-compatible materials directly reduces heat stress and burn risk.
- **Water efficiency and evaporation control**: Material choice affects how much water is lost to evaporation and runoff. Permeable, mulched, and soil-friendly surfaces support infiltration and reduce irrigation demand compared to large exposed hardscape or turf.

Why special considertion of materials ?

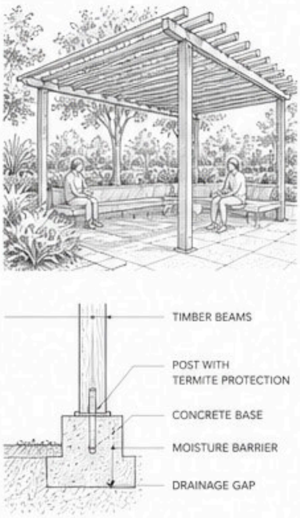
- **Durability under harsh climate stresses:** Arid and semi-arid contexts bring intense UV, large temperature swings, dust abrasion, and (in coastal areas) salinity and corrosion. Materials must withstand these conditions to avoid rapid cracking, warping, fading, or failure.
- **Maintenance practicality and life-cycle cost:** Some finishes look good initially but clog, stain, glare, or degrade quickly in dusty environments. Selecting robust, easy-to-maintain materials lowers long-term costs and keeps spaces functional.
- **Usability, accessibility, and equity:** Materials influence walkability (slip resistance, glare, dust), accessibility for wheelchairs/strollers, and comfort for vulnerable users (children, elderly). The right materials help ensure the GUS is usable year-round and by everyone.

5.1.2.1 Pergolas and shade structures

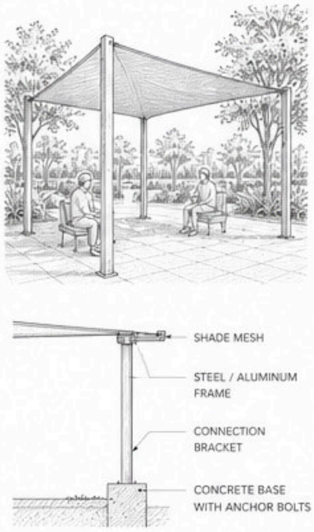
WHAT THEY DO

They reduce solar radiation (MRT), often the biggest driver of discomfort. In arid climates, shade is the priority.

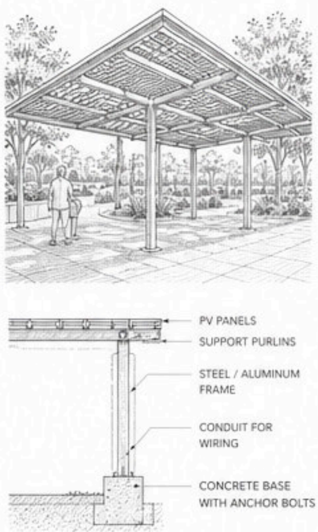
1. TIMBER PERGOLAS
- Warm aesthetic, good thermal behavior (less heat feel than metal)
- Needs detailing for durability (termite protection, moisture protection at bases)



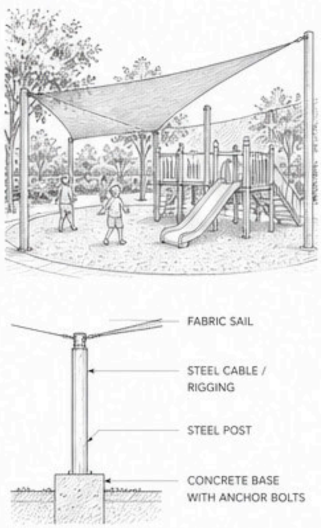
2. STEEL / ALUMINUM FRAMES WITH SHADE MESH
- Durable, lighter sections possible
- Must be designed to reduce heat transfer and glare



3. PHOTOVOLTAIC (PV) CANOPIES (IF BUDGET ALLOWS)
- Provides deep shade + energy (lighting, pumps)
- Great for plazas, parking edges, main promenades



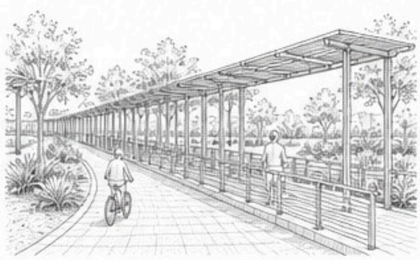
4. TENSILE FABRIC / SHADE SAILS (FAST, COST-EFFECTIVE)
- Excellent for play areas and temporary shade
- Fabric aging and cleaning must be planned



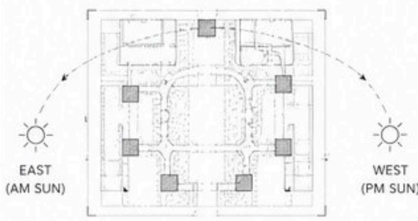
HOW TO USE (PLACEMENT RULES)

1. PUT PERGOLAS OVER HIGH-USE SHADED NODES FIRST: SEATING, PLAY EDGES, QUEUES.

2. USE THEM AS "SHADE BRIDGES" WHERE TREES WON'T MATURE SOON (CONNECTORS).



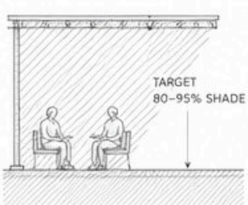
3. ALIGN PERGOLAS BASED ON SUN PATH: PROTECT THE AFTERNOON WEST SUN.



ORIENT TO BLOCK AFTERNOON WEST SUN

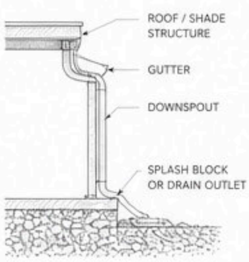
DESIGN / SPEC TIPS

1. TARGET 80–95% SHADE IN CORE SITTING AREAS (NOT JUST "DAPPLED").

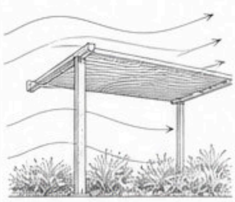


2. PREFER MATTE, LIGHT-TONED UNDERSIDES TO REDUCE RADIANT HEAT AND GLARE.

3. PROVIDE DRAINAGE (IF RARE STORMS OCCUR) SO RUNOFF DOESN'T CREATE EROSION.



4. DESIGN FOR WIND LOADS (IMPORTANT IN COASTAL / DUST-WIND CONTEXTS).

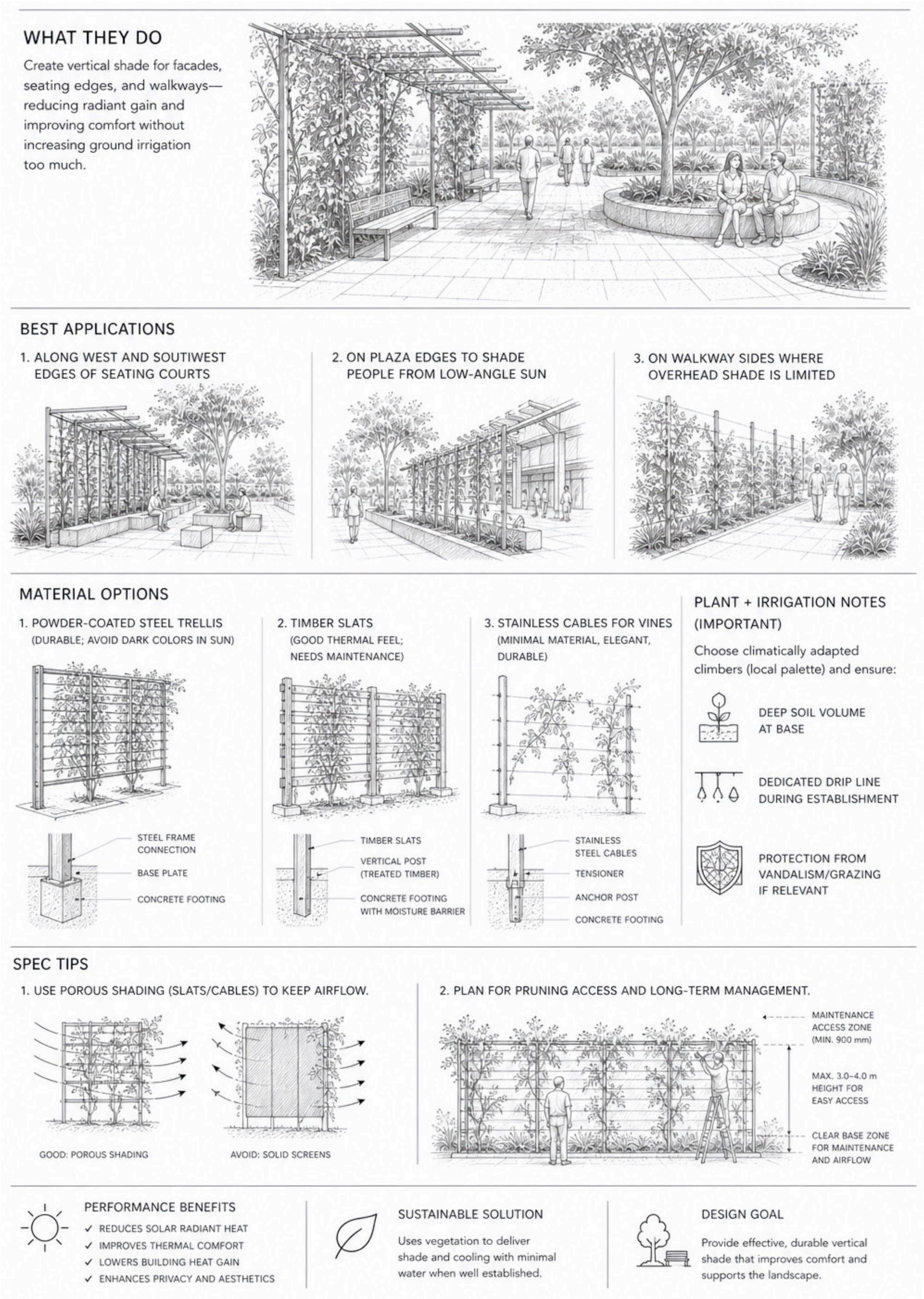


SECURE CONNECTIONS AND ANCHORAGE

ADDITIONAL CONSIDERATIONS

- Use durable materials suited to local climate and context.
- Plan for inspection, cleaning, and maintenance access.
- Integrate lighting and utilities where possible (PV, lighting).
- Ensure clear heights and accessibility under structures.

5.1.2.2 Trellises, green screens, and vine systems (vertical shade)



5.1.2.3 Retaining walls and vertical surfaces

COMFORT RISKS

Walls store heat and radiate it back in afternoon/evening. In hot climates they must be treated as thermal elements.

BETTER MATERIALS + FINISHES

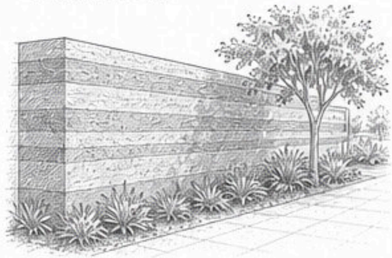
1. LIGHT-COLORED STONE (MATTE) OR LIGHT CONCRETE (TEXTURED)

Reflects more sunlight and stays cooler. Textured/matte finishes reduce glare and radiant return.

2. GABION WALLS ONLY IF SHADED OR PLANTED

Without shade or plants, gabions can store and radiate heat. Use vegetation or shade structures to keep them cool.

3. RAMMED EARTH / STABILIZED EARTH BLOCKS



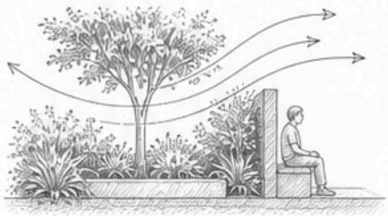
High thermal mass with relatively cool surface feel when shaded. Requires good detailing for durability and drainage.

HOW TO USE

1. PLACE SEAT WALLS IN SHADE (TREE CANOPY OR PERGOLA).

Shade prevents heat storage and makes walls comfortable to sit on.

2. USE WALLS TO CREATE MICROCLIMATE POCKETS (BUT AVOID BLOCKING VENTILATION ENTIRELY).



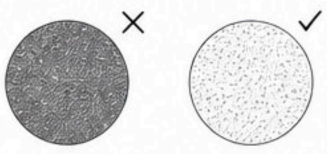
Position walls to buffer wind and sun while maintaining airflow through openings and porous layouts.

3. ADD GREEN EDGES: PLANTING AT WALL BASE REDUCES RADIANT LOAD.

Vegetation cools wall surfaces and reduces reflected heat to surrounding areas.

SPEC TIPS

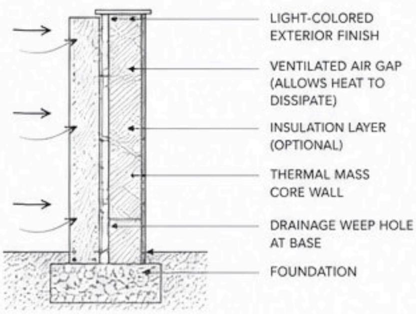
1. AVOID DARK CLADDING AND GLOSSY FINISHES.



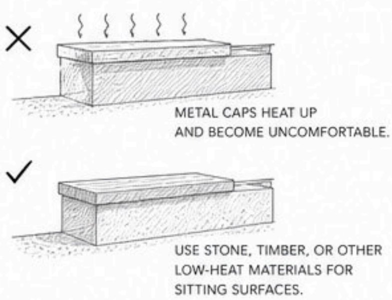
DARK SURFACES ABSORB MORE HEAT AND RADIATE IT BACK.

USE LIGHT, MATTE, TEXTURED FINISHES INSTEAD.

2. CONSIDER VENTILATED WALL SYSTEMS OR TEXTURED FINISHES TO REDUCE HEAT FEEL.



3. WHERE SEAT WALLS EXIST, SPECIFY COMFORTABLE SITTING SURFACES (NOT METAL CAPS IN SUN).



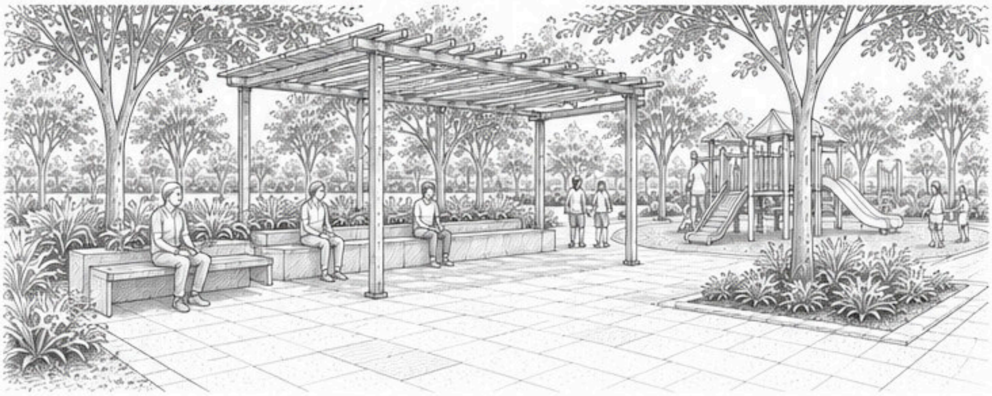
WHY IT MATTERS

- REDUCES HEAT STORAGE AND RADIANT GAIN
- IMPROVES COMFORT IN SEATING AND GATHERING SPACES
- SUPPORTS HEALTHY PLANTING AND MICROCLIMATES
- BUILDS RESILIENT, BEAUTIFUL, AND CLIMATE-SMART PLACES

5.1.2.4 Cool hard scape for high-use shaded nodes (seating play edges, waiting)

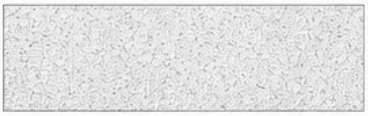
WHY IT MATTERS

Cool hardscape reduces heat storage and improves comfort for people spending time in shaded areas.



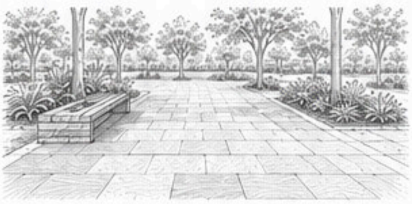
BEST OPTIONS

1. LIGHT-COLORED CONCRETE (BROOM FINISH / LIGHT SANDBLAST)



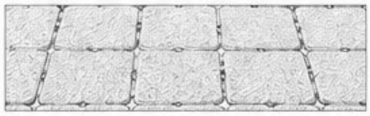
- ✓ Light color reflects more sunlight and stays cooler.
- ✓ Broom or light sandblast finish provides slip resistance with a matte, low-glare surface.

2. STONE PAVERS IN LIGHT TONES (LIMESTONE, LIGHT GRANITE) WITH MATTE FINISH



- ✓ Natural stone in light tones stays cooler and offers a high-quality finish.
- ✓ Matte finish reduces glare and heat perception.

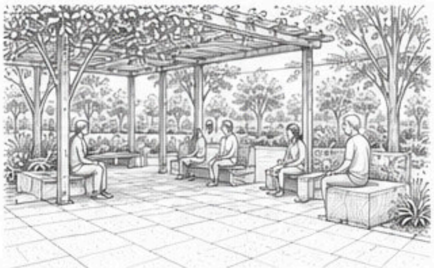
3. UNIT PAVERS (LIGHT, MATTE) WITH OPEN JOINTS TO REDUCE HEAT STORAGE AND ALLOW DRAINAGE



- ✓ Open joints reduce heat storage and allow water infiltration.
- ✓ Modular pattern increases surface stability and ease of replacement.

HOW TO USE

- ✓ Put these in cool core seating courts and around playground seating.
- ✓ Keep finishes matte (avoid glare).
- ✓ Ensure accessible, even surfaces for strollers / wheelchairs.

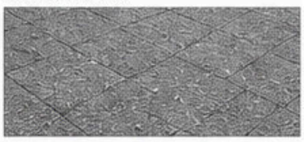


COOL CORE SEATING COURTS

AROUND PLAYGROUND SEATING

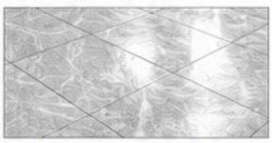
AVOID

✕ DARK BASALT / DARK CONCRETE, BLACK PAVERS



Absorbs more heat and radiates it back, increasing discomfort.

✕ POLISHED STONE



Creates glare and high heat perception, even in shade.

✕ LARGE UNINTERRUPTED SLABS IN SUN

Expands and traps heat; joints are needed for movement and drainage.

KEY BENEFITS				
	LOWER SURFACE TEMPERATURES	IMPROVED COMFORT IN SHADED NODES	ACCESSIBLE AND SAFE FOR ALL USERS	BETTER DRAINAGE AND REDUCED HEAT STORAGE

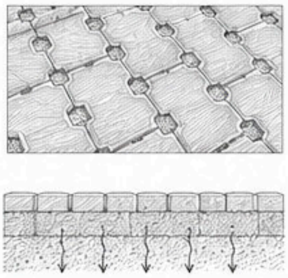
5.1.2.5 Permeable surfaces for transitional semi-shaded spaces (loops, promenades)

WHY IT MATTERS

Permeable surfaces reduce heat storage, allow water to infiltrate, and support cooler, healthier, more comfortable pedestrian routes in semi-shaded conditions.

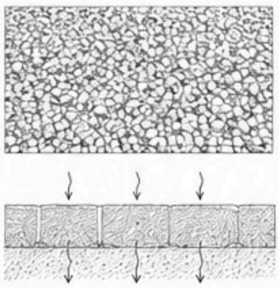
BEST OPTIONS

1. PERMEABLE INTERLOCKING CONCRETE PAVERS (PICP)



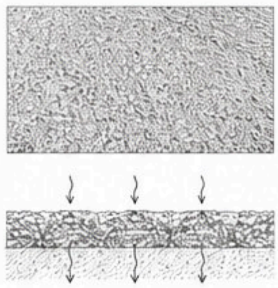
- Strong, durable, and accessible.
- Open joints allow water to infiltrate and reduce runoff.
- Wide range of patterns and finishes in light colors.

2. RESIN-BOUND AGGREGATE (GOOD IF PROPERLY INSTALLED; DUST CONTROL)



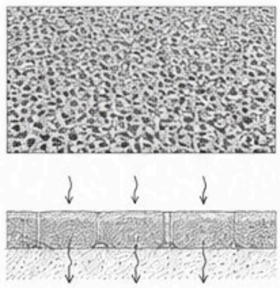
- Smooth, even surface; good for walking and wheeling.
- Permeable and dust-controlled when installed correctly.
- Use light-colored aggregates to reduce heat gain.

3. STABILIZED DECOMPOSED GRANITE (DG) / STABILIZED GRAVEL (WHERE ACCESSIBILITY ALLOWS)



- Natural look that blends with landscapes.
- Permeable and comfortable underfoot.
- Ensure accessibility: firm, stable, and well-compacted.

4. POROUS CONCRETE / POROUS ASPHALT (CAREFUL WITH MAINTENANCE)

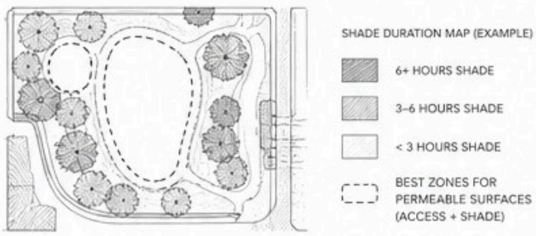


- High porosity for rapid infiltration.
- Ideal for paths with gentle slopes and good base drainage.
- Requires regular maintenance to prevent clogging.

HOW TO USE

- Use on shaded loop paths and secondary promenades.
- Combine with shade duration mapping: permeable surfaces are best where you also have shade and maintenance access.

USE ON SHADED LOOP PATHS AND SECONDARY PROMENADES



PAIR PERMEABLE SURFACES WITH SHADE AND MAINTENANCE ACCESS

AVOID

1. LOOSE GRAVEL IN HIGH-TRAFFIC PEDESTRIAN ZONES (MOBILITY BARRIERS, MIGRATION, DUST))

- Uneven and unstable underfoot.
- Gravel migrates and spreads.
- Creates dust and maintenance issues.

2. PERMEABLE SYSTEMS WITHOUT A MAINTENANCE PLAN (CLOGGING)

- Clogged joints reduce infiltration and performance.
- Standing water, surface damage, and higher maintenance costs.
- Always plan for regular inspection and cleaning.

MAINTENANCE ESSENTIALS

REGULAR SWEEPING
Remove surface debris before it clogs pores/joints.

INSPECT PERIODICALLY
Check for sediment buildup and drainage function.

CLEAN AS NEEDED
Use appropriate methods (e.g., low-pressure washing) to restore permeability.

KEY BENEFITS

- REDUCES SURFACE TEMPERATURES
- IMPROVES STORMWATER INFILTRATION AND REDUCES RUNOFF
- SUPPORTS WALKABLE, COMFORTABLE ENVIRONMENTS
- ENHANCES LANDSCAPE HEALTH AND BIODIVERSITY
- LONG-TERM PERFORMANCE WITH PROPER MAINTENANCE

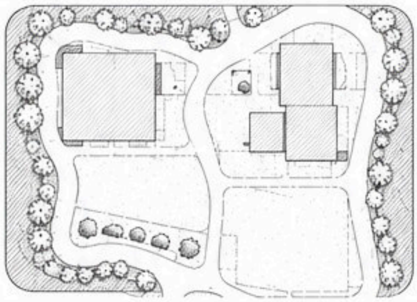
5.1.2.6 “Warm edge” ecological belt surfaces (low-use peripheral zones)

WHAT IT DOES

Creates a buffer along hot exposed edges, reduces evaporation, supports habitat, and improves thermal comfort across the site.

WARM EDGE ECOLOGICAL BELT (LOW-USE PERIPHERAL ZONES)

SOUTH / SOUTHWEST EDGES (PRIORITY ZONE)

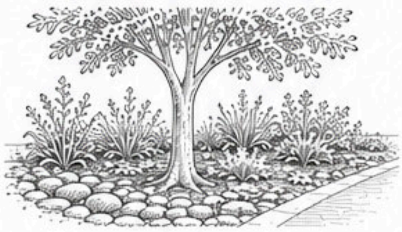


BEST OPTIONS

1. MULCH (ORGANIC OR MINERAL) UNDER TREES / SHRUBS

- Improves soil moisture retention.
- Cools the root zone.
- Supports healthy plant growth.

2. ROCK MULCH / GRAVEL MULCH IN CONTROLLED BANDS (WITH SHADE AND PLANTING)



- Reduces evaporation.
- Protects soil surface.
- Must be used with shade and planting.
- Rock in full sun can still be hot.

3. SOIL STABILIZATION + NATIVE GROUNDCOVER WHERE FEASIBLE

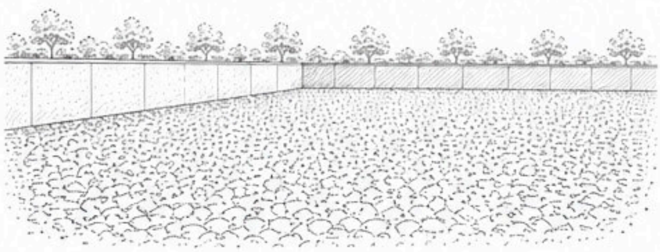
- Living cover reduces dust and erosion.
- Supports biodiversity.
- Low maintenance once established.

HOW TO USE

- Along south / southwest edges as a buffer to reduce evaporation.
- Always pair gravel / rock surfaces with shade or planting; rock in full sun can still be hot.

AVOID

✕ LARGE DECORATIVE GRAVEL FIELDS WITH NO CANOPY



- Stores and radiates heat.
- Causes glare and low visual comfort.
- Increases dust and reduces usability.
- Does not support biodiversity.

5.2 Landscape Plant Material

The planting sub-section is divided into three parts providing guidelines for plant selection, planting strategies and list of plants. These are key concepts, if followed, will increase the survival chances of the plants in the project

5.2.1 Plant Selection Criteria

Selection of plants is a key decision for GUP in arid and semi-arid climates. The approach is focused on the ecological dimension that improves outdoor thermal comfort and lowers water demand while ensuring the health of these plant ecosystems.

5.2.1.1 Native or proven climatically-adapted species

Definition

Species that either occur naturally in the region or have a long, demonstrated track record in similar arid/semi-arid conditions (heat, drought, alkaline soils, wind/dust, occasional salinity).

Why it matters

- Reduces failure risk and replacement costs
- Improves survival under limited irrigation and inconsistent maintenance
- Usually performs better under heat stress (keeps leaves and shade)

Red flags (avoid unless you have high maintenance)

- species that defoliate under heat or drop leaves heavily in summer
- high-water ornamentals used as primary shade
- species prone to pests under heat stress

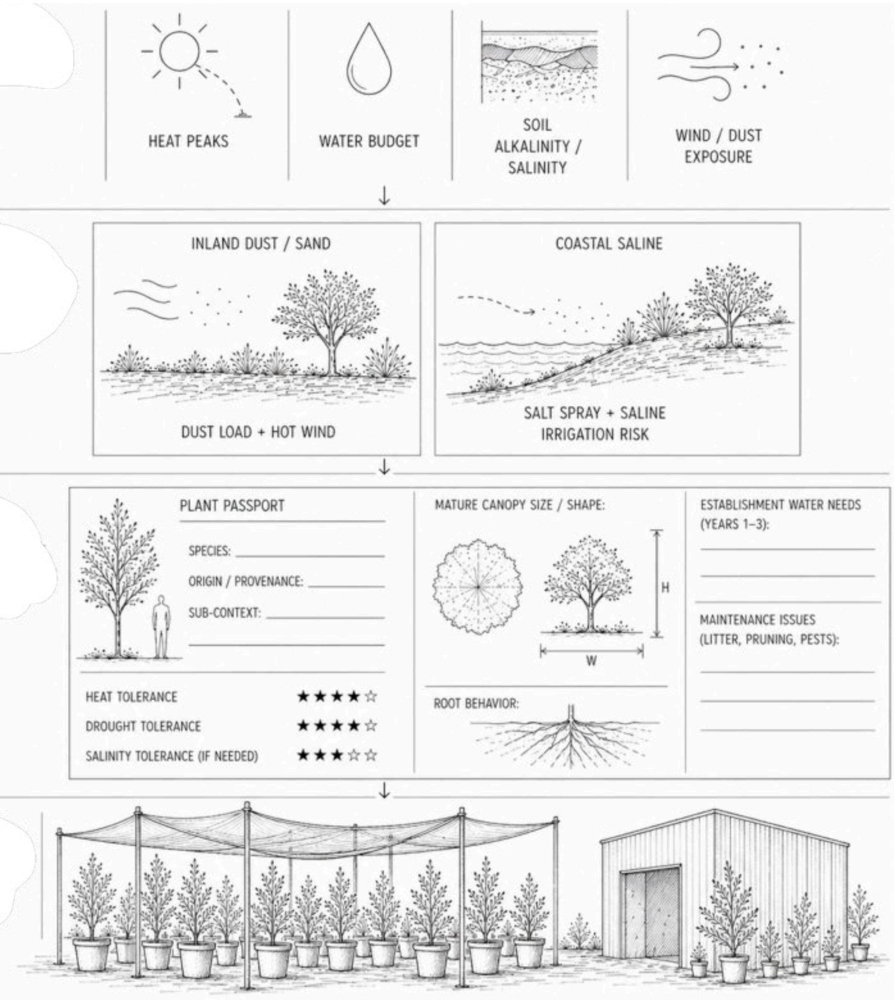
How to apply

Start with constraints, not aesthetics

Short-list species with **proven tolerance in your specific sub-context**

For each candidate, create a simple "plant passport"

Verify availability in local nurseries **(don't specify what can't be sourced).**



5.2.1.2 Canopy Density (more important than ornamentation)

Definition

Prioritize plants that deliver usable shade and microclimate benefits over purely decorative planting.

Why it matters

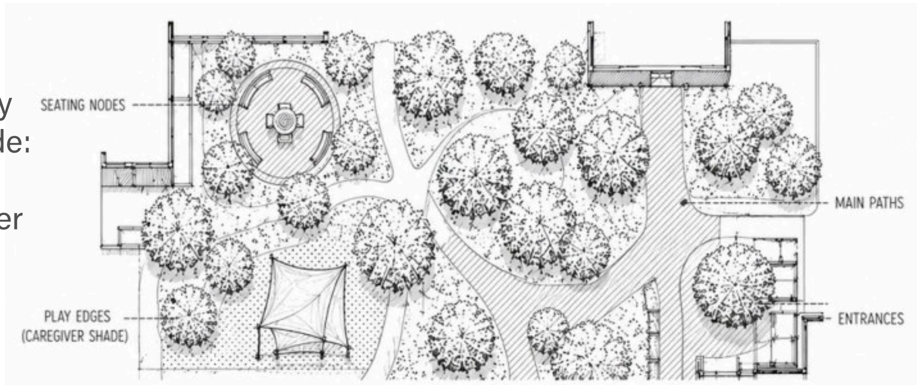
- In hot climates, the driver of comfort is often mean radiant temperature (MRT), which shade reduces dramatically.
- “Beautiful but sparse” trees don’t cool seating/path areas.

What to look for

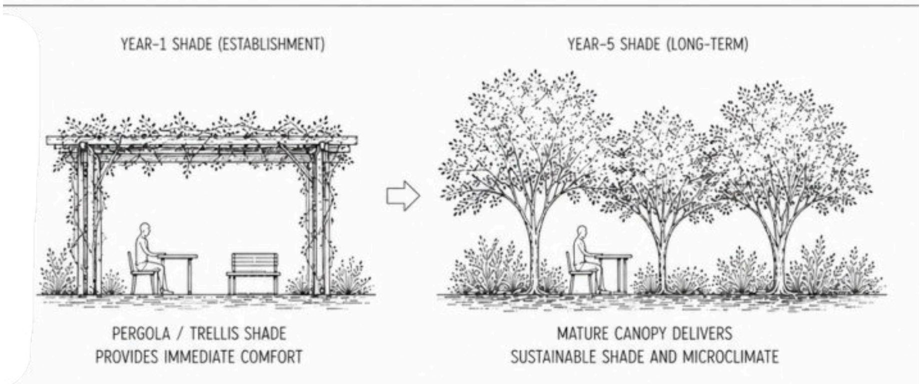
- Broad crowns (shade spread), not just height
- Reliable leaf area during hot season
- Lower canopy shading where people sit/walk (not only high canopy)
- A mix of evergreen and deciduous can be useful:
- evergreen for consistent summer shade
- deciduous for winter sun access

How to apply

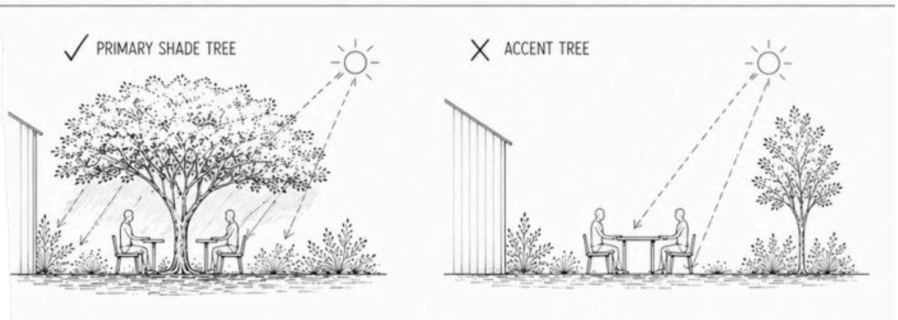
Use sun–shade maps and place best canopy trees where they shade:
- seating nodes
- play edges (caregiver shade)
- main paths and entrances



Design for :
- year-1 shade
- year-5 shade



If a tree doesn’t meaningfully shade people during peak hours, **it’s not a primary shade tree —it’s an accent**



5.2.1.3 Root-soil compatibility

Definition

Match plant root needs to what the site can actually provide (soil depth, compaction, salinity, drainage, root-able volume).

Why it matters

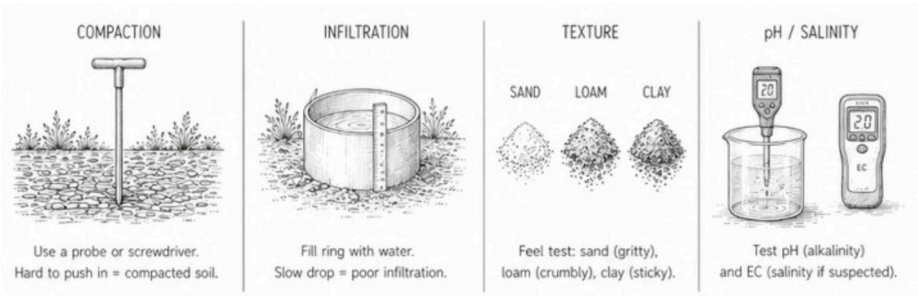
- In arid cities, trees often fail due to soil constraints, not climate.
- Failed trees = failed shade = failed comfort.

Design details that make it work

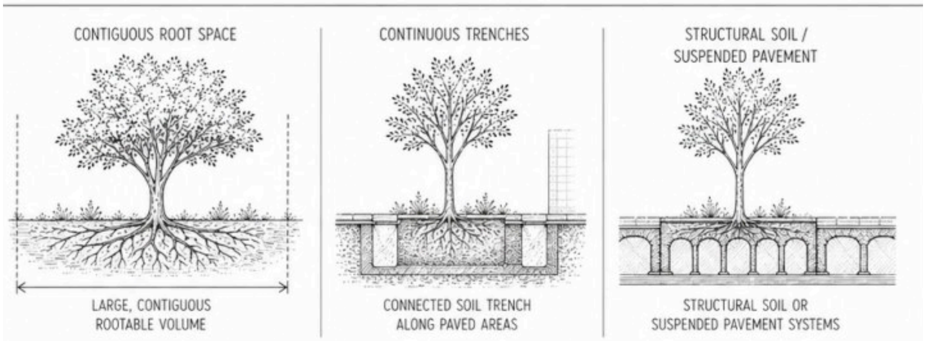
- Larger planting pits than "typical urban minimum"
- Aeration/deep watering points (where relevant)
- Mulch to reduce evaporation and keep soil cooler

How to apply

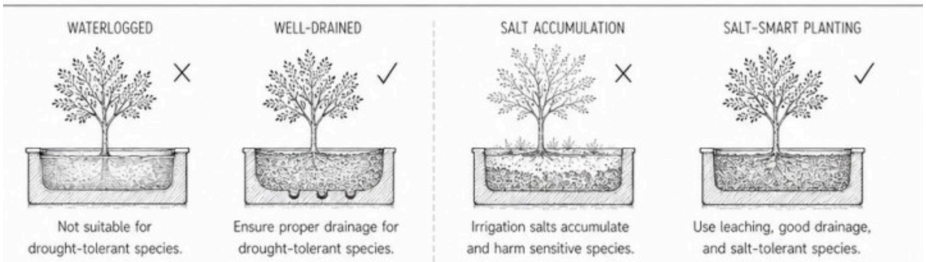
Test/assess soil realities:
- compaction, infiltration, texture
- pH/alkalinity and salinity (if suspected)



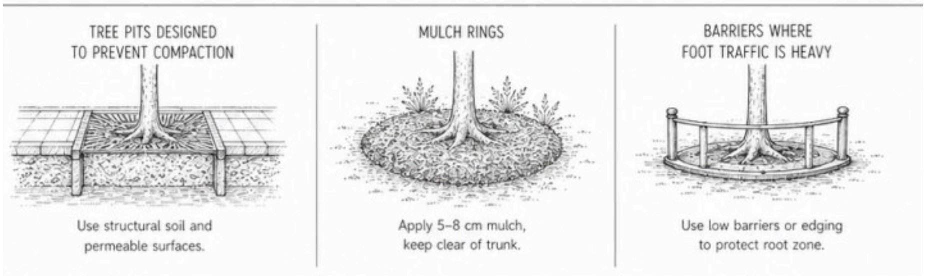
Provide adequate rootable soil volume:
- large shade trees need large contiguous root space
- in paved areas: use continuous trenches, structural soil, or suspended pavement systems



Ensure drainage matches species:
- do not put drought trees in waterlogged planters
- do not put salt-sensitive species where irrigation salts accumulate



Protect roots in public spaces:
- tree pits designed to prevent soil compaction
- mulch rings and barriers where foot traffic is heavy



5.2.1.4 Low water demand & maintenance

Definition

Species that can thrive with limited irrigation after establishment and don't require constant pruning, pest control, or replacement.

Why it matters

- Water and maintenance are the two most common failure points in arid GUS projects.

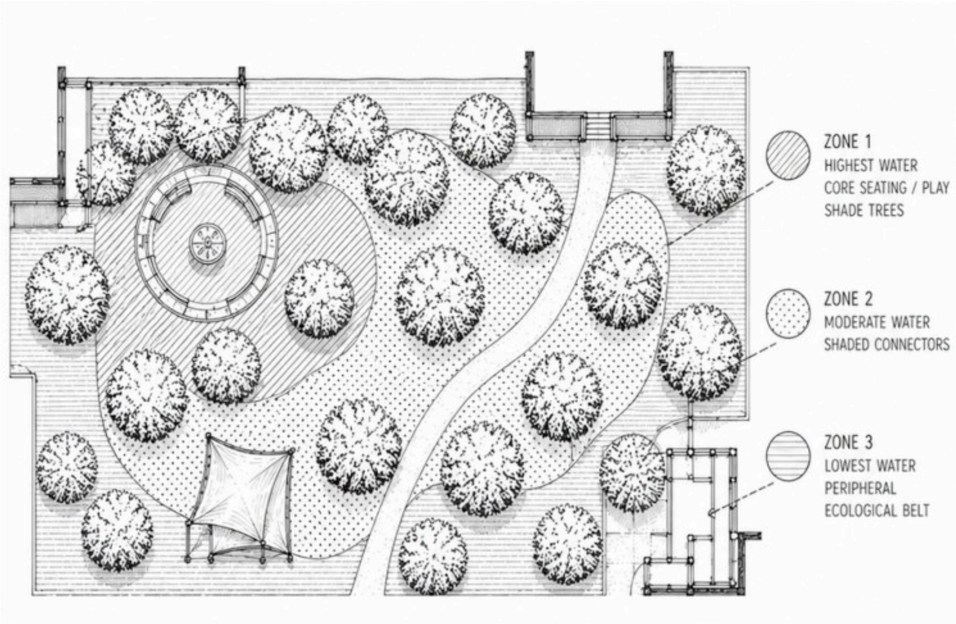
Maintenance-smart tips

- Limit species count (easier procurement and care)
- Avoid thorny plants near circulation/play
- Use plants with predictable pruning cycles and minimal litter in key areas

How to apply

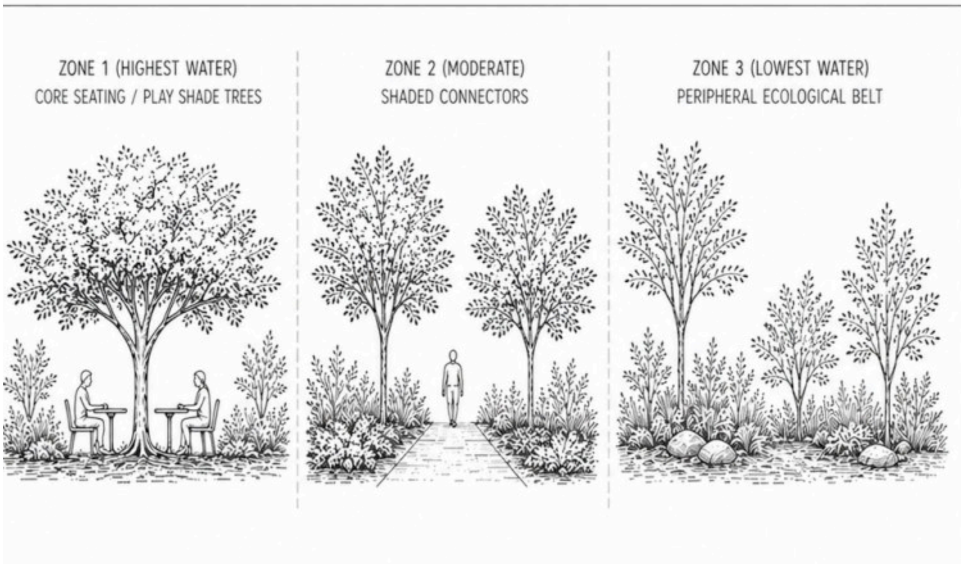
Use hydro zoning:

- Zone 1 (**highest water**): core seating/play shade trees
- Zone 2 (**moderate**): shaded connectors
- Zone 3 (**lowest**): peripheral ecological belt



Design the palette so Zone 3 looks intentional.

(structure + ground layer), not "neglected."



5.2.2 Planting Strategies

In addition to plant selection approach, the vertical and horizontal combination of different plant layers will reduce temperatures, reduce irrigation use and improve overall ecological performance. while emphasis here is on performance, it is essential that designers continue to integrate the aesthetic and spatial value of plants and their contribution to the open spaces being created.

5.2.2.1 Layered canopies: trees + shrubs + groundcovers

Definition

A multi-layer planting system that improves comfort and plant health:

- trees reduce MRT through shade
- shrubs filter wind/dust, reduce glare, define space
- ground-covers/mulch cool the soil, reduce evaporation, suppress dust

Why it enhances comfort

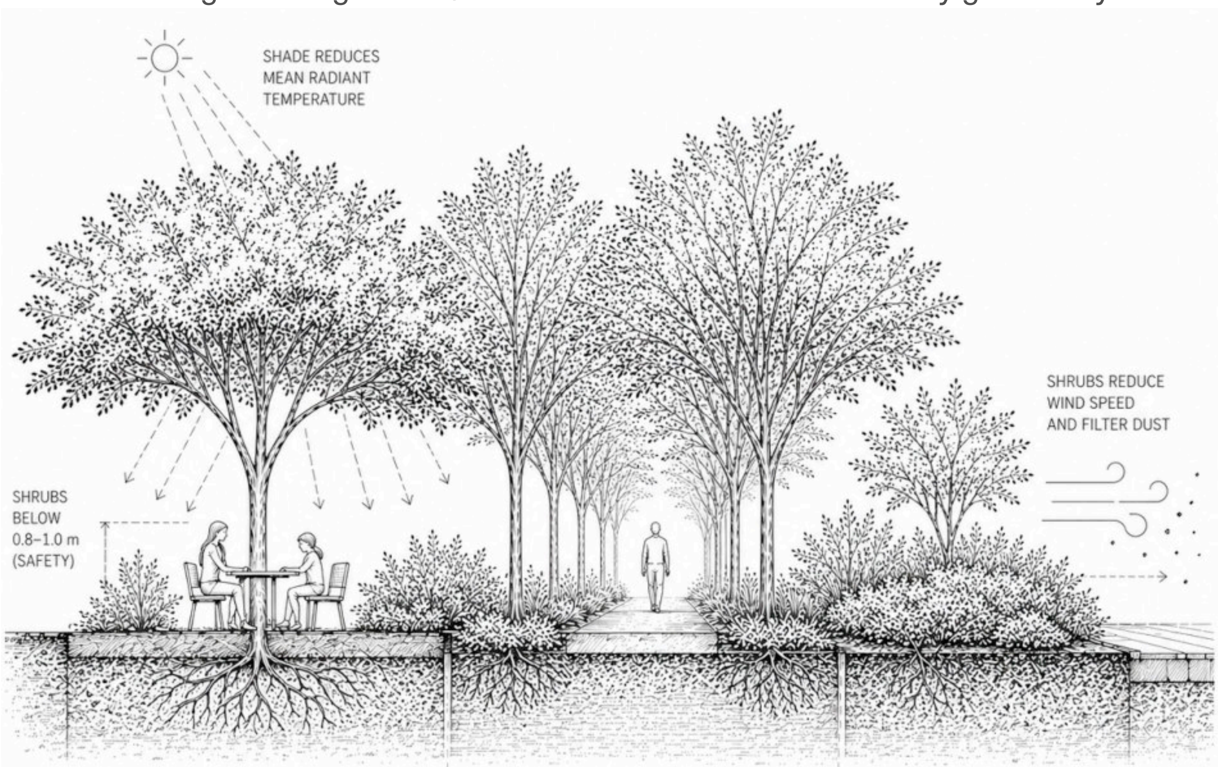
- Shade + reduced ground heat = cooler microclimate
- Ground layer reduces reflected heat from bare soil/paving edges
- Shrubs can reduce wind speed and dust infiltration into seating zones

Public-space safety rule

- Keep shrubs near paths and entrances below ~0.8–1.0 m to preserve visibility.

How to apply

- In cool nodes: canopy trees + low shrubs (kept low for safety) + mulch/groundcover
- In connectors: tree alleys + occasional shrub pockets + continuous ground cover at edges
- In warm edges: drought- and/or salt-tolerant shrub belts + hardy ground layer



5.2.2.2 Clustered planting: reduce evaporation

Definition:

Plant in groves and clusters, not isolated single plants spread thinly.

Why it works in arid climates

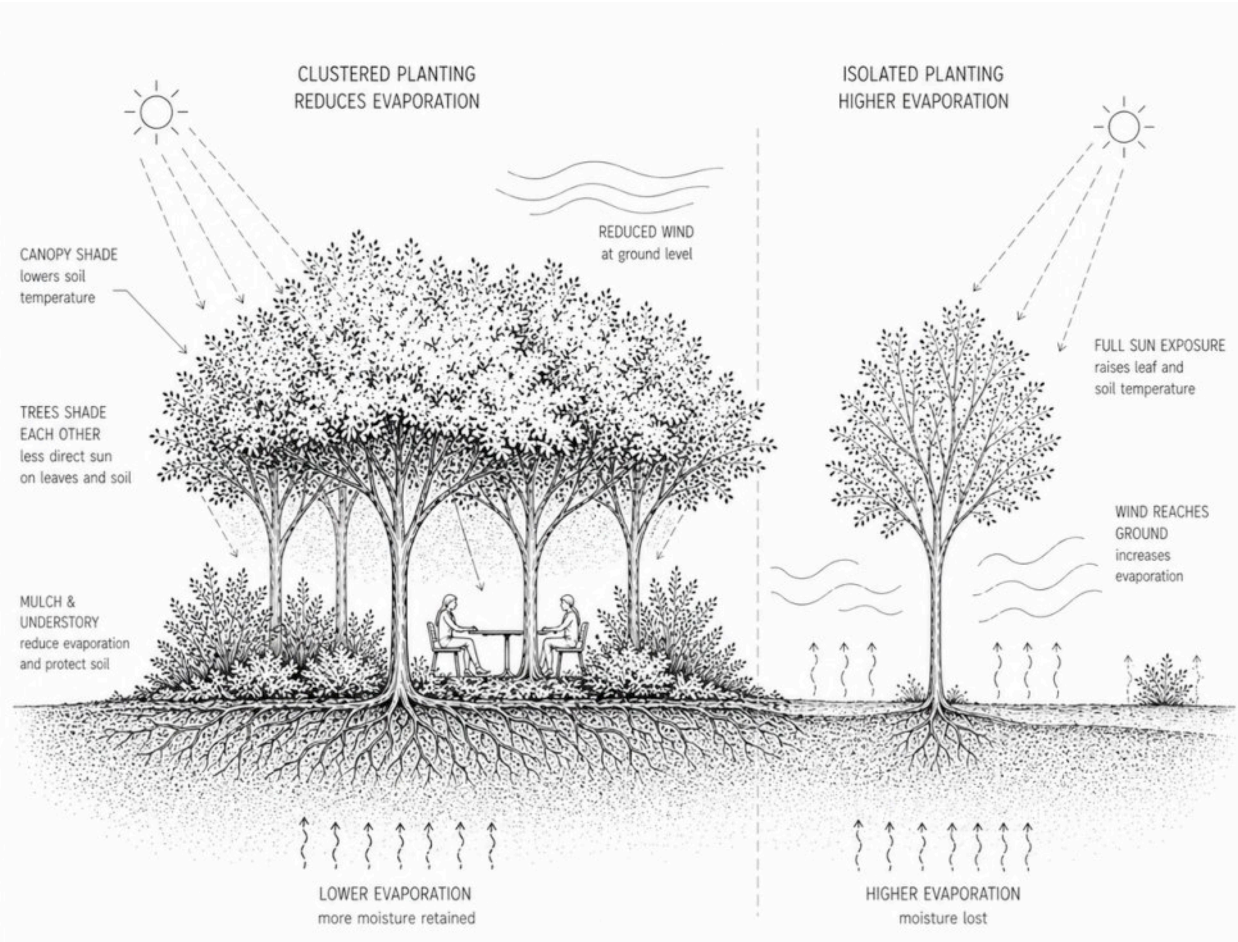
- Creates self-shading (plants shade soil and each other)
- Reduces wind at ground level → lower evaporation
- Concentrates irrigation and improves establishment success

How to apply

- Use groves of 3–7 trees at cool nodes (seating/play) rather than single trees
- Combine with mulch and understory to protect soil
- Keep open areas purposeful (night-use plaza, flexible gathering), not “leftover heat zones”

Irrigation efficiency

- Clusters allow a simple, efficient drip layout and easier maintenance



5.2.2.3 Functional planting: shade, wind filtering, dust control

Definition

Planting that is deliberately assigned a job in the comfort system, not just decoration.

Shade planting (primary comfort job)

Where: seating, play, entrances, main paths

How:

- prioritize canopy trees with broad crowns
- add pergola/trellis where immediate shade is required
- ensure shade is effective in afternoon (often the critical window)

Wind filtering (comfort + usability)

Where: edges exposed to hot or dusty winds

How:

- use porous multi-row planting belts (not solid walls of foliage)
- layer heights: groundcover + shrubs + trees
- keep interior nodes ventilated (avoid trapping hot air)

Dust control (health + comfort)

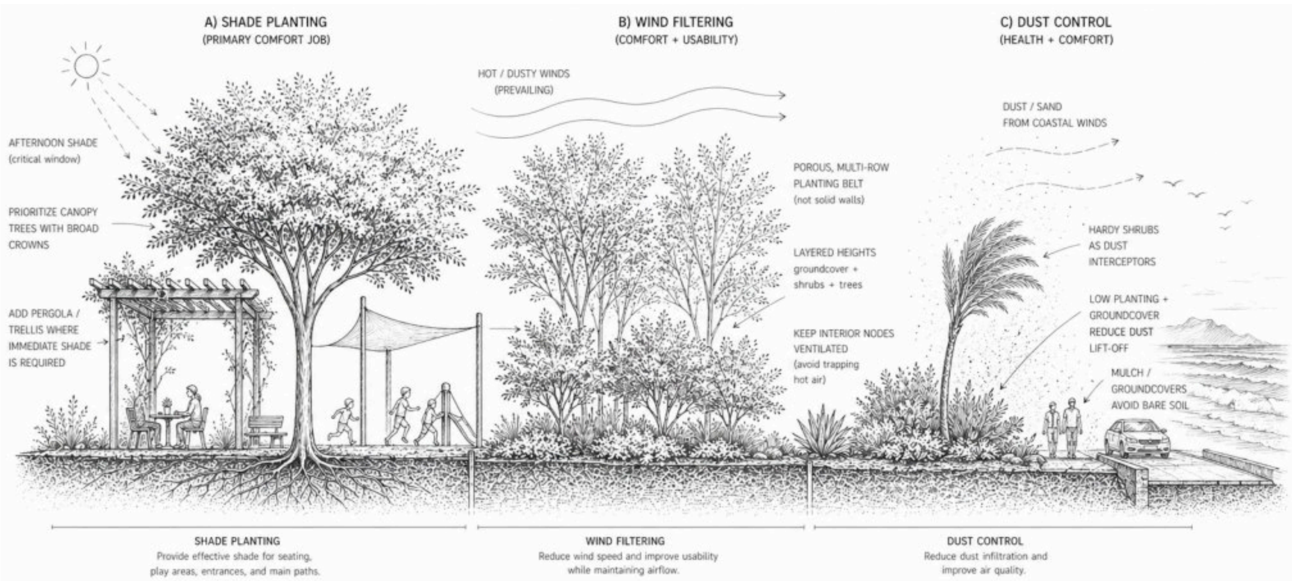
Where: perimeter edges, near streets, along dusty corridors

How:

- avoid bare soil (use mulch/groundcovers)
- add low planting and groundcover to reduce dust lift-off
- use hardy shrubs as dust interceptors on exposed edges
- keep maintenance access for occasional cleaning/pruning

Context notes

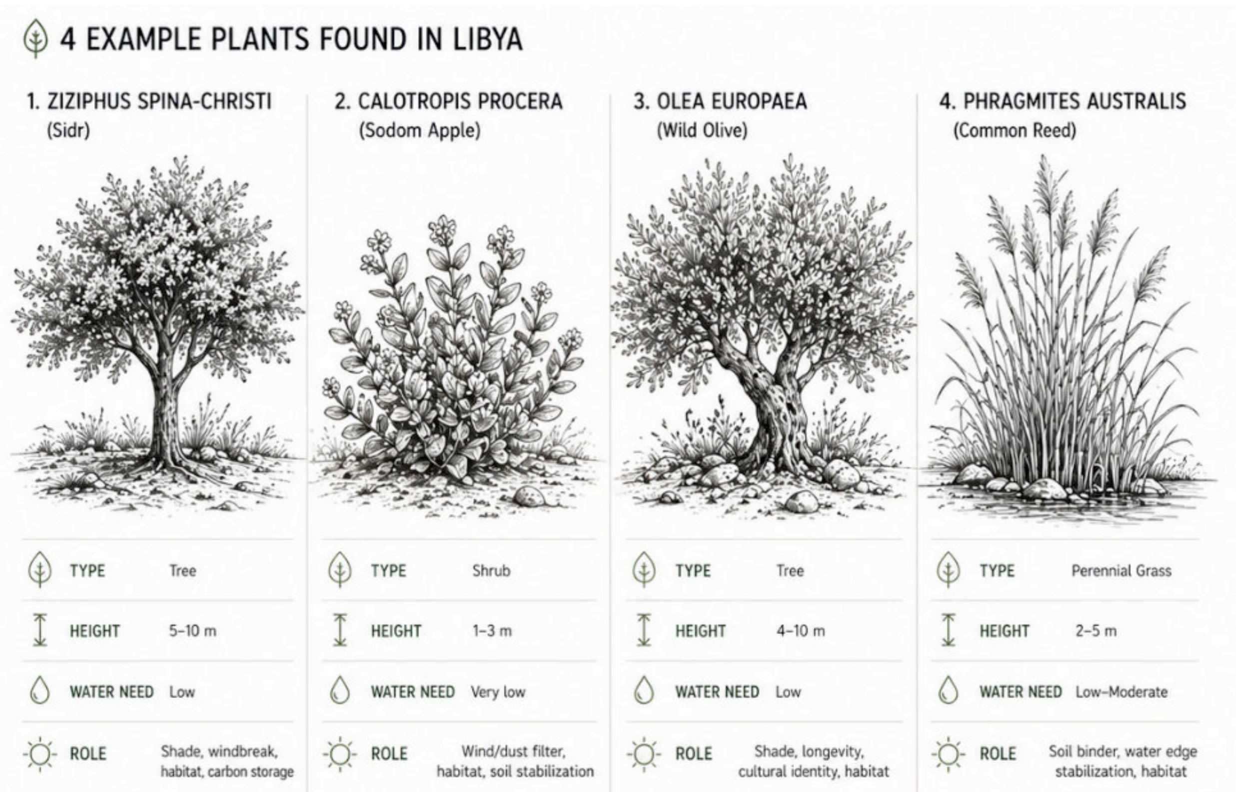
- Inland dust/sand: prioritize dust-tolerant leaves and wind-stable forms; use buffer belts on prevailing dust edge.
- Coastal saline: use salt-tolerant "frontline" belt to protect the interior; manage irrigation salts to avoid buildup.



5.2.3 LIST OF PLANTS

Deciding on which individual plants to use equally contributes to the GUP design as the planting strategies. Planting lists are similar to material specifications as they provide the name, size, function, aesthetic value, function and spacing that will allow implementation. the following points provide a summary of its significance and **Appendix 4** is an example of plant material across ground cover, mid and upper storey plants relevant to Libya.

- **Ensures climate survival, canopy performance and local identity:** A defined planting list prioritizes native/proven heat-, drought-, and (where relevant) salinity-tolerant species that can establish reliably.
- **Aligns planting with water budget and hydrozoning:** It groups species by similar water needs, enabling efficient irrigation design (drip zones, establishment periods) and preventing costly overwatering or plant failure.
- **Improves constructability and maintenance success:** A clear list standardizes sizes, soil requirements, and maintenance needs, making procurement easier, reducing substitutions, and matching the palette to local capacity for pruning, cleaning, and replacement. ESPECIALLY AVAILABILITY IN LOCAL PLANT NURSERIES
- **Supports functional goals (comfort + resilience):** It ensures planting is selected and arranged to perform specific jobs—shade, wind filtering, dust control, habitat—so the GUS functions as a reliable comfort and nature-based system, not just decoration.

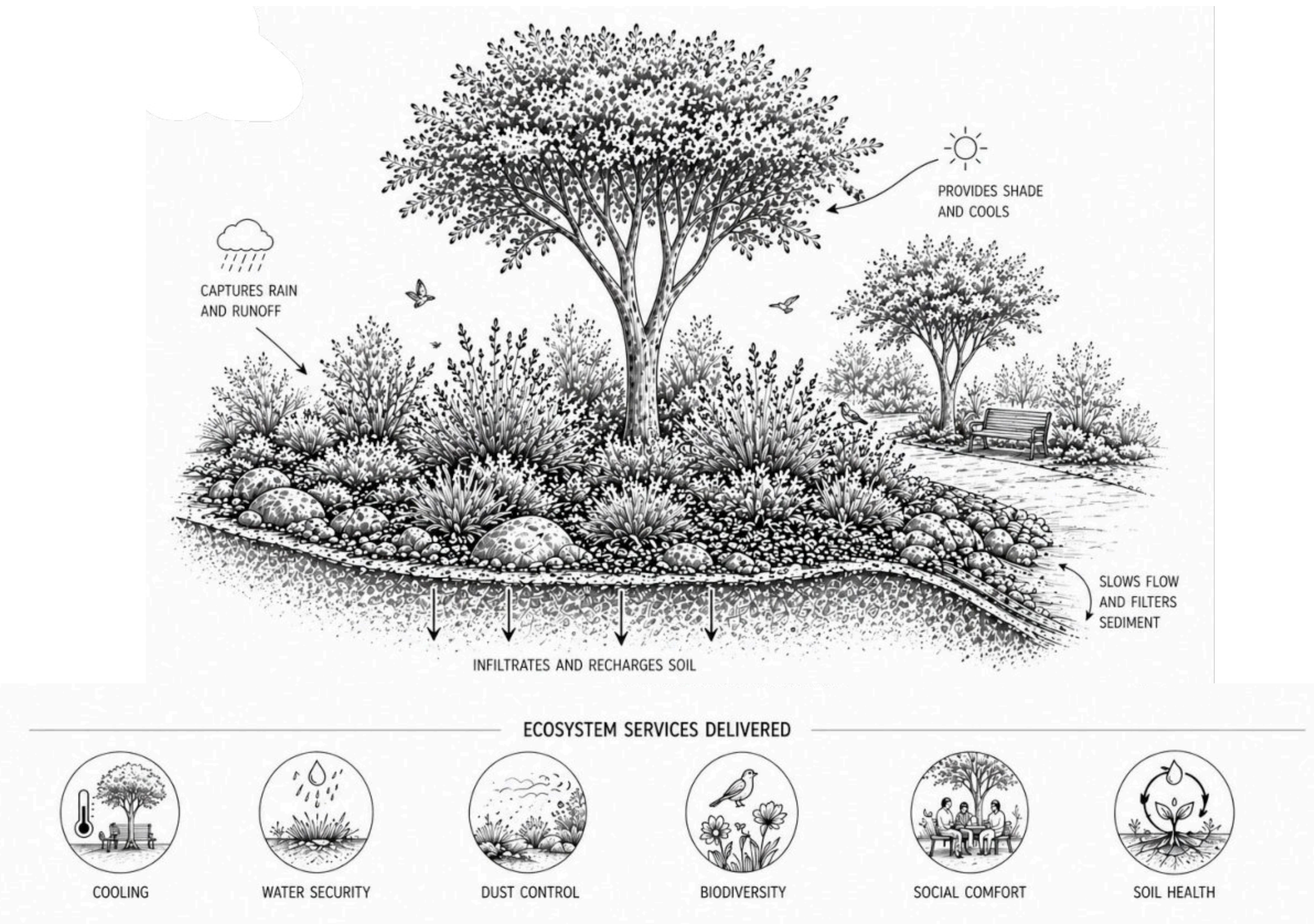


5.3 Arid-Adapted Nature-Based Solutions

5.3.1 Layered canopies: trees + shrubs + groundcovers

What are nature based solutions (NbS)

- **Nature-based solutions (NbS)** are **actions** that **protect, sustainably manage, and restore ecosystems** to address **societal challenges** like climate change, water security, and disaster risk, while simultaneously **benefiting people and biodiversity by providing ecosystem services** (IUCN).
- **Arid-adapted Nature-Based Solutions** (NbS) are landscape interventions that use **natural processes**—soil infiltration, vegetation shading, evapotranspiration, habitat formation, and sediment capture—**to deliver cooling, flood safety, dust control, biodiversity, and social comfort with minimal water and maintenance** (ecosystem services).
- In arid/semi-arid parks, NbS succeed when they are designed around two realities: **water comes in pulses** (rare storms + runoff) and **heat stress is constant**.



5.3.2 Micro-catchments + tree basins ("water to shade")

How it operates

- Park surfaces are graded so that stormwater and incidental runoff flows toward trees.
- Water infiltrates into enlarged basins, recharging soil moisture and sustaining canopy growth (your biggest comfort asset).

Where it fits in a park

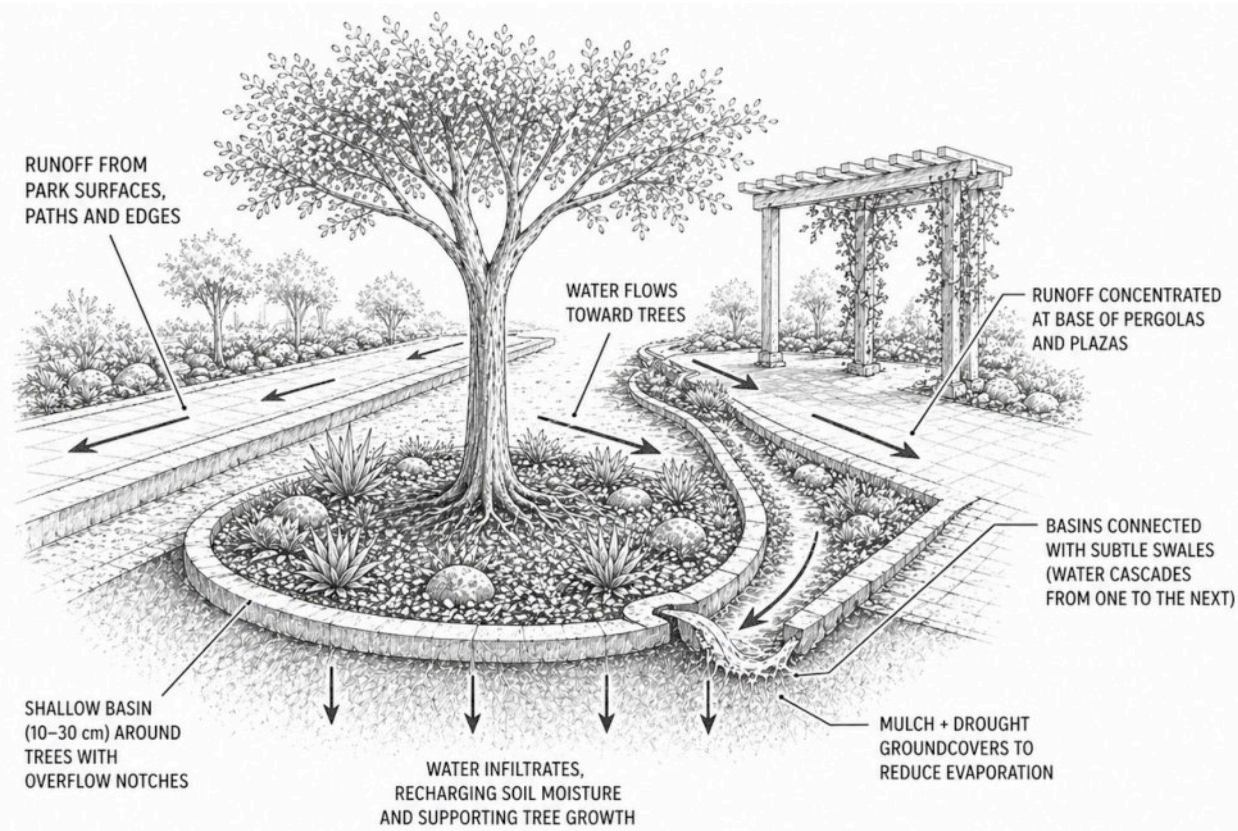
- Around shade grove trees in the cool core
- Along paths and edges that receive runoff from surrounding streets
- At the base of pergolas/plazas (where runoff is concentrated)

Design moves (practical)

- Create shallow basins (typically 10–30 cm) around trees with overflow notches.
- Use mulch + drought groundcovers to reduce evaporation.
- Connect basins with subtle swales so water "cascades" from one to the next.

Benefits

- More resilient canopy with less irrigation
- Reduced surface runoff and puddling
- Cooler microclimates as canopy matures



5.3.3 Bioswales and vegetated conveyance (stormwater streets-to-park)

How it operates

- Linear planted channels slow runoff, filter sediment, and infiltrate water into soil.
- Vegetation and engineered soil media remove pollutants; overflow safely routes excess water.

Where it fits

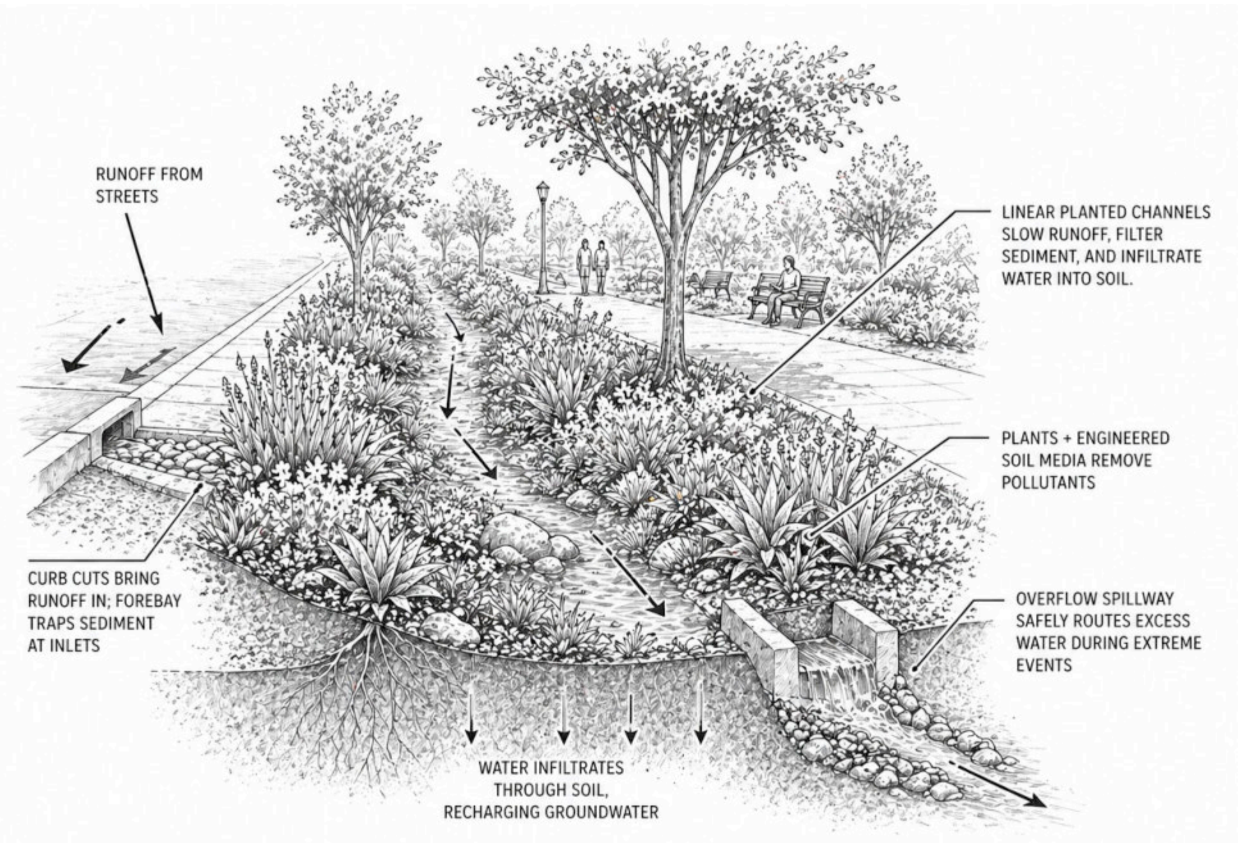
- Along the perimeter comfort belt (inside the park edge)
- Along the “downhill” side of the park
- Near curb cuts receiving water from streets

Design moves

- Use curb cuts to bring runoff in; add a forebay (small sediment trap) at inlets.
- Plant with tolerant species (periodic flooding + drought between storms).
- Provide an overflow spillway to prevent erosion during extreme events.

Benefits

- Flood mitigation for streets and adjacent properties
- Improved tree health via recharge
- Visual “green infrastructure” education feature



5.3.4 Infiltration basins / dry detention (wadi-like park features)

How it operates

- A shallow “dry pond” holds stormwater briefly and drains within 24–72 hours (target varies by soil).
- During dry periods it becomes usable open space (event field, informal play) if designed safely.

Where it fits

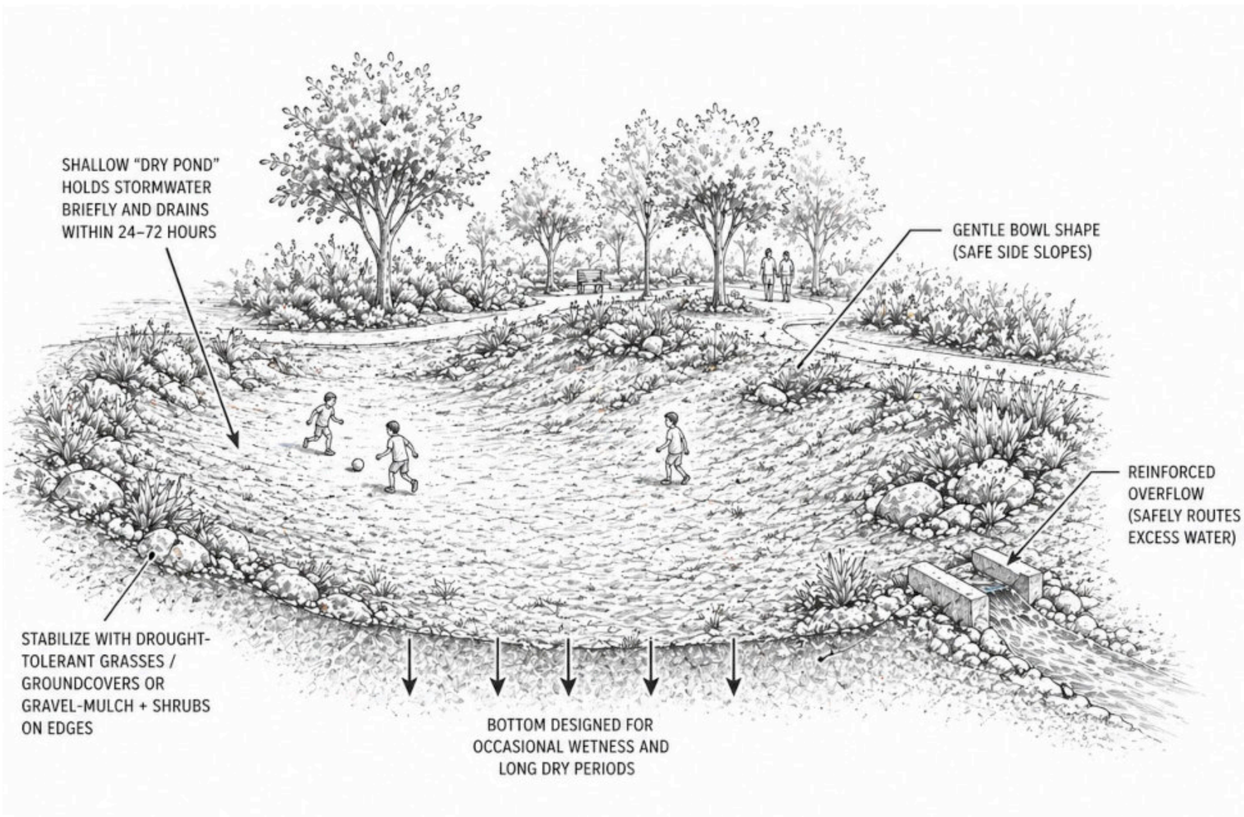
- In low points of the site
- Along the warm edge ecological belt
- Near the park’s stormwater outlet

Design moves

- Shape as a gentle bowl (safe side slopes), with reinforced overflow.
- Stabilize with drought-tolerant grasses/groundcovers or gravel-mulch + shrubs on edges.
- Design the bottom for occasional wetness and long dry periods.

Benefits

- Reduces flood peaks
- Recharges groundwater/soil moisture
- Can become an attractive landscape “wadi” element



5.3.5 Rain gardens (small, high-impact infiltration pockets)

How it operates

- Small planted depressions capture runoff from a defined area and infiltrate it.
- Often used where space is limited (pocket parks, entrances, plazas).

Where it fits

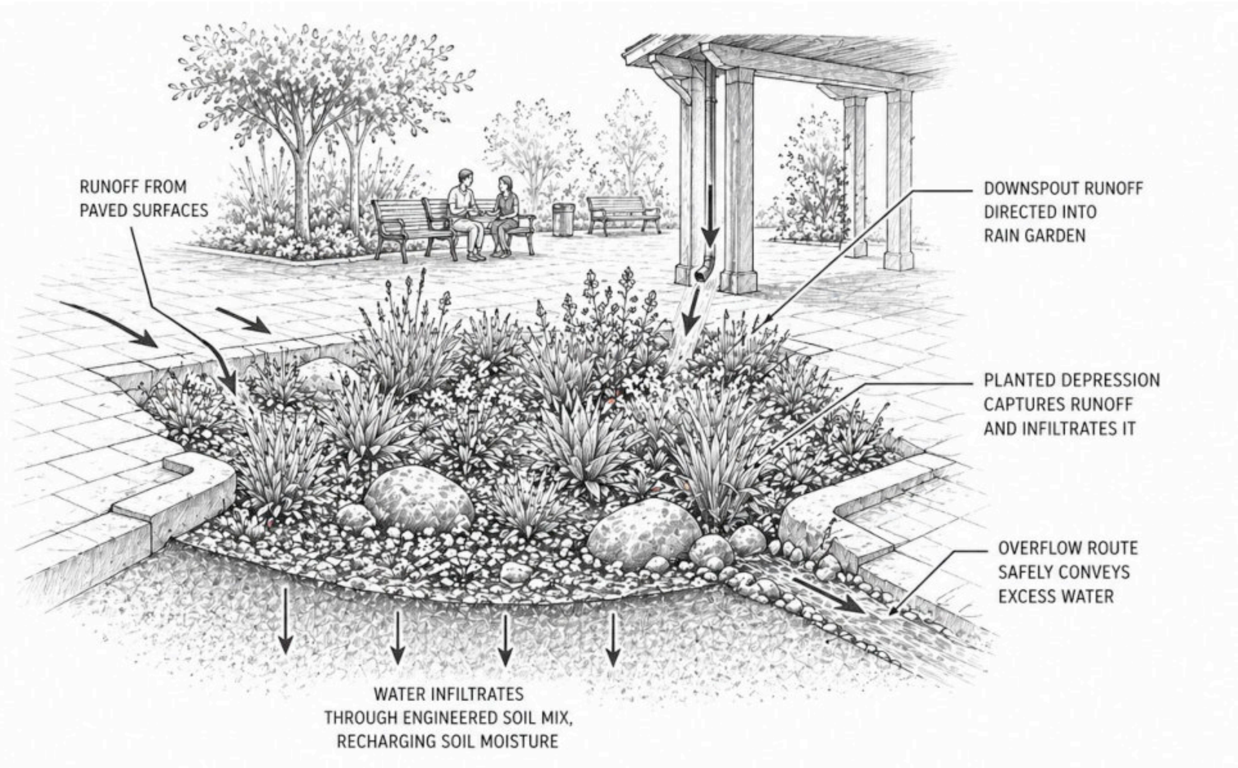
- At entrances, near seating nodes
- Adjacent to paved plazas or parking edges
- Under roof/pavilion downspouts (if present)

Design moves

- Keep rain gardens small but frequent ("distributed system").
- Use engineered soil mix; provide an overflow route.
- Plant for drought and periodic inundation.

Benefits

- Visible, teachable NbS
- Supports local pollinators
- Improves microclimate when paired with shade trees nearby



5.3.6 Mulch-based soil restoration + compost "sponge zones"

How it operates

- Organic matter improves water holding, infiltration, and root health.
- Mulch reduces evaporation, keeps soil cooler, and suppresses dust and weeds.

Where it fits

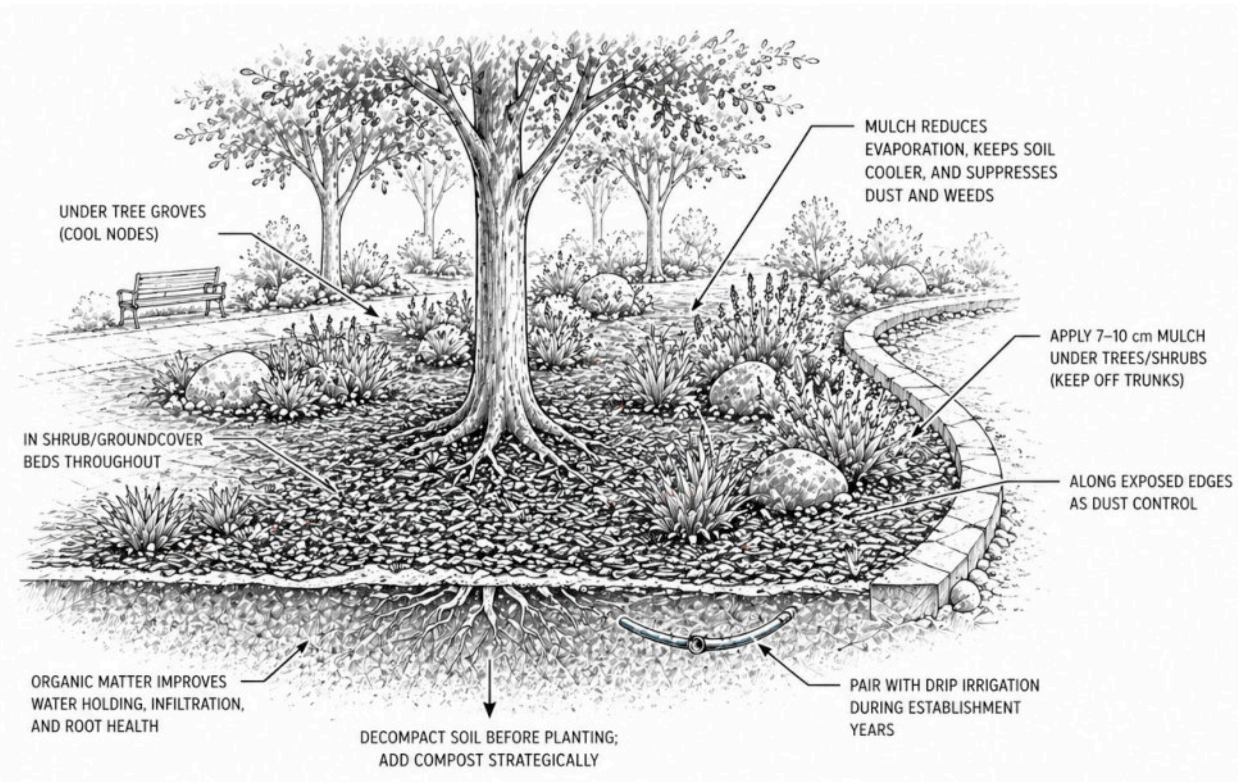
- Under tree groves (cool nodes)
- In shrub/groundcover beds throughout
- Along exposed edges as dust control

Design moves

- Decompact soil before planting; add compost strategically.
- Apply 7–10 cm mulch under trees/shrubs (keep off trunks).
- Pair with drip irrigation during establishment years.

Benefits

- Lower irrigation demand over time
- Better survival and faster canopy growth
- Less dust and hotter bare soil



5.3.7 Shade groves (the “NbS cooling engine”)

How it operates

- Trees provide the largest reduction in radiant heat (MRT).
- A grove creates a cool microclimate by shading ground and people, and modest ET.

Where it fits

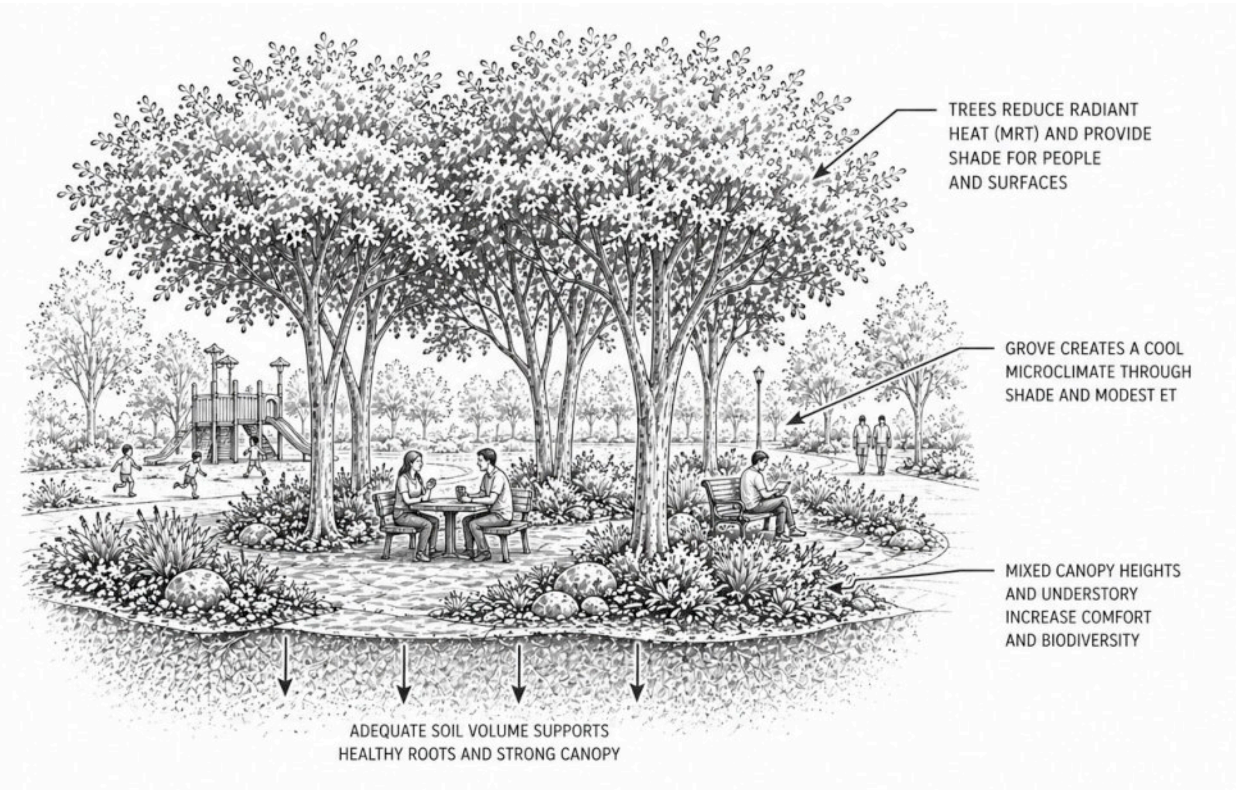
- The cool core: seating, play, gathering
- Along key shaded connectors
- In “stepping-stone” shade nodes across the park

Design moves

- Plant in clusters (3–7 trees) rather than isolated trees.
- Use mixed canopy heights and understory.
- Ensure adequate soil volume and establishment irrigation.

Benefits

- Major comfort improvement with relatively modest water (when designed right)
- Strong social value—people actually use the space



5.3.8 Windbreak and dust-filter planting belts

How it operates

- A layered belt reduces wind speed near the ground, traps dust, and improves comfort.
- Works best as a porous filter, not a solid wall.

Where it fits

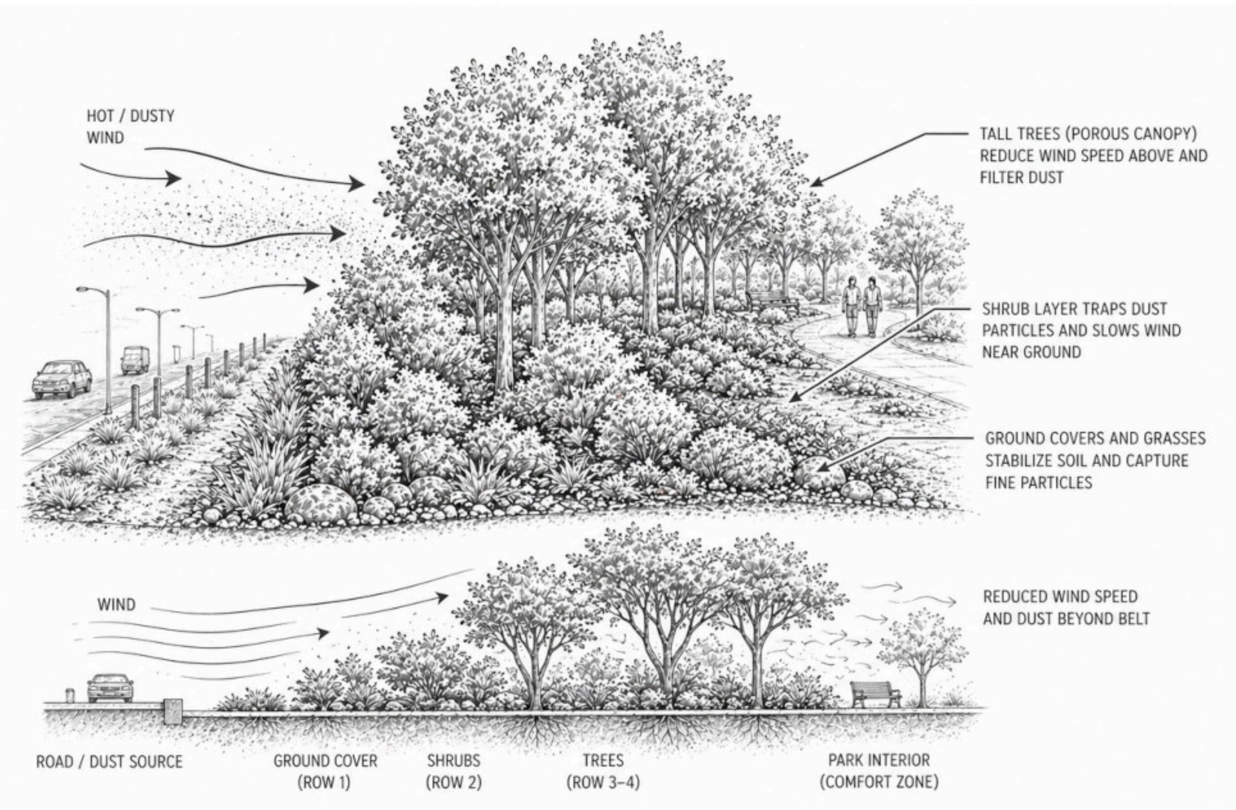
- On the dominant dust/hot wind edge
- Along busy roads to reduce particulate exposure
- As a buffer between active and quiet zones

Design moves

- Use 2–4 rows: groundcover + shrubs + trees.
- Keep internal park areas ventilated; avoid creating stagnant hot pockets.
- Maintain visibility and safety at entrances.

Benefits

- Improved air quality and comfort
- Reduced sand deposition inside the park
- Protects delicate plantings and seating zones



5.3.9 Habitat micro-patches (arid biodiversity nodes)

How it operates

- Small native plant communities provide nectar, seeds, refuge, and stepping-stones for urban biodiversity.
- In arid contexts, these are designed as low-water ecological patches.

Where it fits

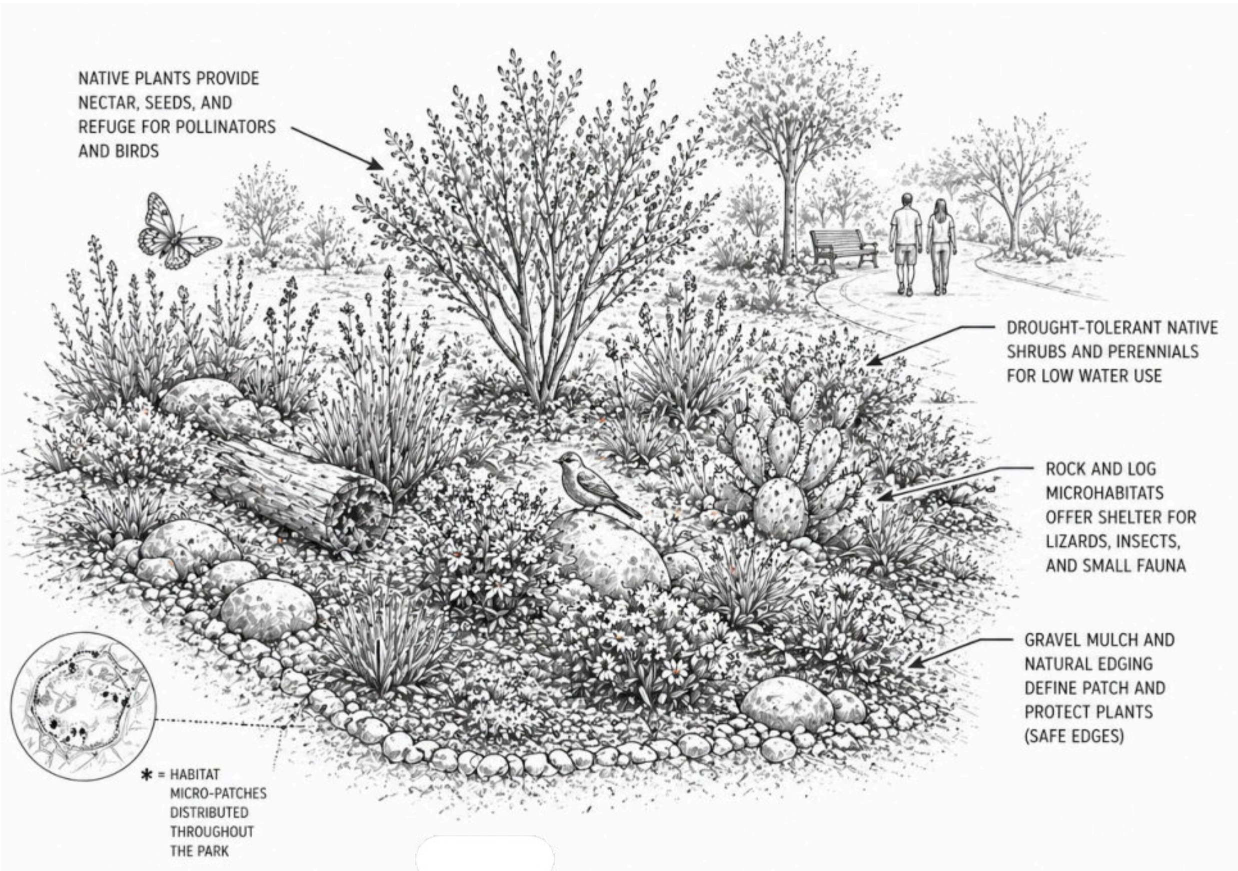
- Warm edge ecological belt
- Along swales/basins
- Quiet corners away from heavy foot traffic

Design moves

- Use native shrubs, flowering perennials, and groundcovers.
- Add rock/log microhabitats (carefully placed, safe edges).
- Keep irrigation minimal after establishment.

Benefits

- Biodiversity and education value
- Often very low water demand long-term
- Adds seasonal interest without lawns



Appendix 1: GUS guidance and checklist

Appendix 2: Site Diagnosis Sheet (English & Arabic)

Appendix 3: GUP site inventory layers

Appendix 4: Example of plant list relevant to Libya