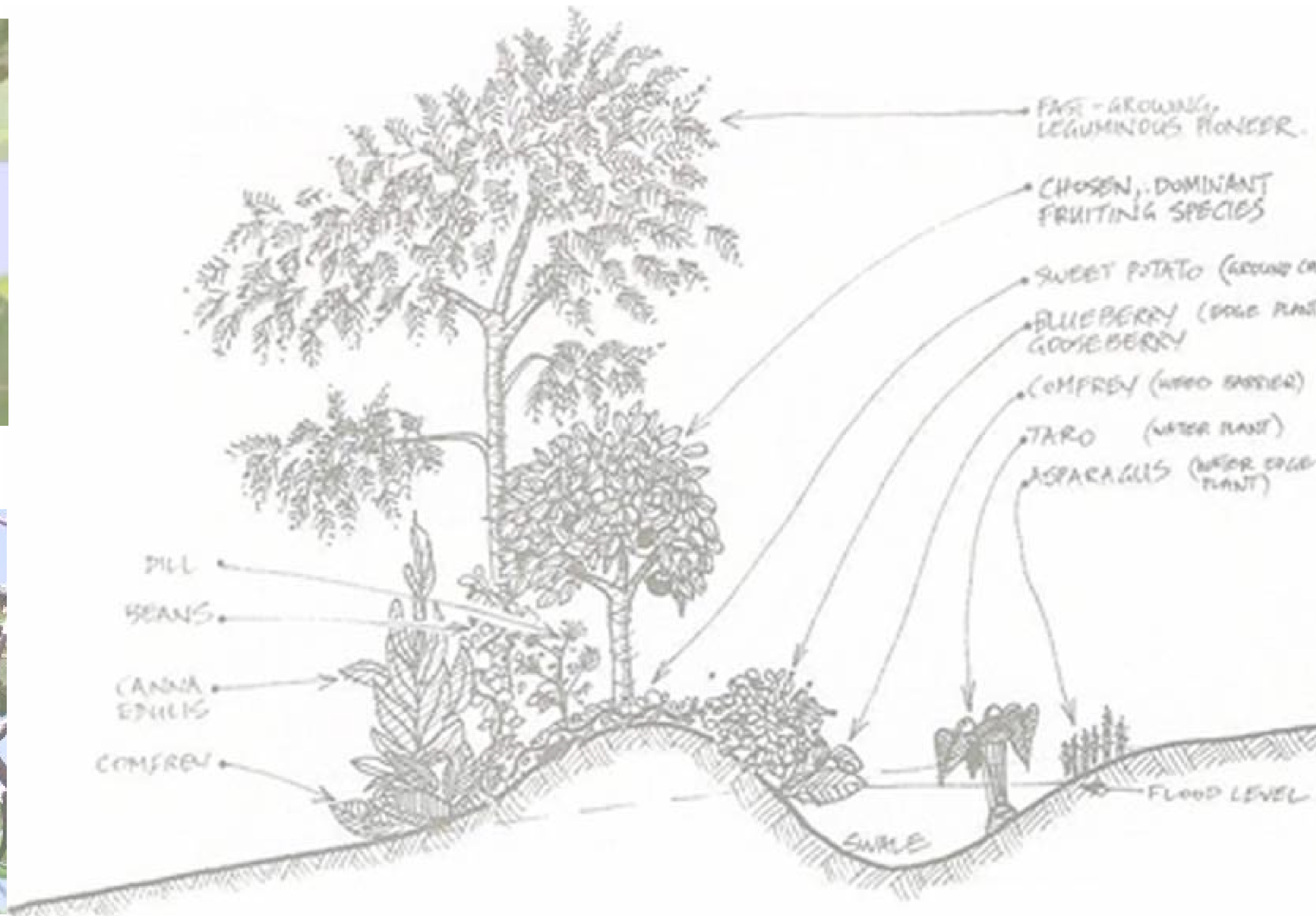
Food and Food Forests for Southwest Gardens

A Residential and Small Farm Approach



The Problem: Food Insecurity

Modern and even organic farming practices destroy the soil 18 to 80 times faster than natural soil formation rate (Jeavons 2005).

In fact, leading scientists suggest that only 40 to 80 years of top soil remain world wide (UN Report 2000).

History told, the fall of every great civilization was often marked by their failure to take care of their soils (Berry 2002)

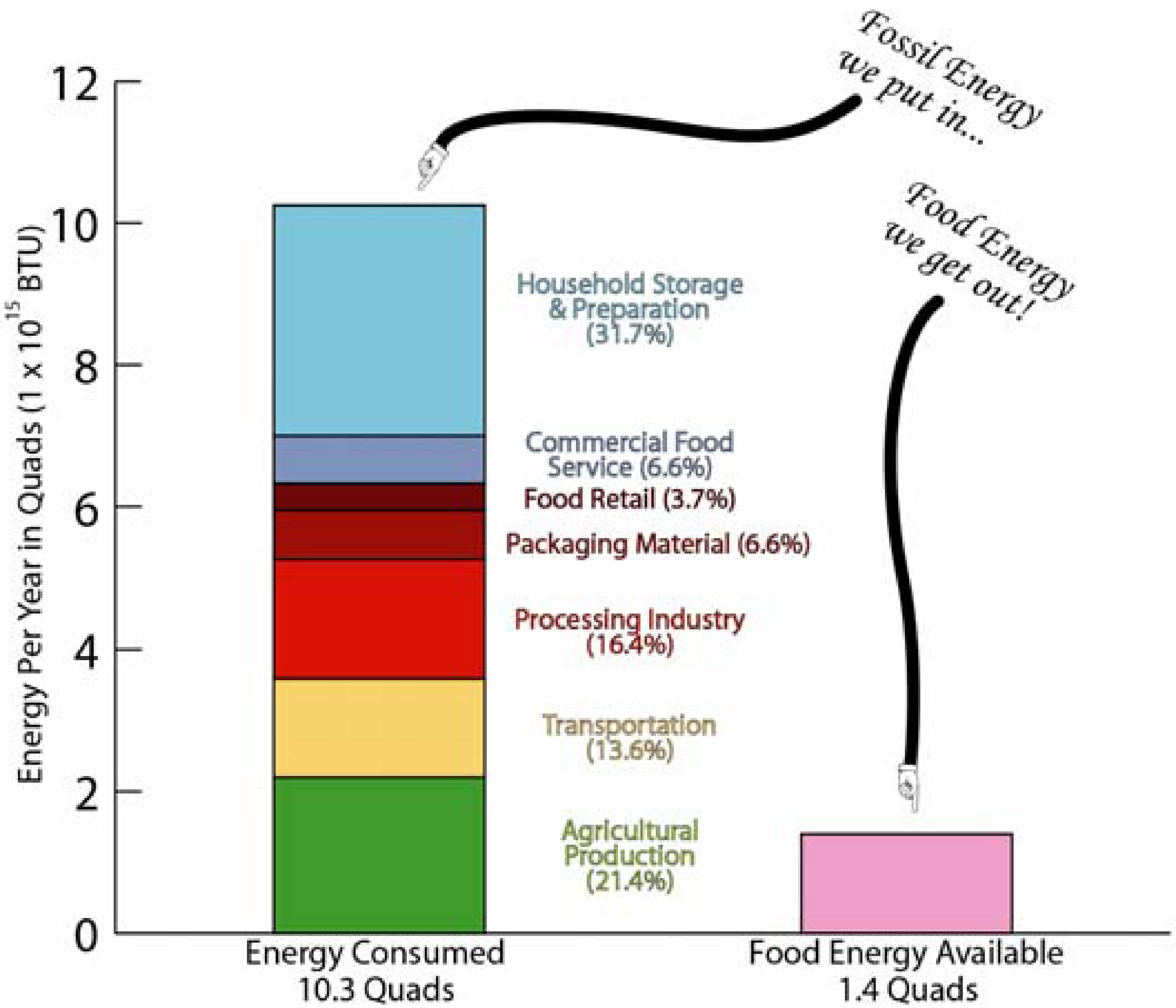
The Problem: Food Insecurity

Much of the problem is scale.

- **Groundwater withdrawal exceeds recharge in most cases.**
- **1.75 billion tons of soil are lost annually to erosion.**

Much of the problem is cultural-based

- Farmers account for less than 1% of our population.
- Factory farming and factory food (fast food) has created an obesogenic nation, 75 billion in medical expenditures to taxpayers.
- 26% of the edible food wasted at consumer level

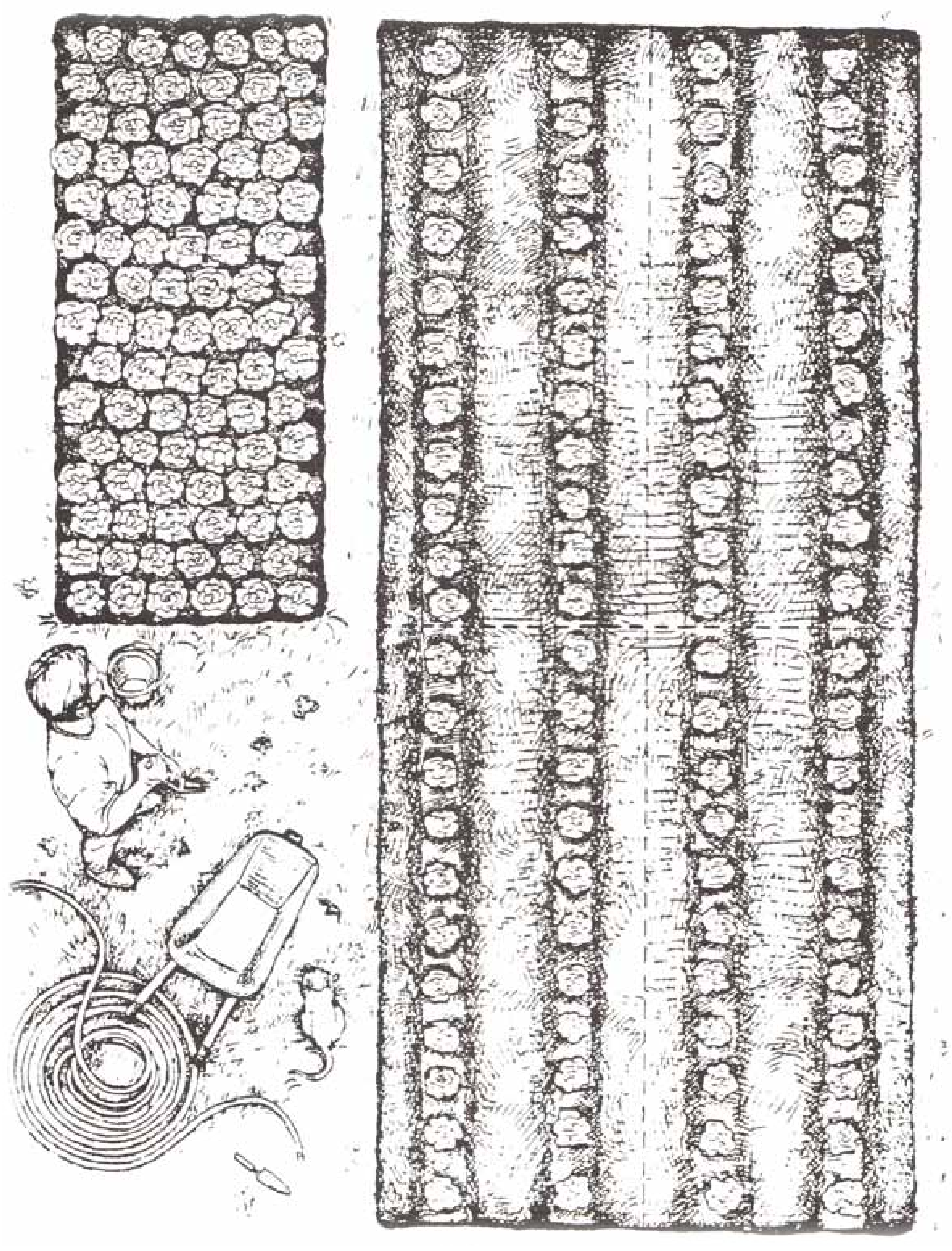


7.3 units of (primarily) fossil energy are consumed for every unit of food energy produced.

Promise of Alternatives

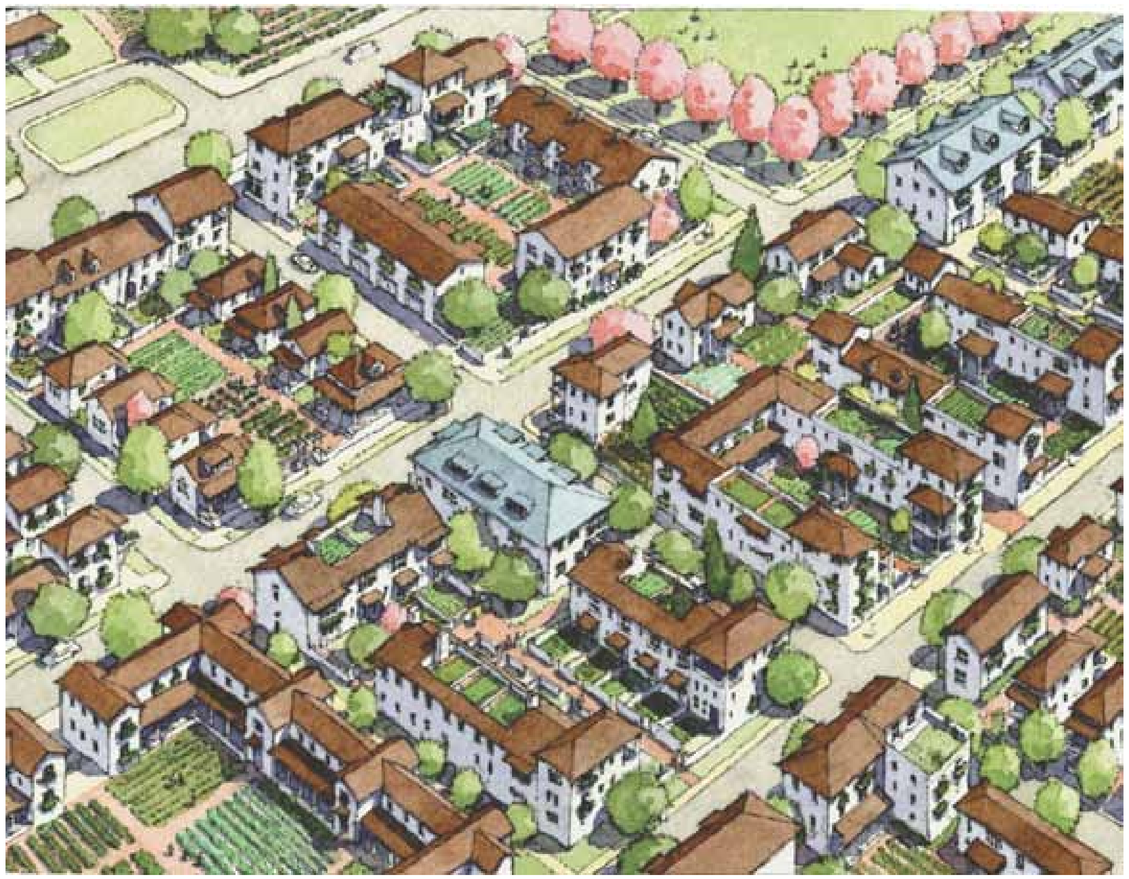
Small scale farming and sustainable farming can have the following benefits:

- May use 10% of the water consumed in conventional agriculture.
- Produce 4 to 8 times more food per area.
- Improve soil formation rates 10 times more than in nature.
- Mitigates or reverses soil erosion
- Focuses on local and diverse economies and food distribution systems.
- Reduces energy consumption and fossil fuel use.



Promise of Alternatives

- In 2006, 53% (by value) of Russia's total agricultural output came from household plots accounting for 2.9% of agricultural land.
- Accounting for nearly all of 90% of potato production and 70% of vegetable production.



- One difference is that Russians spend on average 17 hours a week gardening, while Americans spend 32 hours a week watching TV.

Source: Sharashkin, Leonid. "The Socioeconomic and Cultural Significance of Food Gardening in the Vladimir Region of Russia." 2008.

Philosophical Framework

According to Wendell Berry, at the right scale, small scale, farms were and still are enjoyable places to live.

In fact, some cultures were so successful at small scale farming that researchers found that they spent nearly half the year in festivity (Chayanov 1986).

The Research Question

How can design make food more sustainable and accessible to our local community?

Literature Review

Sustainable Food Approach

Local Ecology

Sustainable Systems: Strategies and Tactics

Sustainable Design

1. Permaculture Design Principles

Permaculture principles highlight the need for functional and beneficial relationships of all elements in the design.

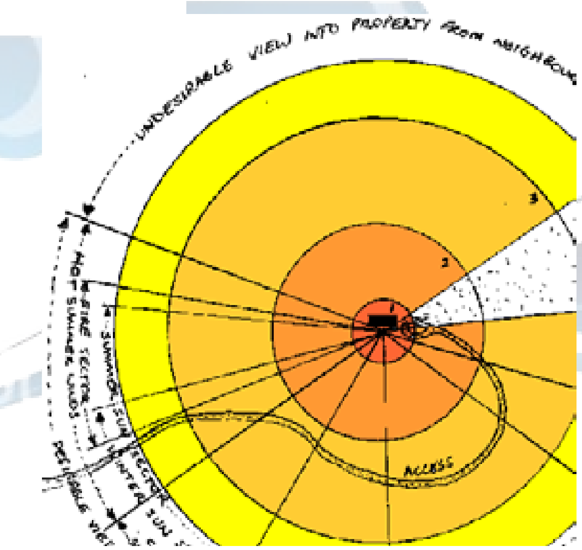
2. Edible Forest Garden Design Process

Edible forest garden design will bridge the gap from permaculture principles to implementable plans.

Design Approach

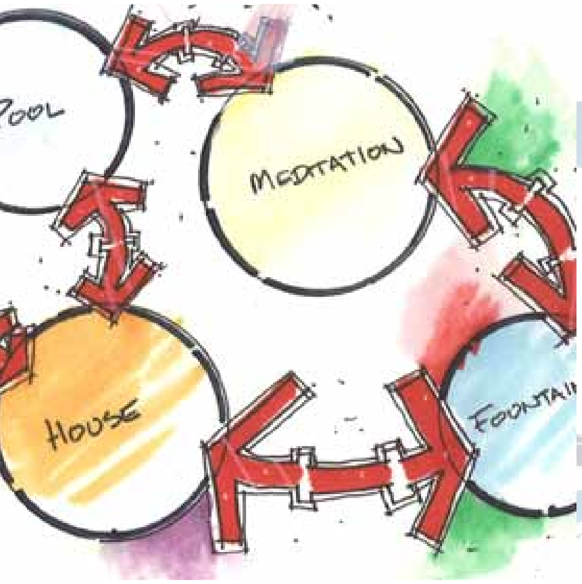
Goal Articulation

Base Mapping:
Grading

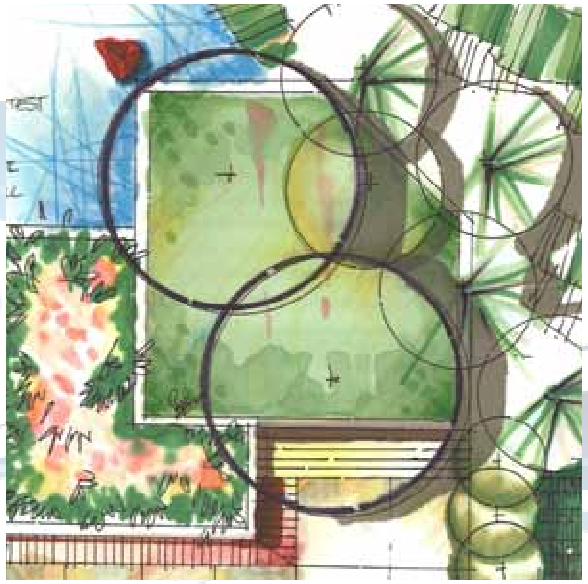


Analyze and Assess Site:
Sector Analysis

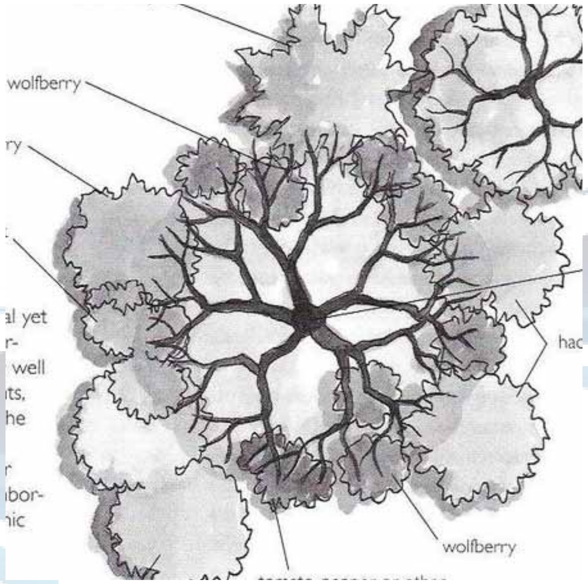
Design Concept:
Vision Statement
Sketches



Schematic Design:
Zonation
Scale
Bubble-e



Detail Design:
Infrastructure
Ecology
Residential Principals



Patch Design
Vegetation
architecture, dynamics
ansd social structures

Implementation & Evaluation

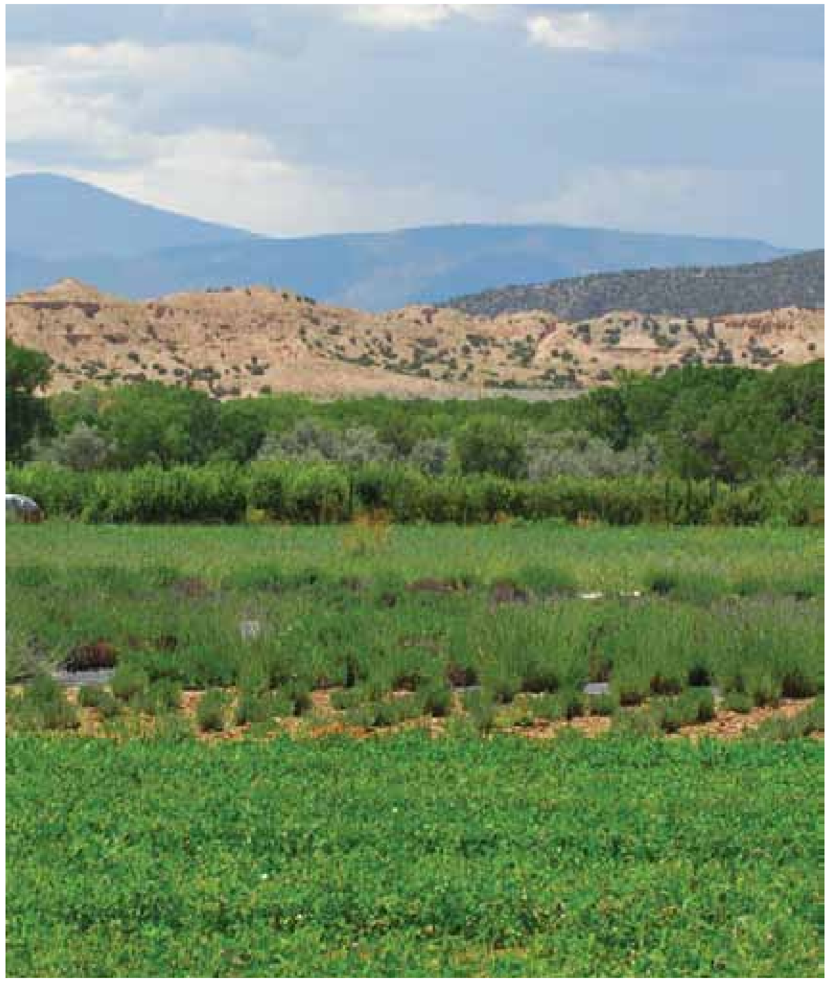
Local Ecology

1. Foodsheds and watersheds

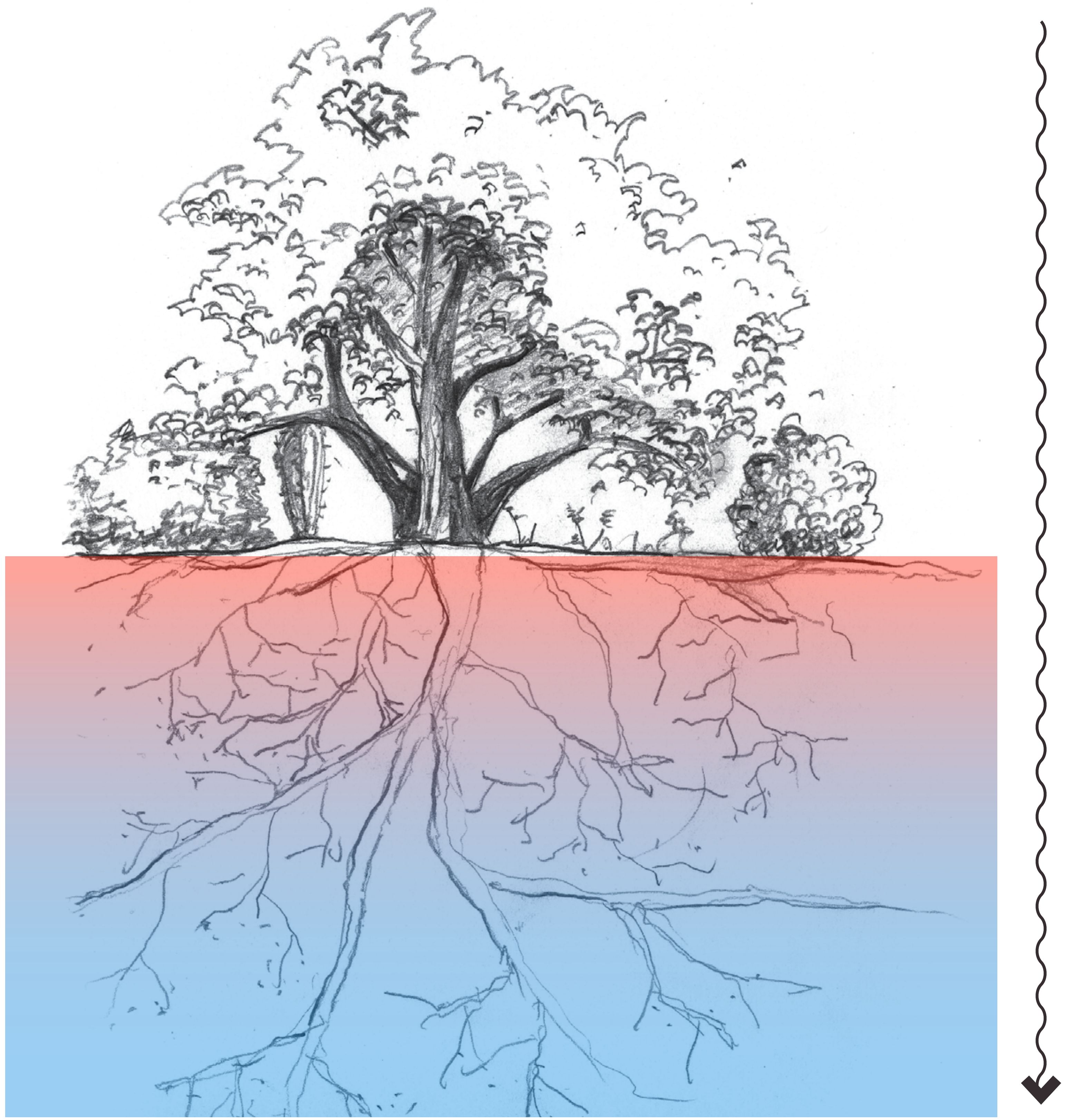
Multiple scales of food production increase resiliency

2. Regional ecology

Organized in the language used in edible forest garden concepts: vegetation architecture, vegetation dynamics, and social structure.



Guild Architecture: The Mesquite

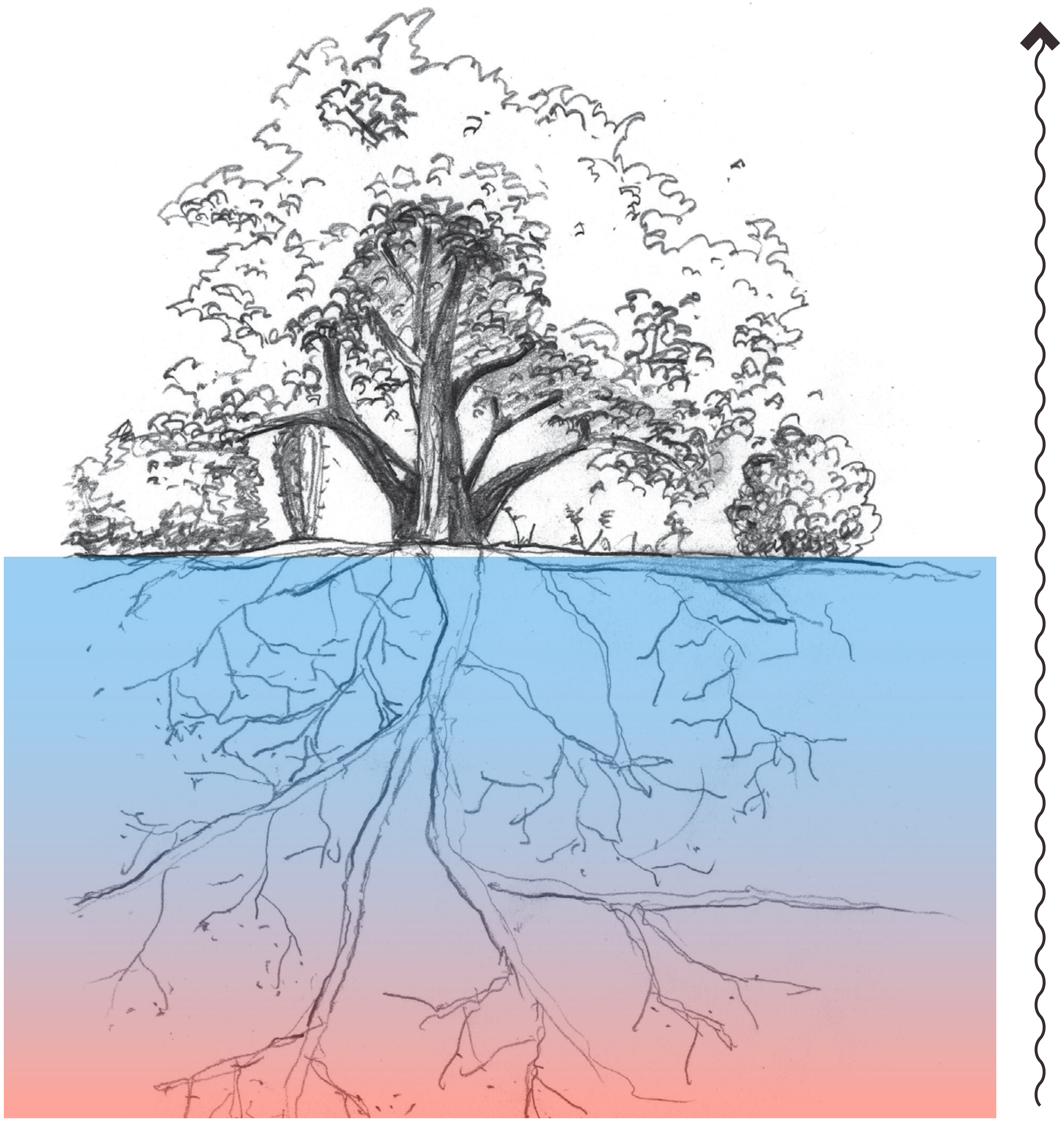


Nurse Plant Qualities

1. Nitrogen fixation
2. Microclimate
3. Hyraulic Lift (Sowell 2001)

During day, shallow soil drys

Guild Architecture: The Mesquite

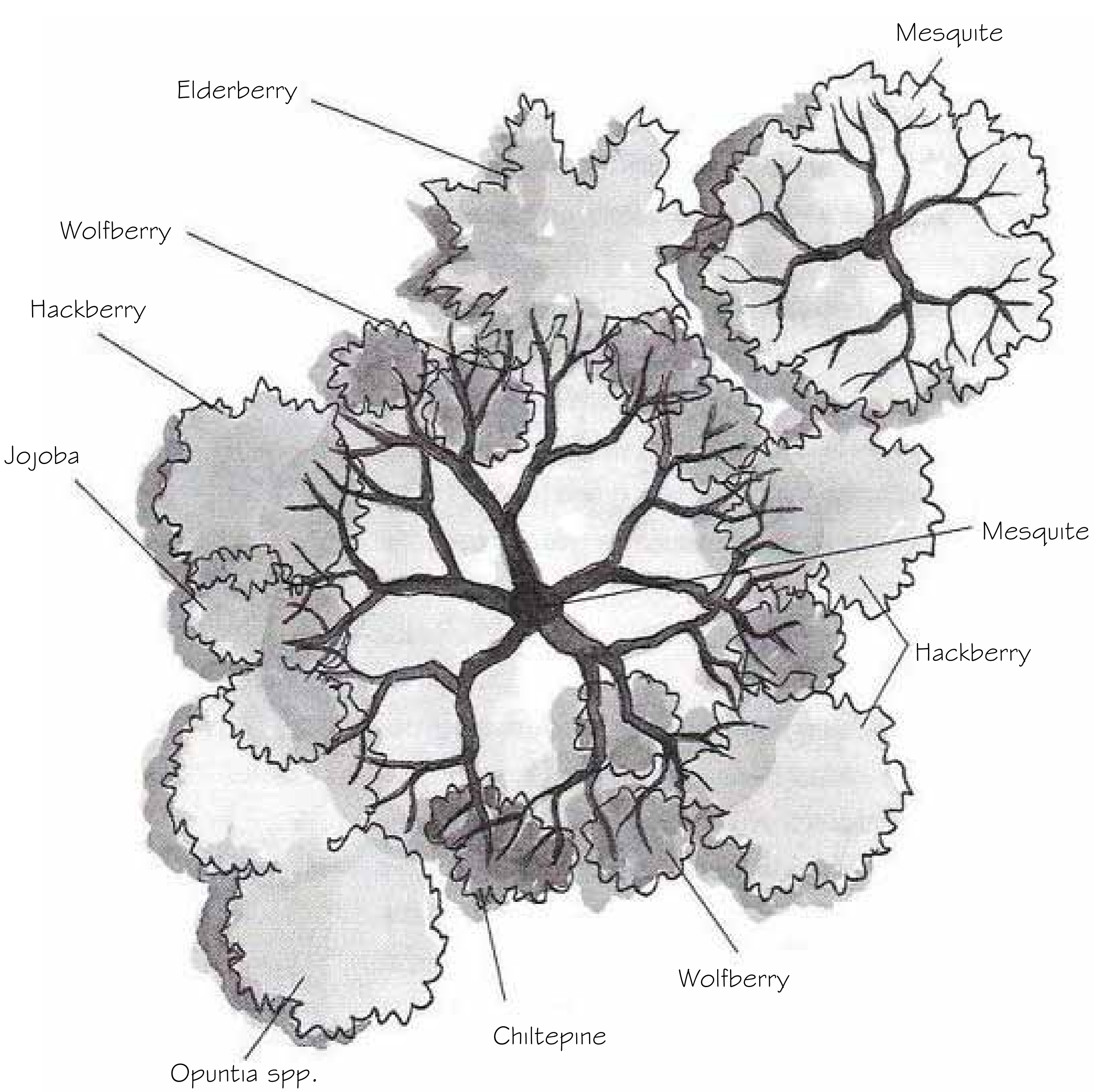


Nurse Plant Qualities

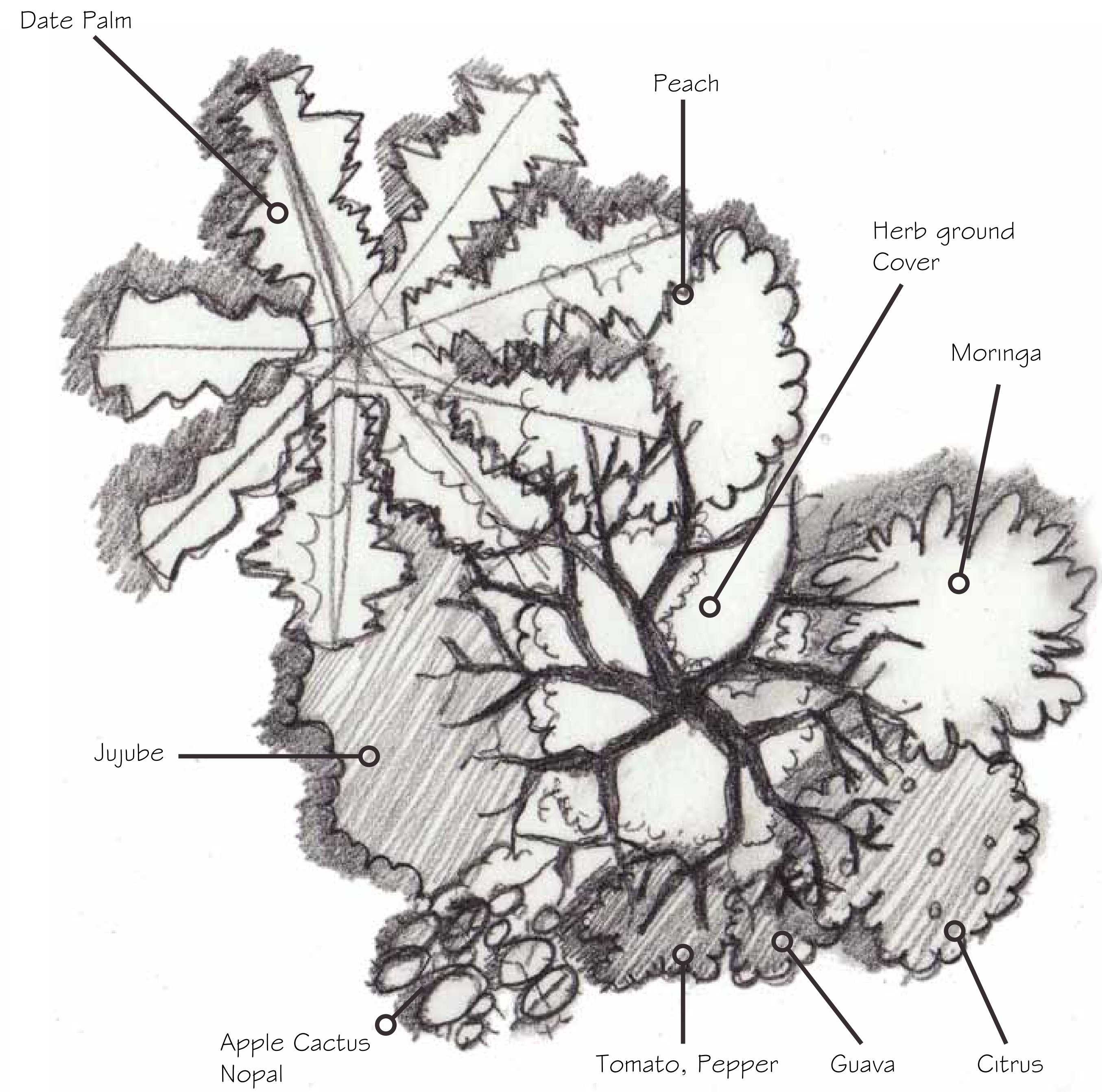
1. Nitrogen fixation
2. Microclimate
3. Hyraulic Lift (Sowell 2001)

By night, hydraulic lift of water from deep to shallow soil and water exudation tend to moisten the soil

The Mesquite Guild



A possible native food forest guild



A higher water use food forest guild

Sustainable Systems

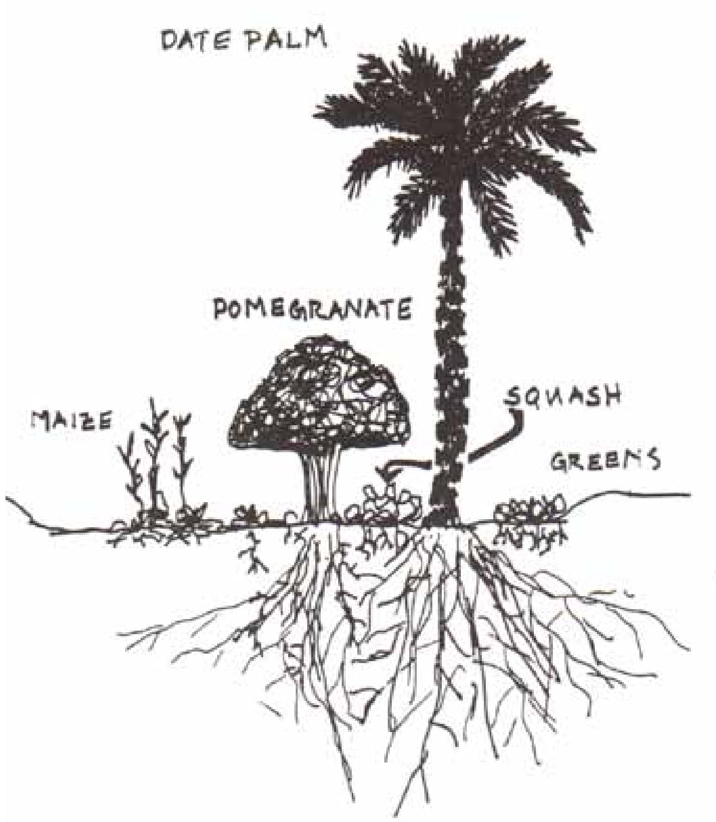
1. Water and production efficient gardening systems

Small scale systems, larger scale systems

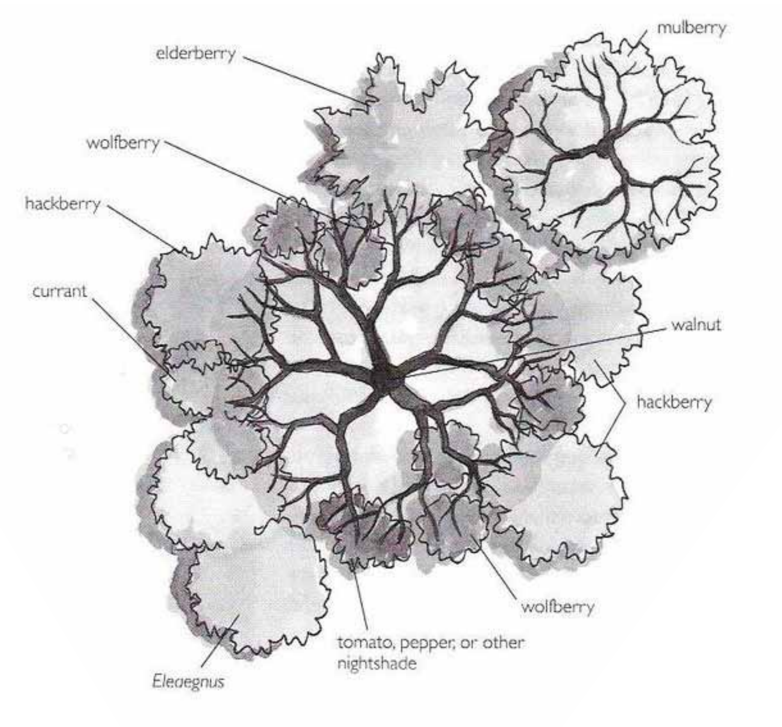
2. Food forest concepts

Vegetation architecture, vegetation dynamics, and social structure.

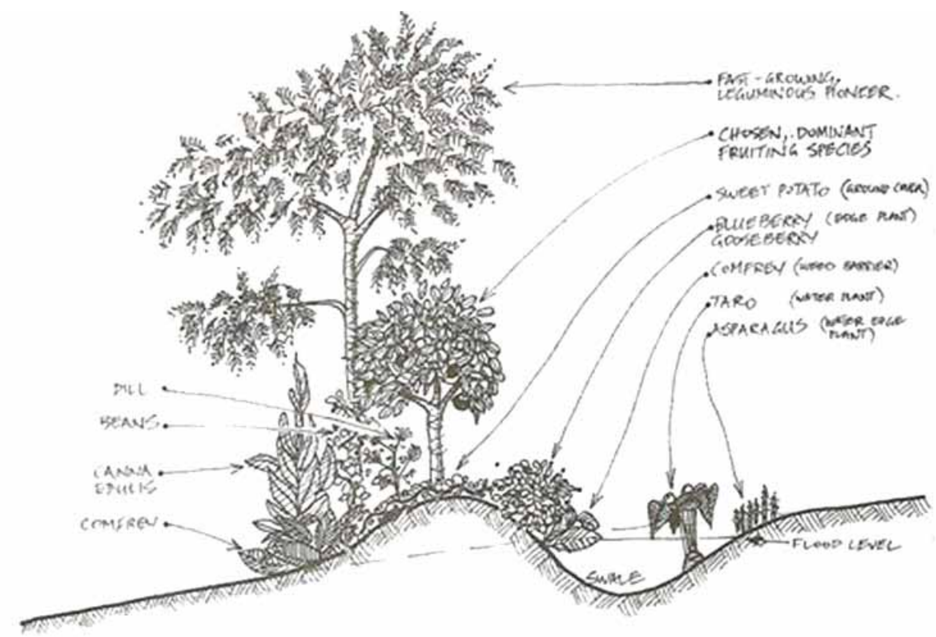
Elements of the Food Forest



Architecture



Plant Selection



Water Guilds

Living Habits and Soil Fertility

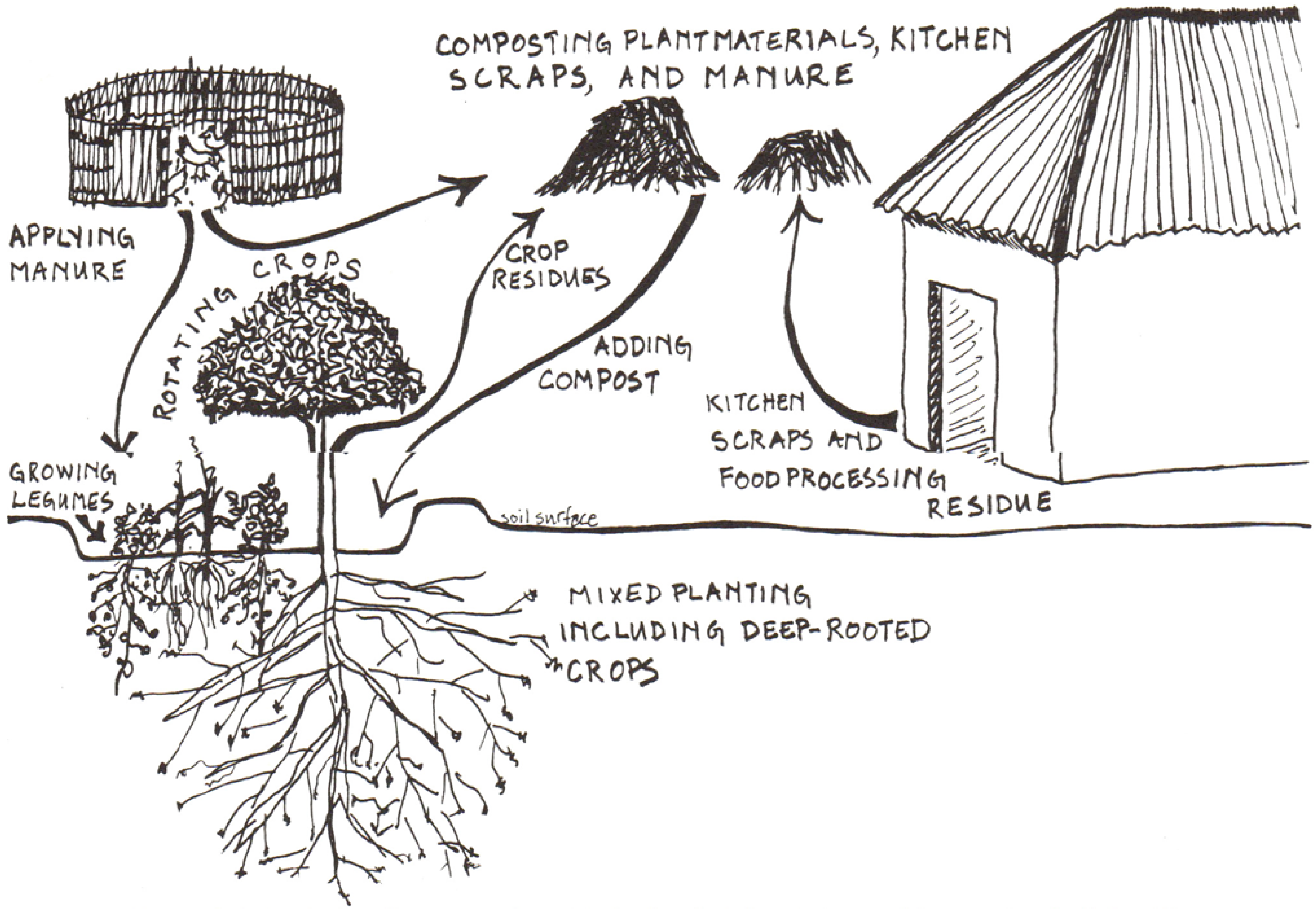
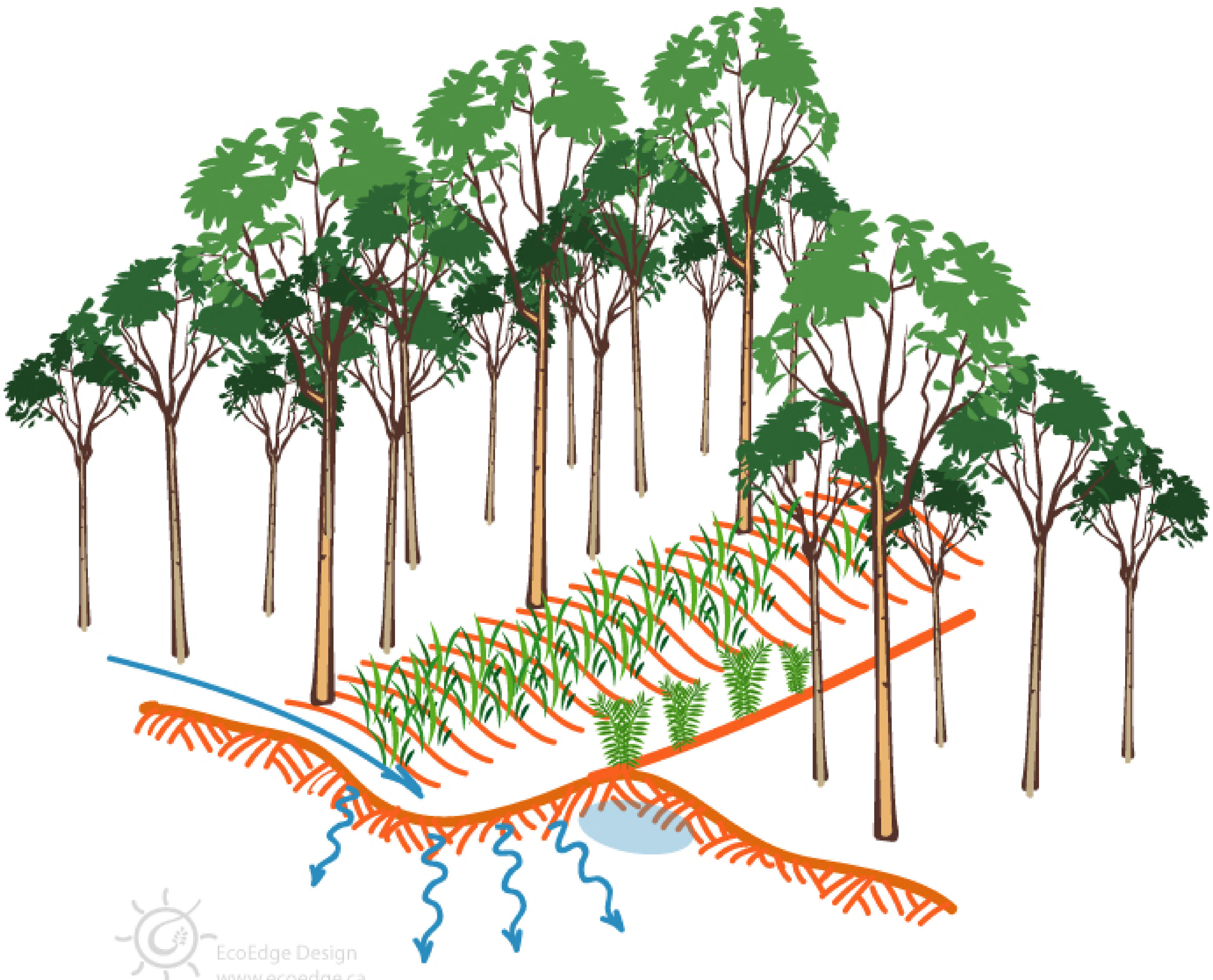
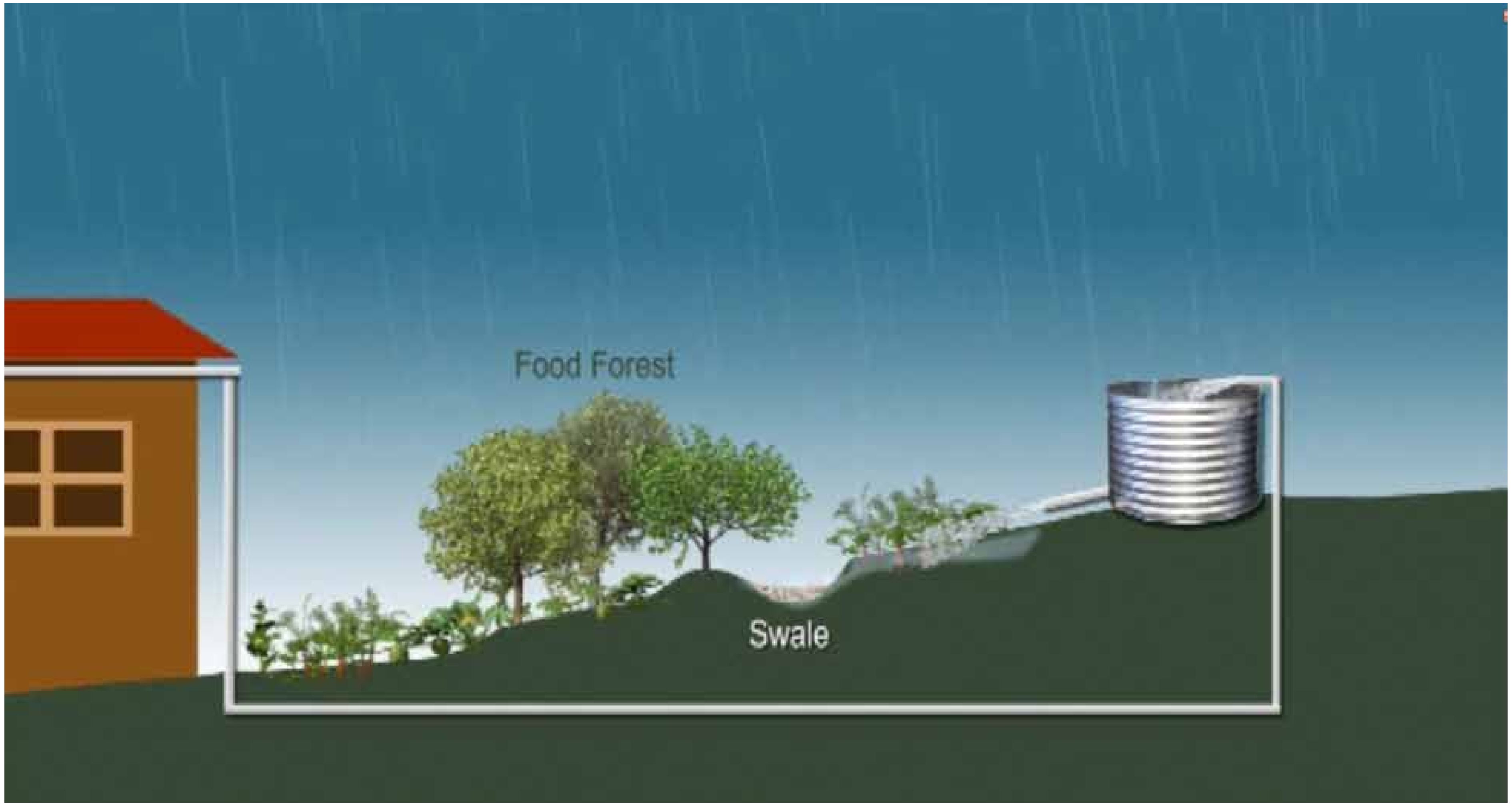


Figure 9.9 High-Quality, Low-Cost Methods of Maintaining and Improving Soil Fertility

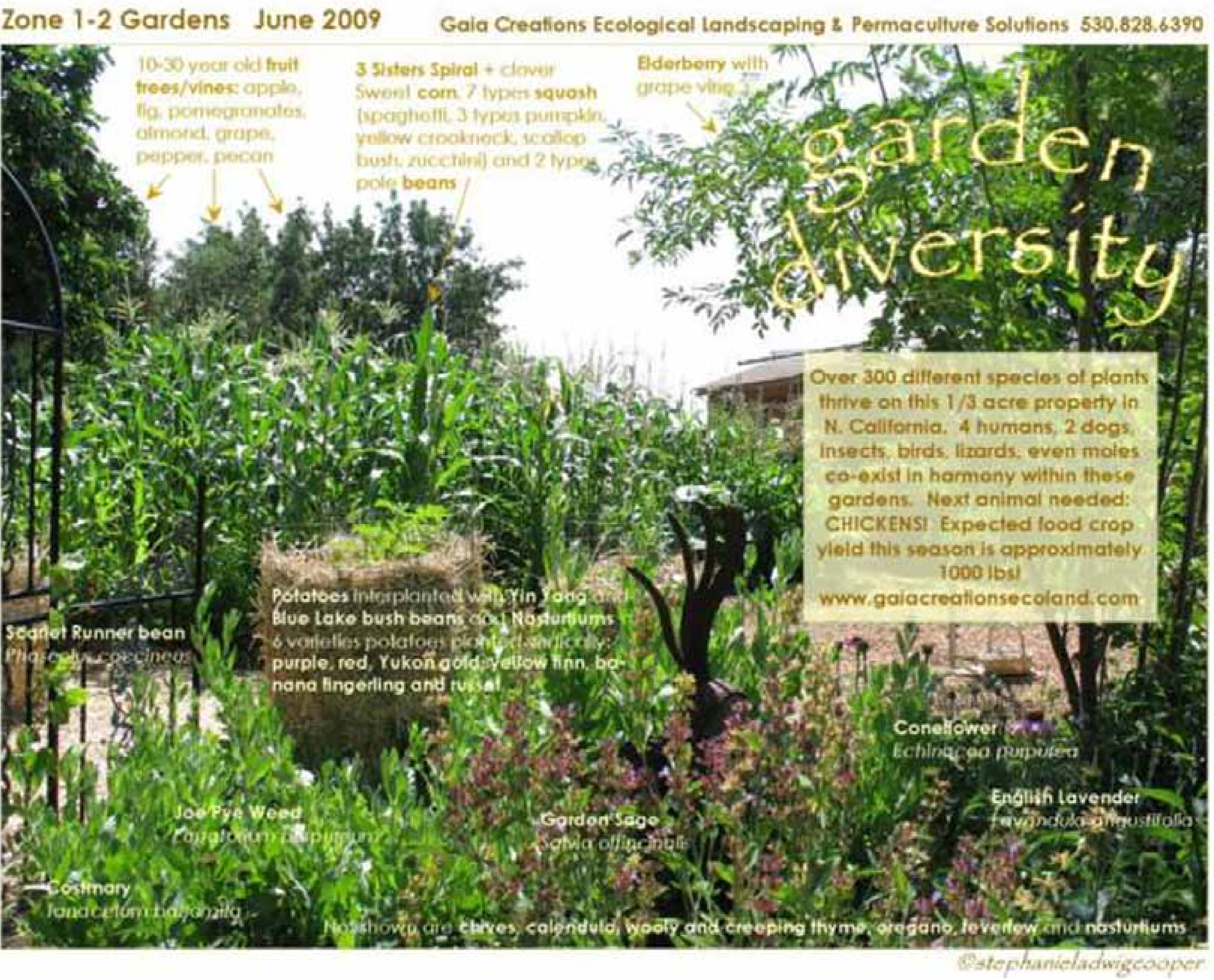
Active and Passive Water Storage



Active and Passive Water Storage



Integrating Elements
Plant Location & Ecology



Introduction Literature Review Analysis Design Conclusions

Case Review

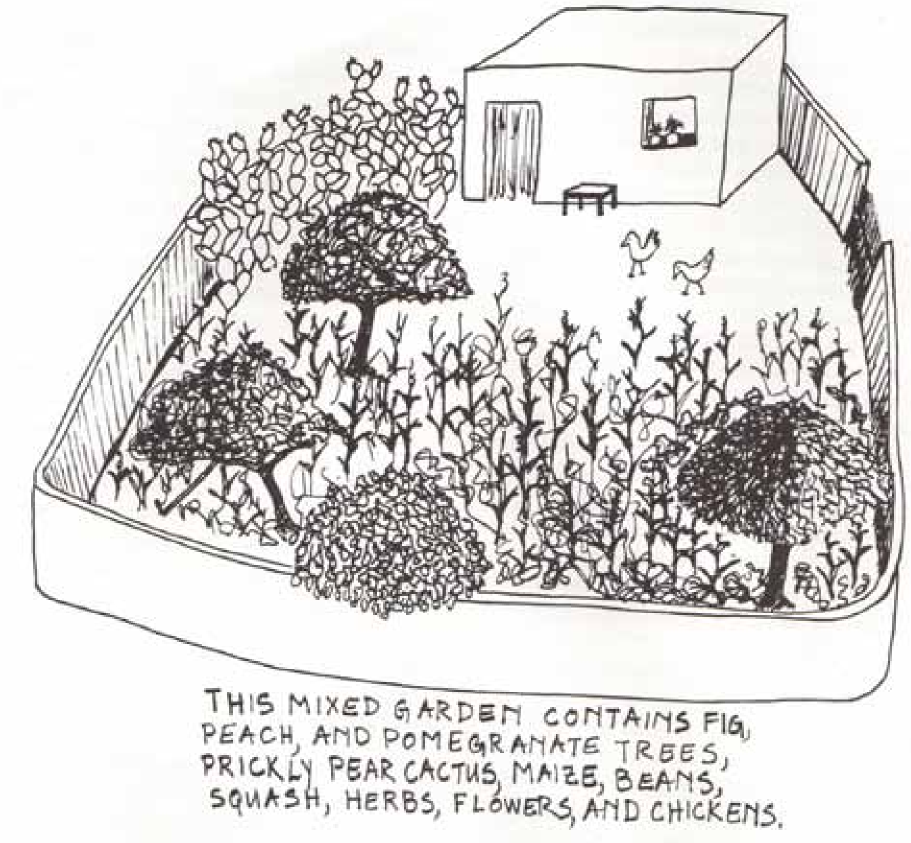
1. Greening the Desert, Jordan

2. 2,000 year old food forest, Morocco

3. Traditional Mexican Garden, Tucson

4. Zvishavane Water Resources Project

5. Food production in Russia



Greening the Desert

Location: Jordan, 5 miles from the Dead Sea

Annual rainfall: 4 to 6 inches

Site conditions: highly saline soils, unproductive agricultural land

Regional conditions: one of the most water deprived countries in the world, only 41,000 gallons per capita per year. (compare to 62,000g per capita in Tucson)

Greening the Desert

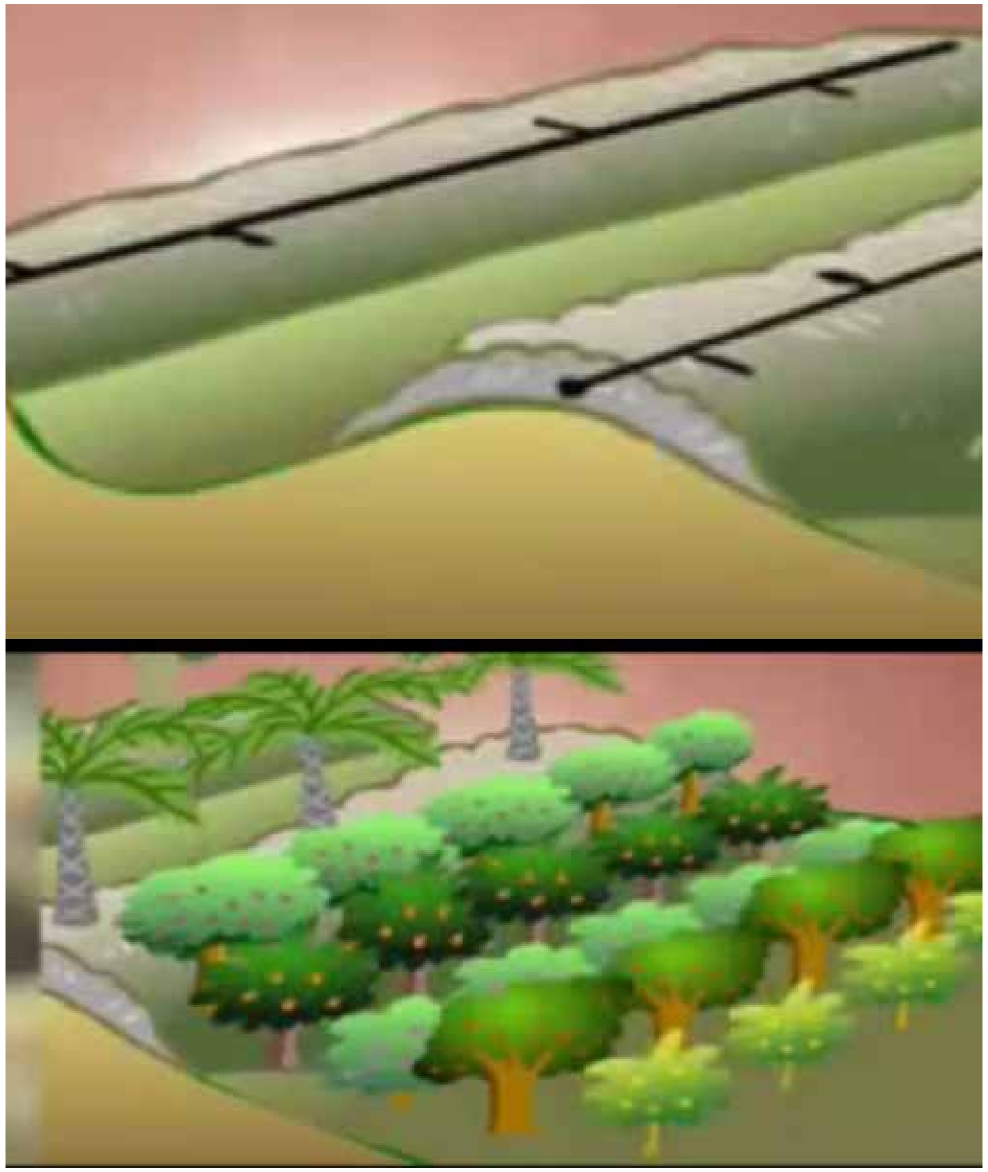
Greening the Desert

The same principles applied on a Jordanian residence.

Greening the desert site in 2000 during construction.

The site a few years after the initial design and implementation.

Greening the Desert



10 swales on 10 acres harvest every drop of water to support a forest of legumes and fruit trees.

Source: Ayesh, Mohammed. Use of permaculture for holistic water resources management under salinity and drought conditions.

Results:
Crop yields with respect to water efficiency was high. 13.3 ton/ha

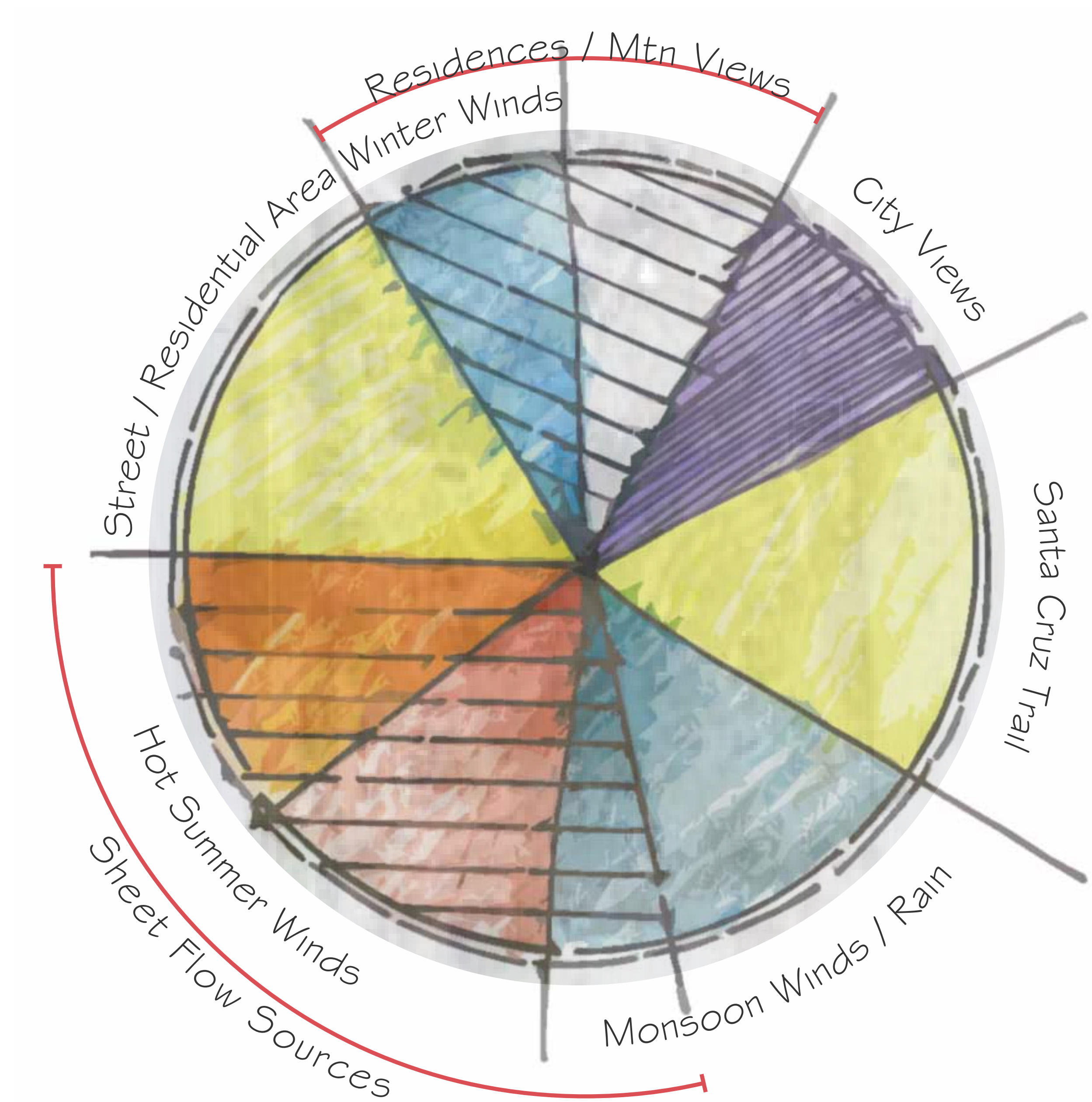
Used a 1/5 of the water conventional agriculture would have used.

Drastic soil improvement

Methods:
- Permaculture design
- Rainwater harvesting
- Greywater
- Animals
- Food forest and ecology

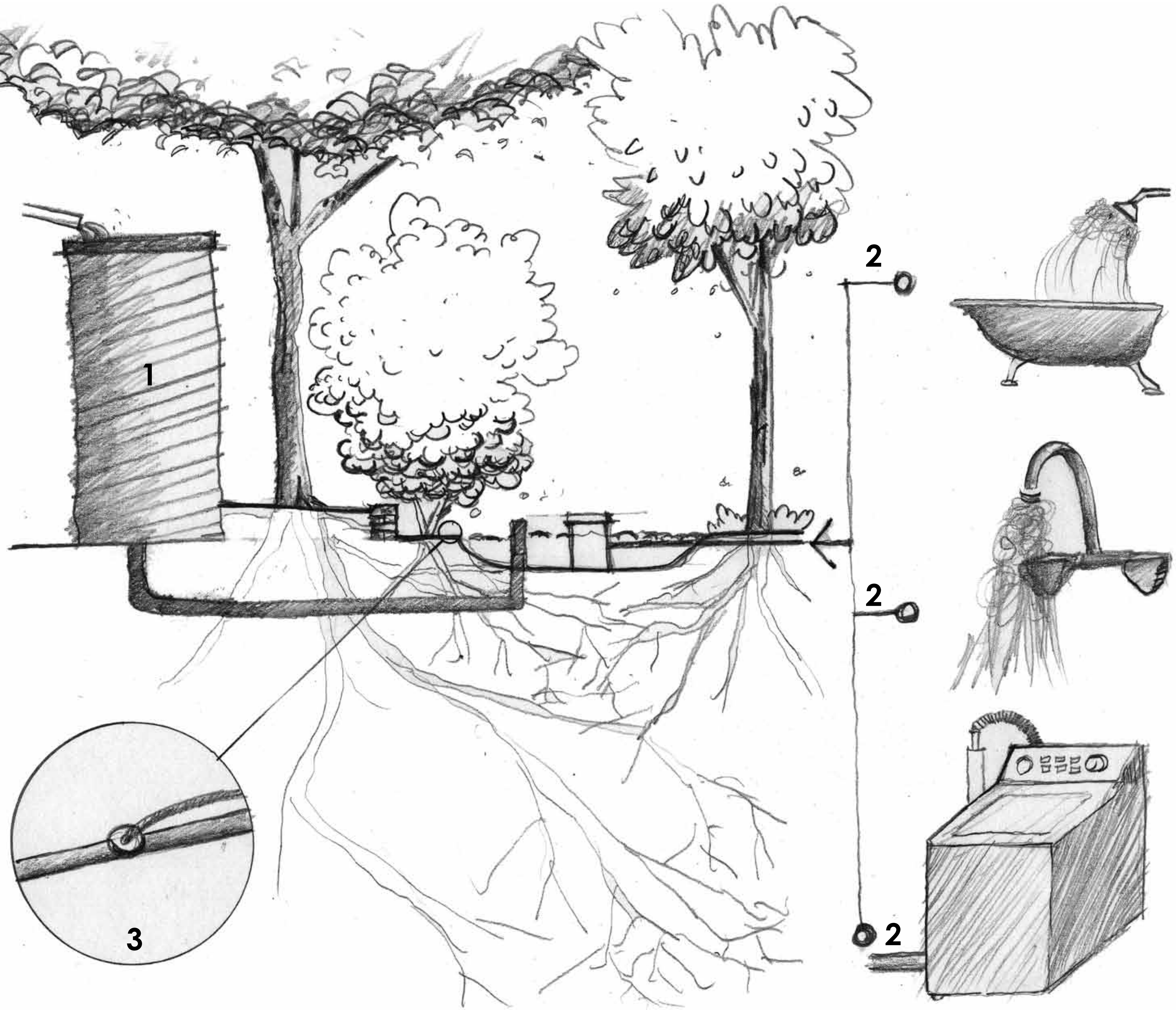
Site A: Site Analysis

Goal: design a productive permaculture landscape at the small farm scale



Sector diagram developed from GIS analysis, neighbor & staff testimonials, onsite observation, and general knowledge of region.

Water Systems as Guilds



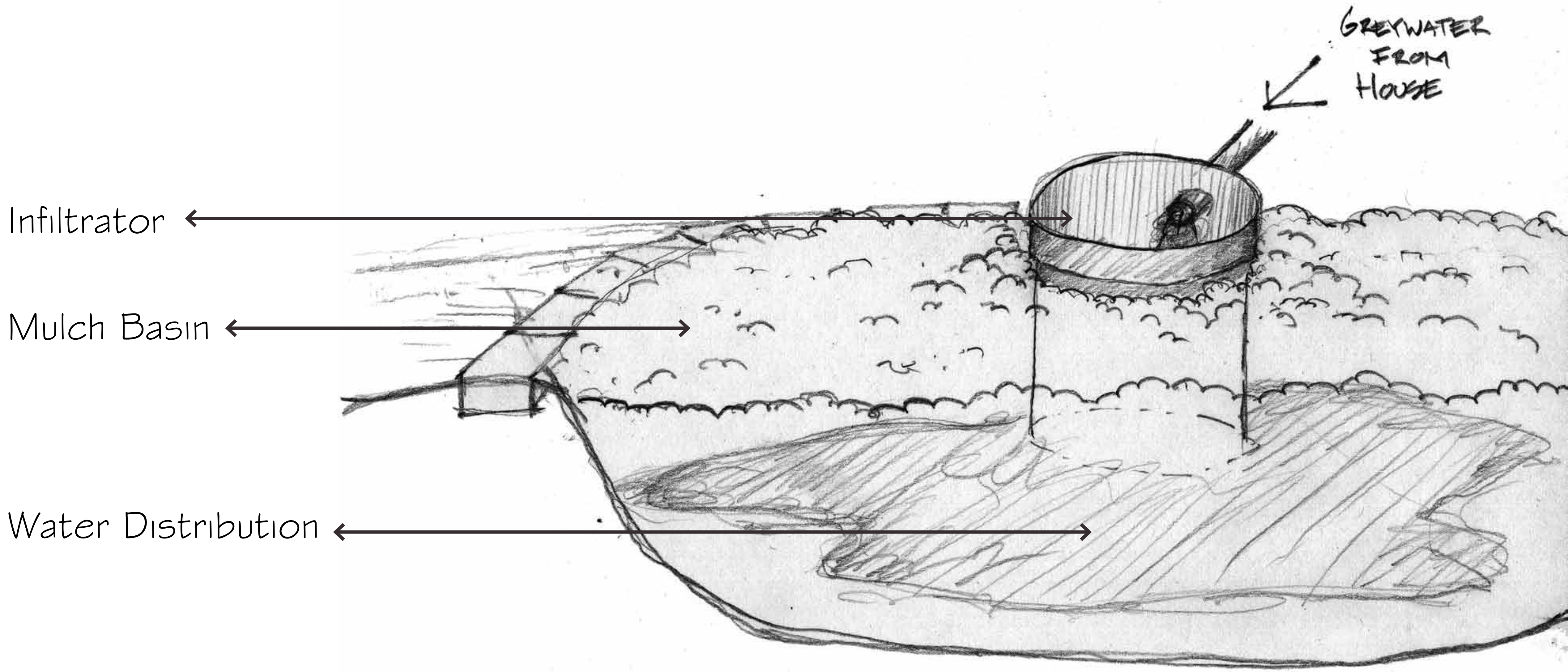
Watering Systems
(in order of use priority)

1 Active and passive rain water

2 Greywater

3 Municipal Water

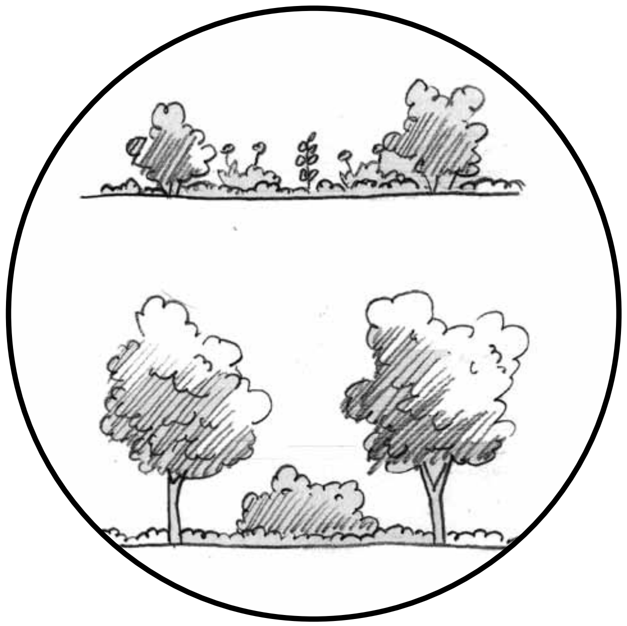
Water Systems as Guilds



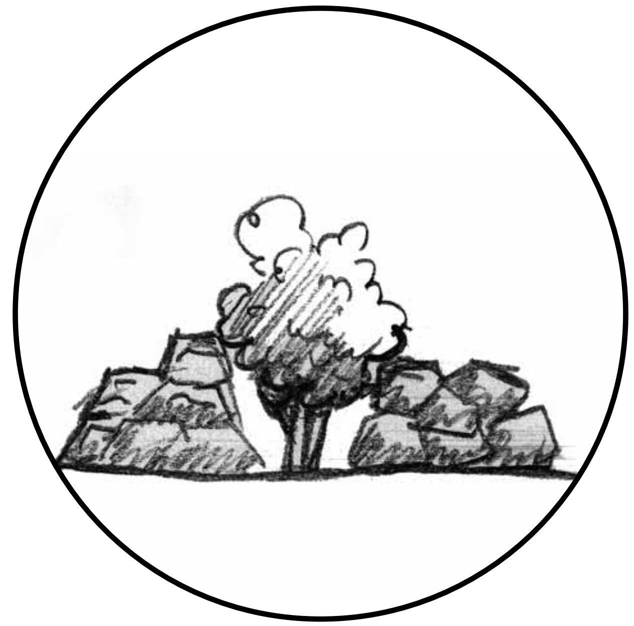
Plants: Vegetation Architecture

Common Name	Family	Native to	Successional Stage	HeigtxWidth	Form	Habit/Root Habit	Light	Soil
carob	fabaceae	mediteranean	Climax	30x30	E tree	Deep, adaptable	Full to part	Fairly salt tolerant
Miracle tree	moringaceae	subtropic to tropic	Climax	30x20	bush/small tree	Deep	Full to part	dry, sandy to heav
olive		mediteranean	Climax	25x25	E tree	Shallow, Runner	Full	Dry, rocky, well-dr
passion vine	passifloraceae	baja california	hot, rocky, sandy	10' sprawl	Vine	Shallow	reflected to part	
jojoba	simmondaceae	Sonoran Desert	Climax	6x5	E shrub	Shallow	full to part	Native, sandy to ro
chiltepine		Sonoran Desert	Climax	3x3	D shrub	Shallow, Fertile	Partial shade	Fertile
wolfberry		Sonoran Desert	Any	3x5	D shrub	Shallow	Partial shade	Native, sandy to ro
Mexican elderberry	caprifoliaceae	Arizona	Any	10-20x8-20	D shrub	Deep fertile	full to part	Native, sandy to ro
agave		Arizona	Any	3x3	Succulent	Shallow, Dry	full	Dry, rocky
natal plum	apocynaceae	South africa	Climax	5x5	E shrub	Shallow	full	
Lemon		unknown	Climax	15x15	E shrub	Shallow to Moderat	full to part	Fertile, well draine
Grapefruit		unknown	Climax	15x15	E shrub	Shallow to Moderat	full to part	Fertile, well draine
Sweet orange		unknown	Climax	15x15	E shrub	Shallow to Moderat	full to part	Fertile, well draine
pineapple guava	Myrtaceae	S. America	Climax	15x15	E shrub	Shallow	full to part	Fertile, well draine
fig	Moraceae	Mediteranean	Climax	30x30	D shrub	Shallow	Full to part	Fertile, well draine
goji berry	solanaceae	Europe/asia	Climax	10x10	D shrub	Shallow	Full to part	Dry, rocky
christ thorn	rhanaceae	M. East	Any	30x25	shrub	Shallow to Moderat	full to part	Most
date palm	arecaceae	northern africa	Climax	100x30	Palm	Shallow	full	well drained
apricot		unknown	Climax	15x15	D tree	Shallow to Moderat	full to part	Fertile, well draine
peach		unknown	Climax	15x15	D tree	Shallow to Moderat	full to part	Fertile, well draine
guava	myrtaceae	Tropical to subtropical	Climax	8x8	E shrub	Shallow	full to part	Fertile, well draine
pomegranate	punicaceae	SE europe	Climax	12-20x10-15	D shrub - vase shape	Shallow	Full	Any
Chinese date	rhamnaceae	China	Poor alkaline	20-40x15-30	D tree	Root runner	Full	Poor alkaline to w
staghorn cholla	Cactaceae	Sonoran Desert	Any	5x5	E shrub	Fallen pads	full to part	Native, dry, rocky
prickley pear	Cactaceae	Sonoran Desert	Any	5x5	E shrub	Fallen pads	full to shade	Native, dry, rocky
apple cactus	S. America	Africa	Any	10x5	E shrub	Fallen pads	full to part	Native, dry, rocky
Indian fig	Cactaceae	unknown	full to reflected	15'	E Shrub	Clumping	full to part	Well drain
almond					D tree		full	
grape		mediteranean	full	15'	Annual	Shallow	full	Fertile, well draine
quince					D tree		full to part	
sapote					Annual		full to part	
freeway acacia	fabaceae	Australia	Primary	4x12	Grd Cvr	Shallow	full to shade	Any
quail bush	amaranthaceae	Sonoran Desert	Primary	8x12	E shrub	Shallow	full	Any
tree alfalfa	fabaceae	Mediteranean		3-5'	SD shrub		full to part	Any
feathery senna	fabaceae	Australia		5-Mar	D shrub	Most	full to part	Any

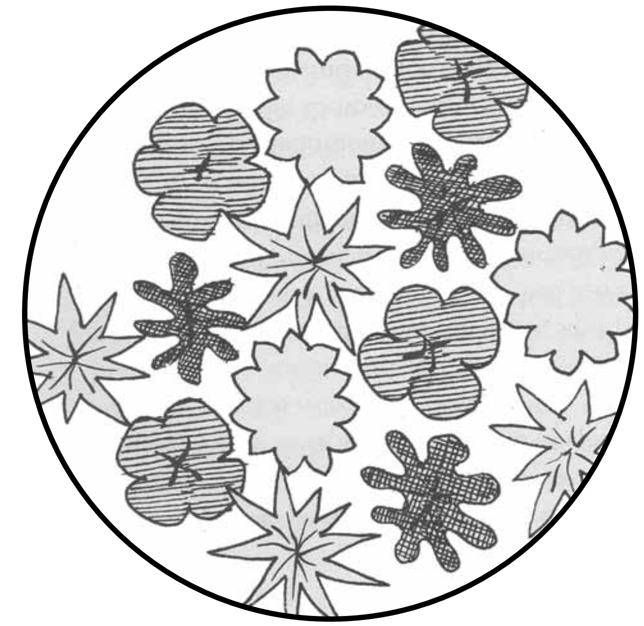
Patterns



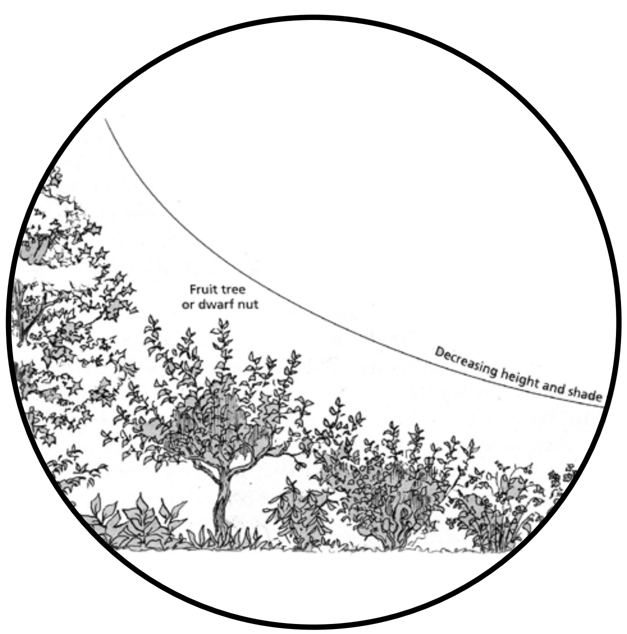
Instant Succession



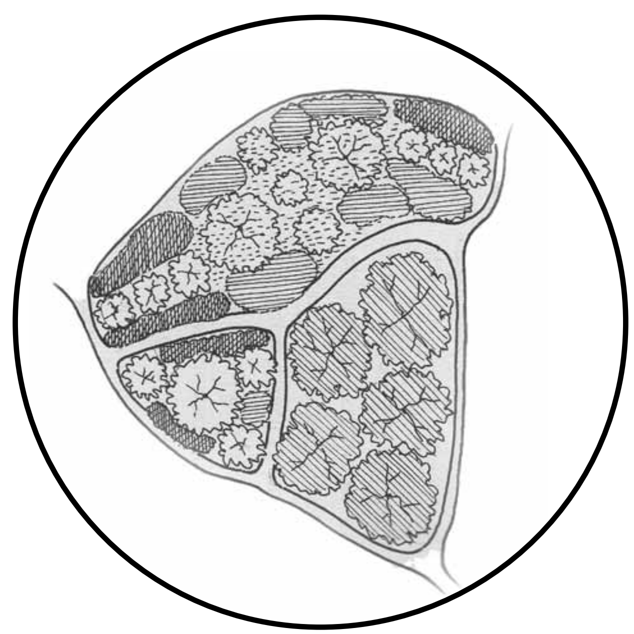
Mulching



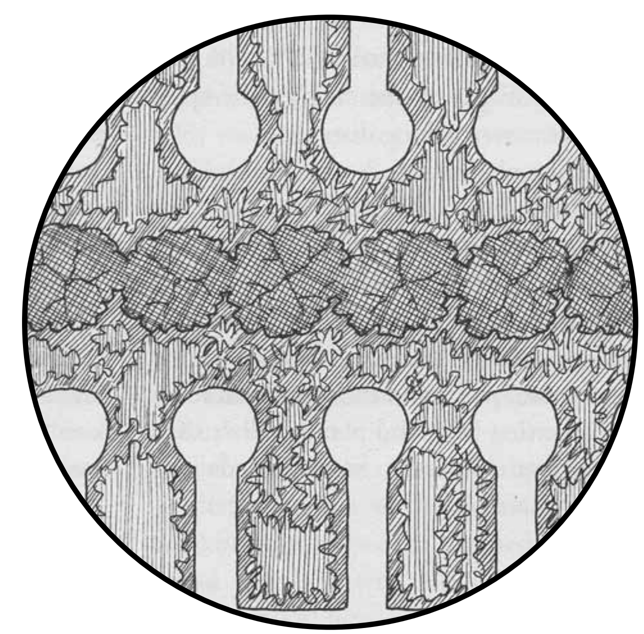
Cross Pollination Clusters



Edge Effect



Dynamic Patches



Keyhole Gardens

Farm Design by Zone

Zone V: Wilderness

Zone II: Demonstration plots, staff core

Zone II: Community garden plots, intensive food forest belts

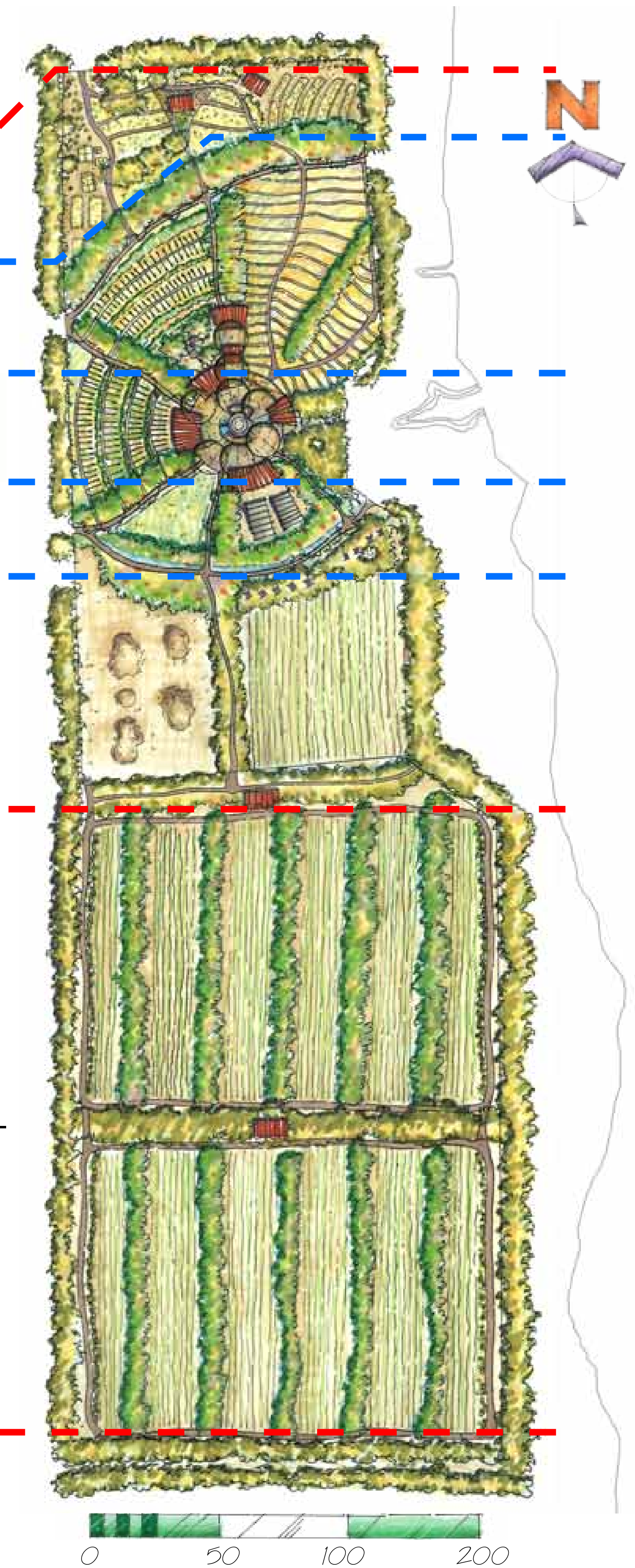
Zone I: Garden Plots, courtyard, water harvesting - cistern and microbasin

Zone II: Community garden plots, greenhouse, intensive food forest belts

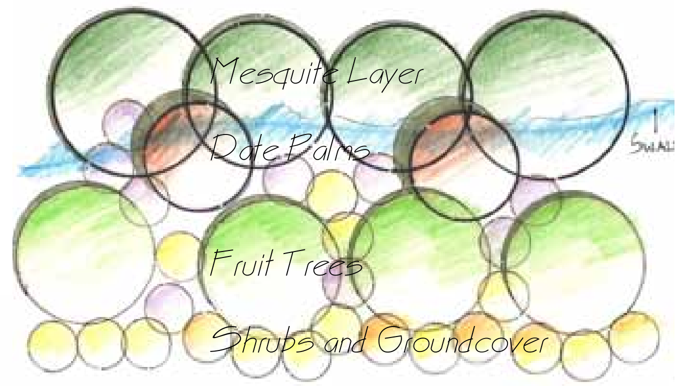
Zone III: Compost operation

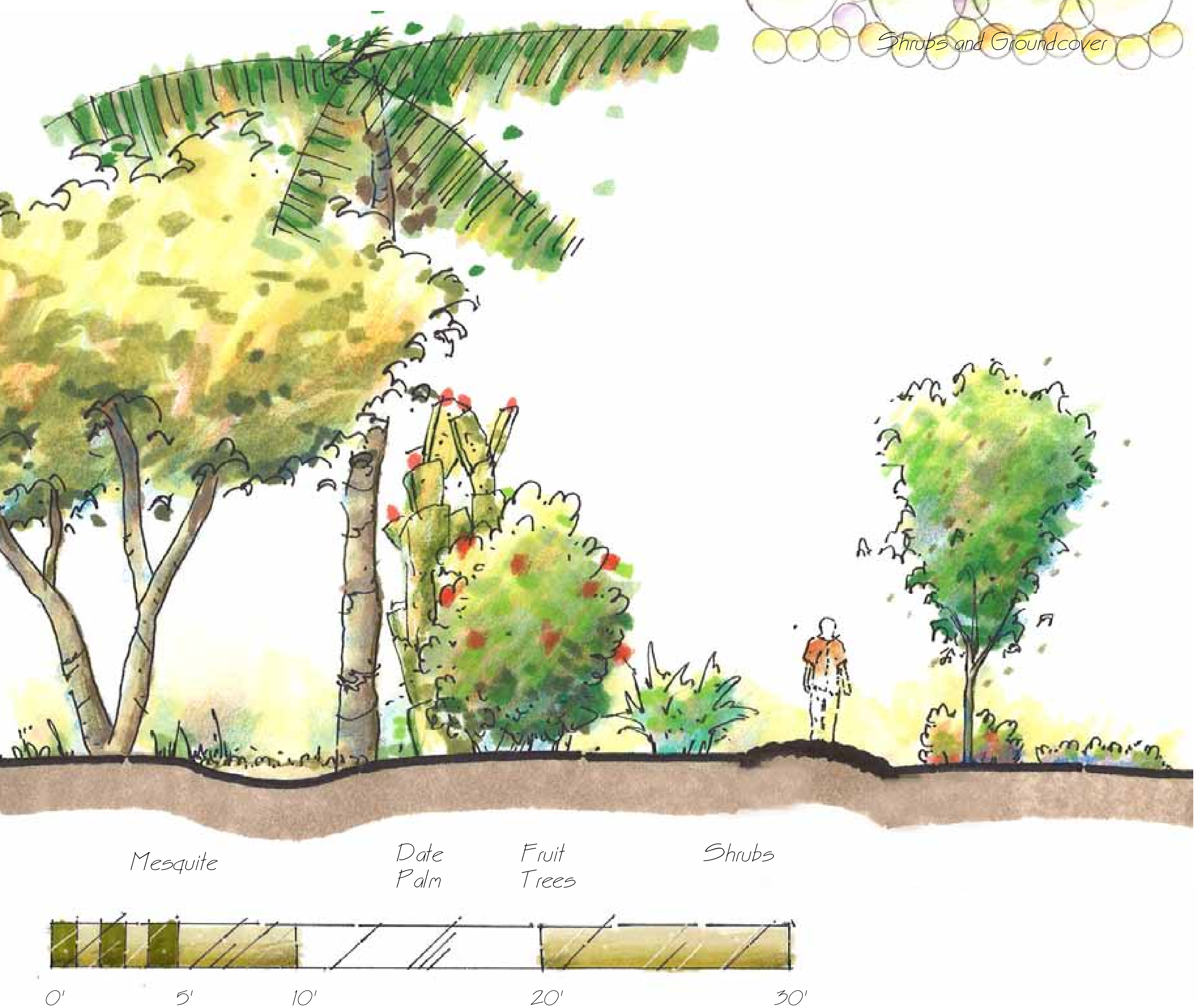
Zone IV: Broad-acre farm incubator plots, hardy food forest belts, larger earth-work swales

Zone V: Wilderness

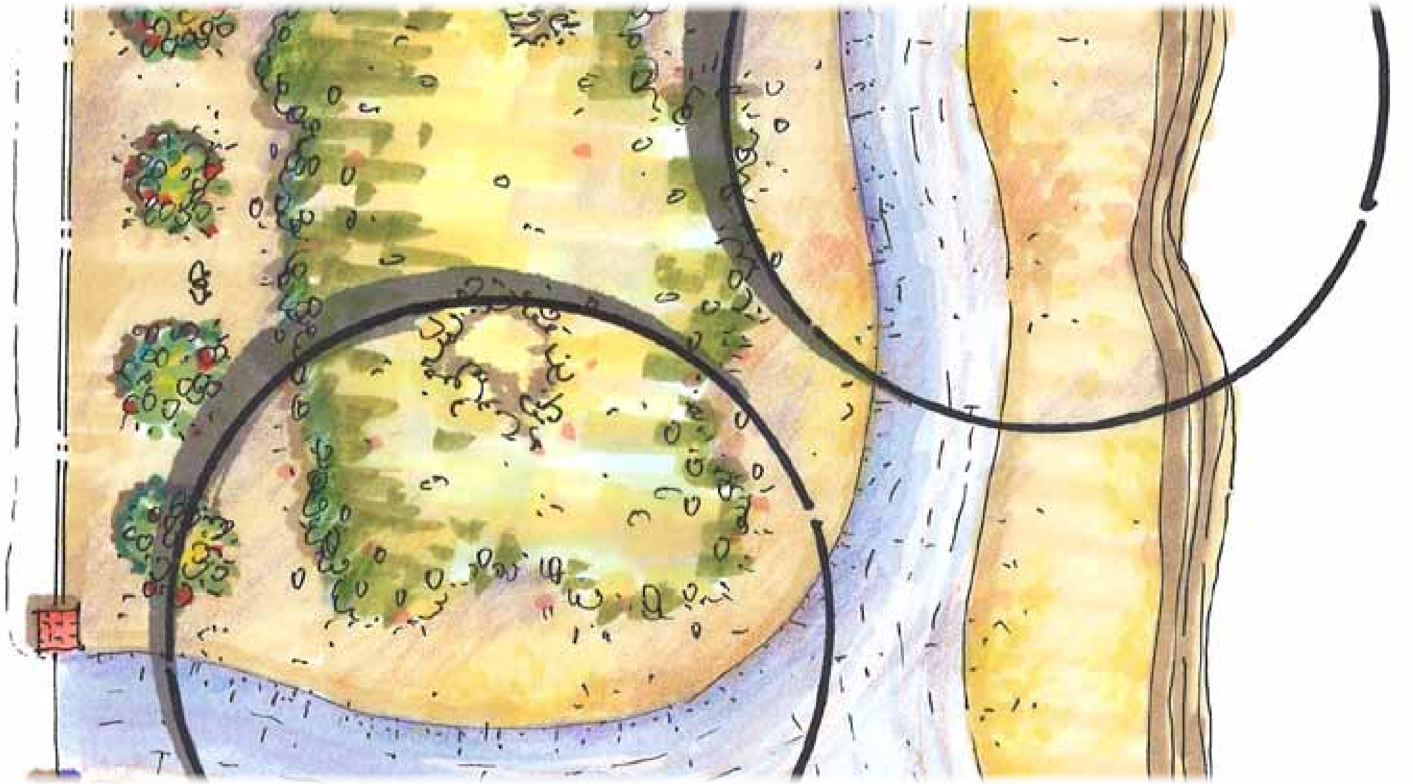


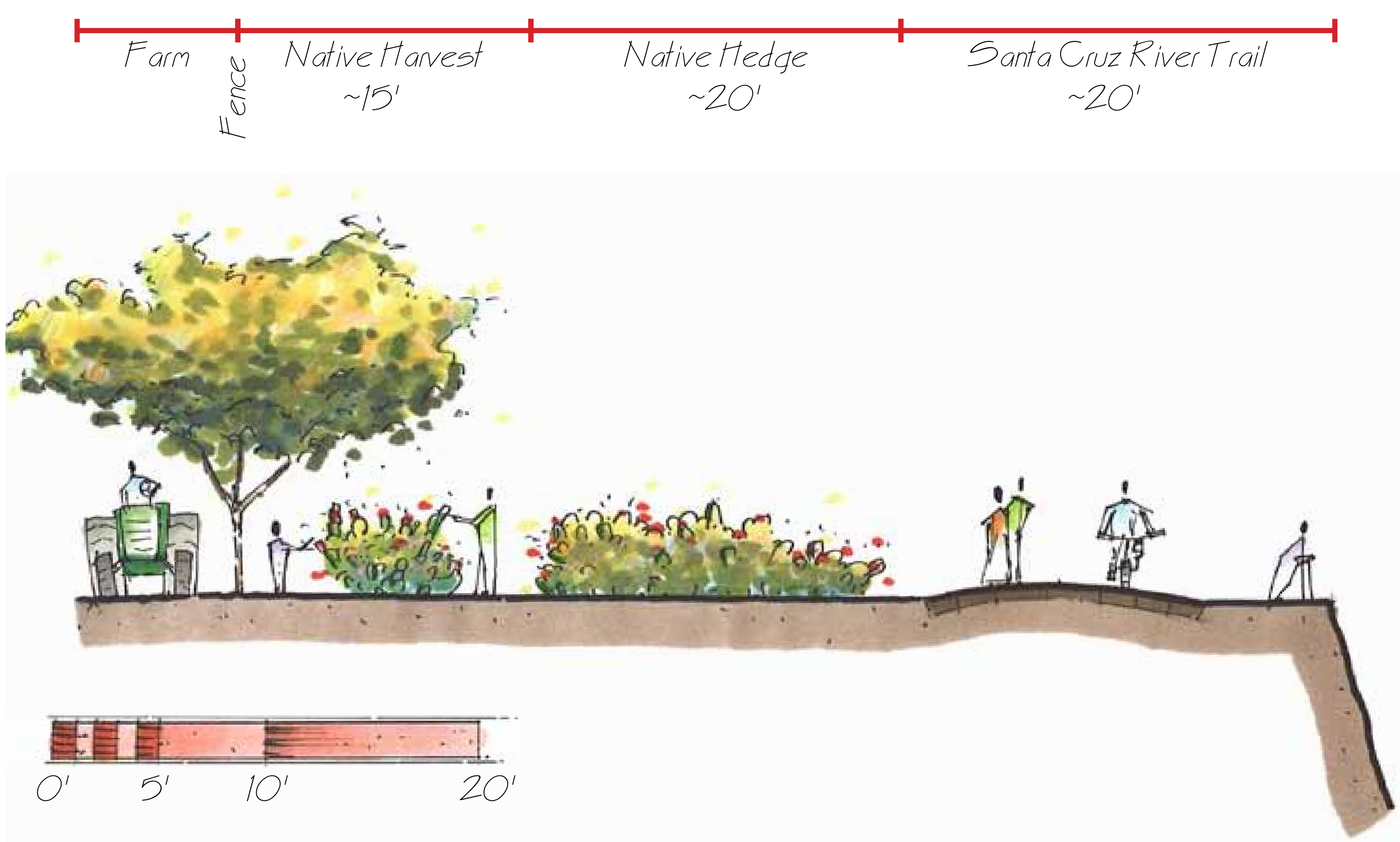
Intensive Food Forest Belt



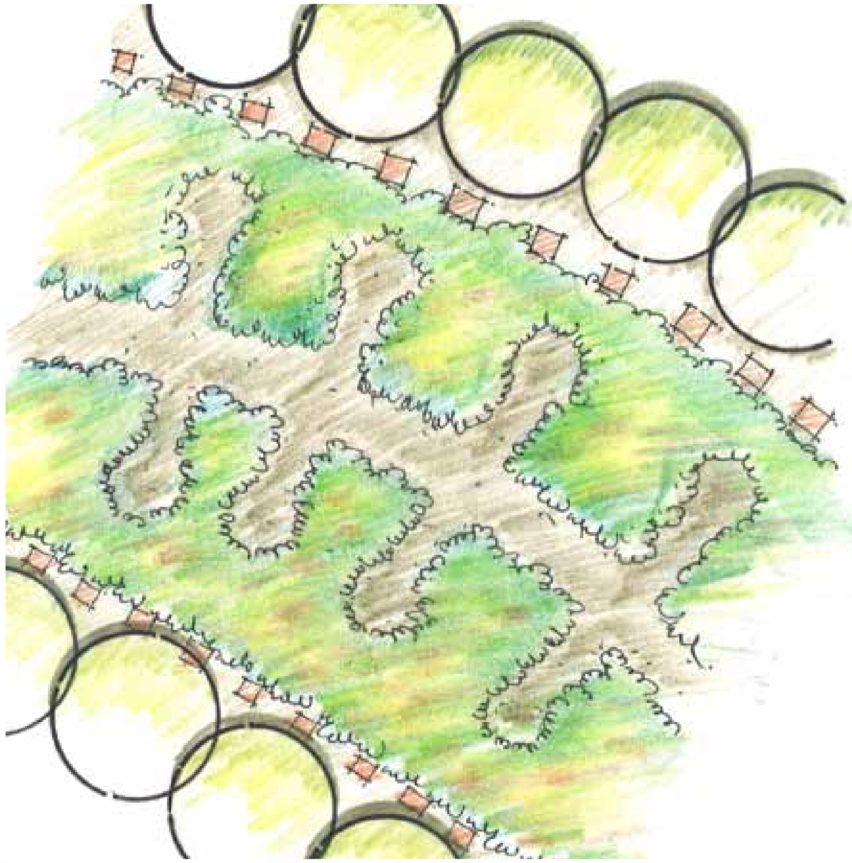


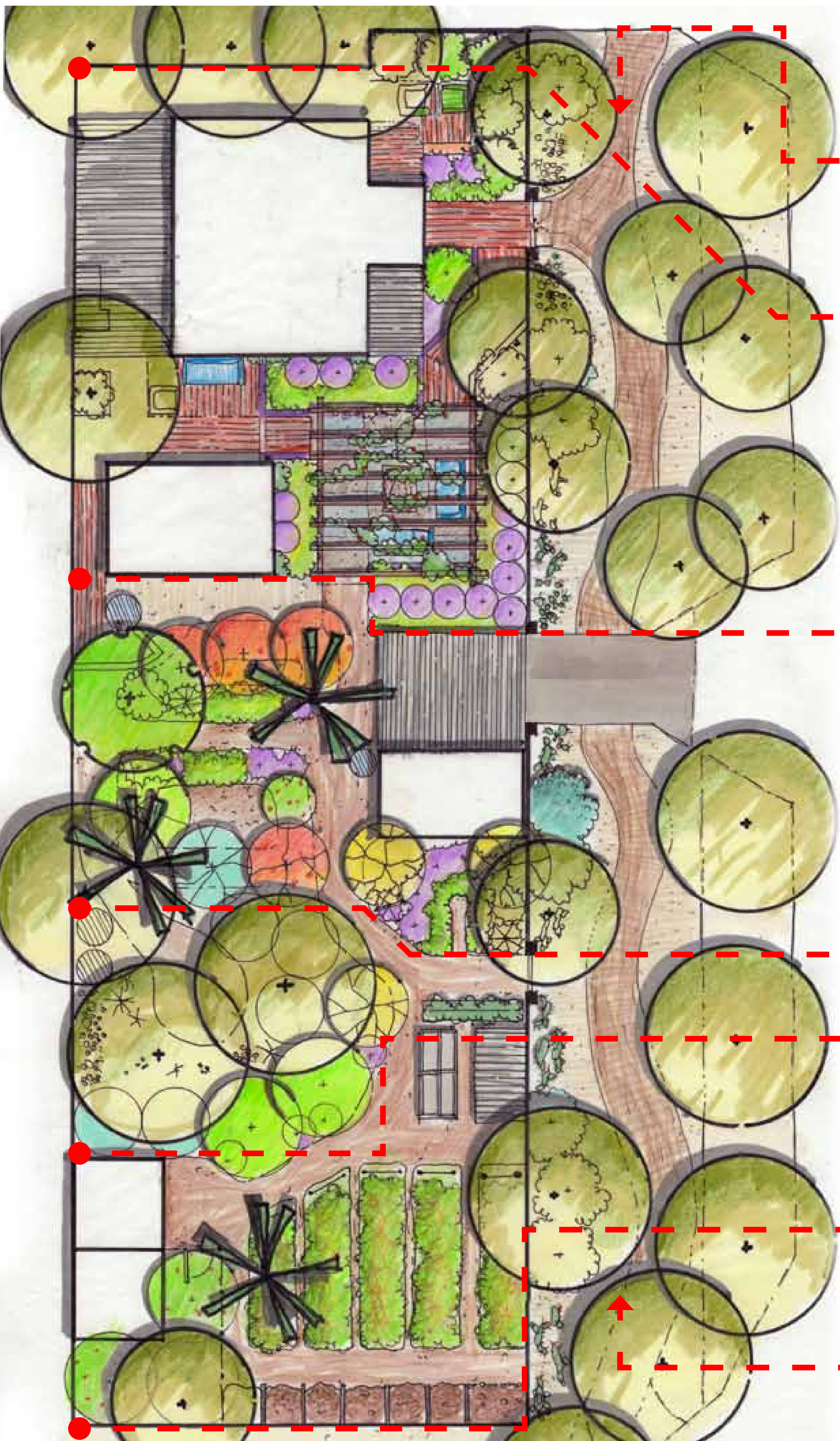
Hardy Food Forest Belt





Between Forest Belts





Intensive Food Systems

Zone IV: low water food producing species, pollinators habitat, right-of-way greenway

Zone I: Integrated living systems including: outdoor living, perennial and annual food gardens, indoor living areas

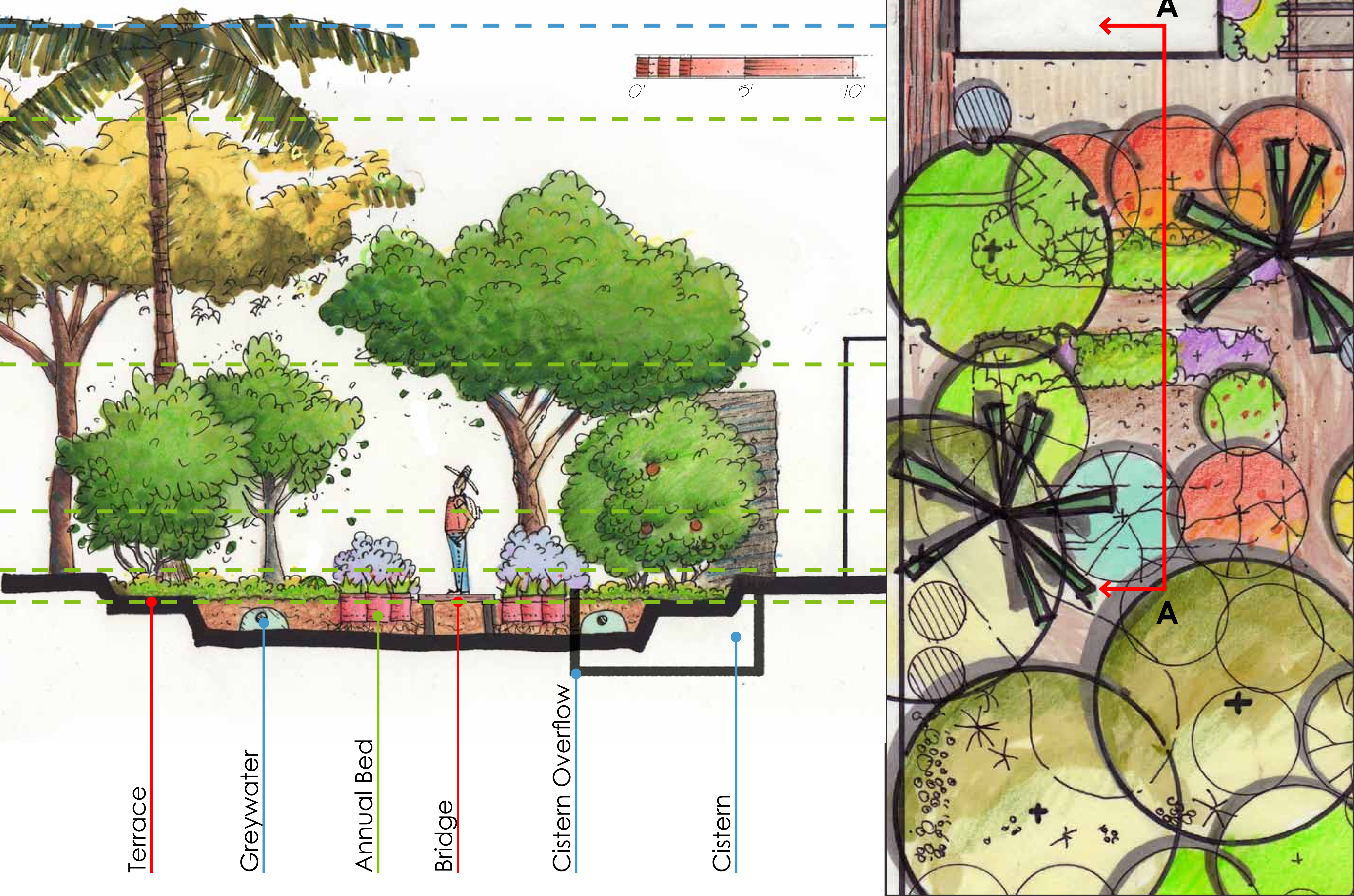
Zone II: Intensive forest garden and energy storage for excess resources water, carport and storage

Zone IV: Low water use native gardens for habitat

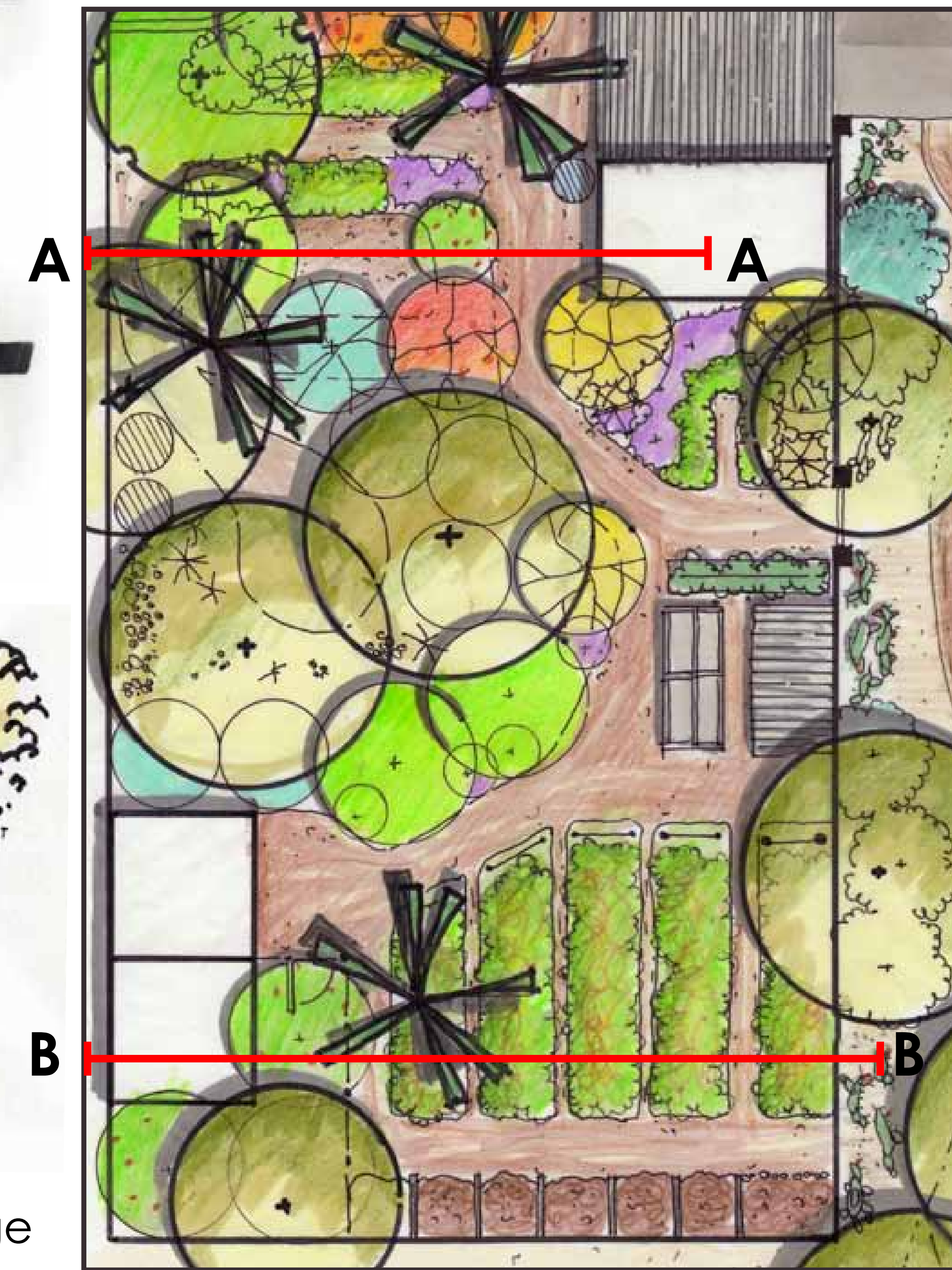
Zone III: Farm zone for larger scale food production, chicken coops and tractors, composting, greenhouse

Zone IV: Minimal management, hardy food producing species, pollinators and habitat, right-of-way greenway

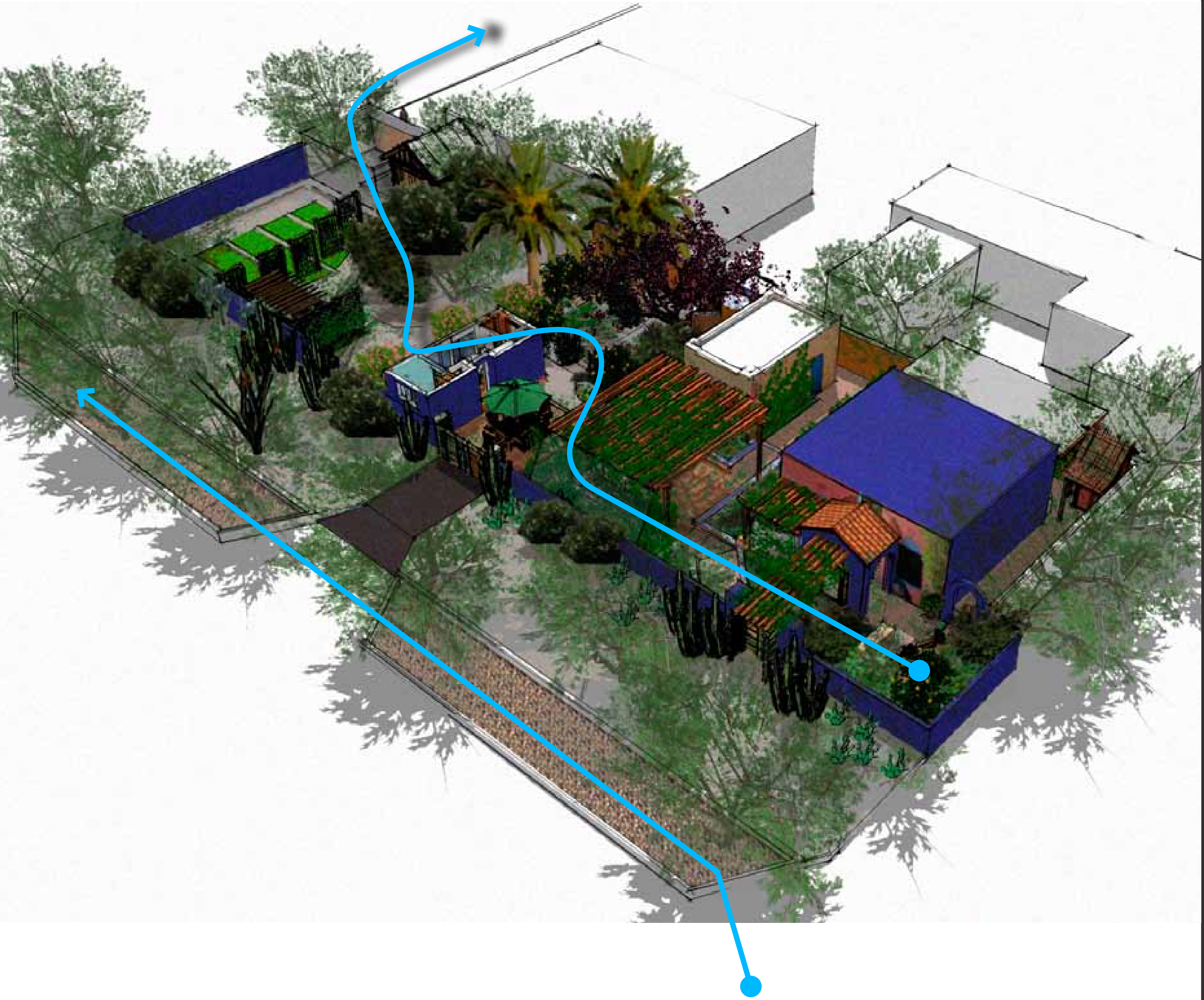
Residential Forest Guild



Residential Food Systems



Water Flow



Before

Outdoor Room

- Seating wall
- Flexible multiuse space with useful hardscape surface

Canopy Layer

- Edible deciduous canopy layer
- Nitrogen fixing trees
- Part shade canopy cover

Vertical Layer

- Vertical elements to create intimacy
- Vertical stacking of food production in microclimate

Perennial Layer

- Part shade tolerant vegetables and herbs
- Full sun perennials, vegetables and fruit trees

Annuals

- Part shade tolerant vegetables and herbs
- Full sun vegetables and fruit trees
- Square foot gardening

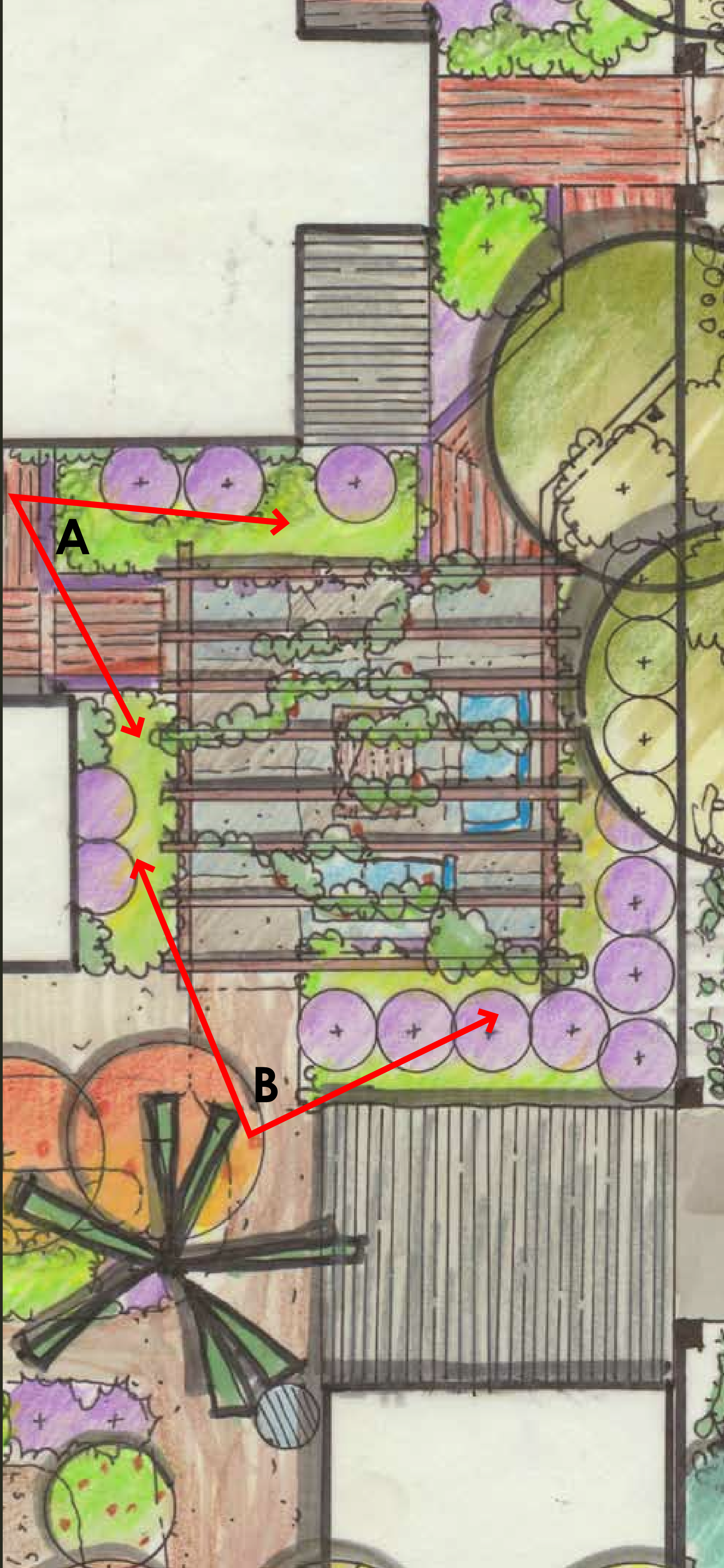
Human Comfort

- Furniture, art, and personal touch to create an oasis

Zone I: Oasis

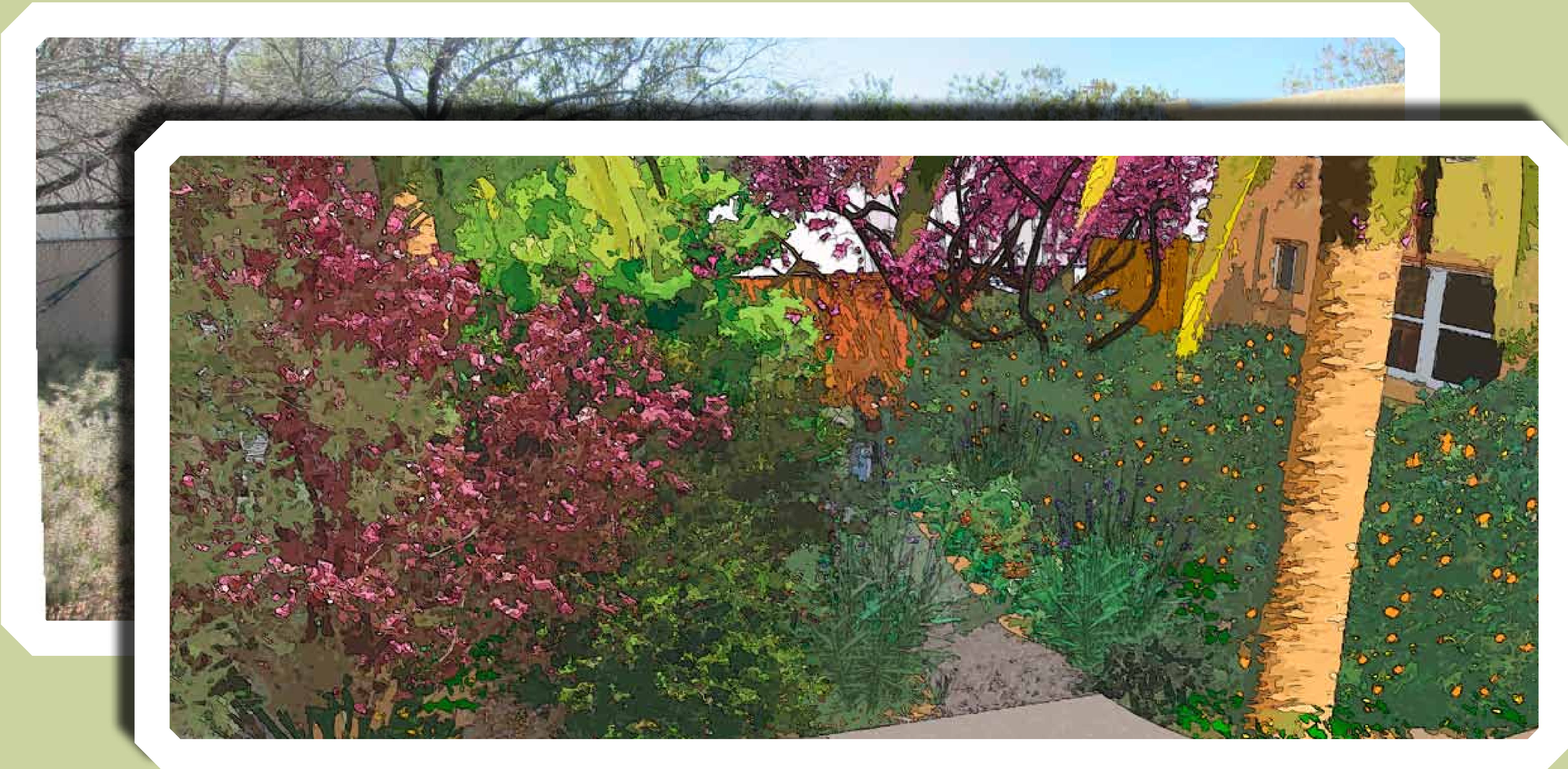
A

B



Zone II: Intensive Food

Zone II: Intensive Food



Zone III: Lower Water Edge