6.9 LOW IMPACT DEVELOPMENT TOOLKIT

The HWP Greenway System is located almost entirely within floodplains of the waterways which they follow. To protect water quality, mitigate the effects of flooding, and improve ecosystem function, it is important to incorporate “Green Infrastructure” elements in future trail design and improvements.

Low Impact Development (LID) refers to landscape elements which use natural systems for water infiltration, detention, and retention to minimize negative impacts of development near water bodies. These methods can be adapted to a wide variety of contexts and climates, however the central principles remain consistent.

BIORETENTION BASIN

Bioretention basins are landscaped depressions that intercept stormwater runoff from adjacent paved surfaces to temporarily store, filter, and infiltrate it in 2-4 feet of soil.

They are commonly placed alongside or into parking lots, where they help remove suspended solids, heavy metals, and other pollutants from the lot's stormwater runoff through a mix of physical, biological, and chemical processes. In addition to these filtration capabilities, bioretention basins can effectively reduce peak runoff rates and volumes for relatively frequent storms.

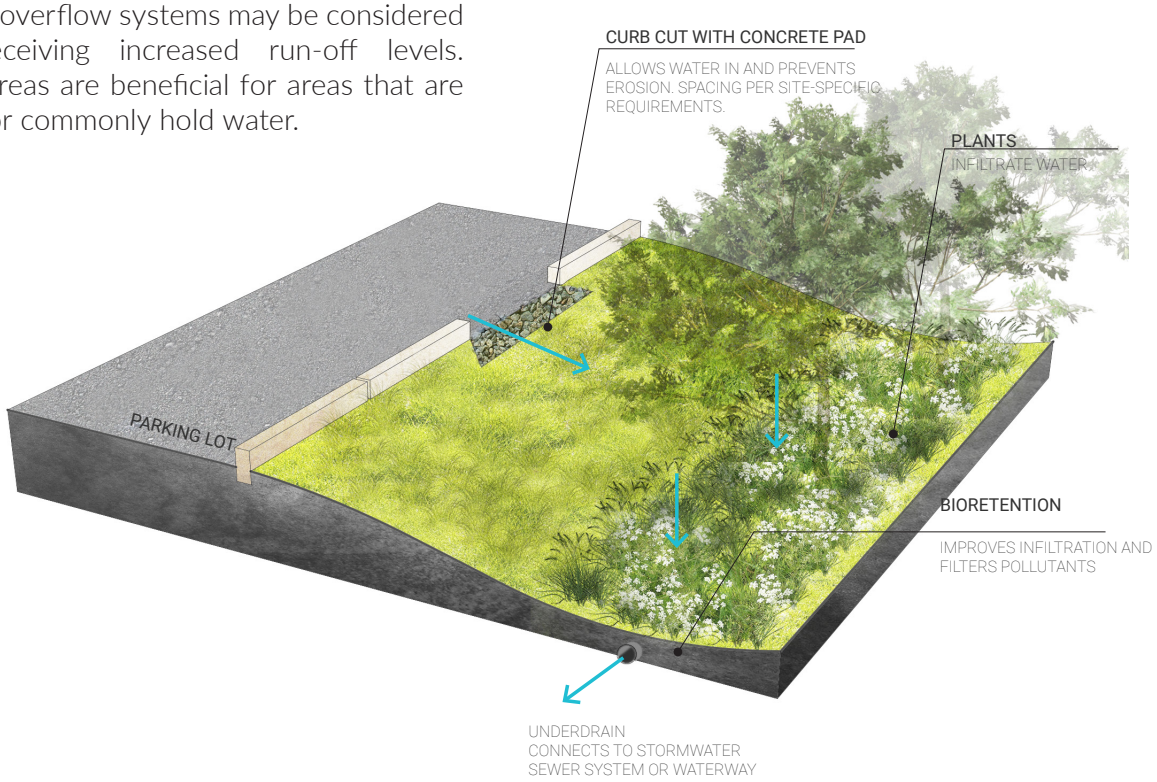
Bioretention basins are well suited for use in small areas, and can be integrated naturally into landscaping to enhance aesthetics and provide habitat for butterflies and bird species (see Pollinator Habitat). The plants selected for bioretention basins must be capable of tolerating both periods of inundation and drought.

Bioretention basins may be best suited in congregating areas such as trail heads, street or neighborhood access points, and rest areas. Underdrain or overflow systems may be considered for areas receiving increased run-off levels. Bioretention areas are beneficial for areas that are hard to drain or commonly hold water.

Typical application

Initial Cost
$-$$

Maintenance
High



BIOSWALE

Bioswales are similar to bioretention areas in that they are vegetated, shallow depressions that capture and temporarily store runoff, however, they are designed to be narrow and linear. The collected runoff is intended to remain for 12 to 48 hours.

Similar to bioretention areas, they treat stormwater runoff by vertical filtration through soil media into underlying soils or convey the water via underdrain to stormwater control systems. While they can serve conveyance purposes, their primary objective is to infiltrate water into the ground and improve water quality.

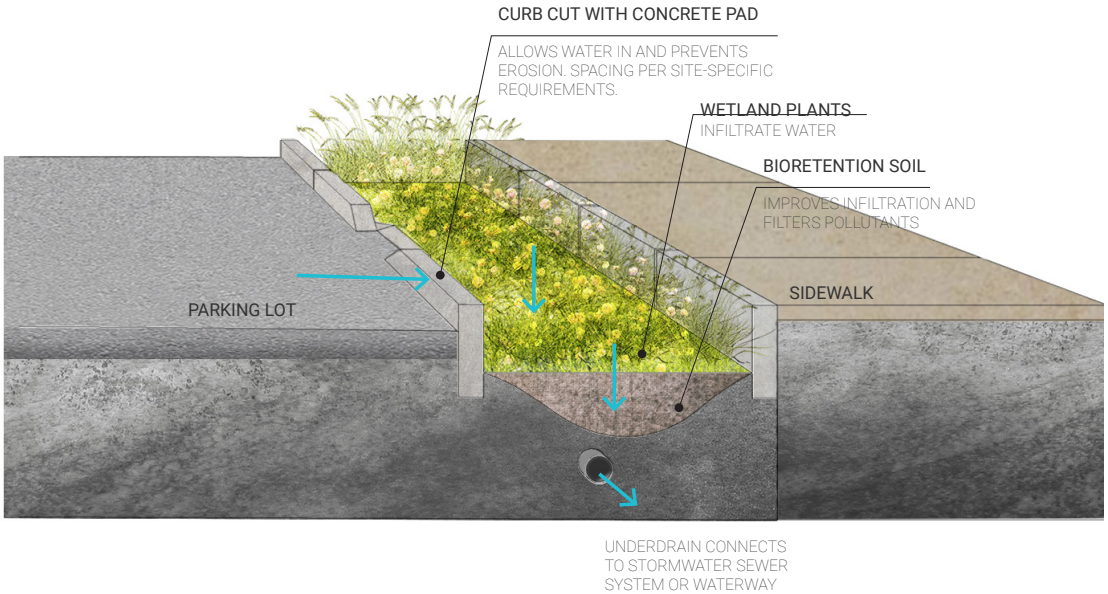
Their linear form makes them well-suited for use along linear impervious surfaces, such as trails, sidewalks, and parking lots.

Underdrain or overflow systems may be considered for areas receiving increased run-off levels. Bioswale depth should be considered to accommodate plant survivability, reduce mosquito habitat, minimize clogging

Typical application

Initial Cost
$-$$

Maintenance
High



VEGETATED SWALE

Reduction in bank erosion and re-meandering to restore the natural shape of the river and reduce water velocity to improve sediment movement. Chemical function improvements may include a reduction of stormwater pollution inputs through the planting of a vegetated riparian buffer. Improvements in biological function may include the planting of species that provide habitat and food for aquatic fish, insects, and other wildlife. The restoration of the riparian zone, or the area surrounding the open water, helps filter pollutants out of stormwater runoff before it reaches the water. Healthy riparian zones improve habitat, stabilize water channels and stream banks, improve water quality, provide stream shade and temperature control, and improve aesthetics.

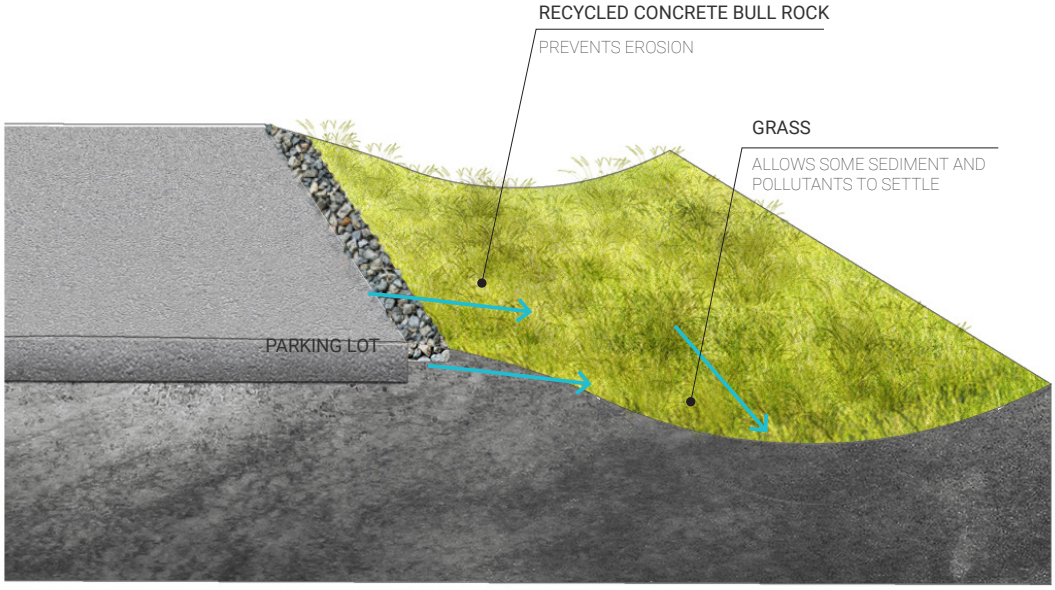
Typical application

Initial Cost

$

Maintenance

Low



VEGETATED FILTER STRIP

Vegetated filter strips are bands of vegetation along a uniform slope that pre-treat runoff from impervious areas before it flows into another LID feature. They help improve stormwater quality and reduce runoff flow velocity through horizontal filtration, however, they are not meant to act as a standalone and are used as pretreatment devices for other, larger-capacity LID features, such as bioretention areas. While they are effective at reducing flow speeds and removing sediment and particulate-bound pollution, they do not provide significant volume reduction. They are often used for treating runoff from roads, highways, driveways along streams to filter water before it reaches riparian areas. They are highly adaptable solutions that are visually similar to landscaping beds.

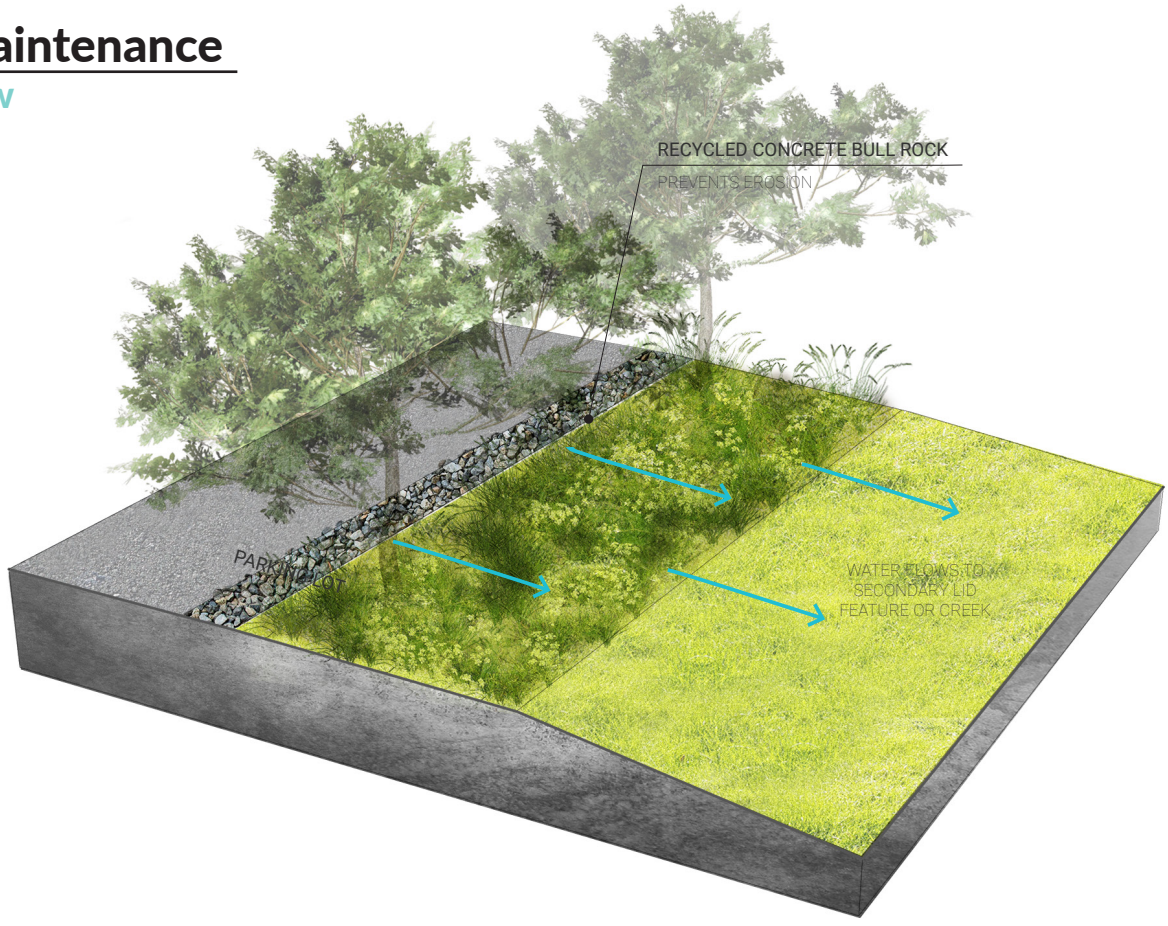
Typical application

Initial Cost

$

Maintenance

Low



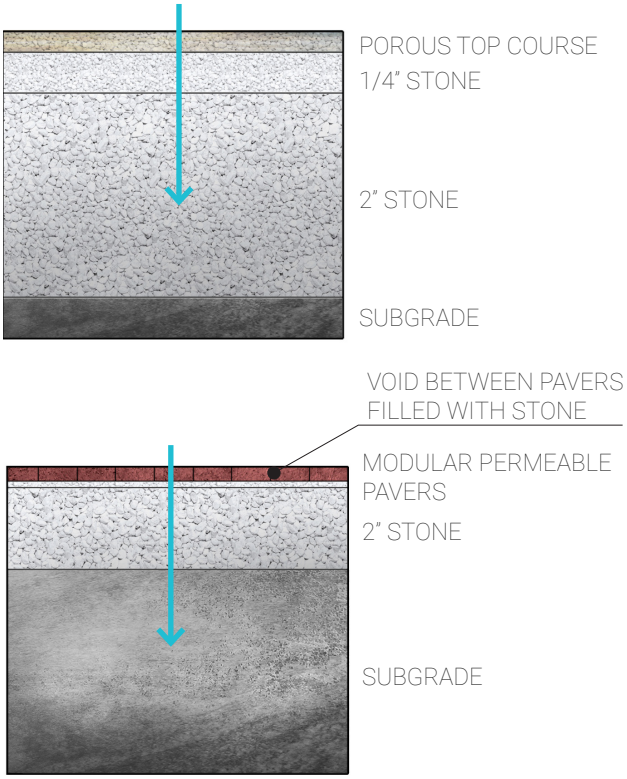
PERMEABLE HARDSCAPES

Permeable surfaces are an alternative to traditional impervious surface materials, such as concrete and asphalt. Permeable surface treatments have small voids or aggregate-filled joints that allow water to drain to a layer of open-grade aggregate, where it either infiltrates into the ground or is conveyed via underdrain to stormwater control systems if soil infiltration is low.

The following systems are recommended for consideration at Tier I trailheads in every character area.

PERMEABLE/POROUS SURFACES

A successful permeable surface (paver, pervious concrete, or porous asphalt) will need to consider structural and hydrological design. The structural design will need to consider the pavement strength required to accommodate bicycle, maintenance, and utility vehicle loading. The hydrological design will need to consider the capacity required to infiltrate, store, and release water in a manner that positively contributes to water quality and stormwater management.

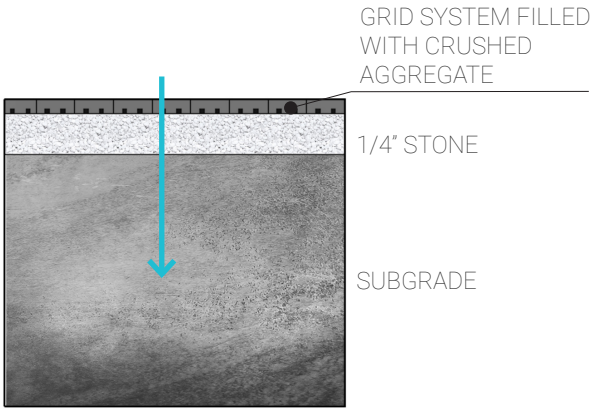


PERVIOUS PAVERS

Pavers can be placed in areas to create contrast for wayfinding, notification, or aesthetics. Can be utilized along trail system, near shade or rest areas, parking areas or in transition areas. Product is used universally in San Antonio, which is appealing for various usages and locations along the trail system. Pervious pavers assist in filtering stormwater pollutants and allow stormwater infiltration.

PERVIOUS/POROUS CONCRETE

Porous/pervious pavement is ideal for Tier I trailheads. The most successful applications are in areas where regular maintenance can be performed to ensure positive performance. Pervious pavement assists in filtering stormwater pollutants and allows stormwater infiltration. Not effective when adjacent to other pervious areas or if receiving high levels of sediment/debris. May require a drainage system to convey water. Large and/or high-traffic areas will require structural design. This option can be desirable for rest areas as the porous pavement absorbs and stores less heat than conventional concrete creating positive impacts for users and the environment.



OTHER LID OPPORTUNITIES

RIPARIAN RESTORATION

When a stream's functions have been compromised relative to its natural potential or historic functions, the stream is considered to be degraded or disturbed. Stream restoration is the attempt to restore physical, chemical, and biological functions of a stream system. Physical function improvements may include a reduction in bank erosion and re-meandering to restore the natural shape of the river and reduce water velocity to improve sediment movement. Chemical function improvements may include a reduction of stormwater pollution inputs through the planting of a vegetated riparian buffer. Improvements in biological function may include the planting of species that provide habitat and food for aquatic fish, insects, and other wildlife. The restoration of the riparian zone, or the area surrounding the open water, helps filter pollutants out of stormwater runoff before it reaches the water. Healthy riparian zones improve habitat, stabilize water channels and stream banks, improve water quality, provide stream shade and temperature control, and improve aesthetics.

PLANTING CONSIDERATIONS

The "Pollinator Plant List" on page 107 and "Recommended Trees" on pages 108 and 109 are high priority considerations for future plantings on the Greenway. However, site-specific considerations should inform a more detailed analysis of plant selection. The following considerations should be taken into account at that time:

- Plants with longer blooming periods tend to have higher nectar production and more showy blooms.
- Drought-tolerant plants should be prioritized over anything necessitating irrigation.
- Plants which can re-seed themselves, such as pink evening primrose, tend to be easier to manage long-term and are more resilient.
- Plants which are native to Bexar County, surrounding counties with similar climate, and areas in Texas with slightly dryer and hotter conditions should be prioritized because of their tolerance of the curernt and future regional climate.
- Plant with little to no maintenance needs should be prioritized over plants with extensive and regular maintenance needs.

POLLINATOR PLANTING

Vegetated LID features, such as bioswales, vegetated filter strips, riparian restoration, and bioretention areas, can serve the dual purpose of providing stormwater management and pollinator habitat and forage. Native Texas pollinators, such as hummingbirds, bees, and butterflies, provide critical services to the state of Texas and the country at large - three quarters of the most common human food crops require pollination. The flowers of plants used within vegetated LID features can provide nectar and pollen to these important animals. Because many Texas pollinators evolved for thousands of years alongside plants native to the area, native Texas plants should be prioritized in LID features over non-native species. To further support important pollinator habitat, plantings should be planted in clumps and layers using trees, shrub layers, and low-growing perennials intermixed with flowering annuals. This diversity in vegetation provides many sheltered niches for pollinators to utilize as both nesting and loafing areas, such as the following:

POLLINATOR PLANT LIST

Scarlet sage
Salvia coccinea
Pollinators: Hummingbirds, Butterflies, Bees

Fall aster
Symphyotrichum oblongifolium
Pollinators: Birds, Butterflies

Blue mistflower
Conoclinium coelestinum
Pollinators: Hummingbirds, Butterflies, Bees

Rock rose
Pavonia lasiopetala
Pollinators: Bees

Snake herb
Dyschoriste linearis
Pollinators: Butterflies

Texas spiderlily
Hymenocallis liriosme
Pollinators: Insects

Frogfruit
Phyla nodiflora
Pollinators: Numerous, Butterflies

Mealy blue sage
Salvia farinaceae
Pollinator: Bees

Pink evening primrose
Oenothera speciosa
Pollinators: Birds

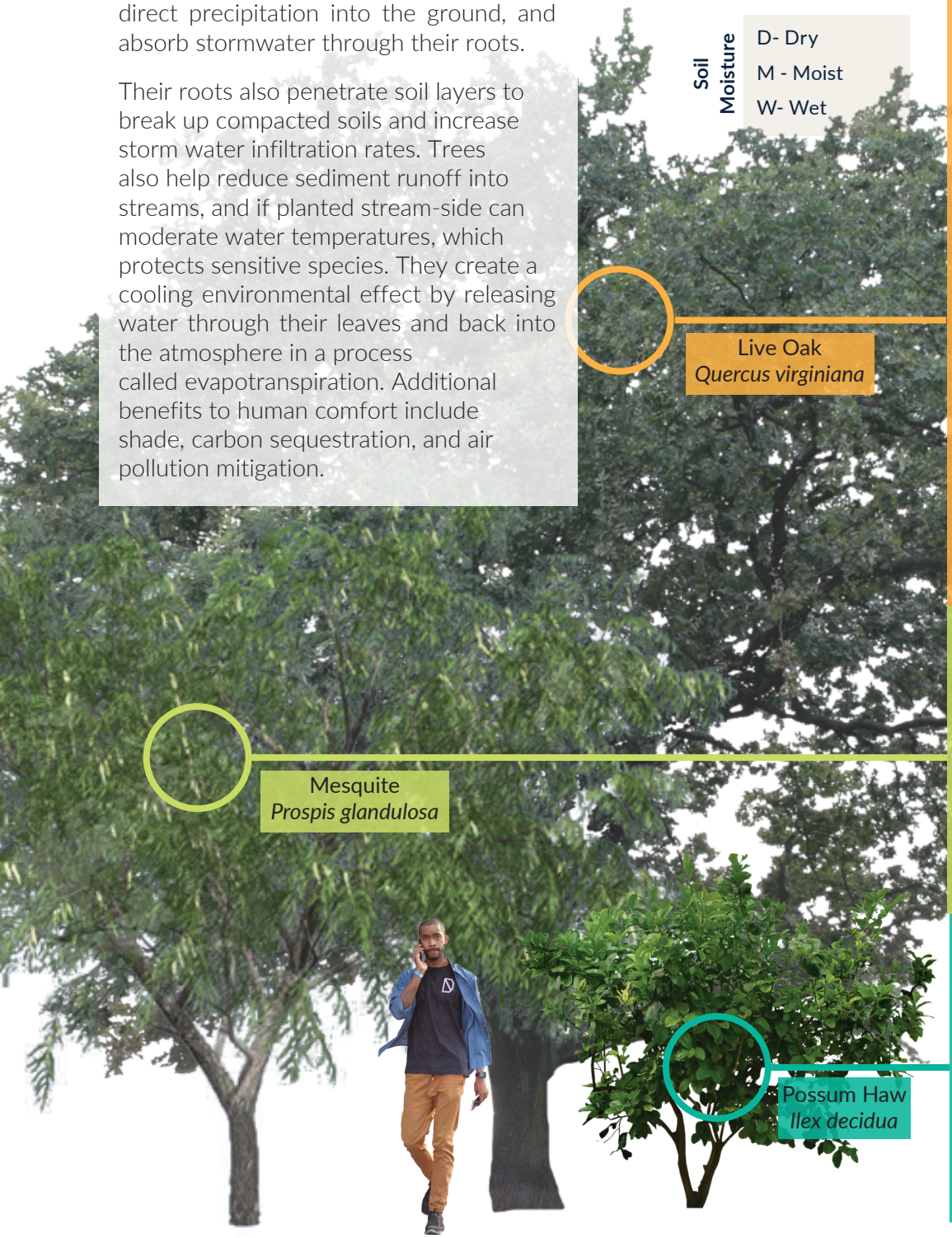
Tick seed
Coreapsis spp.
Pollinators: Butterflies, Bees, Birds

Plants appropriate for some LID features

RECOMMENDED TREES

Trees are a critical feature of stormwater management practices and low impact development. They intercept rainfall, direct precipitation into the ground, and absorb stormwater through their roots.

Their roots also penetrate soil layers to break up compacted soils and increase storm water infiltration rates. Trees also help reduce sediment runoff into streams, and if planted stream-side can moderate water temperatures, which protects sensitive species. They create a cooling environmental effect by releasing water through their leaves and back into the atmosphere in a process called evapotranspiration. Additional benefits to human comfort include shade, carbon sequestration, and air pollution mitigation.



Sun Needs

- Sun
- Part Shade
- Shade

Soil Moisture

- D- Dry
- M - Moist
- W- Wet

	Common Name
TALL SHADE TREES 40-60+ Feet	Black Willow
	Bur Oak
	Cedar Elm
	Chinquapin Oak
	Mexican Sycamore
	Hackberry
	Bald Cypress
	Live Oak
	Anaqua
	Pecan
MEDIUM TREES 25-40 Feet	Huisache
	Eve's Necklace
	Mesquite
	Carolina Buckthorn
	Yaupon Holly
SHORT TREES 15-25 Feet	Kidneywood
	Mexican Buckeye
	Rusty Blackhaw
	Texas Mountain Laurel
	Possumhaw

Latin Name	Size	Shade Provision	Sun Needs	Water Needs	Soil Moisture	Riparian Restoration	Bioswale	Bioretention Basin	Vegetated Filter Strip
Salix nigra	L	max. 875 sf	☼ ◐ ●	High	M, W	●	●	●	
Quercus macrocarpa	L	max 1200 sf	☼ ◐	Medium	D, M				●
Ulmus crassifolia	L	max 875 sf	◐	Medium	M	●	●	●	●
Quercus muhlenbergii	L	max 875 sf	☼ ◐	Medium	D				●
Platanus mexicana	L	max 1200 sf	☼ ◐	High	D,M,W		●	●	●
Celtis spp.	L	max 875 sf	☼ ◐ ●	Low	D, M	●			●
Taxodium distichum	L	max 1200 sf	☼ ◐	Medium	M	●	●	●	●
Quercus virginiana	L	max 875 sf	☼ ◐	Medium	M				●
Ehretia anacua	L	max 875 sf	☼ ◐	Low	D				●
Carya illinoinensis	L	max 1200 sf	☼	High	M				●
Vachellia farnesiana	M	max 550 sf	☼	Low	D				●
Styphnolobium affine	M	max 875 sf	◐	Low	D	●	●	●	●
Prospis glandulosa	M	max 250 sf	☼	Low	D				●
Frangula caroliniana	M	max 250 sf	☼ ◐	Medium	M				●
Ilex vomitoria	M	max125 sf	☼ ◐	Medium	M		●	●	
Eysenhardtia texana	S	too short to shade	☼	Low	D				●
Ungnadia speciosa	S	too short to shade	☼ ◐	Low	D				●
Viburnum rufidulum	S	too short to shade	☼ ◐	Low	D, M, W		●	●	●
Sophora secundiflora	S	too short to shade	☼ ◐	Low	D, M				●
Ilex decidua	S	too short to shade	☼ ◐	Medium	M	●	●	●	●