Biofiltration
a living dynamic system

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THE SUSTAINABLE SITES INITIATIVE™

AMERICAN SOCIETY OF LANDSCAPE ARCHITECTS

Lady Bird Johnson Wildflower center
THE UNIVERSITY OF TEXAS AT AUSTIN

UNITED STATES BOTANIC GARDEN

THE SUSTAINABLE SITES INITIATIVE™

What about Landscape?
$$$ and resources
Wasted potential

SITES fills this gap – all dimensions including building





Sustainability

Provisioning Services

Regulating Services

Supporting Services

Preserving Services

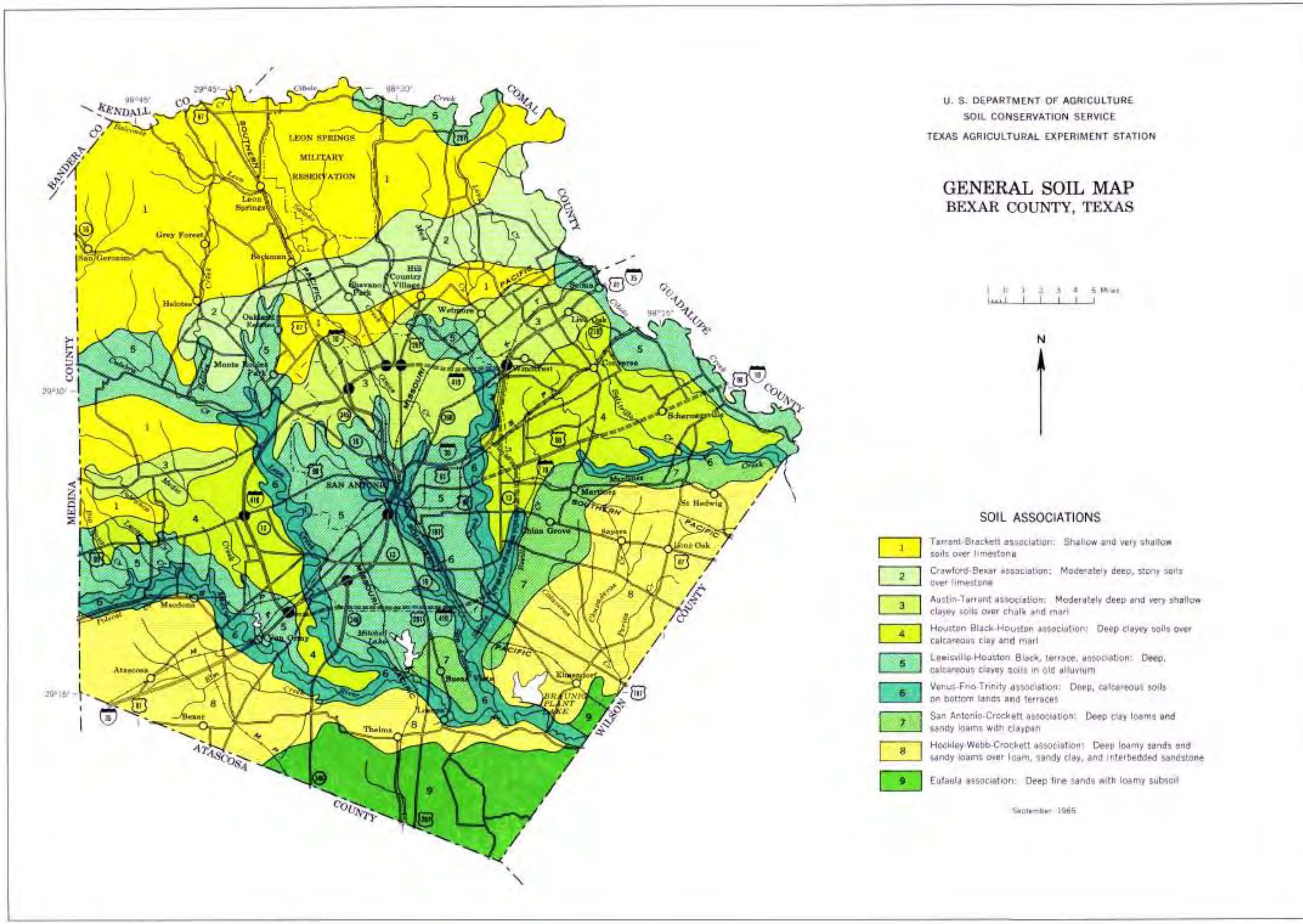
Cultural Services

Climate change Habitat loss Water availability Human well-being

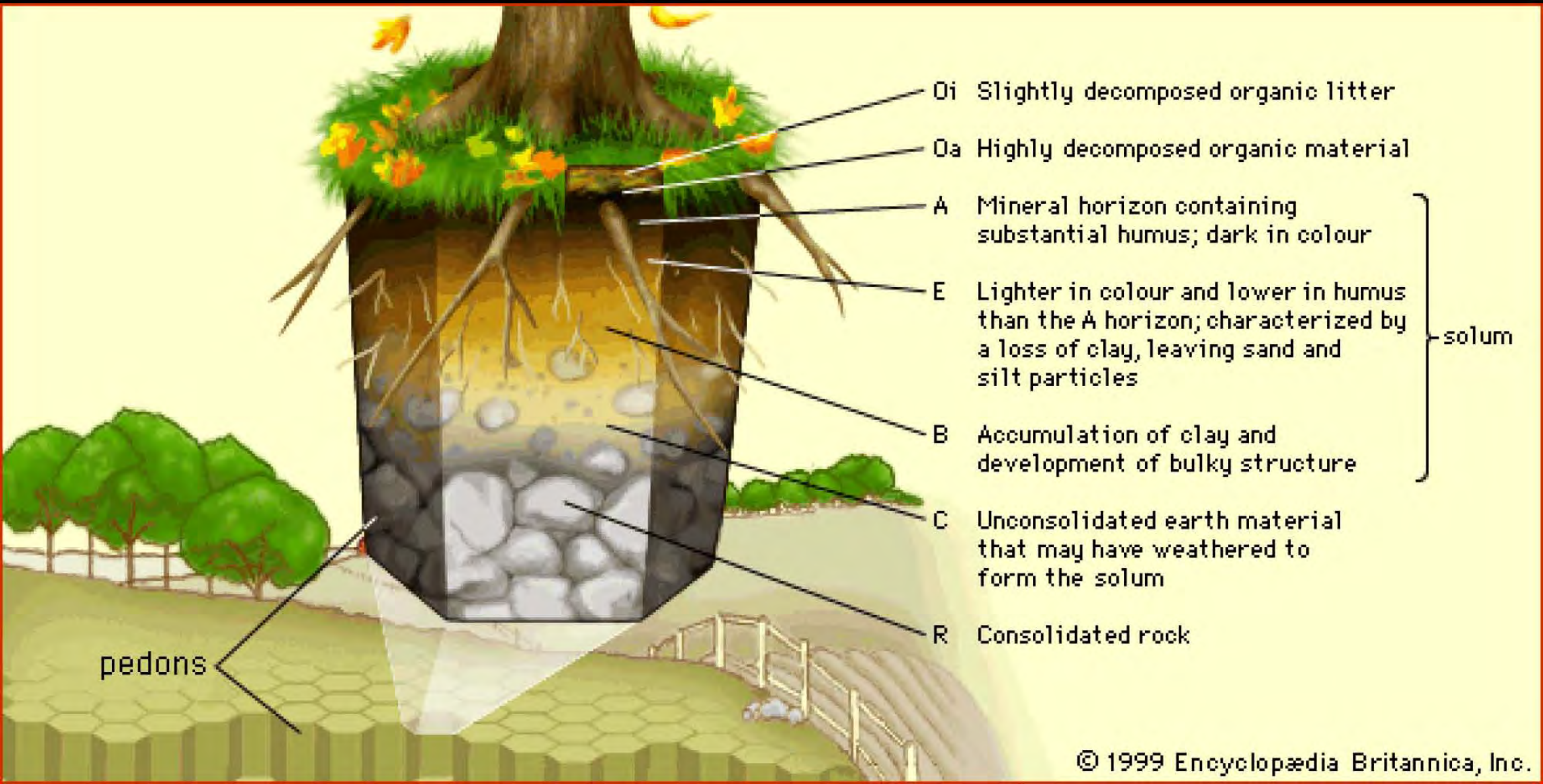
Biofiltration a living dynamic system

Regional
Climatic Influences

Regional
Soil Differences



Soil composition



Chemistry and Biology

Urban Soils and Urban ecology

Urban Ecosystems are:

•Underexploited

•Economical (ecosystem services)

•Biologically complex

Restoring Urban Soils

Pollution Removal Capability

Bioretention Pollutant Removal
University of Maryland

Box Experiments

Cumulative Depth (ft)	Copper	Lead	Zinc	Phos-phorus	TKN	Ammonia	Nitrate
			Removal Efficiency (%)				
1	90	93	87	0	37	54	-97
2	93	99	98	73	60	86	-194
3	93	99	99	81	68	79	23
Field	97	96	95	65	52	92	16

Dr. Allen Davis, University of Maryland

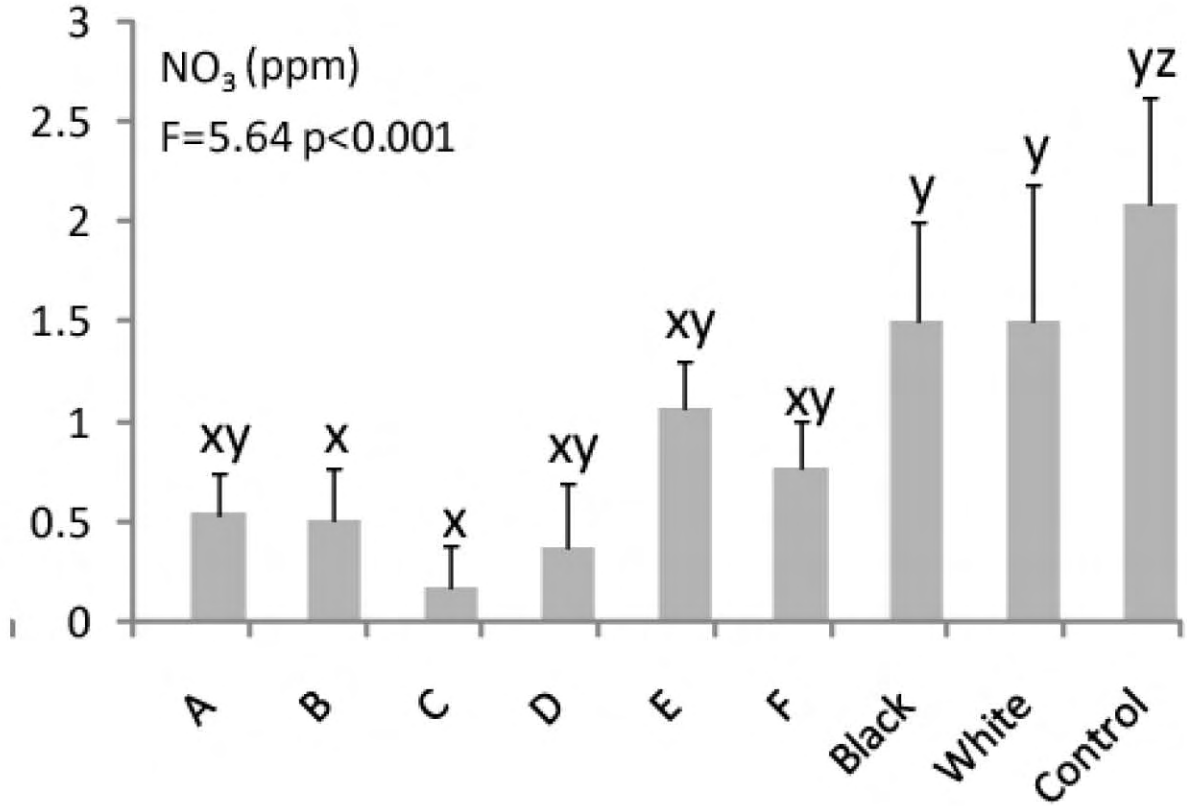
Facility for Advancing Water Biofiltration (FAWB)

Plant Selection



research

6 greenroof manufacturers, and black and white ("cool") roofs, all replicated 3 times = 24 roofs total



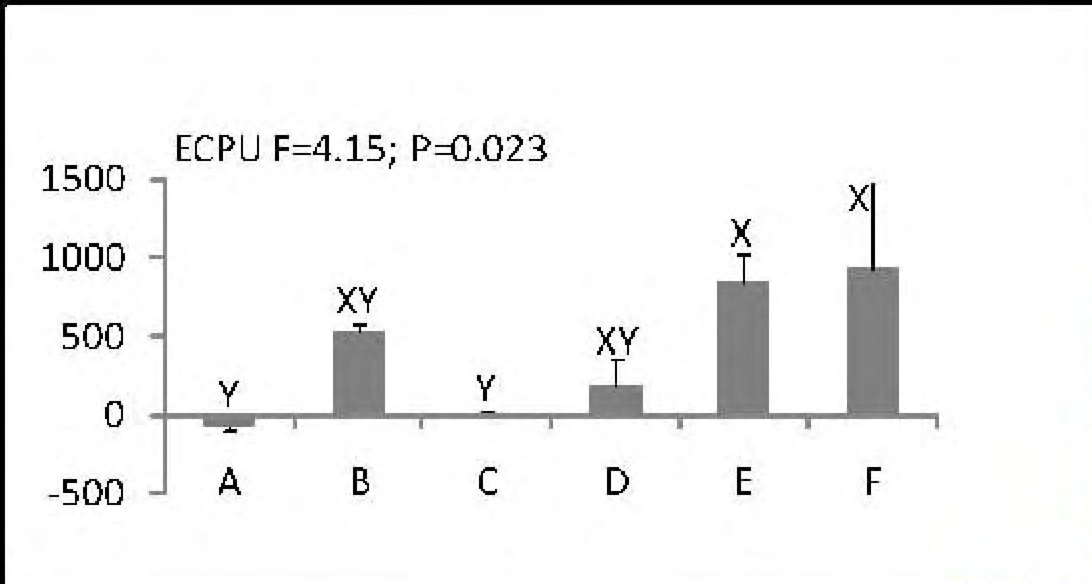
December 2007 (20 l)

High variation among plant species

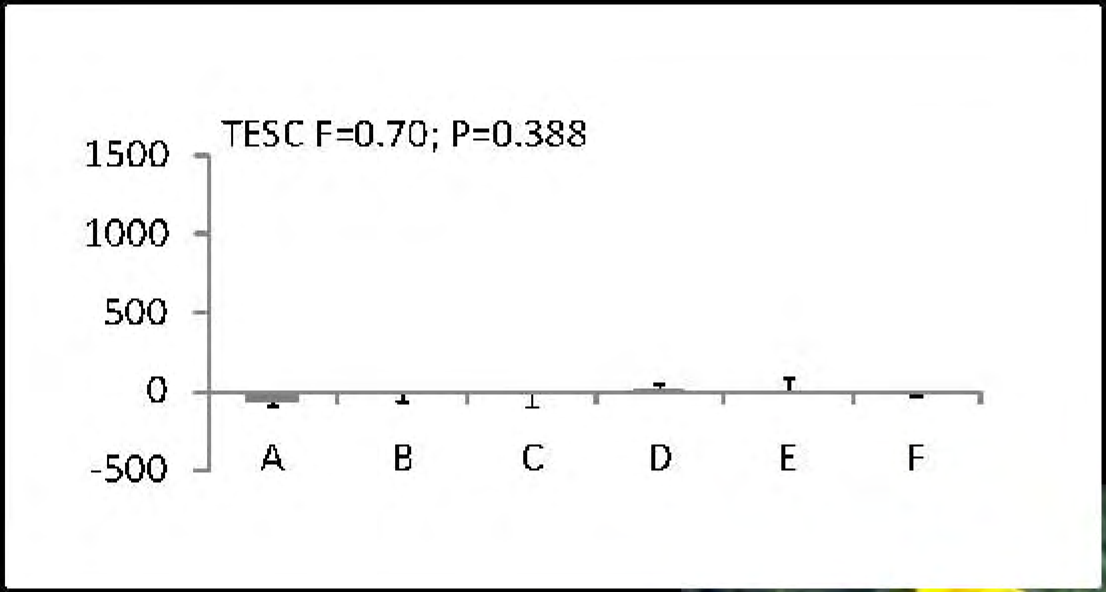
High variation among roof type

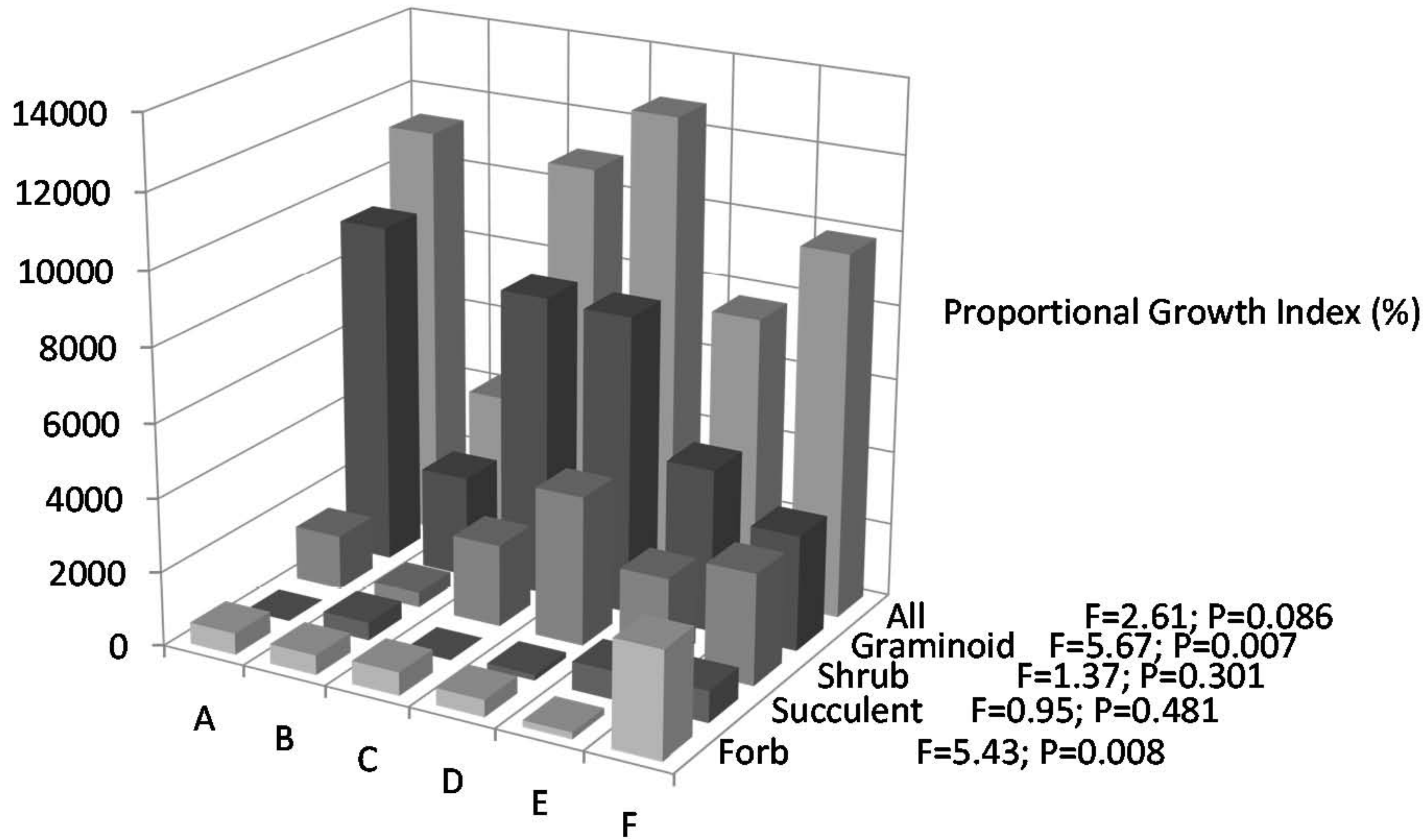
Table 2. Selected plant species and associated growth forms

Latin name	Common name	Code	Number plants per roof	Growth form	Coarse growth form
Bignonia capreolata	Crossvine	BICA	1	Woody climber	Shrub
Bouteloua curtipendula	Sideoats grama	BOCU	5	Bunchgrass	Graminoid
Bouteloua gracilus	Blue grama	BOGR	4	Bunchgrass	Graminoid
Bouteloua rigidiseta	Texas grama	BORI	5	Bunchgrass	Graminoid
Buchloe dactyloides	Buffalograss	BUDA	4	Turf grass	Graminoid
Carex texensis	Texas sedge	CATE	5	Sedge	Graminoid
Dalea greggii	Gregg's dalea	DAGR	1	Woody shrub	Shrub
Echinacea purpurea	Purple coneflower	ECPU	3	Perennial forb	Forb
Hesperaloe parviflora	Red-flowered yucca	HEPA	1	Succulent	Succulent
Hilaria belangerii	Curly mesquite	HIBE	4	Turf grass	Graminoid
Manfreda maculosa	Spice lily	MAMA	2	Succulent	Succulent
Nassella tenuissima	Mexican feathergrass	NATE	4	Bunchgrass	Graminoid
Penstemon triflorus	Hill Country penstemon	PETR	1	Perennial forb	Forb
Salvia farinacea	Mealy bluesage	SAFA	1	Woody shrub	Shrub
Salvia greggii	White sage	SAGR	1	Woody shrub	Shrub
Scutellaria wrightii	Wright's skullcap	SCWR	1	Woody shrub	Shrub
Stemodia lanata	Wooly stemodia	STLA	1	Woody shrub	Shrub
Tetraneuris scaposa	Four-verve daisy	TESC	5	Perennial forb	Forb

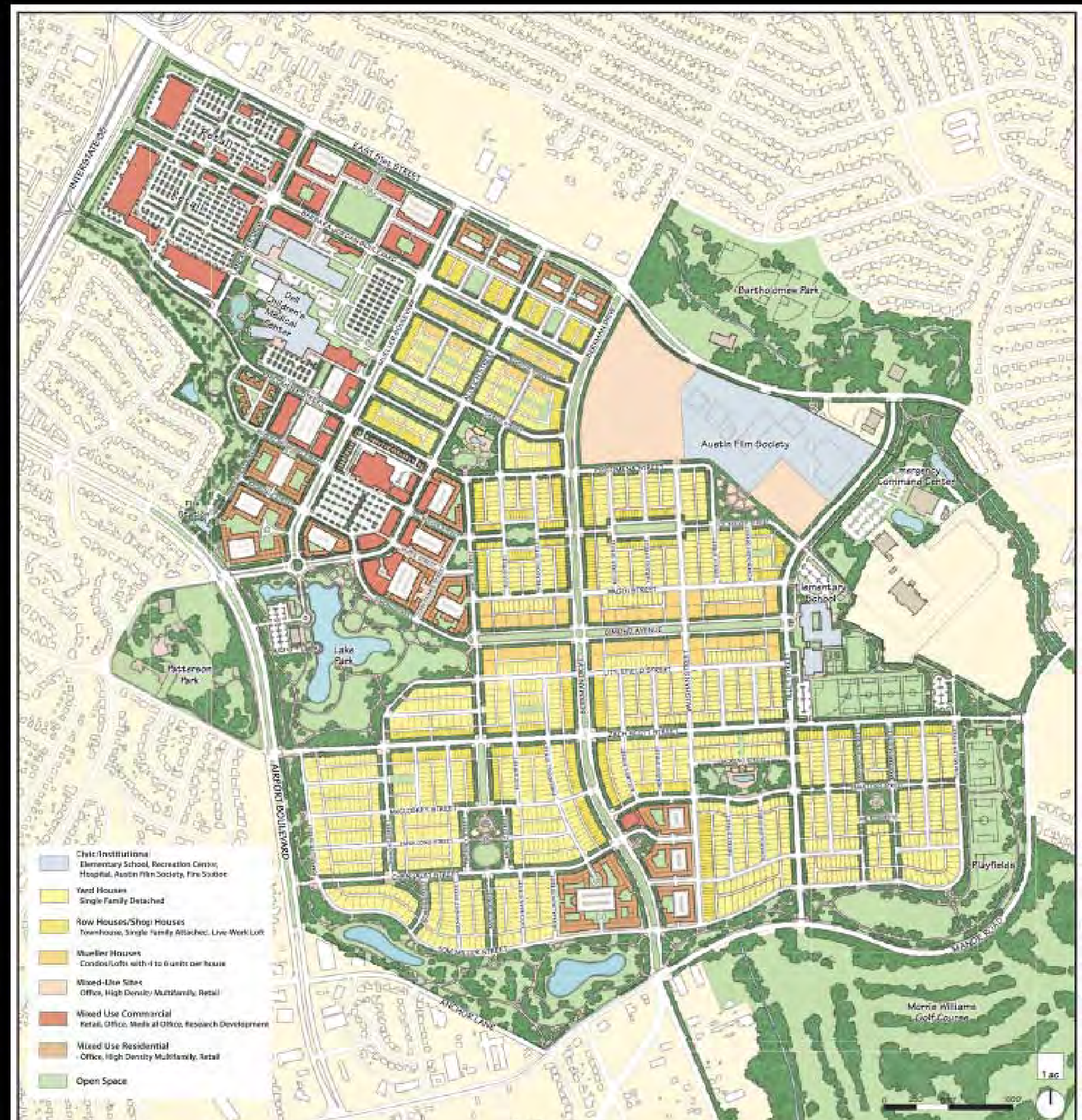


ECPU F=4.15; P=0.023
1500
1000
500
0
-500
Y
XY
Y
XY
X
X
A
B
C
D
E
F


TESC F=0.70; P=0.388
1500
1000
500
0
-500
A
B
C
D
E
F


14000
12000
10000
8000
6000
4000
2000
0
A
B
C
D
E
F
Proportional Growth Index (%)
All F=2.61; P=0.086
Graminoid F=5.67; P=0.007
Shrub F=1.37; P=0.301
Succulent F=0.95; P=0.481
Forb F=5.43; P=0.008

Site Testing of soils



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Mueller Redevelopment of City of Austin Airport Field

700 acres
10,000 residences
1000 affordable
130 acres green

East Ave
Concordia University
Redevelopment


RENDERING BY PIRATE DESIGN


PARCEL 9
NON-RESIDENTIAL
8b
PARCEL 8a
RESIDENTIAL
8c
CONCORDIA AVE
CONCORDIA AVE
PARCEL 7
RESIDENTIAL
EAST AVENUE
PARCEL 6
NON-RESIDENTIAL
CASSELLA WEST DRIVE
CASSELLA WEST DRIVE
PARCEL 5
RESIDENTIAL
NON-RESIDENTIAL
EAST AVENUE
PARCEL 4
NON-RESIDENTIAL
AMAR DRIVE
AMAR DRIVE
PARCEL 3
NON-RESIDENTIAL
EAST AVENUE
PARCEL 1
RESIDENTIAL
NON-RESIDENTIAL
LESS THAN 3 MINUTES TO DOWNTOWN AUSTIN

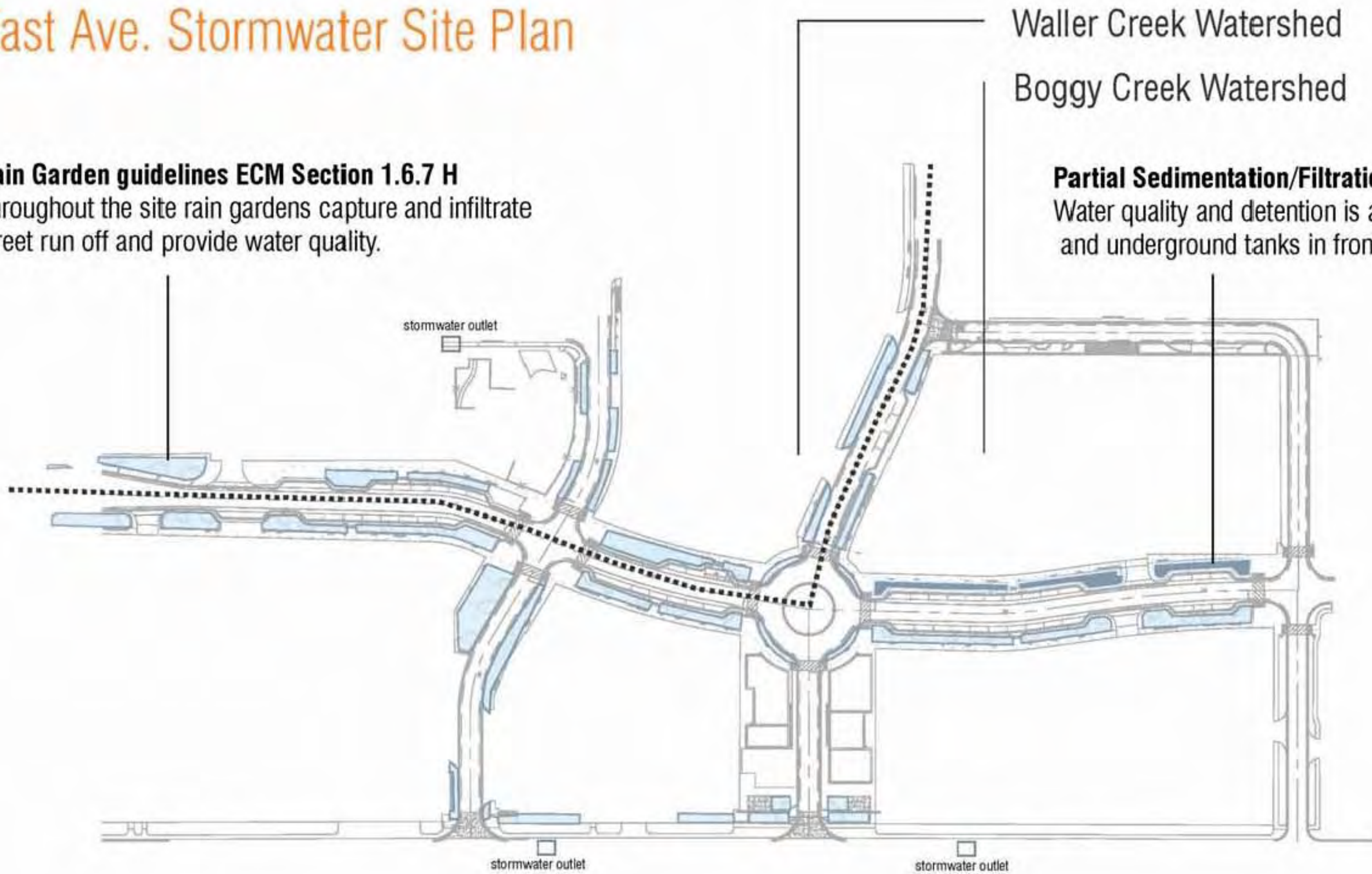
East Ave Saturated Conductivity Measurements

In December 2007, the Wildflower Center undertook a series of saturated conductivity measurements at the site using a Compact Constant Head Permeameter (a.k.a. Amoozemeter). We took eleven (11) measurement in across the Concordia campus in areas that were not under concrete , however, many of these locations were heavily compacted from existing foot traffic, and few had any significant herbaceous vegetation covering them. Saturated conductivity for the site averaged 0.23 inches/hour (or 0.46 feet/day). Individual readings are listed in the following table.

Location	Ksat (cm/hr)	Ksat (in/hr)
A1	1.64	0.64
A2	1.29	0.51
A3	0.52	0.21
B4	1.53	0.60
B5	0.13	0.05
B6	0.05	0.02
C7	0.36	0.14
C8	0.17	0.07
D9	0.33	0.13
E10	0.35	0.14
F11	0.02	0.01

While readings were not consistent, the primary variable associated with saturated conductivity at these sites seemed to be compaction. Using this soil after it is ripped or tilled it in some way to reduce compaction, along with the addition of minimal amounts of organic matter (such as compost) will result in increased rates of conductivity, so the rate of 0.23 inches/hour is a conservative estimate of the actual rate of infiltration you are likely to see in the rain gardens. Similarly, as the existing soil at the site is already primarily clay, it is likely that sediment accumulation over time will have no effect on conductivity, as clay particles are already the smallest soil particles, and cannot be "clogged" by any smaller particles. Conversely, as vegetation in these rain gardens develops, root development -- particularly the fibrous root systems of grasses -- will add additional organic material to the soil and effectively increase the conductivity rate over time ■

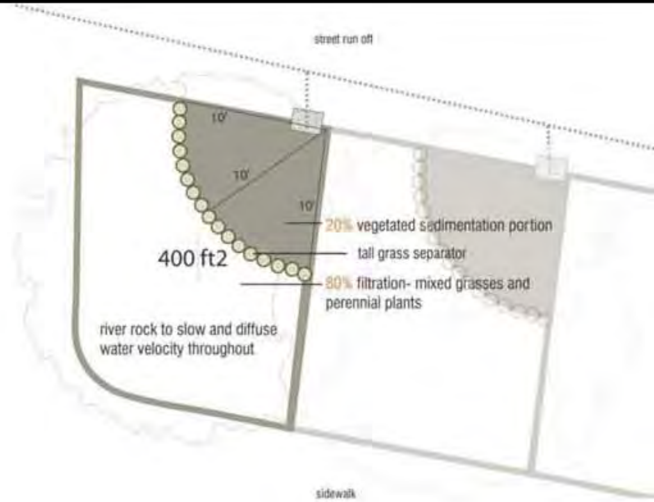
East Ave. Stormwater Site Plan

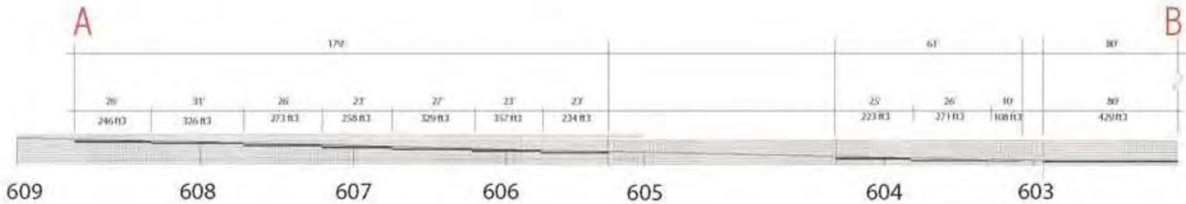


Rain garden detail

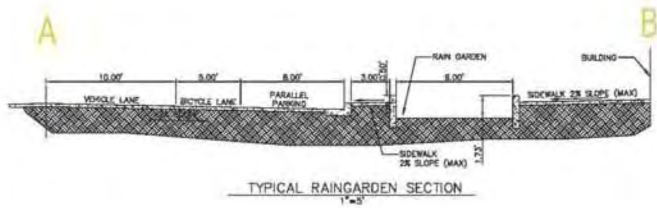
The rain gardens are a system of terraced infiltration beds responding to the topography of the street. At every six inch change in the topography there is a terrace break in the rain gardens. It is understood that some of these locations may need to be modified in the field. The beds are level and are 6 inches below grade at the most shallow portion and 1 foot below grade at the deepest portion. The breaks are proposed to be combination of vegetation and rip rap so that the rain gardens feel as one continuous system. Stormwater from the street enters the rain gardens through curb inlets and ponds up to a six inch-depth of water. Twenty percent of the surface area of the rain gardens also functions as sedimentation bed with a perimeter of densely planted tall grass species. River stones and rip rap along with native groundcovers are present throughout the sedimentation area to diffuse water velocity.

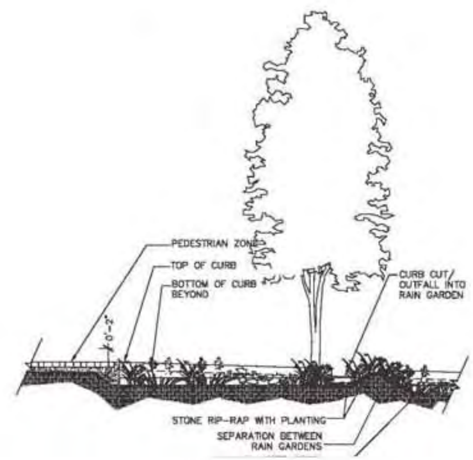
The remaining 80 percent of the rain garden surface area will provide infiltration and will be planted with a single tree and a mixture of grasses and perennial plants.

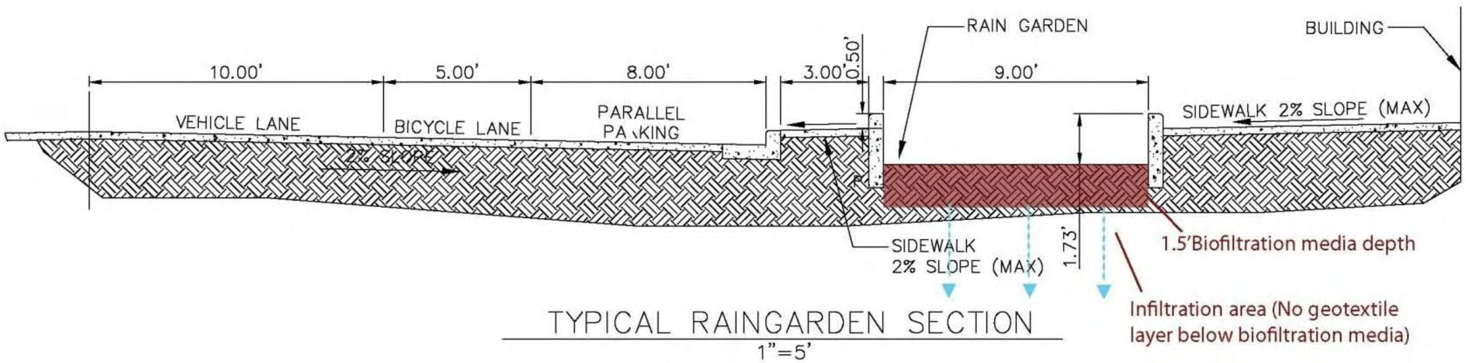




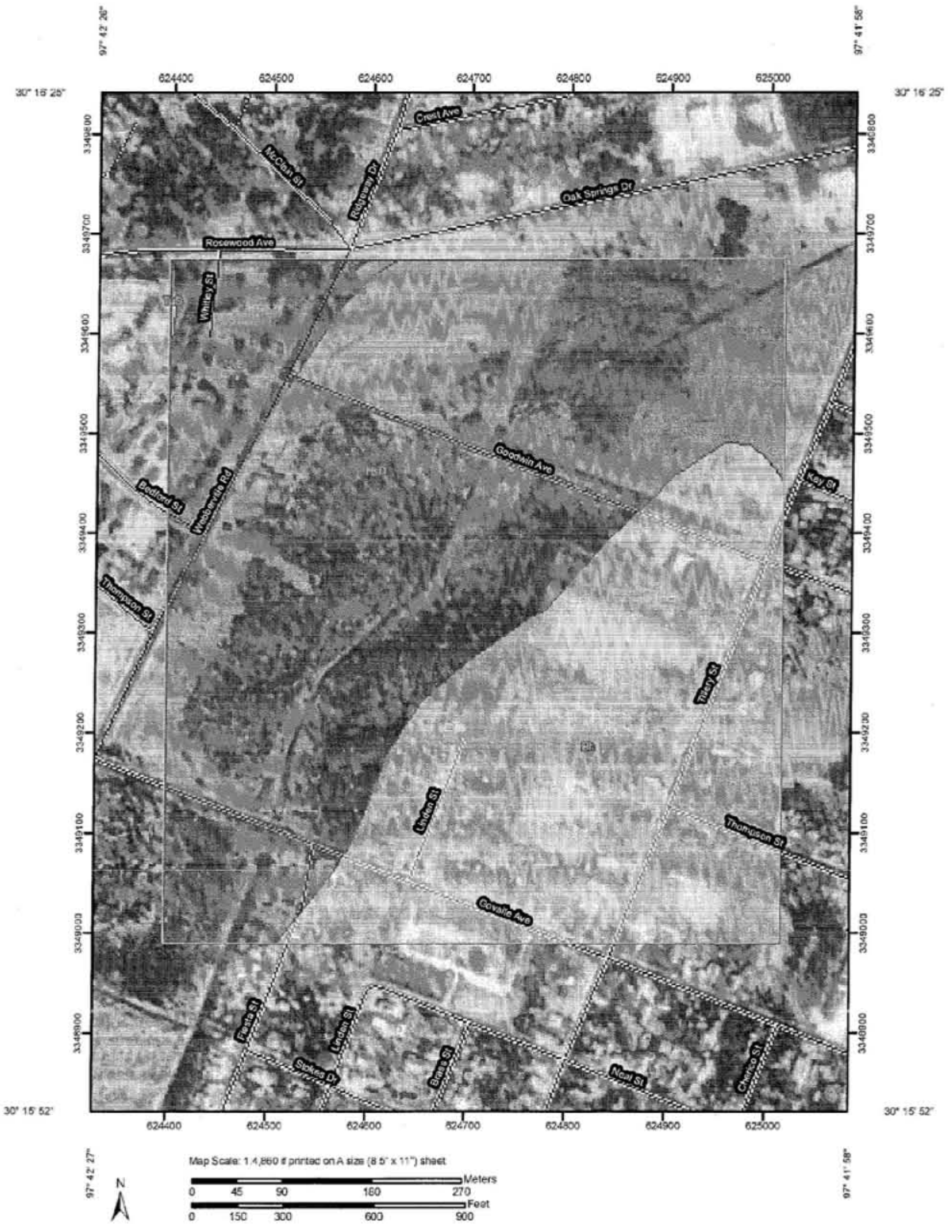
Rain garden ponding depth not to exceed 6 inches.



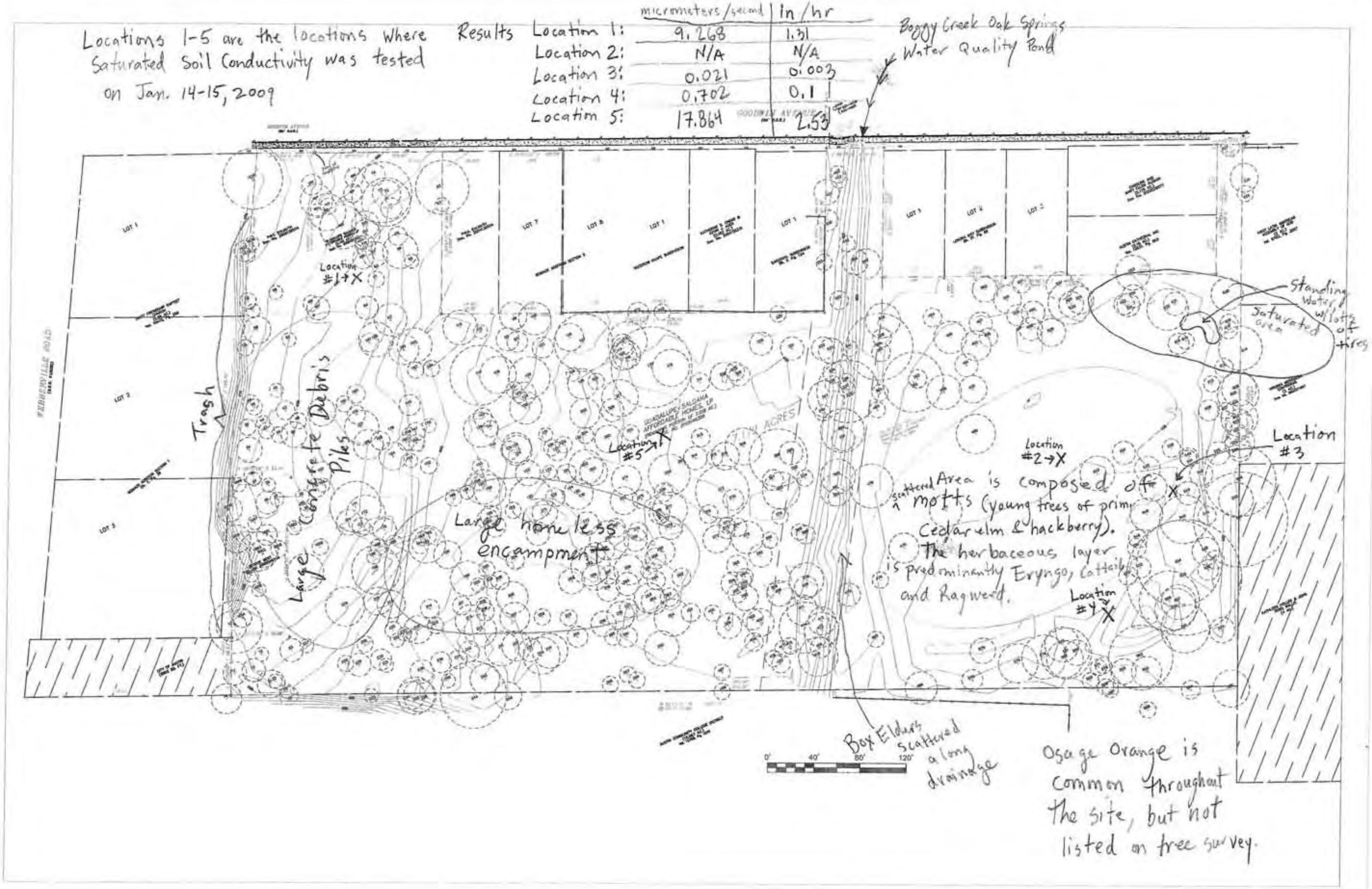



RAIN GARDEN
BUILDING
10.00'
5.00'
8.00'
3.00'
0.50'
9.00'
VEHICLE LANE
BICYCLE LANE
PARALLEL
PARKING
SIDEWALK 2% SLOPE (MAX)
2% SLOPE
SIDEWALK
2% SLOPE (MAX)
1.73'
1.5'Biofiltration media depth
Infiltration area (No geotextile layer below biofiltration media)
TYPICAL RAINGARDEN SECTION
1"=5'

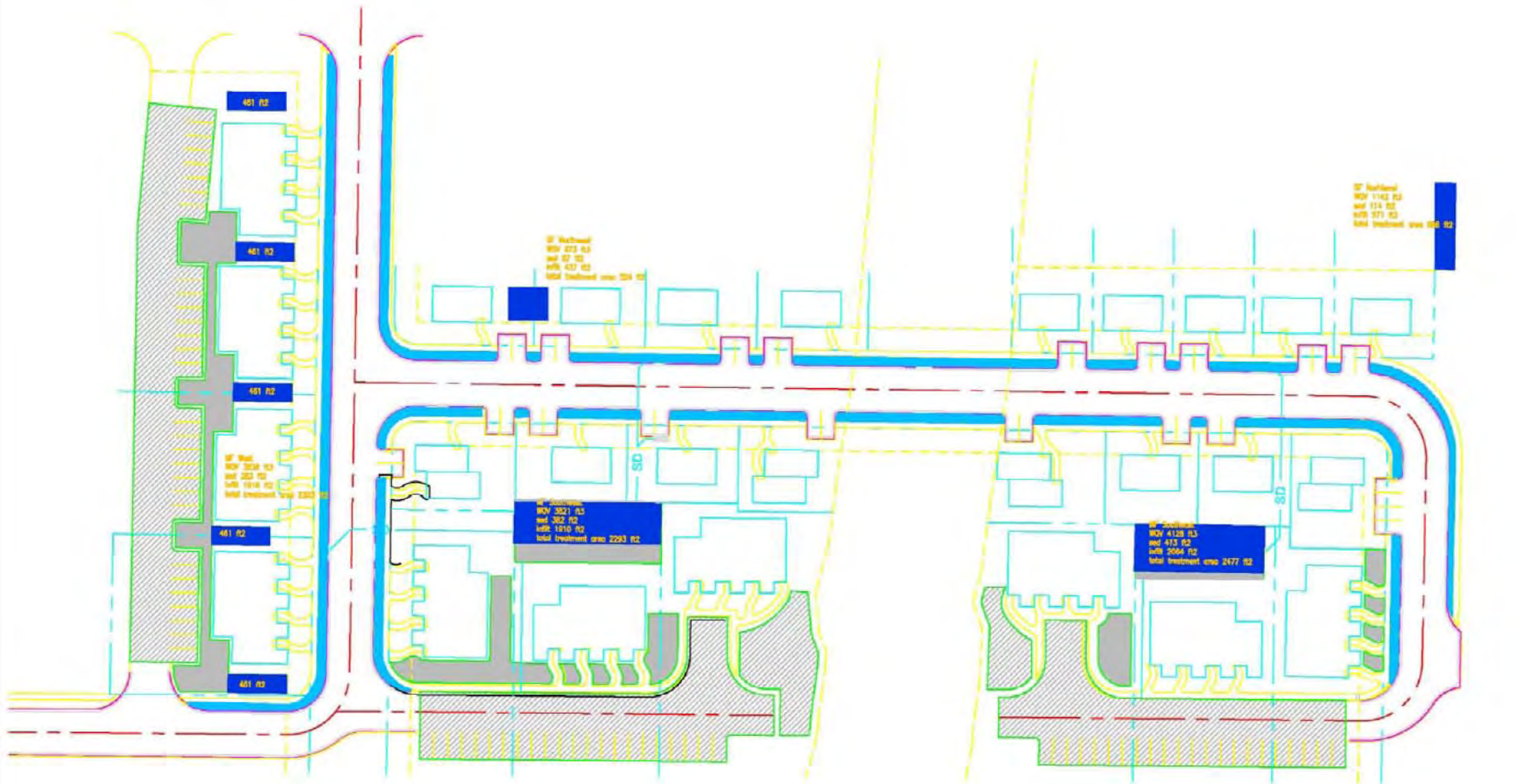
Guadalupe
Saldana Subdivision



97° 42' 26"
97° 41' 58"
30° 16' 25"
30° 16' 25"
624400
624500
624600
624700
624800
624900
625000
3349800
3349700
3349600
3349500
3349400
3349300
3349200
3349100
3349000
3348900
Crest Ave
McClain St
Ridgeway Dr
Oak Springs Dr
Rosewood Ave
Whitley St
Goodwin Ave
Bedford St
Webberville Rd
Kay St
Thompson St
Tillery St
Linden St
Thompson St
Covalle Ave
Pleasant St
Linden St
Stokes Dr
Bass St
Neal St
Chestnut St
30° 15' 52"
30° 15' 52"
97° 42' 27"
97° 41' 58"
Map Scale: 1:4,860 if printed on A size (8.5" x 11") sheet.
N
0
45
90
180
270
Meters
0
150
300
600
900
Feet



Locations 1-5 are the locations where Saturated Soil Conductivity was tested on Jan. 14-15, 2009
Results
micrometers/second | in/hr
Location 1: 9.268 | 1.31
Location 2: N/A | N/A
Location 3: 0.021 | 0.003
Location 4: 0.702 | 0.1
Location 5: 17.864 | 2.53
Boggy Creek Oak Springs Water Quality Pond
Standing Water, w/ lots of trees
Saturated area
Location #1→X
Location #5→X
Location #2→X
Location #3
Location #4→X
Trash
Large Concrete Debris Piles
Large homeless encampment
Area is composed of scattered motts (young trees of primarily Cedar elm & hackberry). The herbaceous layer is predominantly Eryngo, Cattails and Ragweed.
Box Elders scattered along drainage
Osage Orange is common throughout the site, but not listed on tree survey.
0' 40' 80' 120'


461 ft2
461 ft2
461 ft2
461 ft2
461 ft2
WQV 3821 ft3
sed 382 ft2
infilt 1910 ft2
total treatment area 2293 ft2
WQV 4128 ft3
sed 413 ft2
infilt 2064 ft2
total treatment area 2477 ft2
SD
SD

turf

The illusion of “lawn”

turf

The illusion of "lawn"

turf

The illusion of "lawn"

turf

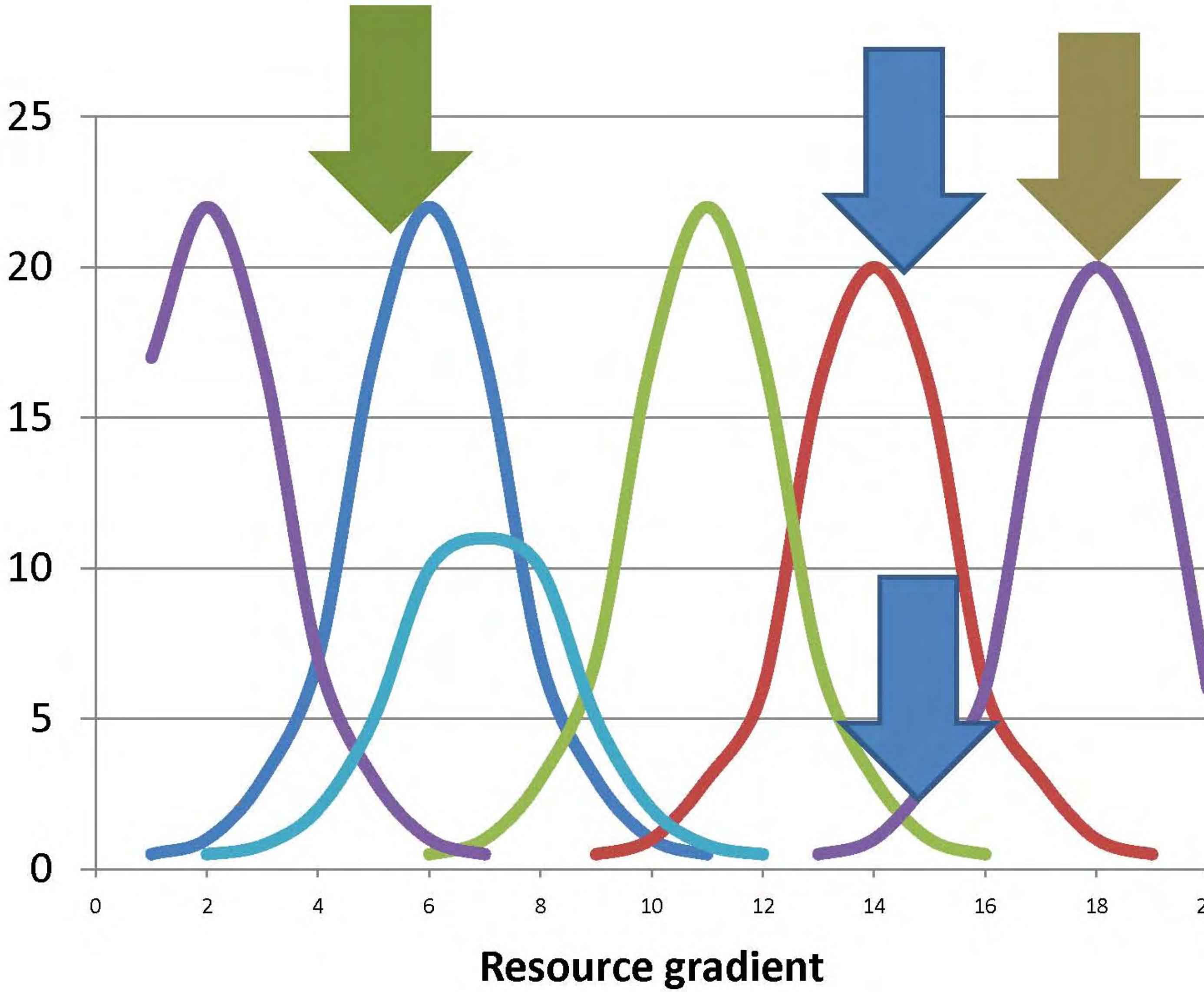
The illusion of "lawn"

turf

The illusion of "lawn"

Many species

"plagio-climax"



25
20
15
10
5
0
0
2
4
6
8
10
12
14
16
18
20
Resource gradient

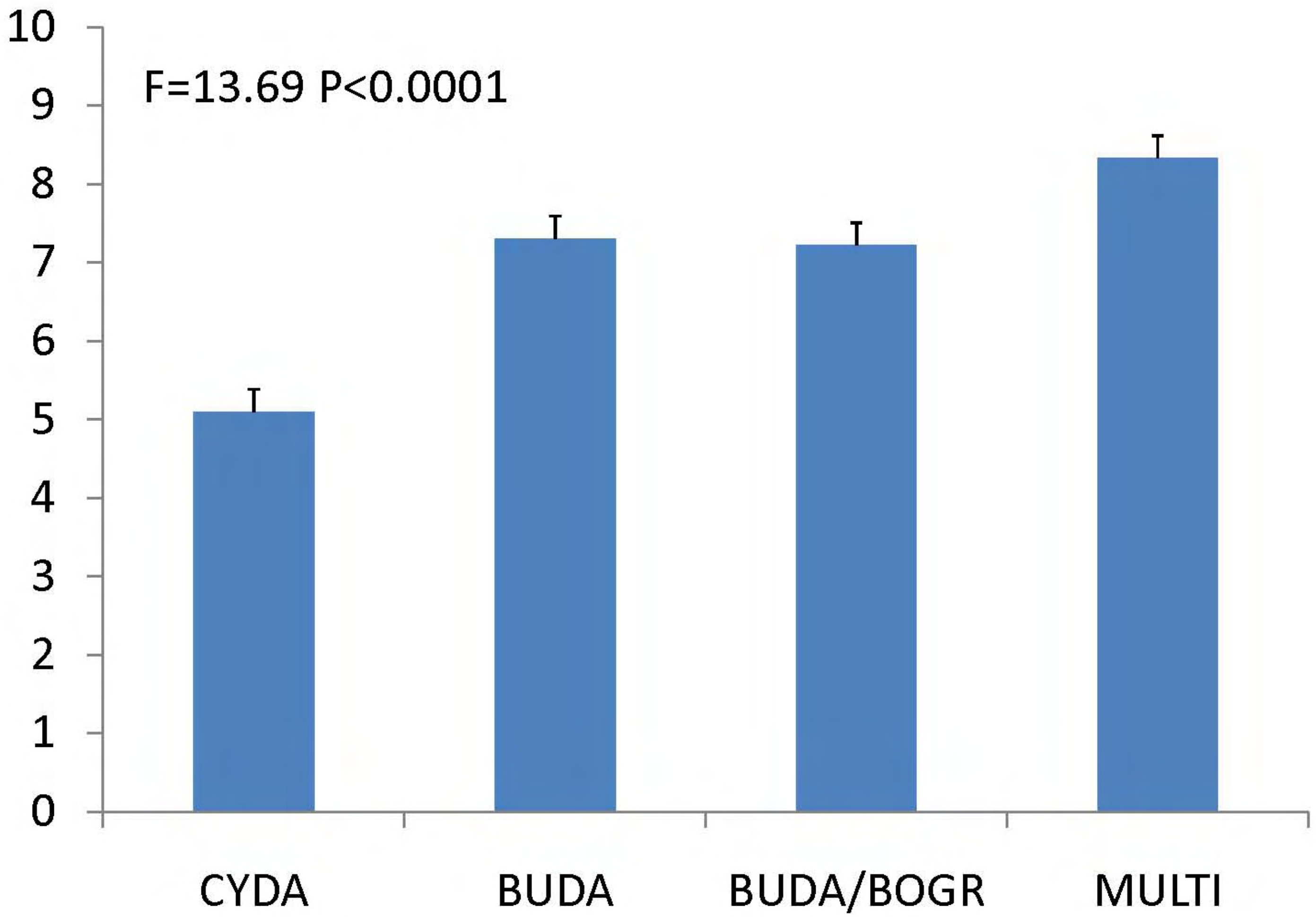
turf

Research

Several mixes

Testing for

- aesthetic
- traffic
- weed
- maintenance



10
9
8
7
6
5
4
3
2
1
0
F=13.69 P<0.0001
CYDA
BUDA
BUDA/BOGR
MULTI

Mt. Tabor Middle School
Portland

Urban sites have advantages

1. Financial resources
2. “Waste" products can enhance growth
3. High educational value

Urban landscapes systems can be created, restored and manipulated to wards multiple goals.

Our vegetation represents a massive untapped resource

Have we overlooked our landscapes to maximize their function?