Putting good ideas to work for a carbon-neutral, flourishing campus

Sustainable CWRU

Treenote: Trees, Soils & Climate

Spring Keynote and Awards Presentation

Case Western Reserve University
EST. 1826
think beyond the possible

Panelists

- Jill Ziegler, Director of Corporate Responsibility for Forest City Realty Trust & Co-chair, Cleveland Tree Plan
- Sandra Albro, Research Associate at Holden Forests & Gardens & Co-chair, Cleveland Tree Plan
- Matt Langan, Landscape Architect, Sasaki
- James Sottilo, President - Ecological Landscape Management

Case Western Reserve University Stats

- 8 millions sq. feet
- $360.1 million in research revenues
- $4.8 billion endowment
- 750,000 annual community volunteer hours
- 185 urban acres
- 140+ buildings
- 400 acres off-campus Univ. Farm
- 18,000+ people (10,000 students)

- $20+ million annual utility spend
- 200,000 mmtco2e
- 1,300 research labs
- 1.8 million local food spend by Bon Appetit (approx)
- 130 fleet vehicles (approx)
- 140 bike racks
- 5 bike fixit stations

What We Work On

- Climate Action Plan
- Green Building + Transportation + Green Grounds
- Recycling & Materials Management
- Sustainability Data Collection
- Engagement and Creating a Culture of Sustainability

Student Sustainability Ambassadors

Recycling & Waste: Lori Sun & Sindhu Yalavarthy

Reuse: Carlos Lewis-Miller & Sierra Leonard

Energy – Res Hall: Maggie McClarren &Divya Manoharan

Energy – Green Labs: Ethan Hill & Emily Herrmann

Green Building: John Kilbane & Kevin Pataroque

Transportation: Thanvi Vatti & Mika Hoecher

Green Grounds: Kayla Buckelew & Claire Holliday

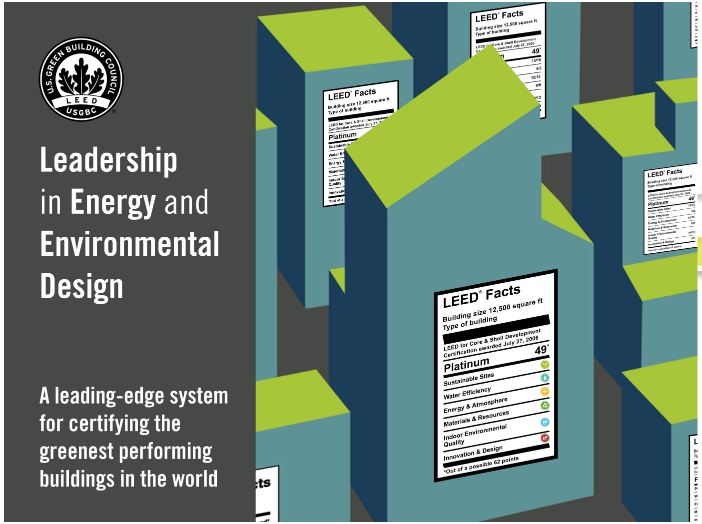
Food (Real Food Challenge): Naveen Rehman & Jason Guo

Climate Action Plan (CAP) Commitments

Signed ACUPCC 2008 / CAP published 2011

- Publicly report CWRU's GHG emissions inventory every year
- Report on CAP progress every 2 years
- Update plan every 5 years
- Requires we build minimum LEED silver for new construction
- Required goal to expand sustainability literacy academically

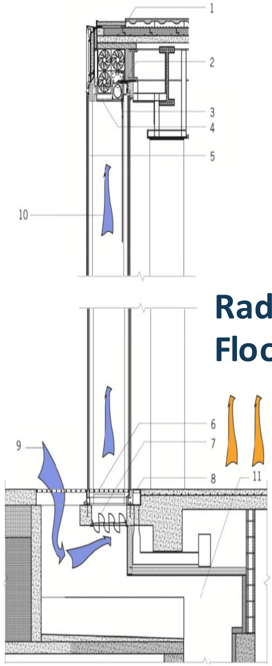
Tink Green Building Technology Features



40kW Solar Array

Live Roof

Double-Skin Facade



Radiant Floor

CASE WESTERN RESERVE UNIVERSITY EST. 1826

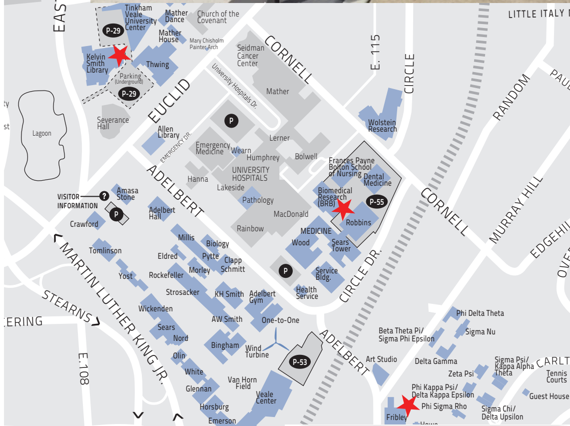
think beyond the possible

Green Grounds:
Policies, Practices & Amenities

TREE CAMPUS USA®

Sustainable Transportation @ CWRU

- 6 Bike Fixit Stations
- Over 130 bike racks
- 4 Bike Share Stations
- Greenie shuttle system (1 runs on CNG)
- Car sharing – Enterprise & Zip
- Gohio ride matching portal
- New Van Pool program in Cuyahoga County
- RTA Commuter Advantage for employees
- U-Pass for Undergrads



CWRU Sustainability Team – sustainability@case.edu

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SANDRA ALBRO

CO-CHAIR, CLEVELAND TREE PLAN

JILL ZIEGLER

CO-CHAIR, CLEVELAND TREE PLAN

More Trees for a Healthier Cleveland

Sandra Albro
Holden Forests & Gardens

Jill Ziegler
Forest City Realty Trust

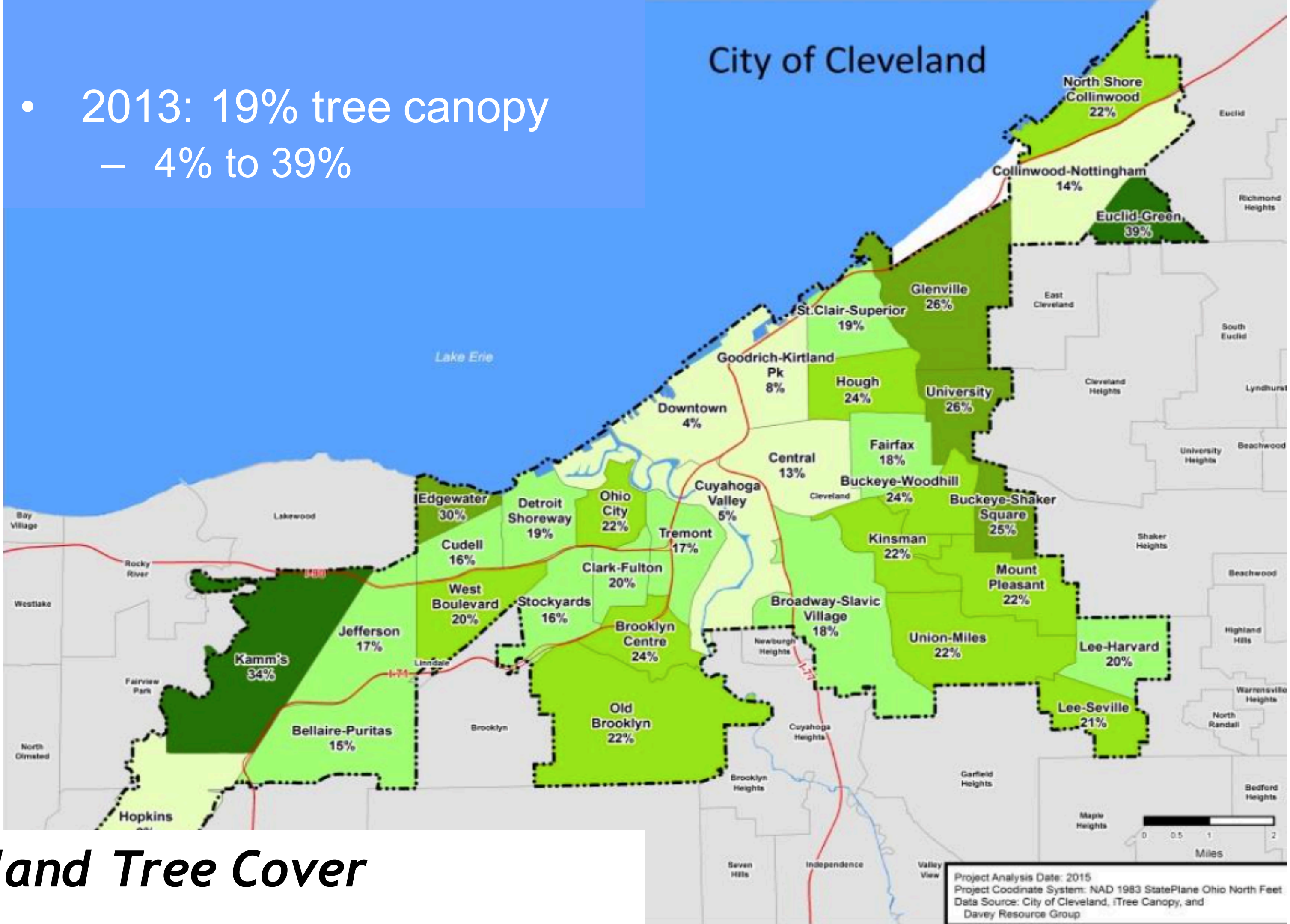
Co-chairs, Cleveland Tree Coalition

↑ air quality

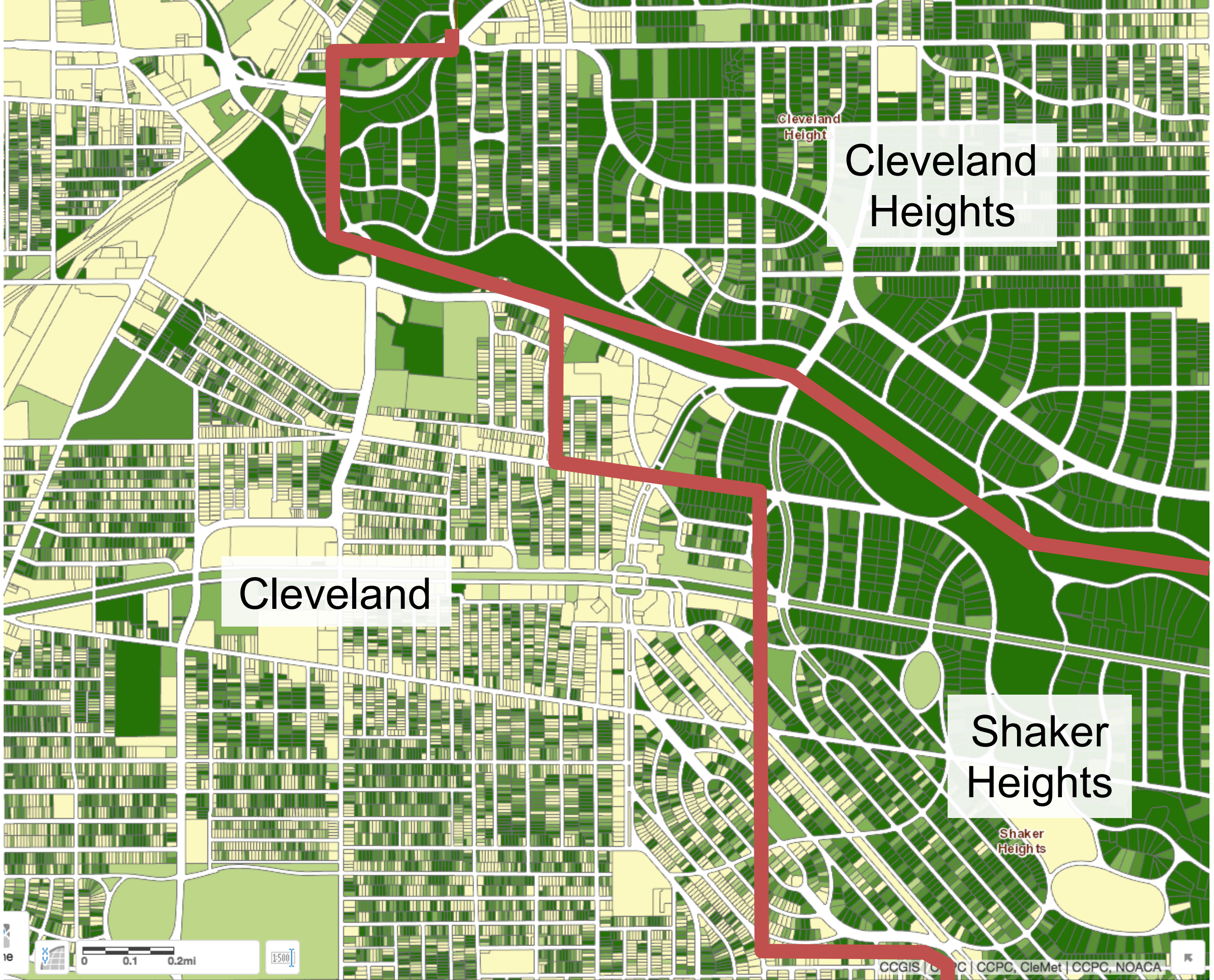
↓ urban heat island
↓ stress

= better health outcomes
= less crime

- 2013: 19% tree canopy
  - 4% to 39%

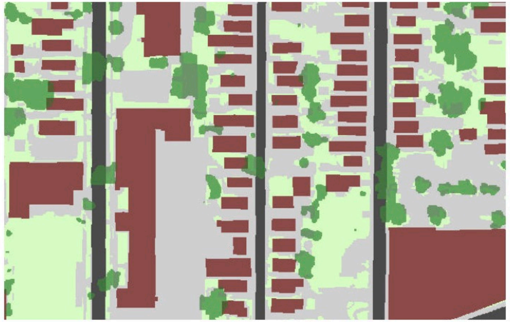


Cleveland Tree Cover


Cleveland Heights
Cleveland
Shaker Heights
Cleveland Heights
Shaker Heights
0 0.1 0.2mi
CCGIS | C... C | CCPC, CleMet | CCPC, NOACA

Cleveland at 30% tree canopy:

Benefit	Value	
	at 19% cover	at 30% cover
Stormwater runoff	$10,800,000	$16,900,000
Energy savings	$3,500,000	$5,500,000
Adverse health effects	$6,900,000	$10,800,000
Air quality improvement	$1,800,000	$2,800,000
Carbon sequestered	$800,000	$1,300,000
Property value increase	$4,500,000	$7,000,000
Total Annual Benefits	**$28,200,000**	**$44,200,000**

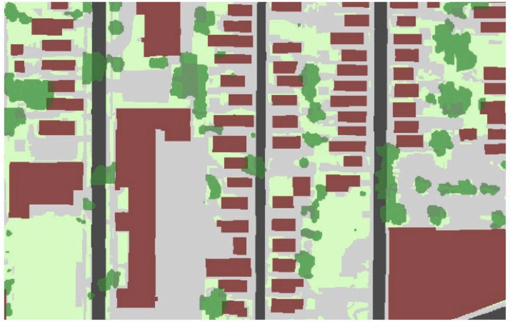


Where we are now:

19%

Detroit-Shoreway SPA

Cleveland Tree Canopy Goal



Where we are now:

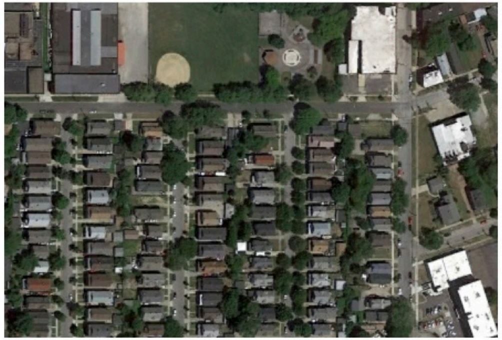
19%

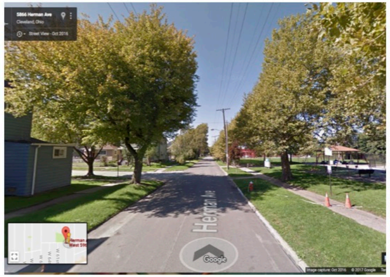
Detroit-Shoreway SPA

Where we want to be:

30%

Edgewater SPA





Cleveland Tree Canopy Goal

Credit: CSU Center for Community Planning and Development using information from the Cleveland Tree Plan, the Cuyahoga County Greenprint and Google Streetview

CLEVELAND
TREE COALITION

- 40+ member organizations
- Implementing Cleveland Tree Plan
- How to fund and plant trees?
    - ~ 361,000 trees for 30% canopy

STAY INVOLVED

- Document tree efforts
    - number trees planted/removed
    - tree inventory
- Tree community service
- Teach importance of trees
- Lead by example

STAY INVOLVED

- /cletrees
- SustainableCleveland.org: Arbor Day

CLEVELAND
TREE COALITION

Sandra Albro
salbro@cbgarden.org

Jill Ziegler
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MATT LANGAN

LANDSCAPE ARCHITECT, SASAKI

CASE WESTERN RESERVE
UNIVERSITY EST. 1826
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SASAKI

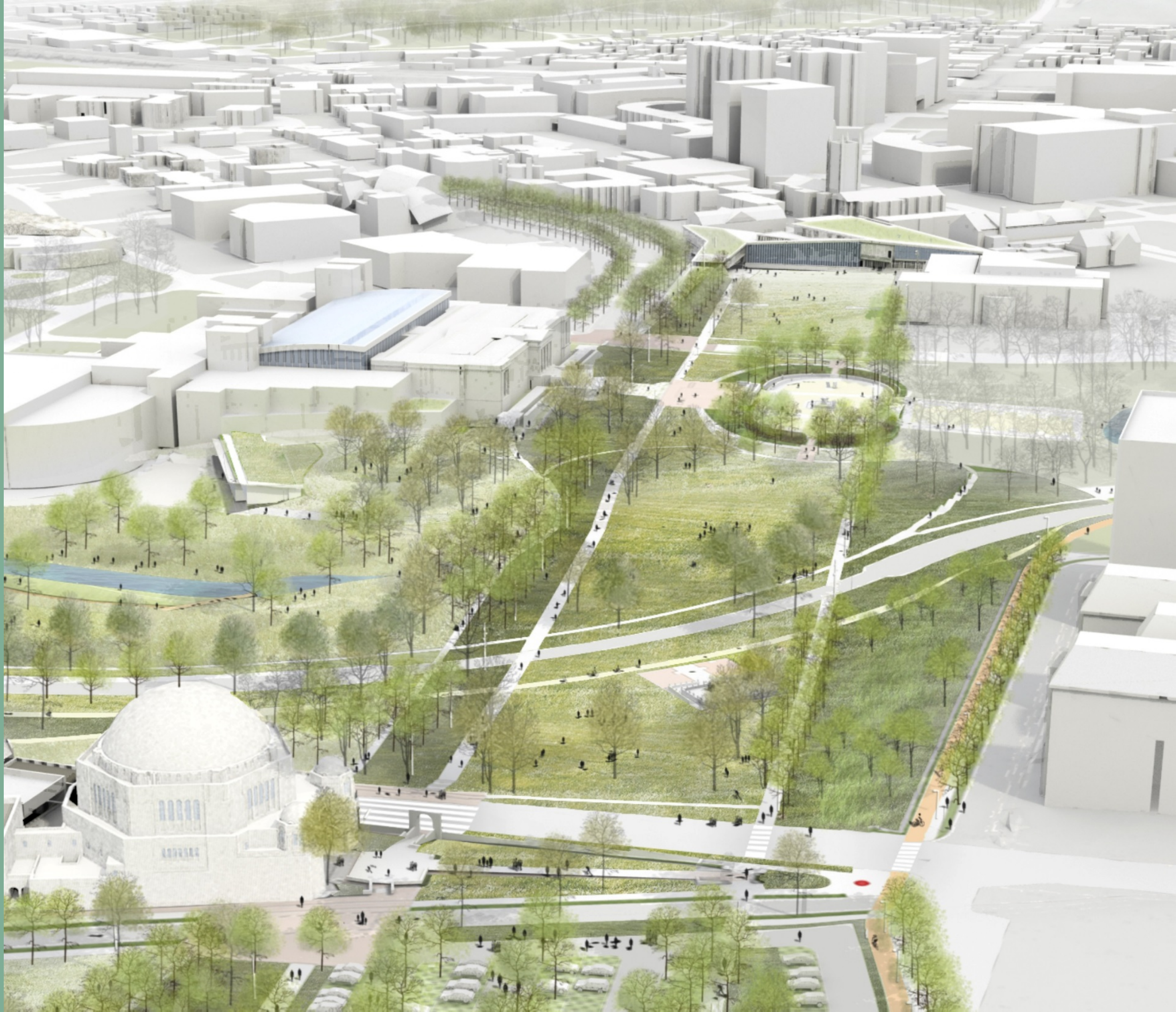
Ecological Landscape Management

The Nord Family Greenway

April 11, 2018

TREENOTE:

Soils, Canopies, and Climate



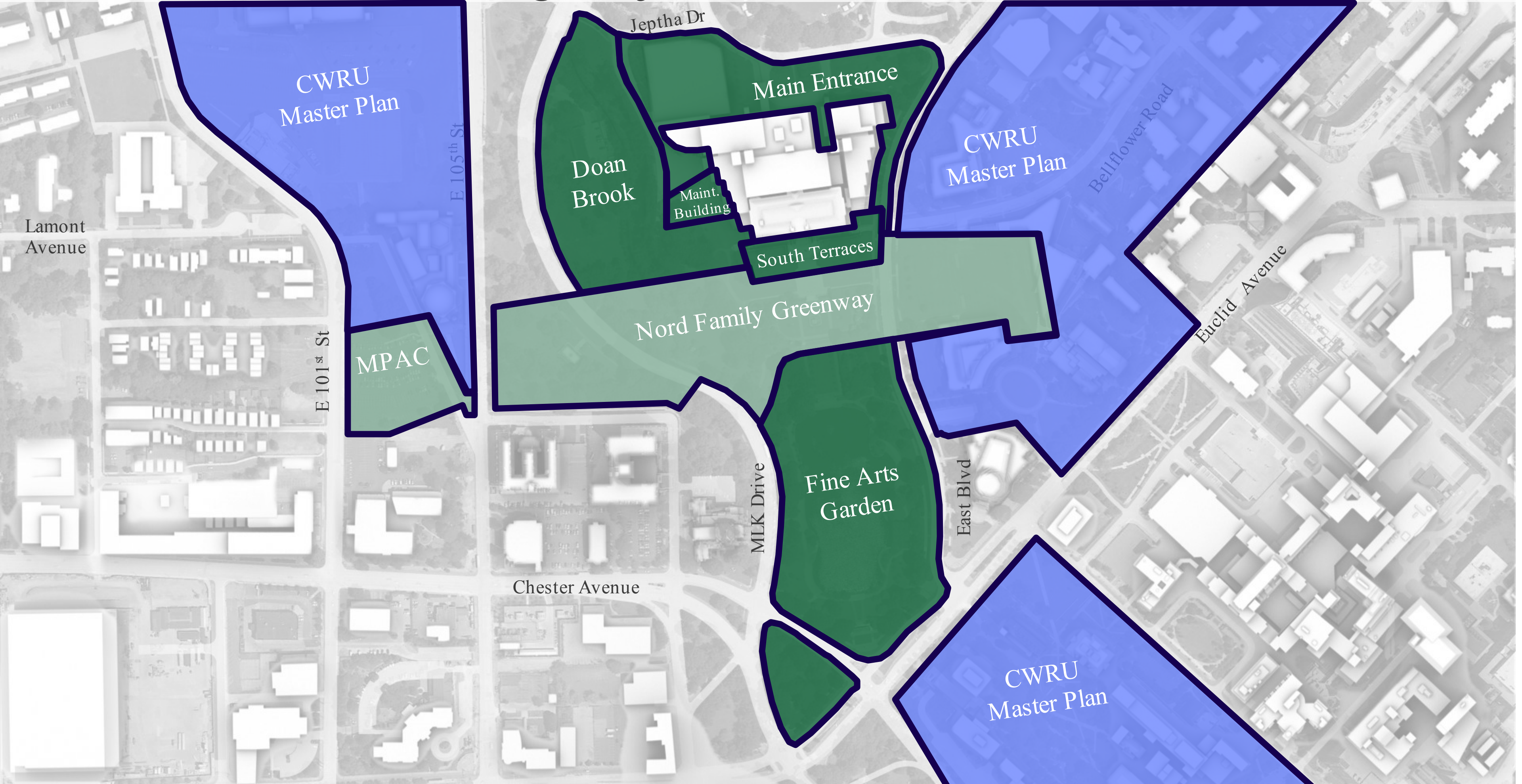
01 PROJECT INTRODUCTION

02 SOILS & SOIL BIOLOGY

03 TREES

04 SUSTAINABILITY

Recent and On-Going Projects




2011


2013


2016

PRINCIPLES

The GREENWAY is both a legacy space and the heart of an active cultural district & campus

Employ sustainable practices to accommodate existing mature trees and new high-performance lawns

A hierarchy of movement, gathering, and long views enhance spatial clarity and wayfinding

Richly planted perimeters frame the central lawn panels

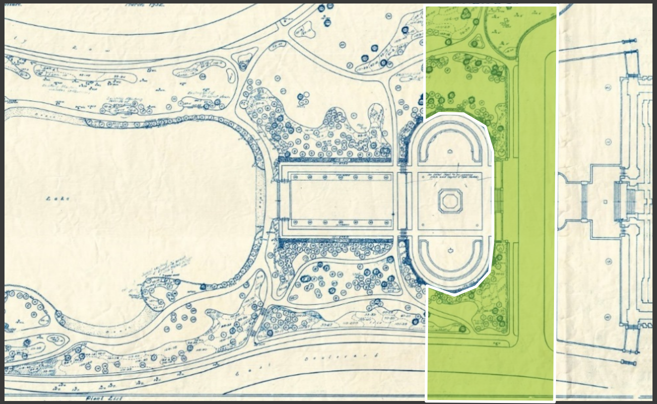
STRATEGIES

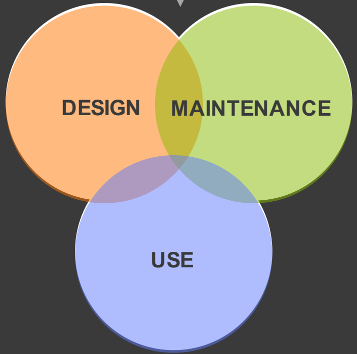
Direct and enable efficient circulation patterns across the site while sustaining this heritage landscape

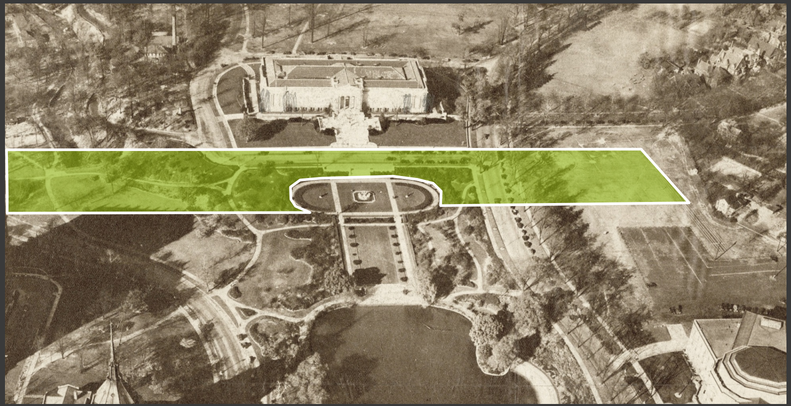
Manage soil moisture, reduce compaction, and improve horticultural conditions to support the anticipated day-to-day use of the community

Distribute and organize a range of programming opportunities providing for social gathering spaces, active and passive recreation, and areas of respite.

Enhance the significance and power of the central connector space with a restored, porous, regionally appropriate, and horticulturally robust “forest” edge



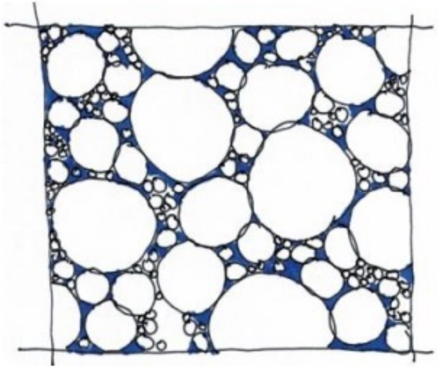




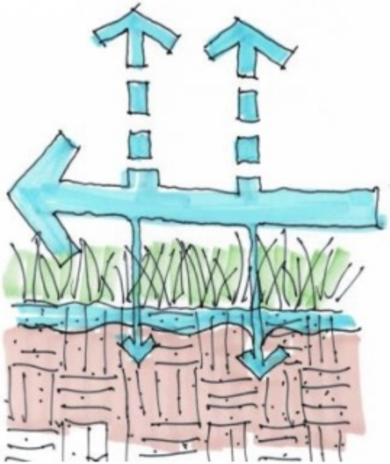

2018

	Existing Soil
Gravel	1-4%
Sand	50-70%
Silt	20-30%
Clay	10-20%
Organic Matter	2.8%
Infiltration Rate ("/hr.)	Less than 0.1

Existing Soil Composition



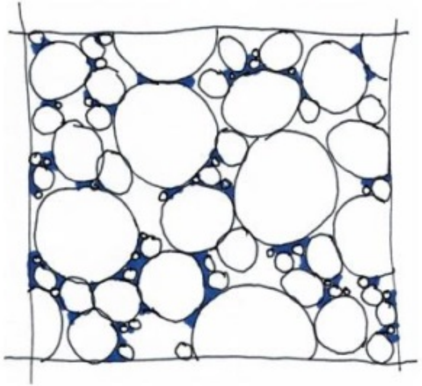
Existing Soil Structure



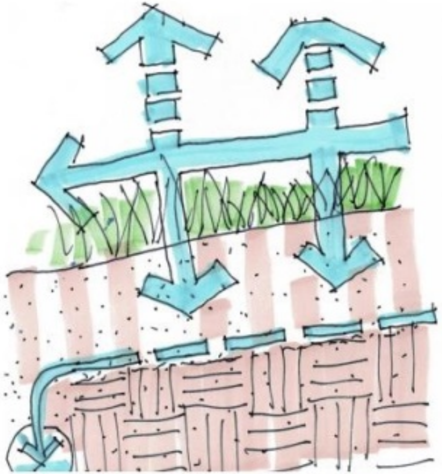
Existing Soil Section

	Proposed Soil Mix
Gravel	1-4%
Sand	83-88%
Silt	10-15%
Clay	5-10%
Organic Matter	5%
Infiltration Rate ("/hr.)	1-3"

Proposed Soil Composition



Proposed Soil Structure

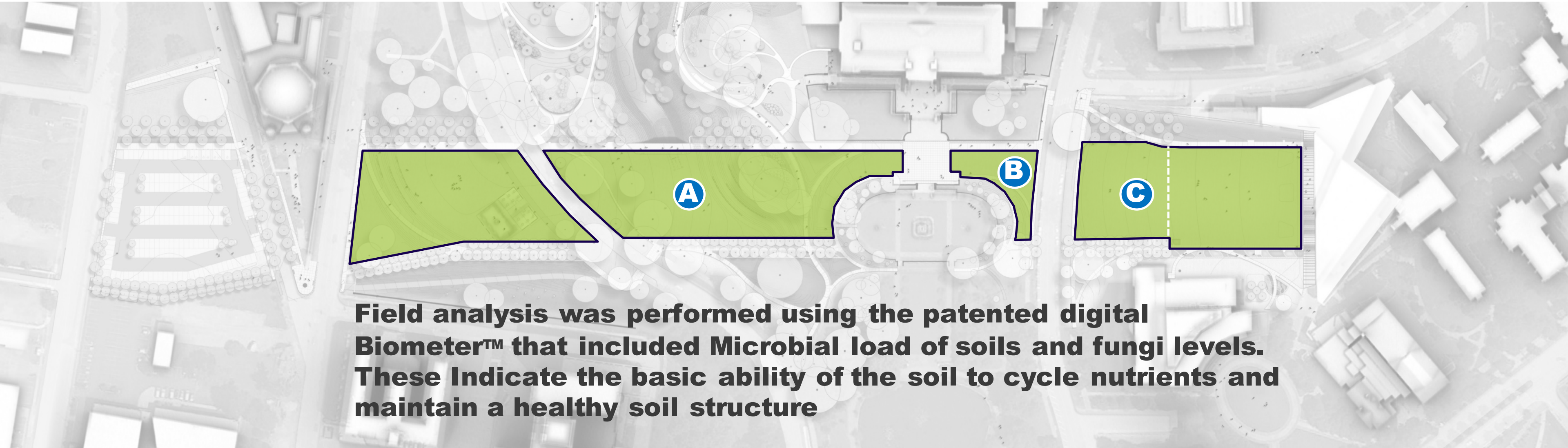


Proposed Soil Section

Soil Biology

- We observed low levels of nutrient cycling protozoa and nematodes. Soil compaction, salt in fertilizers, and pesticides are likely contributors to the baseline condition.
- Large quantities of wood decaying mushrooms were observed around the basal flare and structural roots of many large oak trees throughout the area. These areas have healthy nutrient cycling, but amendments were required to address the pathogens
- Our goal is to develop ecologically sound maintenance practices to ensure a high-quality landscape that is not taxing to our natural resources.

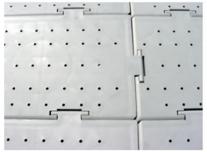
Soil ID	Biometer™ microbial load	Fungal test	Microscope Protozoa	Microscope Nematodes
Sod area on Case Western	12.5 million per cubic center meter of soil volume	Failed dye absorption of fungal enzyme too low	1 flagellate 0 amoeba and 4 ciliates per view of 20 fields too low	0
Lawn behind Museum near road	19.5million per cubic center meter of soil volume	Failed dye absorption of fungal enzyme too low	3 flagellate 1 amoeba per view of 20 fields too low	0
Lawn area with large Oaks at base of hill	22.5 million per a cubic center meter of soil volume	Dark blue- indicate high level of fungal enzymes (lots of wood decay mushrooms noted on site visit growing in lawn area around tree root flares and tree roots)	3 flagellate, 2 amoeba and 1 ciliate per view of 20 fields	1
Acceptable	25 million and greater	Medium to dark blue	total of 8 per 20 fields (ciliates are indicators of anaerobic conditions want very low numbers)	2 plus

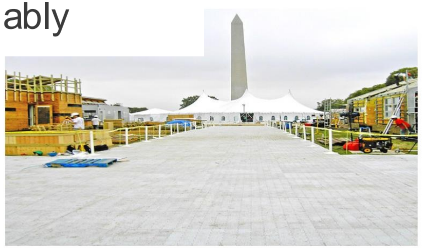


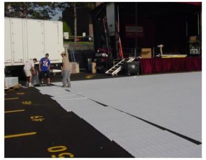
Field analysis was performed using the patented digital Biometer™ that included Microbial load of soils and fungi levels. These Indicate the basic ability of the soil to cycle nutrients and maintain a healthy soil structure

Turf Management

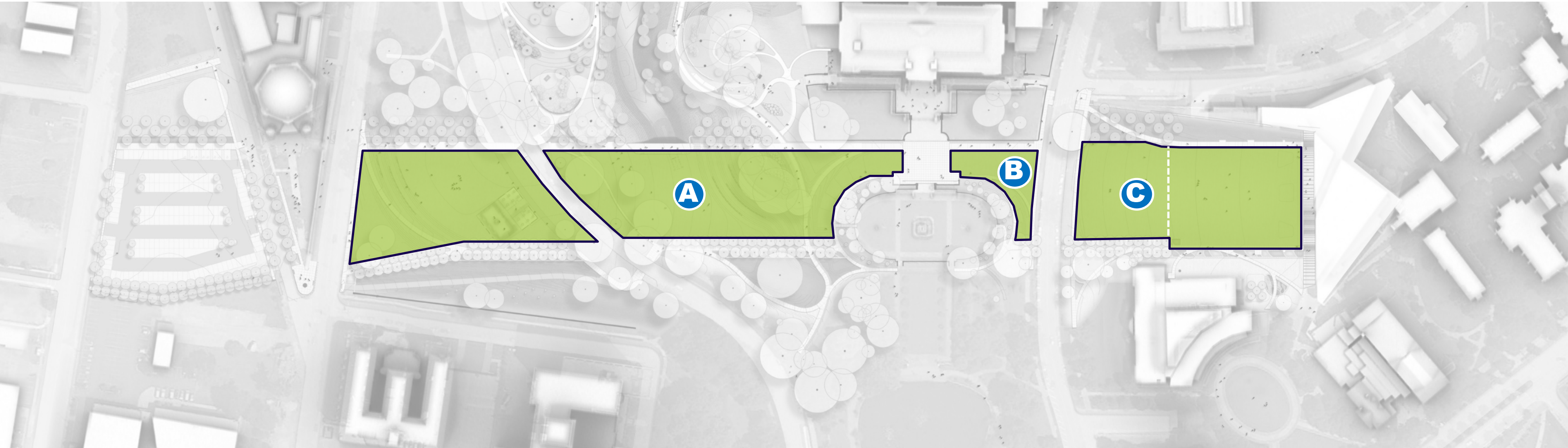
- Develop O&M Procedures
- Deploy Protection Systems
- Manage Sustainably







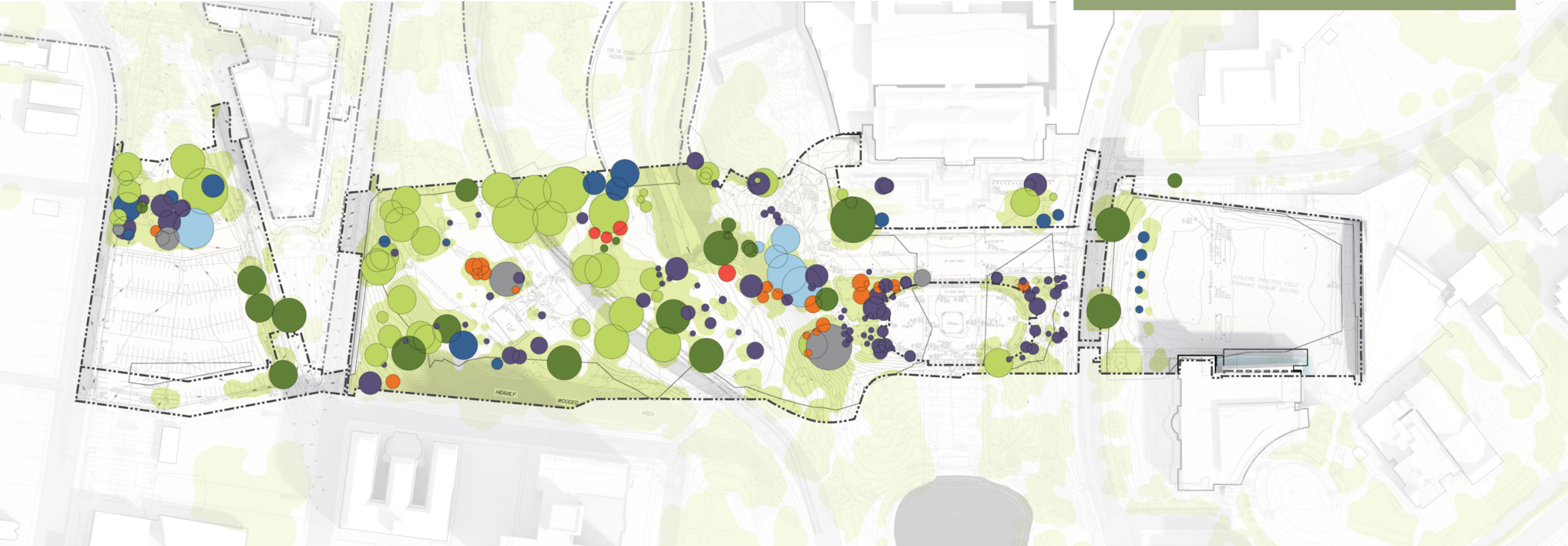
Turf Disease Triangle - "Sports Fields A Manual for Design Construction and Maintenance" by Jim Puhulla, Jeff Krans, and Mike Goatley.



Tree Inventory and Assessment: SPECIES COMPOSITION

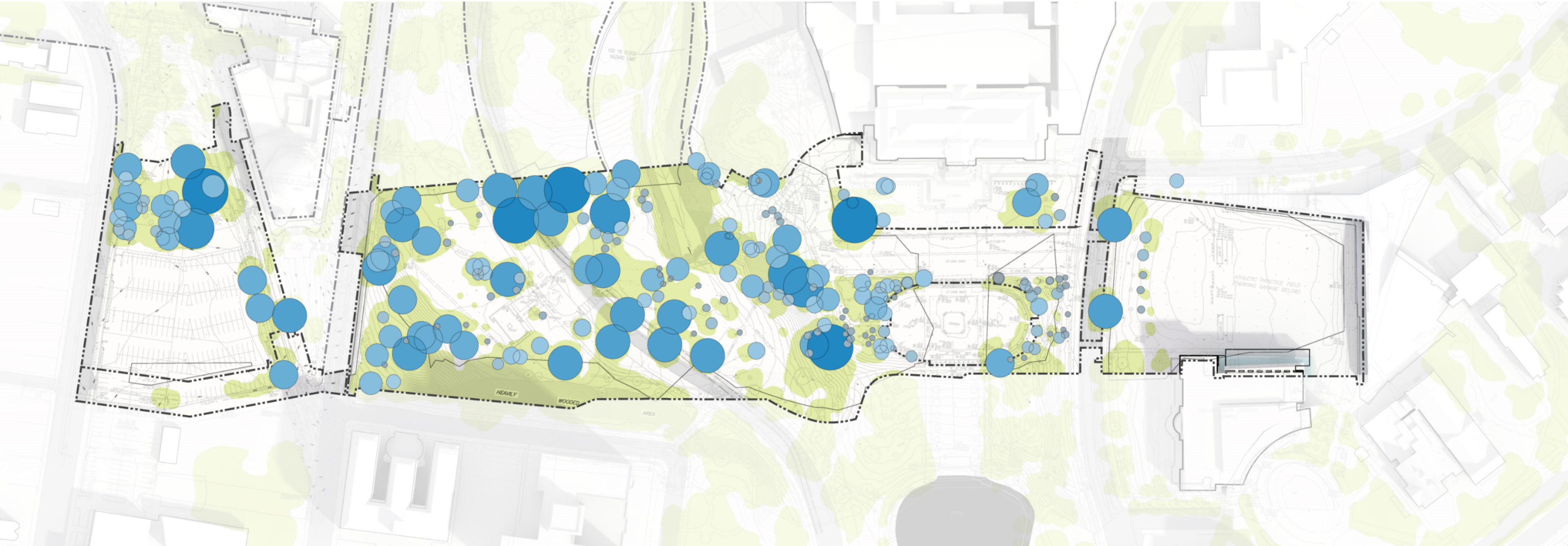
- A total of 451 trees were inventoried
- The most common species was Pin Oak - *Quercus palustris*
- 80% of inventoried trees were in fair condition
- 20% of trees were in poor condition

3 ASH
5 BEECH
6 ELM
15 EVERGREEN
17 MAPLE
47 OAK
102 ORNAMENTAL
18 OTHER



Tree Inventory and Assessment: SIZE (diameter at breast height)

- A total of 451 trees were inventoried
- The most common species was Pin Oak - *Quercus palustris*
- 80% of inventoried trees were in fair condition
- 20% of trees were in poor condition



Tree Inventory and Assessment: TREE HEALTH

- A total of 451 trees were inventoried
- The most common species was Pin Oak - *Quercus palustris*
- 80% of inventoried trees were in fair condition
- 20% of trees were in poor condition

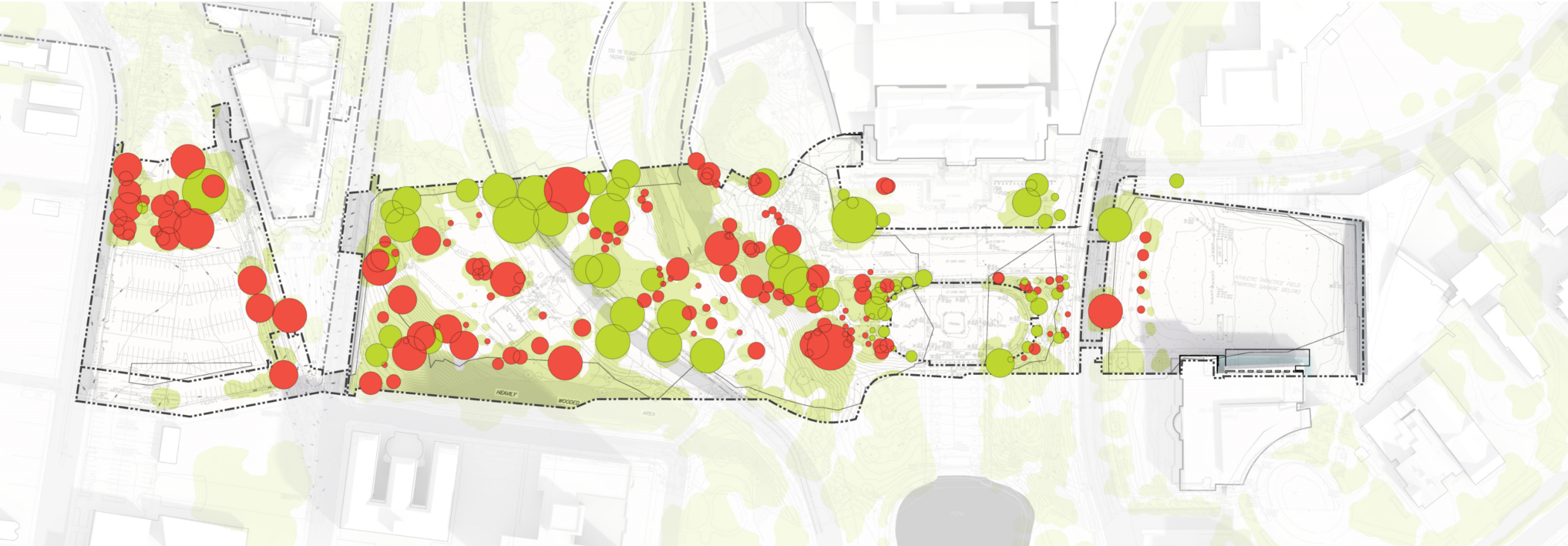
0 Specimen
15 Good to fair
162 Fair
24 fair to poor
9 Poor
3 Dead

Tree Inventory and Assessment: TREE ACTION

- A total of 451 trees were inventoried
- The most common species was Pin Oak - *Quercus palustris*
- 80% of inventoried trees were in fair condition
- 20% of trees were in poor condition

162 Protect

9 Remove



Proposed Tree Planting Strategy

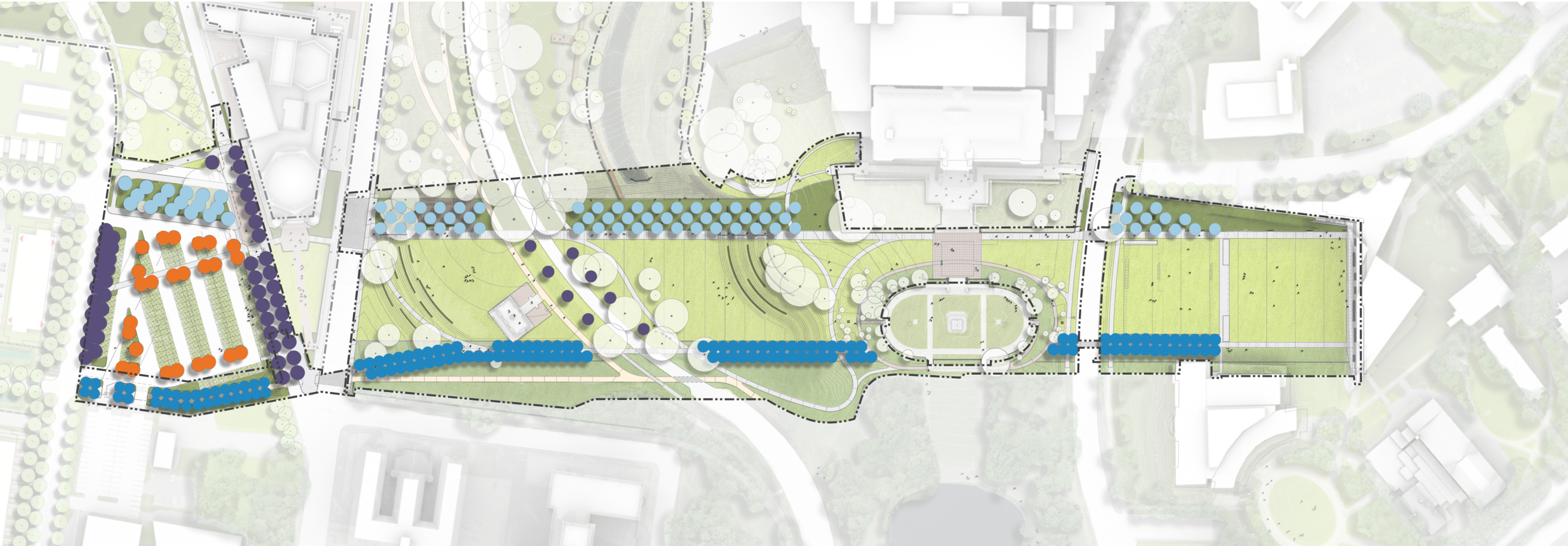
Trees removed:	182
Trees protected:	151
New trees:	272
Net gain:	**+90**

NORTH ALLEE - Mixed Oaks

SOUTH ALLEE - Coffee Tree

STREET TREES - London Plane

PARKING LOT - Honeylocust



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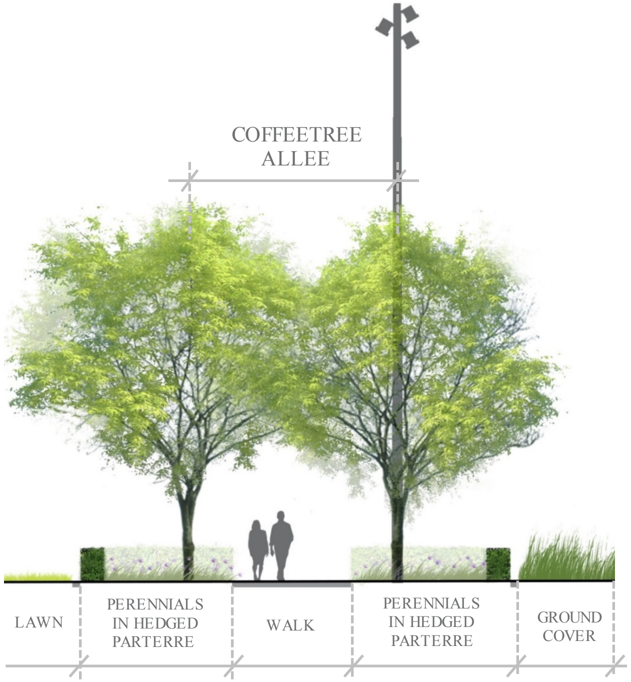
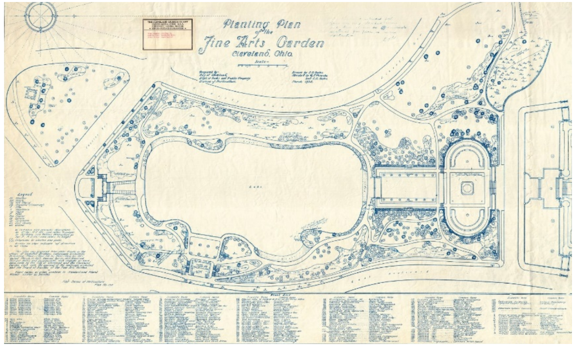
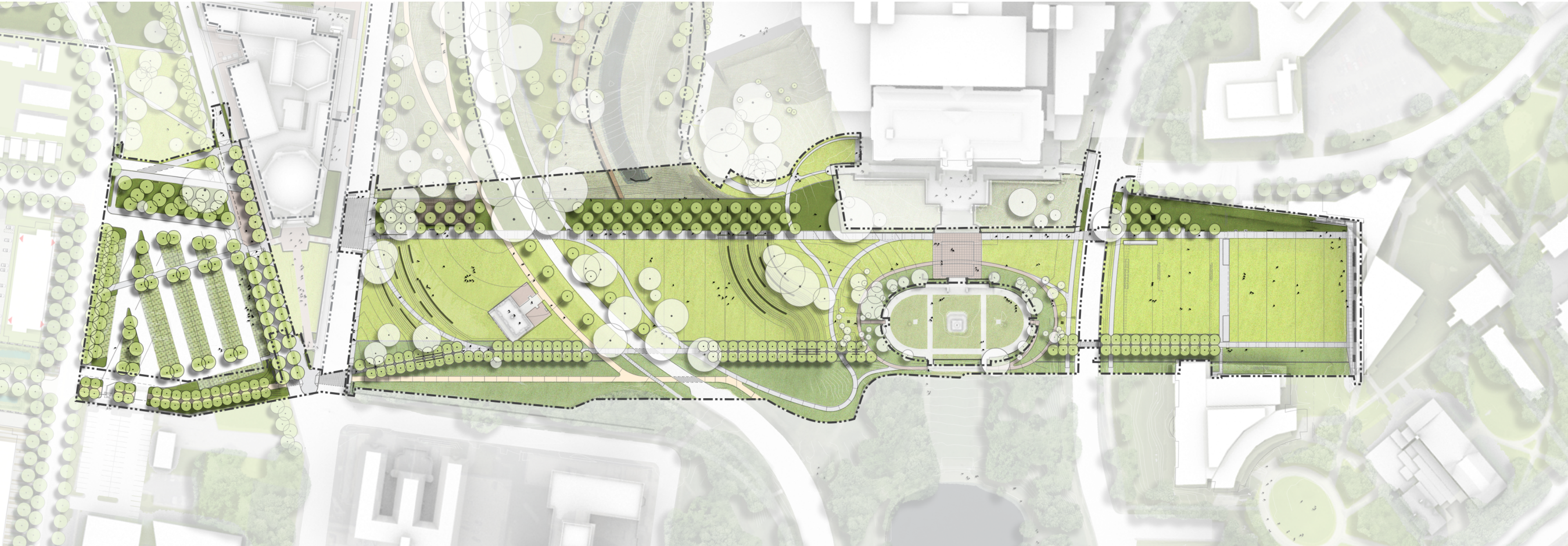


Proposed Tree Planting Strategy



1932 Olmsted Brothers' Fine Arts Garden Plan



JAMES SOTTILO

PRESIDENT - ECOLOGICAL LANDSCAPE MANAGEMENT

CASE WESTERN RESERVE UNIVERSITY EST. 1826
think beyond the possible


Sustainability in the Landscape
Transformation and Imperative Nature
Presented by
James Sottilo
Ecological Landscape Management

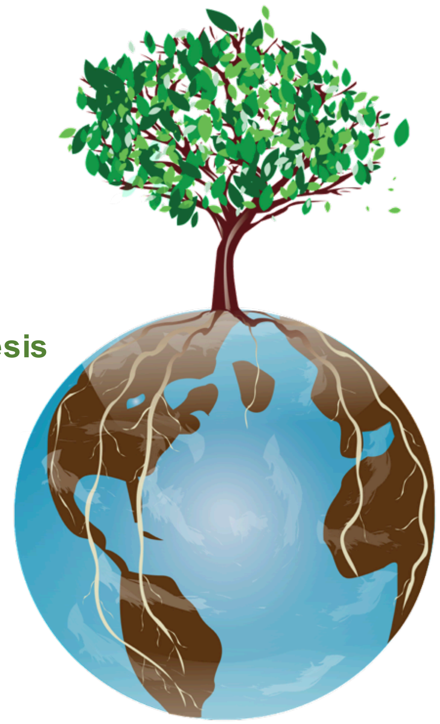
Microbial Biomass –
the foundation for naturally healthy landscapes

It is well-established that **microbial biomass** (MB) is the best single indicator of soil fertility (Doran and Weiss 2000) and it is the gold standard for academic studies evaluating soil quality.

Microbial biomass:

- indicates a healthy nutrient level in the soil and MB contains the nutrients needed by plants in the ratios required by plants (Kirkby et al 2011).
- increases the water holding capacity of the soil, thus decreasing the water irrigation requirements by as much as 50%.
- increases soil texture, decreasing erosion.
- increases the ability of soil to retain nutrients thus decreasing the need for fertilizer and significantly reducing chemical fertilizer pollution of groundwater and streams.
- increases the resistance of plants to stress and disease so fewer pesticides are required.
- increasing MB over time mitigates global warming. The microbes turn into carbon rich humus when they die, which over time stores carbon in soil, replacing some of the 50% of soil's carbon that we have released.

The process of **Photosynthesis**
and the **Carbon Flow**

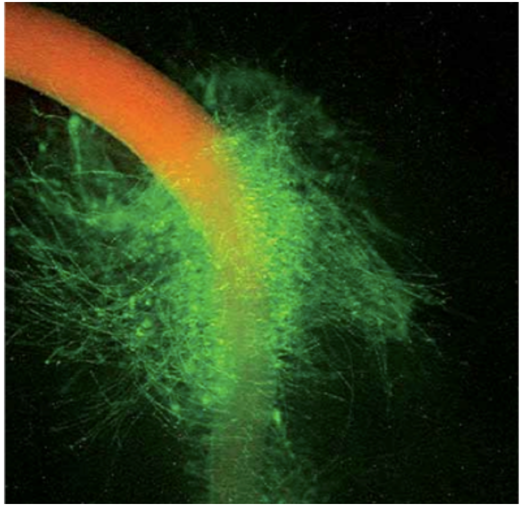


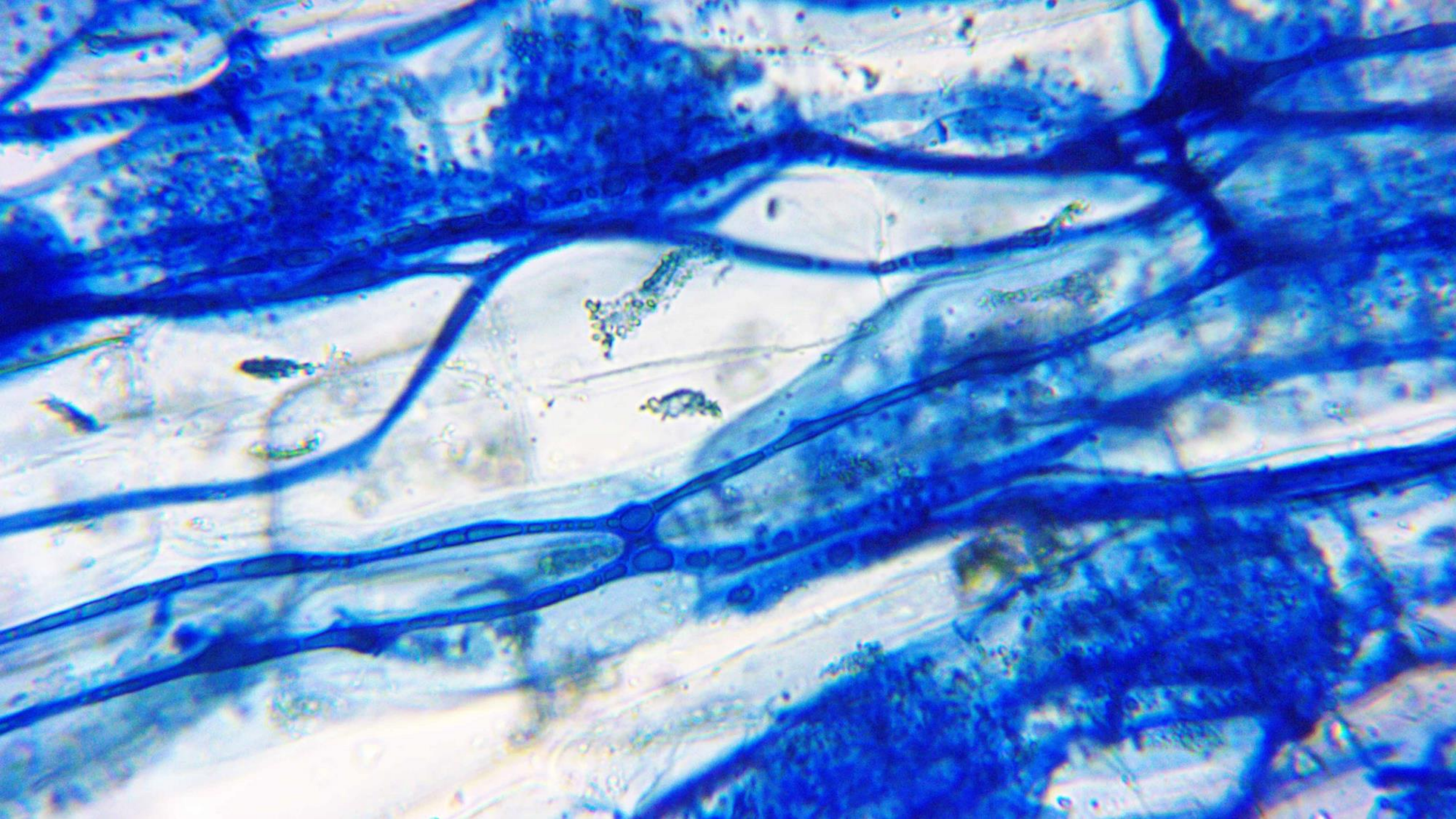
The sun provides an incredible input to fuel growth- the plants provide an equal output of carbon to feed the micro organisms.

Captured sunlight is transformed into foods such as carbon and sugars, which are then translocated; up to 80% of the nutrients will leak out of the roots and feed the correct sets of organisms.

VAM Mycorrhiza sequester large amounts of carbon as well as release glomalin - a soil carbon.

Ultimately, all soil communities depend on plant derived carbon.





Memorial Park

Ecological Restoration

- Ecto mycorrhiza inoculum

Understanding **Compost** – the Good, the Bad, and the Reality

Microbial contribution to SOM quantity and quality in density fractions of temperate arable soils
Ludwig et al., 2015

The objectives of the study focused on investigating the microbial contribution of SOM in pools of different stability and it impact on SOM quality.

Results – The relative microbial contribution to arable soil organic matter was identified as significant within every SOM fraction. In addition, scanning electron microscopy revealed that microbial (bio)mass is a considerable source for stable SOM which is also increasing with density.

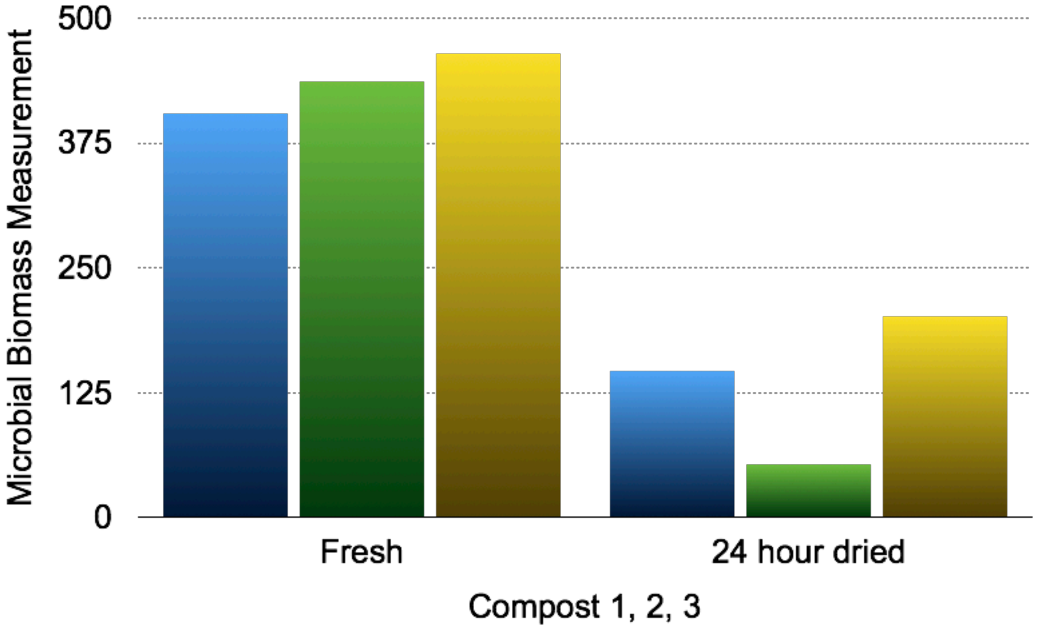
- the organic matter component of soil, consisting of plant and animal residues from decomposition, cells and tissues of soil organisms, and substances synthesized by soil microbes.
- SOM exerts numerous positive effects on soil's physical and chemical properties as well as the soil's capacity to provide effective ecosystem behaviors.
- the presence of SOM is regarded as being critical for soil function and soil quality.

- building new soils is more than combining sand, silt and clay
- composting is critical in Green Waste Management
- all composts are not the same in regard to quality and benefits to soil microbial rejuvenation

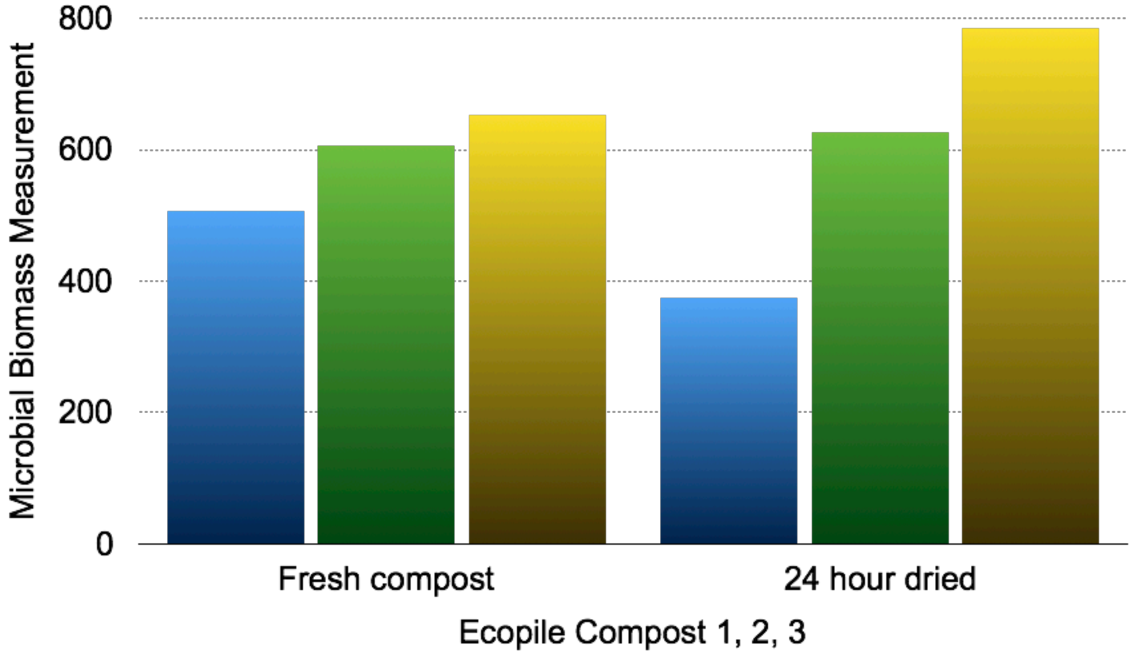
90% of compost used in soils is in a thermophilic stage

Psychrophilic	Mesophilic	Thermophilic	Cooling
Cool-temperature bacteria invade the pile and begin to burn or oxidize carbon, releasing heat and nutrients in the form of amino acids.	Decomposition of readily available substrates. Excess energy is released as heat, causing pile temperature to increase. Most microbes are able to habitat this temperature and function appropriately.	At high temperatures, thermophiles arrive to do the "hot" composting. They work efficiently to raising the temperature high enough to destroy germs or weed seeds. High temperatures also generate humic acid, which enables plants to assimilate the nutrients in the compost. Heat intolerant organisms go dormant or are destroyed. High temperatures accelerate breakdown of proteins, fats, and complex polymers.	Further chemical and physical changes in the compost. Decomposition of recalcitrant polymers by actinomycetes and fungi. Degradation of fermentation products, methane, and other noxious gases which accumulated earlier in anaerobic microsites Reduction of odors and toxic intermediates. Compost returns to a mesophilic-like state and a larger abundance of microbes can begin to dwell.
0-55°F	**60-100°F**	**100-160°F**	**Decreasing temps, usually under 100°F**

- organisms are not the same organisms in mesophilic soil
- once applied to the land, organisms die - releasing a net positive of nutrients to plants but also releasing carbon dioxide back into the atmosphere
- research shows close to a 70% die off of microbial biomass within 24 hours with traditional composting



Fresh Ecopile™ compost maintains and increases micro-organisms that sequester carbon within soil

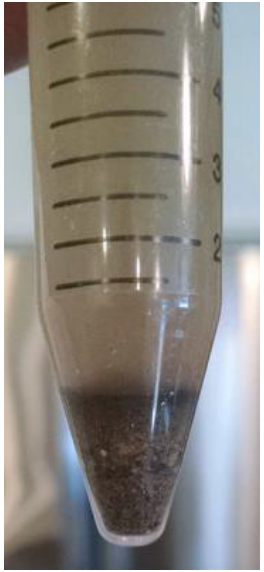


"In God we trust. All others must bring **data**."

– *W. Edwards Deming*

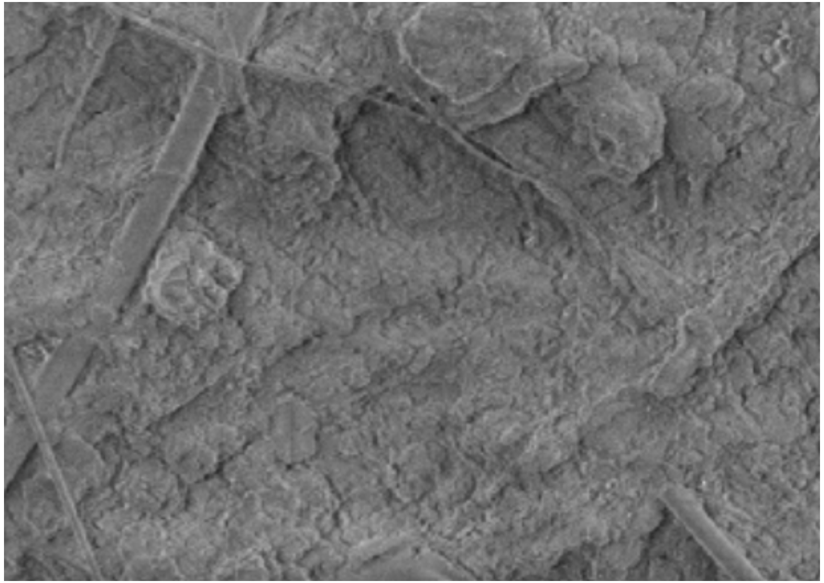
●○○○○ AT&T 6:57 AM
Visualize Pile
Enter Simple Description
Details
PILE DETAILS
Save data first
LOCATION
Latitude::Longitude 0.000000::0.000000
PILE STATUS
Mature (<= 100.0 F) 0.0 %
Still Cooking (>= 12… 84.0 %
<50
>50
>90
>110
>130
●○○○○ AT&T 6:56 AM
Visualize Pile
Enter Simple Description
Details
PILE DETAILS
Save data first
LOCATION
Latitude::Longitude 0.000000::0.000000
PILE STATUS
Mature (<= 100.0 F) 12.0 %
Still Cooking (>= 12… 0.0 %
<50
>50
>90
>110
>130

Scientific Microbial Biomass tests available on smart phone apps 10 mins

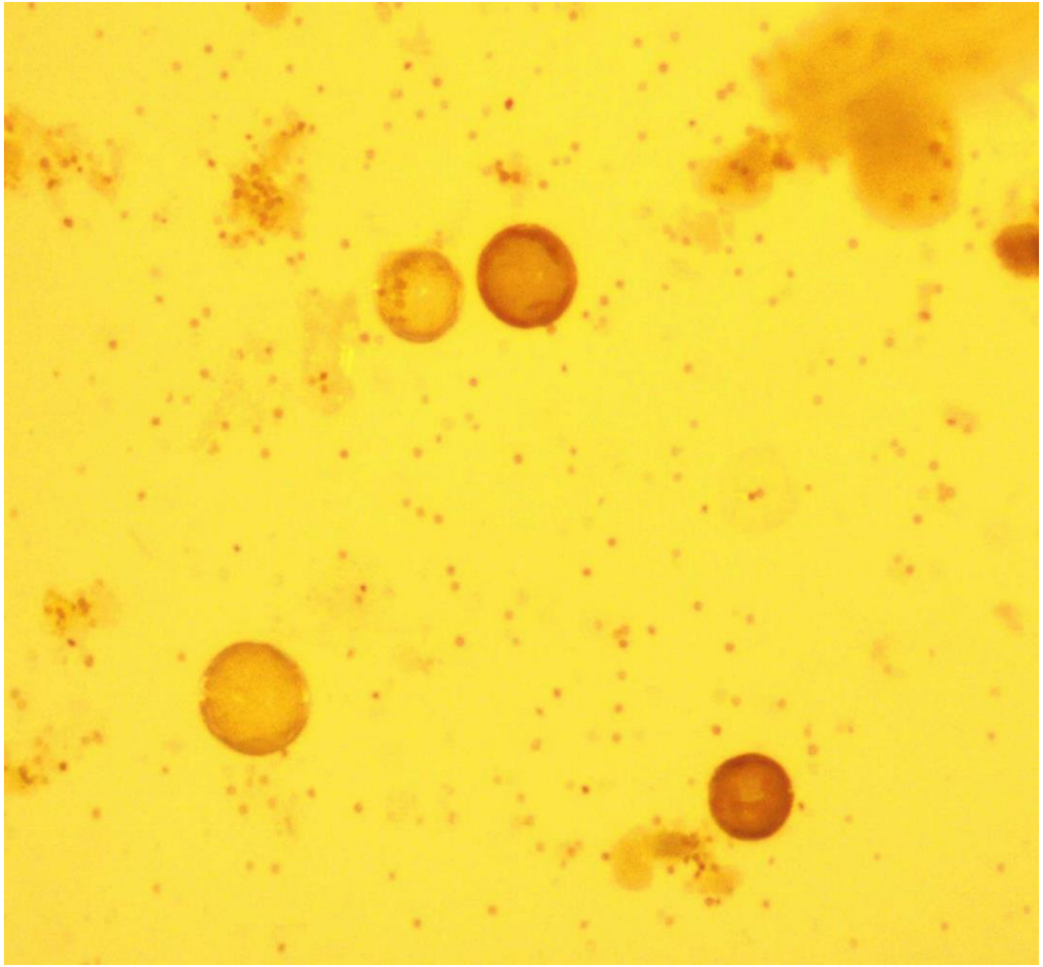


Separate microbes from soil

Place drops on Membrane read with smart phone



Electron microscope scan of membrane



VAM Mycorrhiza Spore in Soil

Implementing **Living Systems**
into the Landscape


ST. LOUIS GATEWAY ARCH RENOVATION


2014
2015



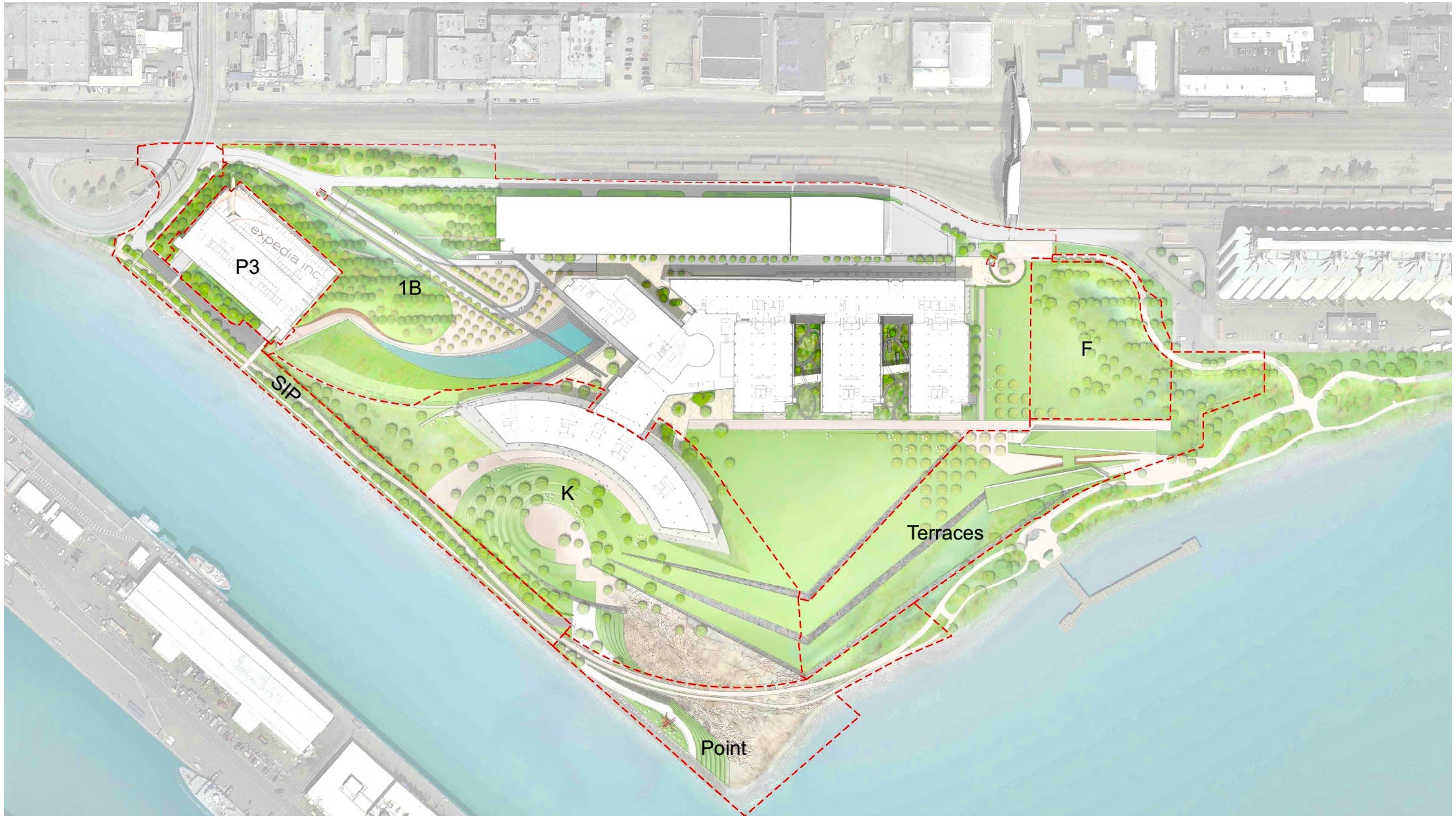

3

	Fresh 12/16/16	Fresh 4/27/17	Fresh 8/17/17	card		Percent Mycorrhiza	Type of Mycorrhiza	Microbial Carbon/ per acre 12/16/16	Microbial Carbon/ per acre 4/27/17		Microbial Carbon /per 1000square feet 12/16/16	Microbial Carbon per 1000.square feet 4/27/17	Microbial carbon per 1000 square feet	Microbial Carbon/per site/1000 square feet 12/16/16	Average Microbial carbon per 1000 square feet 4/27/17		Microbial Carbon average per campus/1000 square feet 12/16/16	Average Microbial Carbon per 1000 square feet per campus 4/27/17	Microbial Nitrogen per acre 4/27/17	Microbial Nitrogen per acre 4/27/17	
1a	47	153	124	62	New planted ornamental grasses in old soil			4000	16000	20000	90	363	454						9.4	30.6	40.4
1b	17	99	114	85				2000	10000	12000	45	227	272						3.4	19.8	22.8
1c	30	101	93	78				3000	10000	12000	68	227	272	67	272				6	20.2	24.8
2a	40	280	127	69	turf grass parking island old campus			4000	28000	16000	90	636	363						8	56	33
2b	42	134	138	70				4000	14000	14000	90	318	318		477				8.4	26.8	27.6
2c	29		98	70				0	0	0	0	0		68					5.8		
3a	38	262	111	66	Mature Live Oak native site	71	ecto	4000	26000	12000	90	590	272						7.6	52.4	22.2
3b	38	115	114	67				4000	12000	12000	90	272	272		43				7.6	23	22.8
3c	72							0	0		0	0		120					14.4		
4a	78	116	129	40	Oak tree and grass in old parking island			8000	12000	18000	181	272	409						15.6	23.2	35
4b	28	93	114	75				3000	10000	16000	68	227	363		249			54 percent	5.6	18.6	31.2
4c	171							0	0		0	0		219			118	260	34.2		
5a	76	103	247	70	6 month old new soil and grass			8000	10000	24000	90	227	545						15.2	20.6	49.4
5b	93	294	252	63				10,000	30000	26000	227	681	590	158	454				18.6	58.8	50.4
6a	135	122	198	32	12 month old soil with plants			14000	12000	20000	318	272	454						27	24.4	39.6
6b	78	193	312	75				8000	20000	32000	181	454	727						15.6	38.6	62.4
6c	170	202	259	34				18,000	20000	26000	409	454	590	302	393				34	40.4	51.8
7a	11	92	237	95	Palm tree 18 month soil			2000	10000	24000	45	227	545						2.2	18.4	47.4
7b	97	188	163	40				10,000	18000	16000	227	409	227		318			22 percent increa	19.4	37.6	32.6
7c	108		99					0	0	0	0	0	0	166			365	467	21.6		
8a	65	245	248	74	3 year New planted oak tree	55	ecto	6000	24000	24000	136	545	545						13	49	49.6
8b	108	111	154	30				10,000	12000	16000	227	272	363	181	408				21.6	22.2	30.8
9a	86	102	201	57	Plants in 3 year old soil			8000	10000	20000	181	227	454						17.2	20.4	40.2
9b	109	398	147	35				10000	40000	14000	227	909	318		568				21.8	79.6	29.4
9c	70		84	17				0	0	0	0	0	0	196					14		
10a	91	196	267	66	Formal lawn	16	endo	8000	20000	26000	181	454	590						18.2	39.2	53.4
10b	84	106	231	64				8000	10000	24000	181	227	545						16.8	21.2	46.2
10c	80	101	117	32				8000	10000	10000	181	227	227	181	302				16	20.2	23.4
11a	168	187	208	20	Turf grass 3 year old new soil	26	endo	18000	18000	20000	409	409	454						33.6	37.4	41.6
11b	116	105	131	11				12000	10000	14000	272	227	318	340	318				23.2	21	26.2
12a	141	84	278	50	Anerobic new soil no roots			14000	8000	26000	318	181	590						28.2	16.8	55.6
12b	109	189	164	33				10000	20000	26000	227	454	590						21.8	37.8	32.8
12c	131		143	8				0	0	0	0	0	0	287	317				26.2		
13a	162	190	264	39	Manure amended soil grass	28	endo	18000	20000	26000	409	454	590						32.4	38	52.8
13b	159	211	298	45				16000	22000	30000	363	500	681		477				31.8	42.2	59.6
13c	299		179					0	0	0	0	0	0	484					59.8		
14a	291	106	345	16	Manure amended soil grass	32	endo	30,000	10000	34000	681	227	772						58.2	21.2	69
14b	299	230	237					30,000	24000	24000	681	545	545	681	386				59.8	46	47.4
15a	238	276	389	31	turf grass new soil			24,000	28000	38000	545	636	863						47.6	55.2	77.8
15b	169	201	311	46				18,000	20000	30000	409	454	681		545				33.8	40.2	62.2
15c	189		197	4				0	0	0	0	0	0	454					37.8		
16a	157	211	217	28	Anerobic new soil no roots			16,000	22000	22000	363	500	500						31.4	42.2	43.4
16b	172	219	202	15				18,000	22000	20000	409	500	454		500				34.4	43.8	40.4
16c	176		146					0	0	0	0	0	0	393					35.2		
17a	299	283	428	30	Native untouched			30,000	28000	42000	681	636	954						59.8	56.6	85.6
17b	295	428	475	38				30,000	42000	48000	681	954	1090	681	795				59	85.6	95
18a	176	127	317	45	18 month old transplanted oak	91	ecto	18,000	12000	32000	409	272	727						35.2	25.4	63.4
18b	189	253	302	37				19,000	24000	30000	431	545	681		408				37.8	50.6	60.4
18c	156		174	0.8				0	0	0	0	0	0	401					31.2		
19a	214	475	532	60	18 month old new soil grass			22,000	48000	54000	500	1090	1227						42.8	95	106.4
19b	177	443	417	58				18,000	44000	42000	409	1000	954		1045				35.4	88.6	83.4
19c	146		263	45				0	0	0	0	0	0	416					29.2		0
20a	170	111	251	32	Native untouched			18,000	12000	26000	409	272	590						34	22.2	50.2
20b	288	101	148					28,000	10000	14000	636	227	318	522	249				57.6	20.2	29.6
							Total acre	[illegible]	[illegible]	[illegible]	88 percent										

Measurements	Average Microbial Biomass	Pounds of Microbial Carbon per acre	Pounds of Microbial Nitrogen per acre
Old Campus built on soils with no specs in the 90's	52.5	5416	10.5
Native woodland areas on campus	263	26,500	52.6
Phase one soils not managed when installed	97.7	9,800	19.5
Phase two soils properly managed from day one	242	24,800	48.5

When quality designed soils are managed correctly

- Nutrient sustainability- no leaching
- Carbon sequestration
- Water savings
- Vibrant plants
- Healthy ecology


P3
expedia inc
1B
F
SIP
K
Terraces
Point

The rectangle of DEATH?

Seattle Waterfront Project

Ecological & Soil Restoration

- Microbial Biomass 265 ug/G
- Mycorrhiza spores per a gram 135

OLSSON® ASSOCIATES | Ecological Landscape Management

Seattle Waterfront Project

Ecological and Soil Restoration

- Microbial Biomass 381 ug/G
- Mycorrhiza spores per a gram 66

Seattle Waterfront Project

Ecological & Soil Restoration

- Microbial Biomass 541 ug/G
- Mycorrhiza spores per a gram 16

Putting good ideas to work for a carbon-neutral, flourishing campus

Sustainable CWRU

Treenote: Trees, Soils & Climate

Spring Keynote and Awards Presentation

Panelists

- Jill Ziegler, Director of Corporate Responsibility for Forest City Realty Trust & Co-chair, Cleveland Tree Plan
- Sandra Albro, Research Associate at Holden Forests & Gardens & Co-chair, Cleveland Tree Plan
- Matt Langan, Landscape Architect, Sasaki
- James Sottilo, President - Ecological Landscape Management

CWRU 2018 Sustainability Champions

- Student
- Staff
- Faculty