SUSTAINABLE LANDSCAPE DEMONSTRATION GARDEN

Dr. Ellen Vincent
Clemson University Horticulture Dept.
Planning + Design in the Built Environment
14Feb2014
WHAT IS THE DOMINATING THEORY?

Health in the built environment

Nassauer

Hester

Brundtland

Tallamy
**Triangulation**: response to a social science question with multiple measures or methods that do not share the same methodological weaknesses.

If different approaches produce similar findings, confidence in the results increases (Singleton and Straits, 2005, p. 574)
“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission, 1987, p. 8).

GRO HARLAN BRUNDTLAND (B. 1939)

- Norwegian Minister for Environmental Affairs (1974-1979)
- Chair of United Nations World Commission on Environment and Development, published *Our Common Future* (April, 1987)
“The ‘environment’ is where we all live; and ‘development’ is what we all do in attempting to improve our lot within that abode. The two are inseparable” – Gro Harlem Brundtland (The Case for Sustainable Landscapes, 2009, p. 8).
“Sustainability is defined as design, construction, operations, and maintenance practices that meet the needs of the present without compromising the ability of future generations to meet their own needs” (The Case for Sustainable Sites, 2009, p. 5).

Does the sustainable landscape demonstration garden have potential to increase human and environmental health and wellness in the urban setting?

If so, what are identifiable process(es) that have measurable results?
Create an urban sustainable garden model to promote environmental and human health and well-being.

- Should be replicable.
  [http://www.clemson.edu/cafls/demo/index.html](http://www.clemson.edu/cafls/demo/index.html)

- Should be measurable.
  - Perception surveys of passersby
  - Soil sampling and analysis
  - Plant health rating sheets
1) Environmental educational displays are needed in the busiest, hectic urban environments in order to reach and influence greater numbers and diverse people (Hester, 2006)

Pre-installation spaces on college campus 1,400 sf (left) 1,800 sf (right)

2) The display should be aesthetically pleasing as well as educational so as to generate sales and production of these less common, but environmentally beneficial [native] plants (Nassauer, 1997)

3) The experimental nature of the garden should include a participatory role for passersby to share their opinion and judgment of the display. Participation is engaged learning and often results in greater knowledge retention and continued involvement (Hester, 2006).

Assemble a diverse (career) interdisciplinary team.

- Byrd, commercial design
- Gerus, director of grounds
- Hall, ethnobotanist
- Park, professor & soils researcher
- Tanner, extension
- Vincent, prof of hort & health res
- White, extension & water researcher
- Conduct a competitive design process using native plant selections to provide eco-system services, e.g. habitat and food source for native insects and animals (Tallamy, 2011).
- Install and maintain garden using low-maintenance techniques.
- Study environmental health and human perceptions.

6” leaf mold compost tilled to a depth of 8”

Girdling roots loosened prior to planting

- Provide on-site and Web educational materials.
- Student workers serve as educational ambassadors.
STUDENT CONTRIBUTORS

Fraser, HORT designer
Lombardo, HORT designer
Reburn, FOR designer
Kelly, HORT designer
Cochran, HORT install
Blakely, FOR maintenance
Clarkin, ARCH maintenance
Smolka, BIOSC maintenance
PRE-INSTALLATION

Pre-installation spaces on college campus 1,400 sf (left) 1,800 sf (right)

Post-installation spaces on college campus 1,400 sf (left) 1,800 sf (right)

On a scale of 1 to 10, how aesthetically pleasing (beautiful) is the landscape to you?

<table>
<thead>
<tr>
<th>Extremely poor</th>
<th>Average</th>
<th>Extremely high</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3</td>
<td>4 5 6</td>
<td>7 8 9 10</td>
</tr>
</tbody>
</table>

**PRE & POST INSTALLATION SURVEY DATA**

- Spring 2012 \((n = 171)\)
- Fall 2012 \((n = 86)\)
- Fall 2013 \((n = 162)\)

*LS Means Differences Tukey HSD \((P < 0.0001)\)
On a scale of 1 to 10, how well maintained does the landscape here appear to you?

Extremely poor       Average      Extremely high
1 2 3 4 5 6 7 8 9 10

PRE & POST INSTALLATION SURVEY DATA

**On a scale of 1 to 10, how well maintained does the landscape here appear to you?**

<table>
<thead>
<tr>
<th></th>
<th>0 - Pre-install</th>
<th>1 - Post-install Y1</th>
<th>2 - Post-install Y2</th>
</tr>
</thead>
<tbody>
<tr>
<td>maintenance*</td>
<td>spring 2012</td>
<td>fall 2012</td>
<td>fall 2013</td>
</tr>
<tr>
<td>1</td>
<td>4.8</td>
<td>6.8</td>
<td>7.4</td>
</tr>
</tbody>
</table>

*LS Means Differences Tukey HSD (P < 0.0001)
On a scale of 1 to 10, how **safe** do you feel in this landscape space?

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<tr>
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<tbody>
<tr>
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**PRE & POST INSTALLATION SURVEY DATA**

Spring 2012 (n = 171)  
Fall 2012 (n = 86)  
Fall 2013 (n = 162)  

*LS Means Differences Tukey HSD (P < 0.0001)
What type of plant here in this landscape do you most value or appreciate?

0 - Pre-install

1 - Post-install Y1

2 - Post-install Y2

- Grass
- Groundcover
- Flowers
- Shrubs
- Trees
Does this landscape or the gardens right here teach you anything about soil, plants, or water?

**PRE & POST INSTALLATION SURVEY DATA**

- **0 - Pre-install**
- **1 - Post-install Y1**
- **2 - Post-install Y2**

<table>
<thead>
<tr>
<th>0%</th>
<th>20%</th>
<th>40%</th>
<th>60%</th>
<th>80%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td>Unknown</td>
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<tr>
<td>Yes</td>
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Do you think this landscape or the gardens right here are good for the environment?

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<th>100%</th>
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<tr>
<td><strong>0 - Pre-install</strong></td>
<td>Yes</td>
<td>No</td>
<td>Unknown</td>
<td>0%</td>
<td>20%</td>
<td>40%</td>
</tr>
<tr>
<td><strong>1 - Post-install Y1</strong></td>
<td>Yes</td>
<td>No</td>
<td>Unknown</td>
<td>0%</td>
<td>20%</td>
<td>40%</td>
</tr>
<tr>
<td><strong>2 - Post-install Y2</strong></td>
<td>Yes</td>
<td>No</td>
<td>Unknown</td>
<td>0%</td>
<td>20%</td>
<td>40%</td>
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</tbody>
</table>
Do you think this landscape or the gardens right here are good for human health and well-being?

PRE & POST INSTALLATION SURVEY DATA

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<td></td>
</tr>
<tr>
<td>2 - Post-install Y2</td>
<td></td>
<td></td>
<td></td>
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</table>

- Yes
- No
- Unknown
Positive changes in perception of aesthetics and the quality of maintenance encouraging, considering that perennial plants generally require two complete growing seasons to reach peak performance and the post-installation survey was conducted after only one growing season.

- 38% increase in aesthetic perception
- 30% increase in landscape maintenance perception
Minimal change between pre & post soil sample data for
- minerals
- organic matter
- CEC suggest

Depletion of most minerals did not occur while plants establishing

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Results</th>
<th>PRE</th>
<th>POST</th>
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</thead>
<tbody>
<tr>
<td>Soil pH</td>
<td>7.2</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Buffer pH</td>
<td>7.80</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Phosphorus (P)</td>
<td>45 lb/acre</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>216 lb/acre</td>
<td>Sufficient</td>
<td>Sufficient</td>
</tr>
<tr>
<td>Calcium (Ca)</td>
<td>4981 lb/acre</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>342 lb/acre</td>
<td>Excessive</td>
<td>Excessive</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>10.3 lb/acre</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>81 lb/acre</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Boron (B)</td>
<td>3.3 lb/acre</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>0.6 lb/acre</td>
<td>Sufficient</td>
<td>Sufficient</td>
</tr>
<tr>
<td>Sodium (Na)</td>
<td>14 lb/acre</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Sulfur (S)</td>
<td>lb/acre</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Soluble Salts</td>
<td>n/h/mhos/cm</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Nitrate Nitrogen</td>
<td>ppm</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Organic Matter</td>
<td>5.6 % (LOI)</td>
<td>Medium</td>
<td>Medium</td>
</tr>
</tbody>
</table>
WEB ANALYTICS (WEB HITS)

Graph and Photos by Sarah White
WEB ANALYTICS (WEB HITS)

3. Symphyotrichum patens
   Late purple aster (65)

4. Carex flaccosperma
   Blue wood sedge (64)

5. Fothergilla gardenii
   Dwarf fothergilla (59)

6. Echinacea purpurea
   Kim’s knee high (51)

Photos by Sarah White
WEB ANALYTICS (WEB HITS)

6. *Cornus florida* (Flowering Dogwood (51))

7. *Helianthus angustifolius* (Narrow-leaf Sunflower (51))

7. *Asclepias tuberosa* (Butterfly weed (48))

8. *Rudbeckia fulgida* (Goldsturm black-eyed susan (47))

Photos by Sarah White
**Latin name:** Muhlenbergia capillaris

**Common name:** Pink Muhly Grass

**Flowers:** Showy light purple late summer into autumn

**Fruit:** Not noticeable

**Height & Width:** 3’ x 3’

**Type:** Perennial ornamental grass

**Habit:** Upright grass

**Wetland indicator category:** FACU

**Texture:** Fine textured basal foliage

**Growth rate:** Medium

**Light:** Sun to light shade

**Moisture:** Very drought tolerant

**Soil:** Well drained soil does well in hot dry sandy sites

**Zones:** 6-9

**Origin:** Western-central United States

**Ecosystem benefits:**
Aesthetically pleasing foliage & flowers
Low maintenance
Deer Resistant: High

Photo by Walker Massey

[http://www.clemson.edu/cafls/demo/plant_profiles/muhlenbergia_capillaris.html](http://www.clemson.edu/cafls/demo/plant_profiles/muhlenbergia_capillaris.html)
**MUHLENBERGIA CAPILLARIS**

‘WHITE CLOUD’

http://myfolia.com/retailers/854-park-seed/catalogue_items/73797-muhly-grass-white-cloud

**Latin name:** *Muhlenbergia capillaris*  
‘White Cloud’  
**Common name:** White Muhly Grass

**Flowers:** Showy\(^{12}\)  
**Fruit:** Not noticeable\(^{12}\)

**Height & Width:** 3’ x 3’\(^{12}\)

**Type:** Perennial ornamental grass\(^{12}\)  
**Habit:** Upright grass \(^{12}\)

**Wetland indicator category**: FACU\(^{17}\)

**Texture:** Fine textured basal foliage\(^{12}\)

**Growth rate:** Medium\(^{12}\)

**Light:** Sun to light shade\(^{12}\)

**Moisture:** Very drought tolerant\(^{12}\)

**Soil:** Well drained soil does well in hot dry sandy sites\(^{12}\)

**Zones:** 6-9\(^{12}\)

**Origin:** Western-central United States\(^{12}\)

**Ecosystem benefits:**
Aesthetically pleasing foliage & flowers  
Low maintenance  
Deer Resistant: High

http://www.clemson.edu/cafls/demo/plant_profiles/muhlenbergia_capillaris_white.html
**Latin name:** *Carex flaccosperma*

**Common name:** Blue Wood Sedge

**Flowers:** Non showy flowers

**Fruit:** Insignificant

**Height & Width:** 1’ x 1’

**Type:** Sedge

**Wetland indicator category:** FAC+(2)

**Habit:** Upright clumps

**Texture:** Medium

**Growth rate:** Slow

**Light:** Part shade

**Moisture:** Medium to wet

**Soil:** Fine or medium

**Zones:** 5 to 8

**Origin:** Southeast

**Ecosystem benefits:**

Shade tolerant

Wetland tolerant

Low maintenance

Deer Resistant: High
SYMPHYOTRICHUM PATENS

Latin name: *Symphyotrichum patens*

**Common name:** Late Purple Aster

**Flowers:** Thin rayed purple

**Fruit:** Not noticeable

**Height & Width:** 3’ x 3’

**Type:** Perennial

**Habit:** Forb/herb

**Wetland indicator category:** N/A

**Texture:** Coarse

**Growth rate:** Moderate

**Light:** Full sun

**Moisture:** Medium

**Soil:** Coarse to medium soils

**Zones:** 7 to 8

**Origin:** Southwest to eastern United States

**Ecosystem benefits:**
Drought tolerant
Low maintenance
Attracts butterflies

http://www.clemson.edu/cafls/demo/plant_profiles/symphyotrichum_patens.html
Latin name: *Helianthus angustifolius*

**Common name:** Swamp sunflower

**Flowers:** Prolific 2-3” flowers in fall with narrow yellow petals surrounding a brown or purple disc.

**Fruit:** Inconspicuous

**Height & Width:** 5-7’ x 4’

**Type:** Perennial

**Habit:** Upright; Flowering herb

**Wetland indicator category**: FAC, FACW

**Texture:** Medium

**Growth rate:** Moderate

**Light:** Full sun to part shade

**Moisture:** Medium to wet

**Soil**: pH preference 4-7, tolerates Sandy, Sandy Loam, Medium Loam, Clay Loam, Clay, Acid-based soils

**Zones:** 5-9

**Origin:** Eastern North America

---

**Ecosystem Benefits:**
Wetland tolerant (for bog or pond area)
Attracts birds
Special value to native bees
**ASCLEPIAS TUBEROSE**

**Latin name:** *Asclepias tuberosa*

**Common name:** Butterfly Weed

**Flowers:** Vibrant orange umbels that produce colored follicles if left

**Fruit or cones:** Ornamental follicles

**Height & Width:** 1’x1.5’

**Type:** Herbaceous

**Wetland Indicator category:** Not available

**Texture:** Coarse

**Growth rate:** Initially slow, medium when established

**Light:** Full sun

**Moisture:** Low

**Soil:** Course to medium soils

**Zones:** 4-9

**Origin:** Eastern North America

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**Ecosystem Benefits**

**Attracts:** Hummingbirds, Butterflies

**Larval Host:** Grey Hairstreak, Monarch, Queens

**Nectar Source:** Yes

**Deer Resistant:** High

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http://www.bing.com/images/search?q=asclepias+tuberosa&FORM=HDRSC2#view=detail&id=27D409B3CECC4FEF3D5C2590BA8B536503346A8&selectedIndex=37

http://www.clemson.edu/cafls/demo/plant_profiles/asclepias_tuberosa.html


http://www.wildflower.org/mobile/plants/result.php?id_plant=astu
**Latin name:** *Eupatorium maculatum*

**Common name:** Spotted Joe-Pye Weed

**Flowers:** Flat-topped clusters in late summer with 9-15 flowers

**Fruit:** Inconspicuous

**Height & Width:** 5-7’ x 4’

**Type:** Herbaceous perennial

**Habit:** Upright

**Wetland indicator category:** FACW

**Texture:** Medium

**Growth rate:** Medium

**Light:** Sun to part shade

**Moisture:** Wet to moist

**Soil:** Loamy and calcareous soils

**Zones:** 4 - 8

**Origin:** Eastern North America

**Ecosystem Benefits:**

**Use Wildlife:** Not a preferred food source for herbivores, but may be eaten occasionally by deer, rabbits and livestock.

**Conspicuous Flowers:** yes

**Fragrant Flowers:** yes

**Interesting Foliage:** yes

**Attracts:** Butterflies

**Larval Host:** The caterpillars of some moth species feed on various parts.

**Nectar Source:** yes

**Special value** to native bees

http://www.clemson.edu/cafls/demo/plant_profiles/eupatorium_maculatum.html

http://www.wildflower.org/plants/result.php?id_plant=EUMA12
ECHINACEA PURPUREA ‘KIM’S KNEE HIGH’

**Latin name:** Echinacea purpurea ‘Kim’s Knee-High’
**Common name:** Purple coneflower

**Flowers:** Purple-pinkish petals surround a raised brown-bronze-colored center disk\(^2,12\)

**Fruit:** Inconspicuous\(^3\)

**Height & Width:** 2’ x 2’\(^3\)

**Type:** Herbaceous perennial\(^4,10\)

**Habit:** Upright\(^3,12\)

**Wetland indicator category**: Not available\(^17\)

**Texture:** Coarse\(^4\)

**Growth rate:** Medium\(^4\)

**Light:** Full sun to part shade

**Moisture:** Dry to medium\(^10\)

**Soil:** Tolerates clay, sandy to rich soils\(^10,12\)

**Zones:** 3 - 8\(^2\)

**Origin:** Midwestern to Eastern United States, including South Carolina\(^16\)

**Ecosystem Benefits:**

**Use Wildlife:** Echinacea spp. attract butterflies and hummingbirds.

**Use:** Medicinal

**Consipicuous Flowers:** yes

**Nectar Source:** yes

**Deer Resistant:** No

**Special value to native bees**

http://www.wildflower.org/plants/result.php?id_plant=ECPU
**ECHINACEA LAEVIGATA**

**Latin name:** *Echinacea laevigata*

**Common name:** Smooth Purple Coneflower

**Flowers:** Purple to pink, showy and delicate drooping purple rays. Blooms June to August

**Fruit:** Not significant

**Height & Width:** 2-5’ x 1.5-2’

**Type:** Herbaceous perennial

**Habit:** Upright, cascading, mound

**Wetland indicator category:** No Wetland indicator was available for this plant.

**Texture:** Fine

**Growth rate:** Moderate

**Light:** Full sun to part shade

**Moisture:** Dry to medium

**Soil:** Tolerates clay soil, dry soil, shallow and rocky soil

**Zones:** 3-8

**Origin:** Southeastern United States

**Note:** This plant is on the United States threatened and endangered species list

**Ecosystem benefits:** Special value to native bees

http://www.clemson.edu/cafls/demo/plant_profiles/echinacea_laevigata.html
**RUDBECKIA FULGIDA ‘GOLDSTURM’**

**Latin name:** *Rudbeckia fulgida* var. *sullivantii* ‘Goldsturm’

**Common name:** Goldsturm Black-eyed Susan

**Flowers:** Yellow rays with black center disk

**Fruit:** Inconspicuous

**Height & Width:** 2-3’ x 1-2’

**Type:** Herbaceous perennial

**Habit:** Upright, clump forming

**Wetland indicator category:** FAC

**Texture:** Coarse

**Growth rate:** Medium

**Light:** Full sun

**Moisture:** Medium to dry

**Soil:** Tolerates a wide variety of soils

**Zones:** 3-9

**Origin:** Eastern North America, including South Carolina

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**Ecosystem Benefits:**

Attracts: Birds

Special value to native bees
NEXT STEPS-PLANT RATINGS SHEETS

- Commercial ratings of individual plants
- Please visit the Sustainable Garden and rate the plants
- Ratings sheets available on line at all times
- Clemson Web; Sustainable Landscape Demonstration; Plants; Plant Ratings Sheets

Photo by J. Windham
Commercial ratings of individual plants

Please visit the Sustainable Garden and rate the plants

Ratings sheets available online at all times

38% increase in aesthetic perception

30% increase in landscape maintenance perception

PLANT RATING SHEETS (PDF)

- Amsonia tabernaemontana: Eastern Blue Star
- Andropogon glomeratus: Bushy Bluestem
- Asclepias tuberosa: Butterfly weed
- Baptisia australis: Blue False Indigo
- Calycanthus floridus: Carolina Allspice
- Carex flaccosperma: Blue wood sedge
- Carya ovata: Shagbark Hickory
- Chionanthus virginicus: Fringe Tree
## INDIVIDUAL PLANT RATING SHEET

<table>
<thead>
<tr>
<th>Plant name:</th>
<th>Poor</th>
<th>Average</th>
<th>Excellent</th>
<th>N/A</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
<td>Bloom color</td>
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<tr>
<td>Bloom shape</td>
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<tr>
<td>Foliage color</td>
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<tr>
<td>Foliage habit (behavior)</td>
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<tr>
<td>Size</td>
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<tr>
<td>Plant health</td>
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<tr>
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Dr. Ellen Vincent  ellenav@clemson.edu  Fax: 864-656-4860  Poole Ag Center  Room 173  Clemson, SC 29634-0310

Thank you for completing this plant rating sheet!
NEXT STEPS – OBSERVATIONS USER

Inspired by William H. Whyte’s *Social life of small urban spaces* (1980).

Graph created by Russell Buchanan, graduate student of Dr. Chris Post (Forestry).
WHAT IS THE DOMINATING THEORY?
CAN YOU FIND TRIANGULATION IN THE METHODS?

- **Triangulation**: response to a social science question with multiple measures or methods that do not share the same methodological weaknesses.
- If different approaches produce similar findings, confidence in the results increases (Singleton and Straits, 2005, p. 574)
Ellen Vincent, Ph.D.
Environmental Landscape Specialist

ISA Certified Arborist

Environmental Horticulture
Dept. SAFES
173 Poole Agricultural Center
Box 340310
Clemson, SC 29634-0310

864.656.1342 (office)
803. 243.8888 (cell)
864.656.4960 (FAX)
elenav@clemson.edu

Sustainable Landscape Demonstration Garden : http://www.clemson.edu/cafls/demo/
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