Building the Future of Public Gardens Under Glass

Tim Pollak, Chicago Botanic Garden
Kimberlie McCue, Desert Botanical Garden
Scott Scarfone, Oasis Design Group
Ryan Charek, Rough Brothers Greenhouses
Monty Holmes, Smithsonian Gardens
Margie Radebaugh, Phipps Conservatory and Botanical Gardens

Why build new support facilities?

- Undersized growing space related to increased display gardens
  - Improve proper plant culture and overall quality of plants grown ==SPACE!
- Increased programming and initiatives
  - Community and urban programs, education, summer camps, etc., etc.
  - Need for growing organically, and quarantine areas
- Aging buildings and facilities
  - Cost of yearly maintenance and repairs increasing
- New plant collections, increased need from science and research
  - i.e. Orchids, Bonsai collection increase, Southern Hemisphere bulb collection, plant evaluations, plant breeding, climate change studies, etc.
- New displays, exhibits or shows
  - CBG > Orchid Show, increase winter bloom for conservatories
  - More “Wow” displays and plants

CHICAGO BOTANIC GARDEN

CHICAGO BOTANIC GARDEN

Getting started with the plan…

- Create the idea and demonstrate the need for new facilities
- Develop the “program” for the new space
- Figure out how is it going to be paid for
  - 10 year $125M Capital Campaign- *“Keep Growing”*

CHICAGO BOTANIC GARDEN
Plant Production Expansion Project
Current Space/Programming Chart

New Compartment Number	Name	Existing Area	Programmed Area	Duration	Category	Temperature	Blackout Horizontal & Vertical	Shades	Shade Cloth %	Lights
GREENHOUSES										
GH 01	Tall House / Baskets		1,440	January - April	IF, OF	45-50		X	40	X
				May - September	IF, OF	60-65				
				October - December	IF, OF	45-50				
GH 02	Tall House / Baskets		1,440	January - December	IF, OF	65-70		X	40	X
GH 03	Orchids		2,880	January-December	OR	70-75		X	50	
GH 04	Orchids		2,880	January-December	OR	60-65		X	60	
GH 05	Orchids		2,880	January-December	OR	55-60		X	60	
GH 06	Outdoor / Indoor Display		2,880	January - March	OF(Spring)	50-55	X	X	40	X
				April - May	OF(Summer)	60-65				
				June - August	IF(Display)	65-70				
				September - December	IF(Display)	60-65				
GH 07	Outdoor / Indoor Display		2,880	January	EM	40-45	X	X	40	X
				February - March	OF(Spring)	50-55				
				April - May	OF(Summer)	60-65				
				June - August	IF(Display)	65-70				
				September - December	IF(Display)	60-65				
GH 08	Floor Growing / Baskets		1,440	January	IF, OF	55-60	X	X	40	X
				February - March	IF, OF(Spring)	55-60				
				April - June	IF, OF(Fall)	65-70				

"….The nine overwintering houses in the nursery are sagging, and plywood is peeling. The heaters inside are at the end of their useful lives. In the gravel area and container area, benches are 25 years old and the wood is rotting."


AERIAL VIEW: NORTH OF THE SHADE EVALUATION GARDEN
WIRTZ INTERNATIONAL


The Kris Jarantoski Campus
Redefining a tradition of horticultural excellence
Nursery
Greenhouses
Shade garden
CHICAGO BOTANIC GARDEN

“Building the Future of Public Gardens Under Glass”

Kimberlie McCue
Asst. Director, Research, Conservation and Collections
Desert Botanical Garden

DESERT BOTANICAL garden

- Motivation for planning new facilities
- Integrative Design—many voices, one table
- Sustainability—Demolition-Construction-Operation

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Propagation & staff support areas

- As needs and staff numbers increased, additional structures would be erected.
- Staff support areas would become filled and/or expand to other areas – aka “the creep factor”.

Space limitations

- Growing collection has maximized existing facilities.
- Reduction in air circulation between plants if pots too close together.
- Up-potting of plants limited by available space.

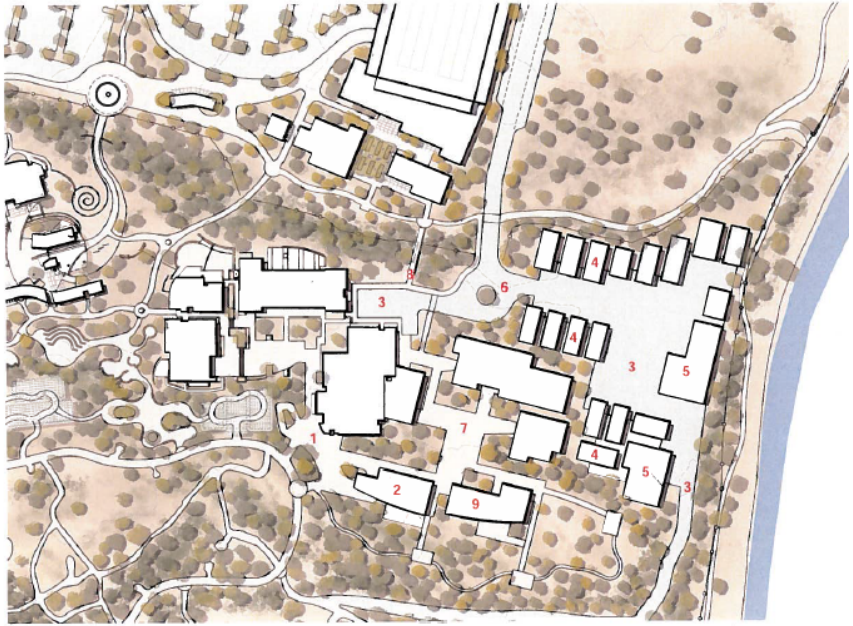
Environmental Condition Limitations

- Evaporative cooling wall and heating system were state of the art at the time.
- Inability to provide optimal conditions for collection variety.
- Surviving not thriving.

Library plaza and East Courtyard:
The Library is the anchor for the east campus; it is the gateway to the new east courtyard and is a link—both in terms of location and program function—between the existing core campus and the new east campus. The space between the library and succulent house currently features a shaded seating spot among the agaves and aloes; this would be expanded to accommodate small events.

A 3,650 square foot expansion off the east side of Pulliam would house additional lab and office space for research and serve as an additional link between the office and support spaces and the buildings that form the new east campus. The Pulliam Center, with its rich mix of departmental users would become a literal and metaphorical hinge between the old and new campuses.

Building on the successful hybrid use of Boppart Courtyard, the East Courtyard will be an 8,400 square foot plaza space surrounded by five buildings jointly used by Research, Horticulture, Education and Administration. As with the Dorrance Hall, an educational lab building and greenhouse/ exhibit space will draw visitors into the East Courtyard and demonstrate how the varied strands of the DBG mission come together. Located at the edge of the east exhibit trail, the 5,350 square foot educational lab building can host a variety of activities including classes, hands-on activities or overnight adventures. In addition, these spaces can potentially serve a year-round function.

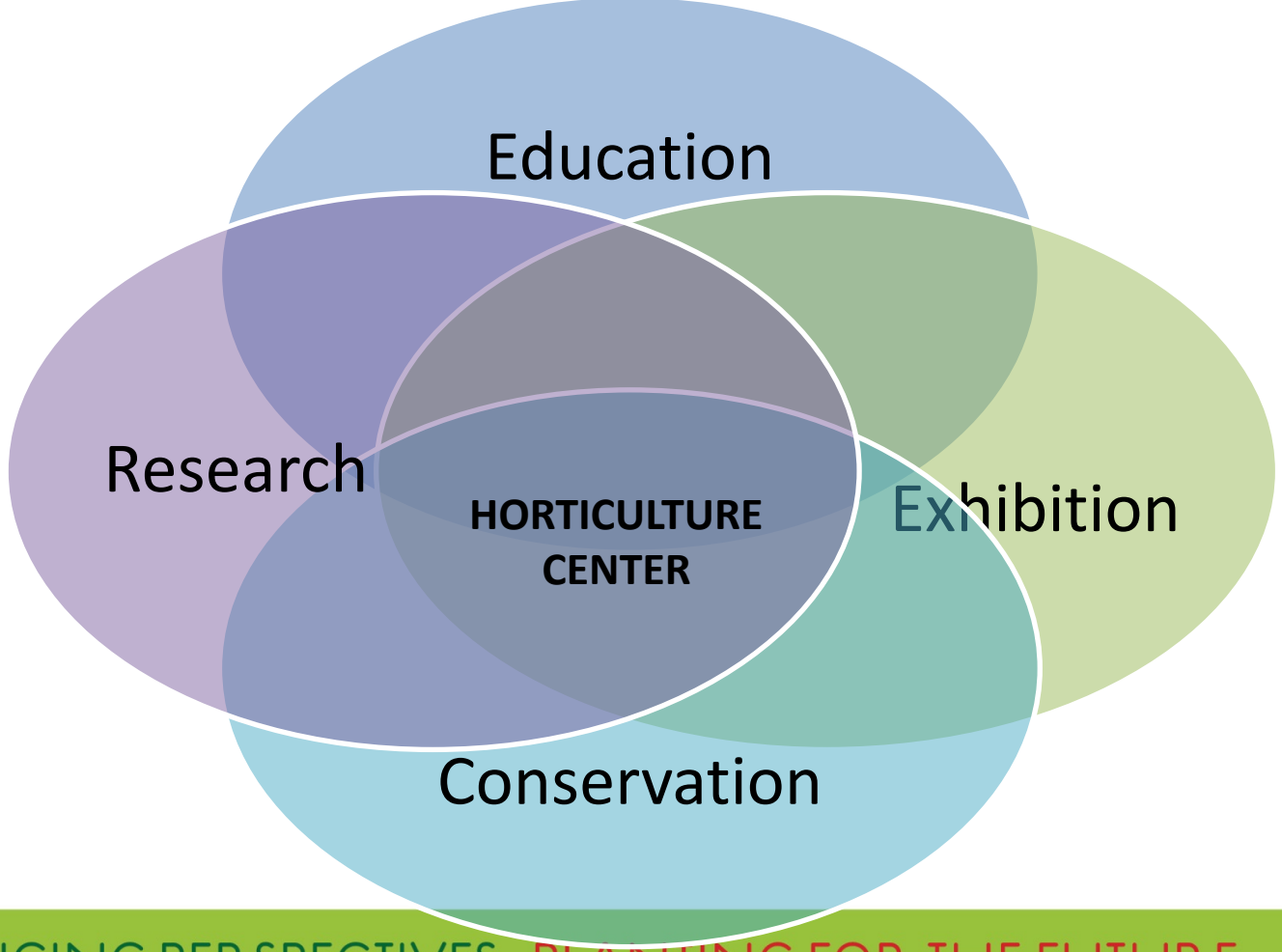


EAST CAMPUS

Fig. 27

1 LIBRARY TERRACE
2 EAST EXHIBIT BUILDING AND TRAIL
3 MAINTENANCE YARD AND DRIVE
4 SHADE AND PROPAGATION HOUSES
5 MAINTENANCE BUILDING
6 LARGE VEHICLE TURNAROUND
7 EAST CAMPUS
8 CONNECTION TO NORTH CAMPUS
9 EDUCATIONAL LAB BUILDING

From DBG 20 year Physical Master Plan (2008)


Education
Research
HORTICULTURE CENTER
Exhibition
Conservation

Integrative Design—Phipps: A Case Study

coLAB studio, LLC
art + architecture

Matthew Salenger, AIA

180 degrees
a design + build company

James Trahan, AIA

Montgomery Smith-Inc.
Professional services for the Restoration of Historic Structures – Designers • Engineers • Builders

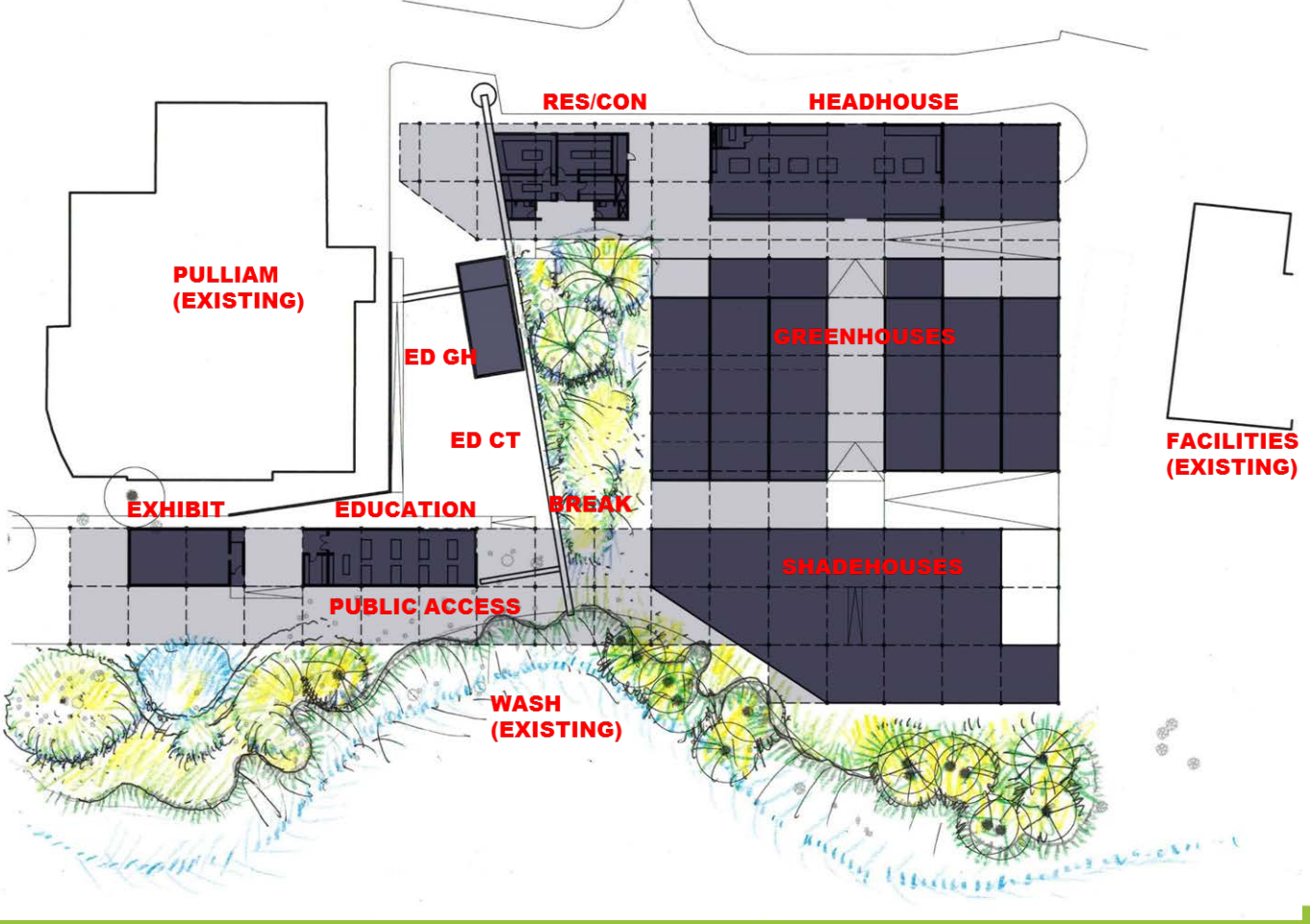
Jim Smith

TOUCHSTONES

- Plants
- Model for Sustainability
- Environmental Conditions for Plants
- Workflow/Efficiency
- Leave No Trace
- Creativity
- Sense of Place

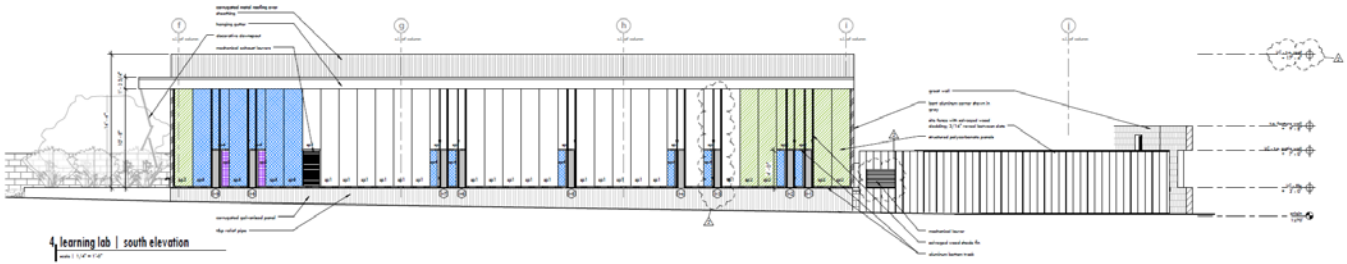

EXIT
EXIT

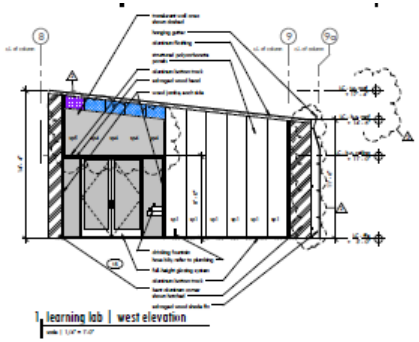

WWF

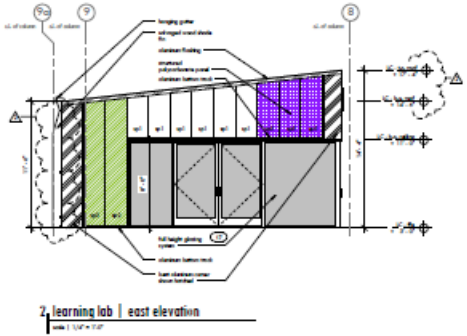

RES/CON
HEADHOUSE
PULLIAM
(EXISTING)
ED GH
GREENHOUSES
ED CT
FACILITIES
(EXISTING)
EXHIBIT
EDUCATION
BREAK
SHADEHOUSES
PUBLIC ACCESS
WASH
(EXISTING)

Phase 1 Elements

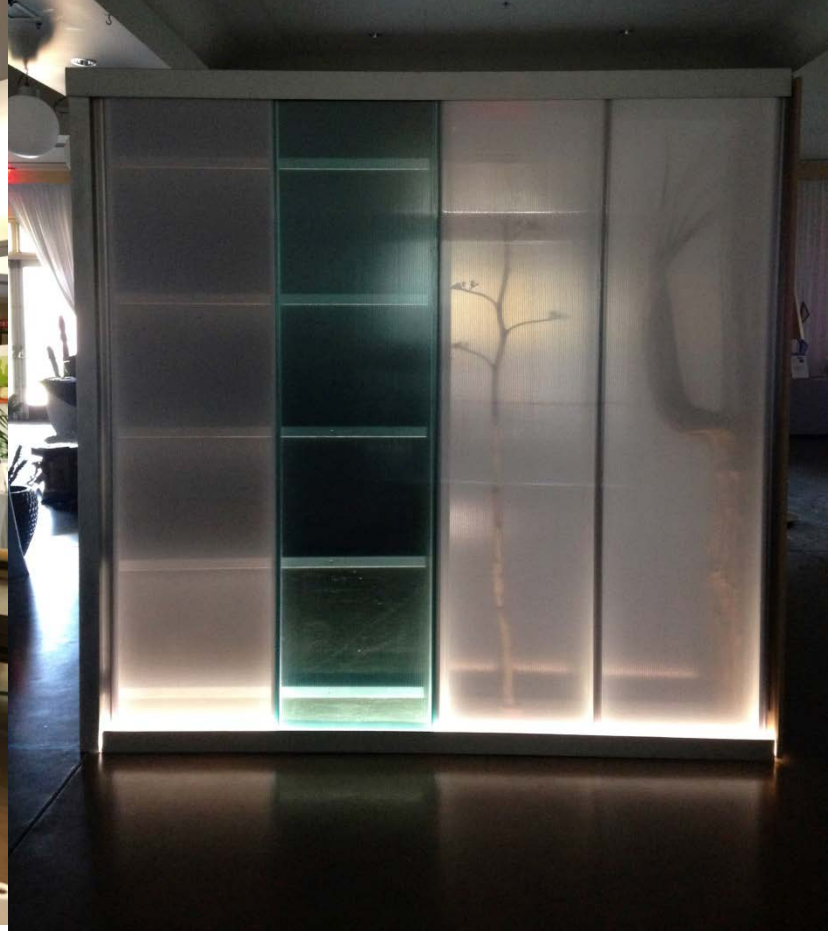
Learning Lab ~ Exterior

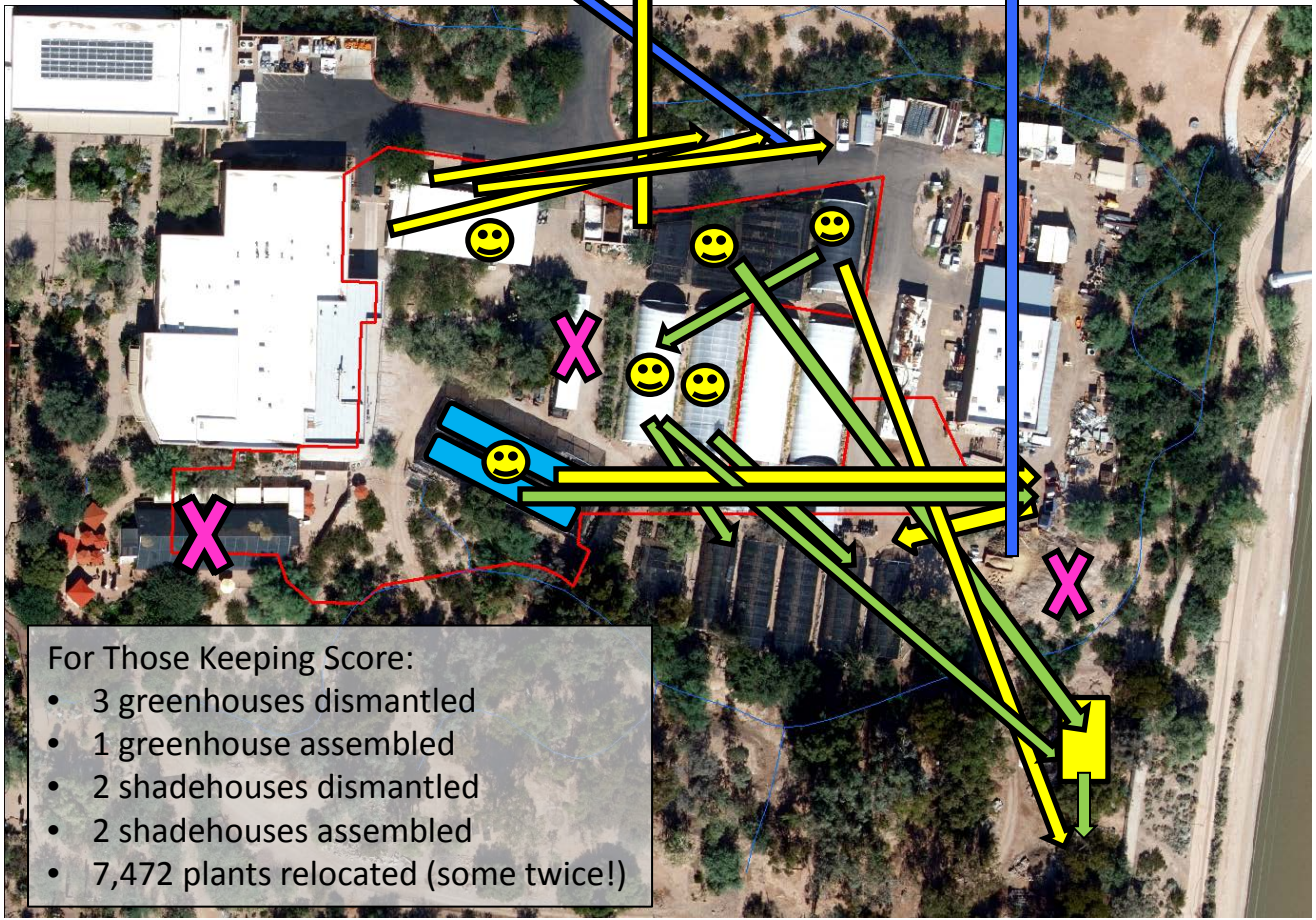






Learning Lab
Wall Mock-up




For Those Keeping Score:
• 3 greenhouses dismantled
• 1 greenhouse assembled
• 2 shadehouses dismantled
• 2 shadehouses assembled
• 7,472 plants relocated (some twice!)

Greenhouse 2

Donated to **Borderlands Restoration** to be repurposed as a growing area to propagate native plants which are used in habitat restoration projects in National Parks, BLM lands and several projects including pollinators, monarch butterflies, etc.

Cactus Shade House

- Plant benches were “hooped” to protect the plants while the structure was dismantled around them and relocated.
- The structure footprint went from 40’ x 100’ to 50’ x 80’.
- Same square footage (4000 sq/ft) but the new arrangement of tables provides room for more plants.

Butterfly Pavilion

- Metal frame was recycled.
- Metal posts from walkway canopy will be repurposed into a trellis or shade canopy.
- Plants were salvaged to be used elsewhere in the garden.
- Don’t forget the fish!

Fleischer Propagation Building

Frame and exterior shell to be repurposed as a desert home for a client from Switzerland.

Vicki Bone
Shade Structure

Metal posts and cross beams salvaged by our own Dr. Joe McAuliffe and Raul Puente to be repurposed as benches and/or counter tops in the new design.

A Clean Slate Full of Potential…

horticulture operations committee
“hOps”

- Staff from Education, Horticulture, Facilities, Research/Conservation/Collections, Safety Coordinator
- Culture Shift, Overlapping Areas, Centralization and Uniformity of Tasks, Best Practices, Work Flow Efficiency and Responsibility/Accountability

- Greenhouse Operation and System (GOS) Lead.
- GOS co-Lead
- Purchasing Lead
- Tool Lead
- Best Practices Lead
- Irrigation and Non-Potable Water Lead
- Safety Lead (includes Chemical Lead)
- Public Interface Lead

SO WE BEGIN…

February 1, 2016

OASIS DESIGN GROUP

Master Planning the Glass 'Houses' – *Production and Display*

Scott C. Scarfone, ASLA
sscarfone@oasisdesigngroup.com

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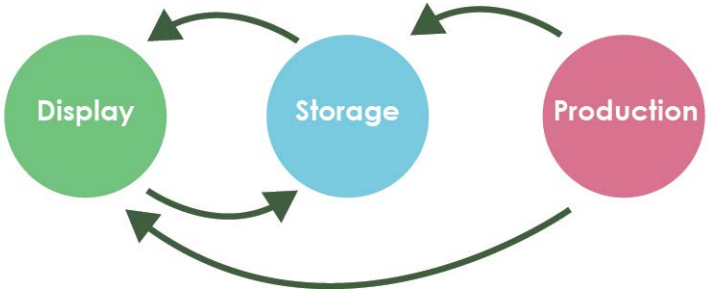
Efficient greenhouse and display conservatories must consider the botanical '**spatial supply chain**' which feeds the system.



Storage and production spaces within conservatories and greenhouses should be designed to consider display and flexible spaces required for a pre-established set of objectives.

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Conservatory Display Types

Permanent Collections

The majority of a conservatory's display, permanent collections need to be grown/replaced constantly to ensure visual consistency and plant health.

Mass 'filler'

Mass plantings, or 'filler,' is the glue that holds different collections and displays together and creates continuity between displays. Specific filler content can fluctuate through the seasons.

Seasonal Displays

Seasonal displays require a variety of growing conditions and spaces, but provide the diversity of experience necessary to attract return visitors.

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Greenhouse growing types/categories

- **Holding / Quarantine Areas**
  - Holds crops received from outside vendors until certain they are disease/infestation free
- **Vendor Receiving / Storage**
  - Stores crops grown by outside vendors for specialized temporary shows
- **Seasonal Crops**
  - The largest growing space raises plants for seasonal shows
- **Scientific Collections**
  - Holds any scientific or research oriented plant collections
- **Special Display Collections**
  - Significant grow space (often 2:1) for special collections (orchids, bonsai, etc.)
- **Permanent Collections**
  - Limited space for replacing or expanding permanent display plants

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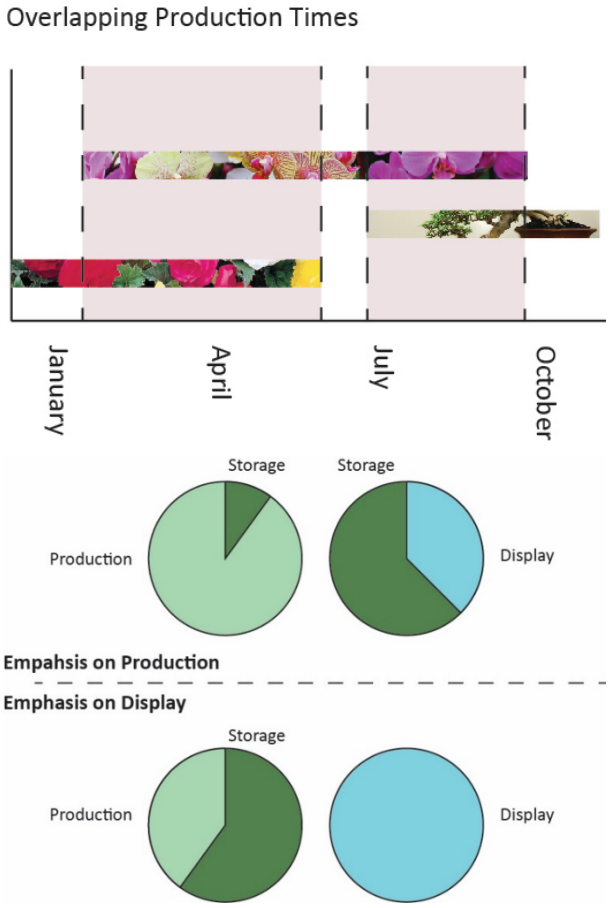
Designing for Overlap

- Production Overlap
  - Different plant communities require different gestation and growth times, so different seasons might require different spatial needs
- Storage overlap
  - As productions needs fluctuate, space can be delegated to storage or receiving space for vendor grown plants
- Vendor Support
  - The quantity of plant material for seasonal displays purchased from vendors can also vary based on the current production need of the Conservatory



Birmingham Botanical Gardens

Master Plan for the Greenhouse and Conservatory Complex

2016 MIAMI

CHANGING PERSPECTIVES: PLANTING FOR THE FUTURE

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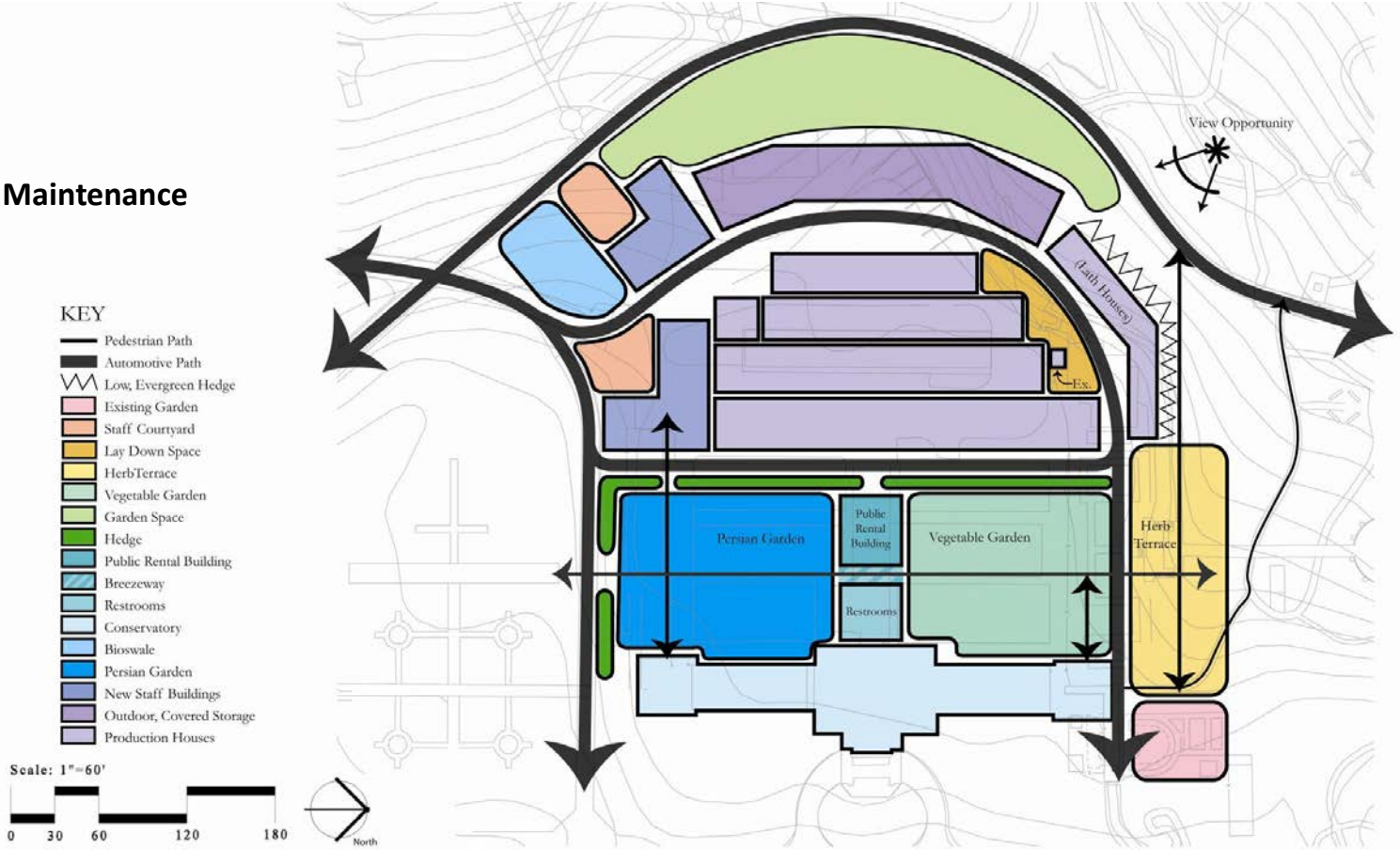
Conservatory and Maintenance Facilities Concept



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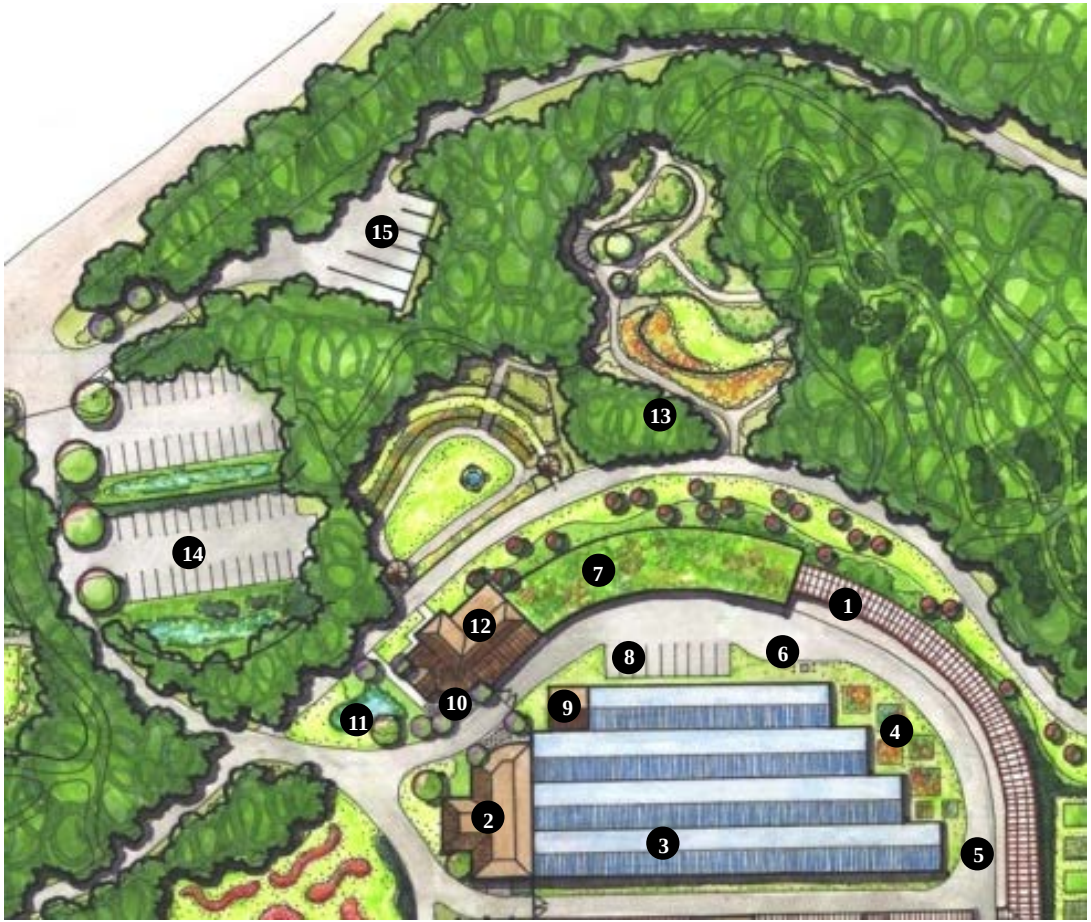
Production and Back of the House

1. LATH HOUSES
2. POTTING SHED
3. PRODUCTION GREEN HOUSES
4. PLANT LAY DOWN AREA
5. SERVICE DRIVE
6. GAS PUMP
7. MAINTENANCE STORAGE FACILITY W. GREEN ROOF
8. MAINTENANCE PARKING
9. POWER PLANT
10. ENTRANCE PLAZA
11. BIOSWALE
12. MAINTENANCE OFFICE
13. PLANT WALK
14. STAFF PARKING
15. BULK STORAGE



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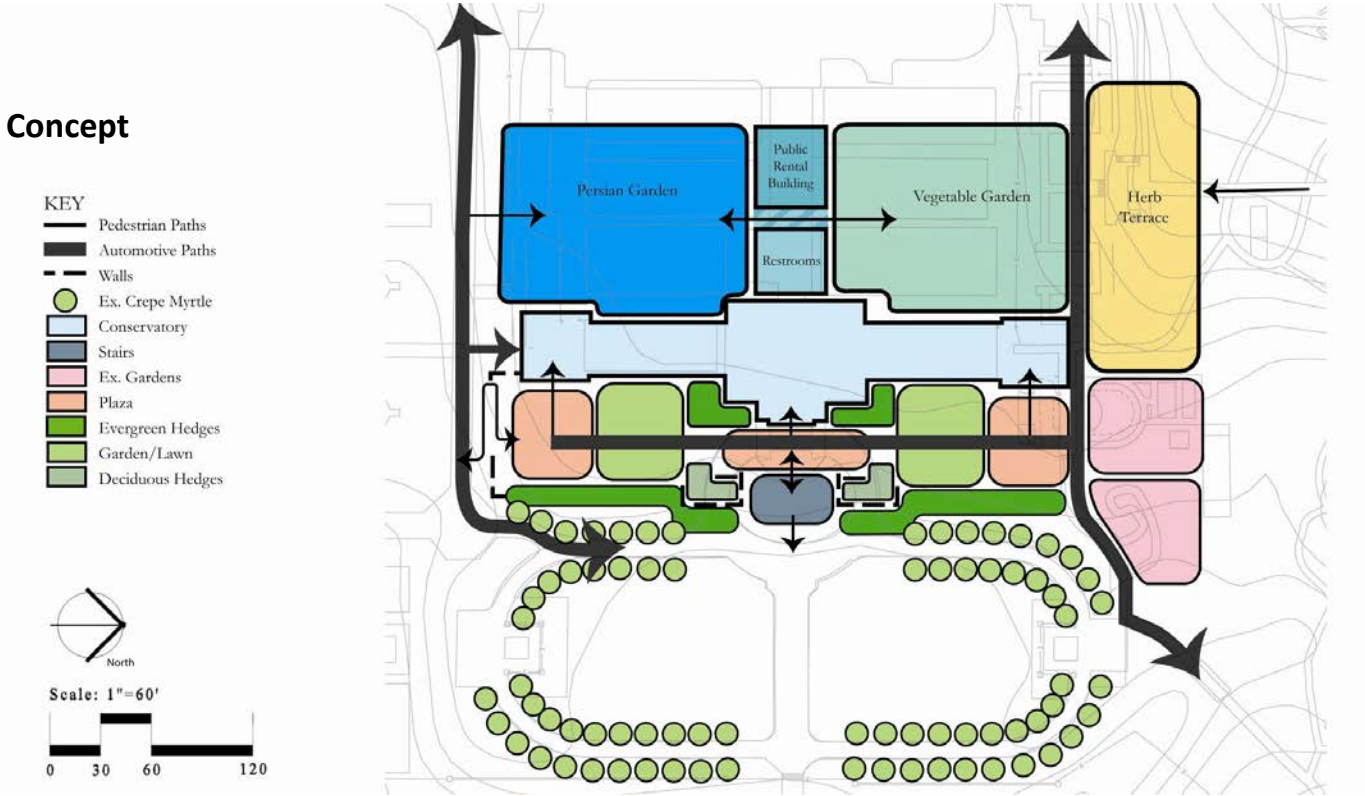
Conservatory Gardens Concept



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Conservatory Gardens

Persian Garden

1. CONSERVATORY
2. CONSERVATORY ADDITIONS
3. DECORATIVE PAVING
4. BOSQUE
5. CITRIS TREES IN POTS
6. POOLS
7. DECORATIVE GARDEN GATE
8. LATH HOUSES
9. ACTIVITY BUILDING
10. BREEZE WAY
11. RESTROOMS

Vegetable Garden & Herb Terrace

12. GARDEN PLOTS
13. HERB TERRACE
14. PAVILION
15. STONE COLUMNS
16. GEORGE WASHINGTON CARVER CROPS

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Conservatory Entry Gardens

1. FORMAL GARDEN
2. GRAND ENTRANCE STEPS
3. ENTRANCE TERRACE
4. CONSERVATORY
5. CONSERVATORY ADDITIONS
6. EVENT TERRACES
7. EXISTING GARDENS
8. SEASONAL PLANTINGS
9. HANDICAP RAMP
10. SEASONAL PLANTINGS

Buffalo and Erie Botanic Garden

Master Plan for the Conservatory Complex and Gardens

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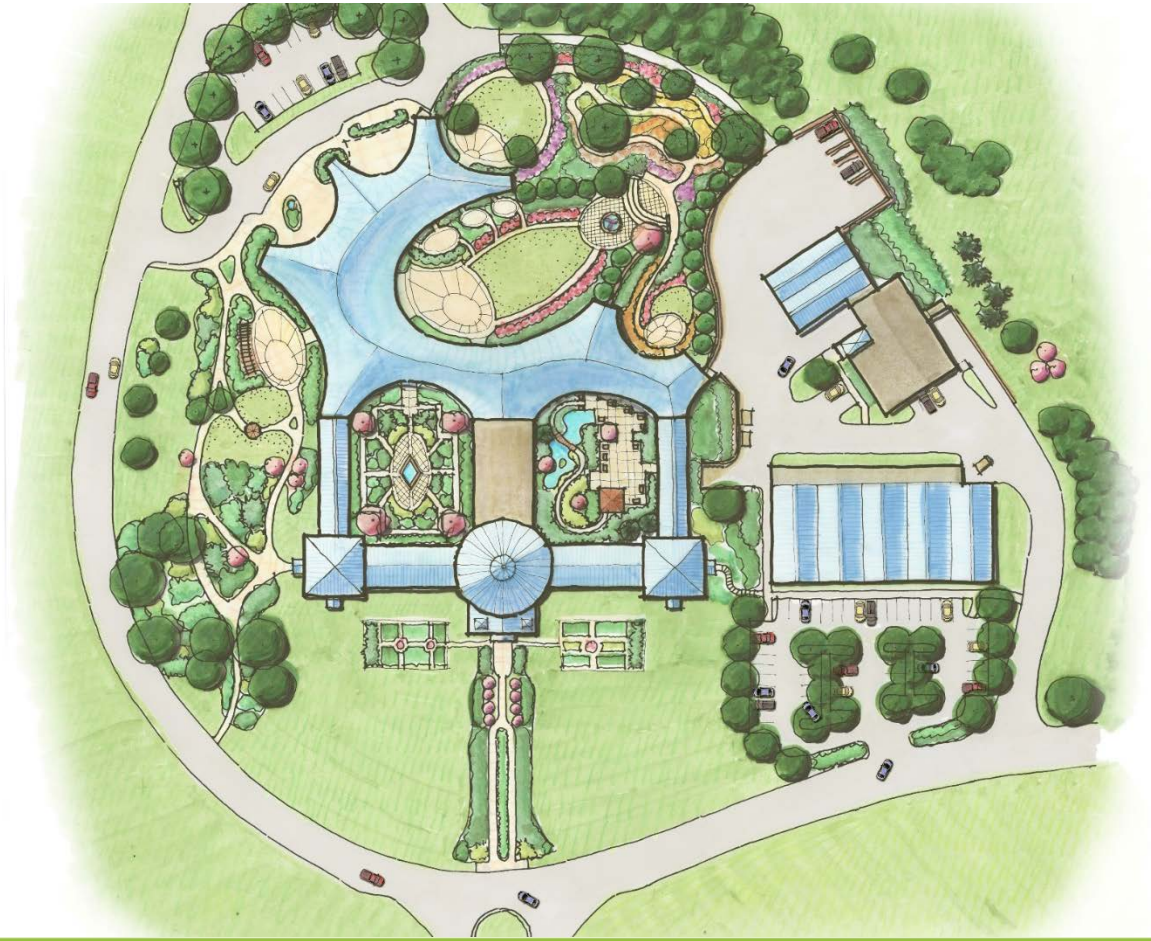
Conservatory Complex Master Plan Concept



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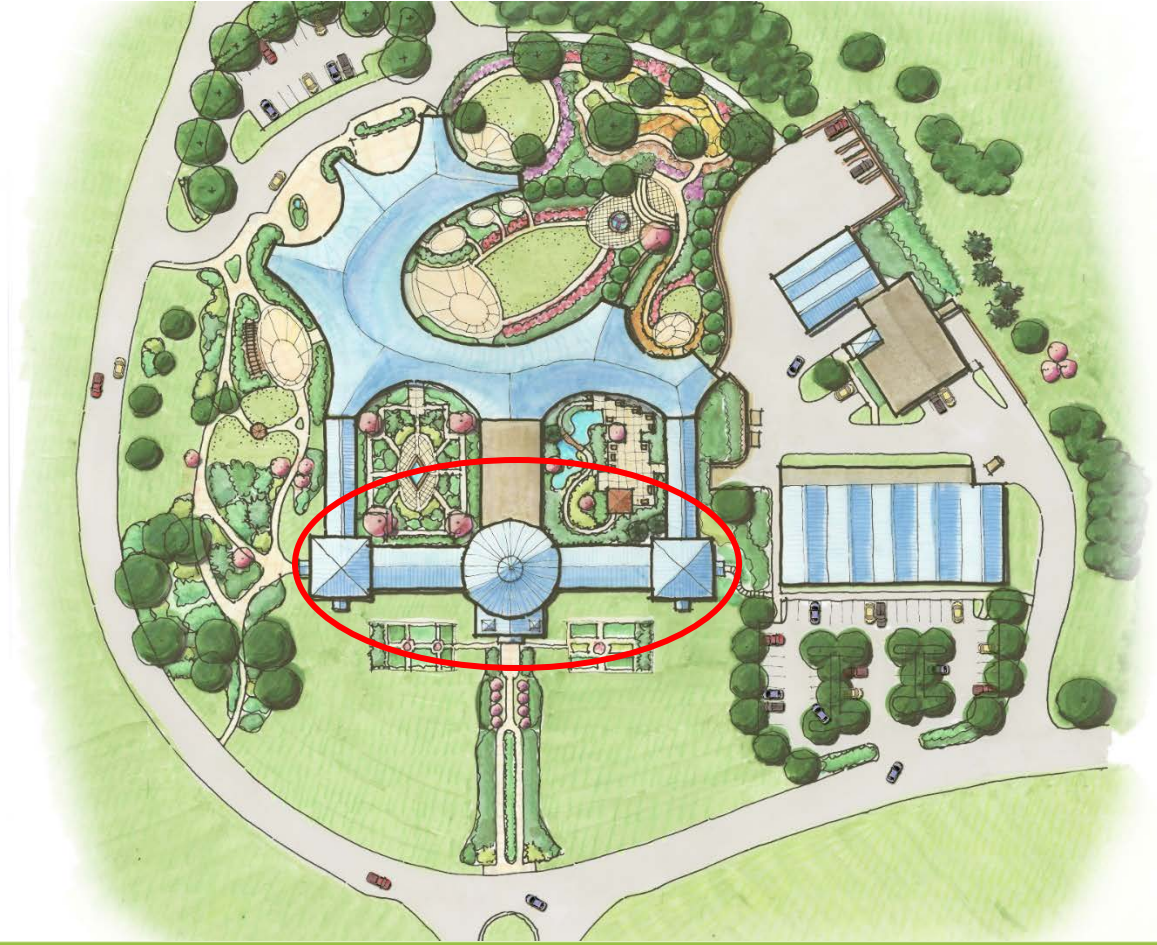
Master Plan Components

1. Historic Conservatory



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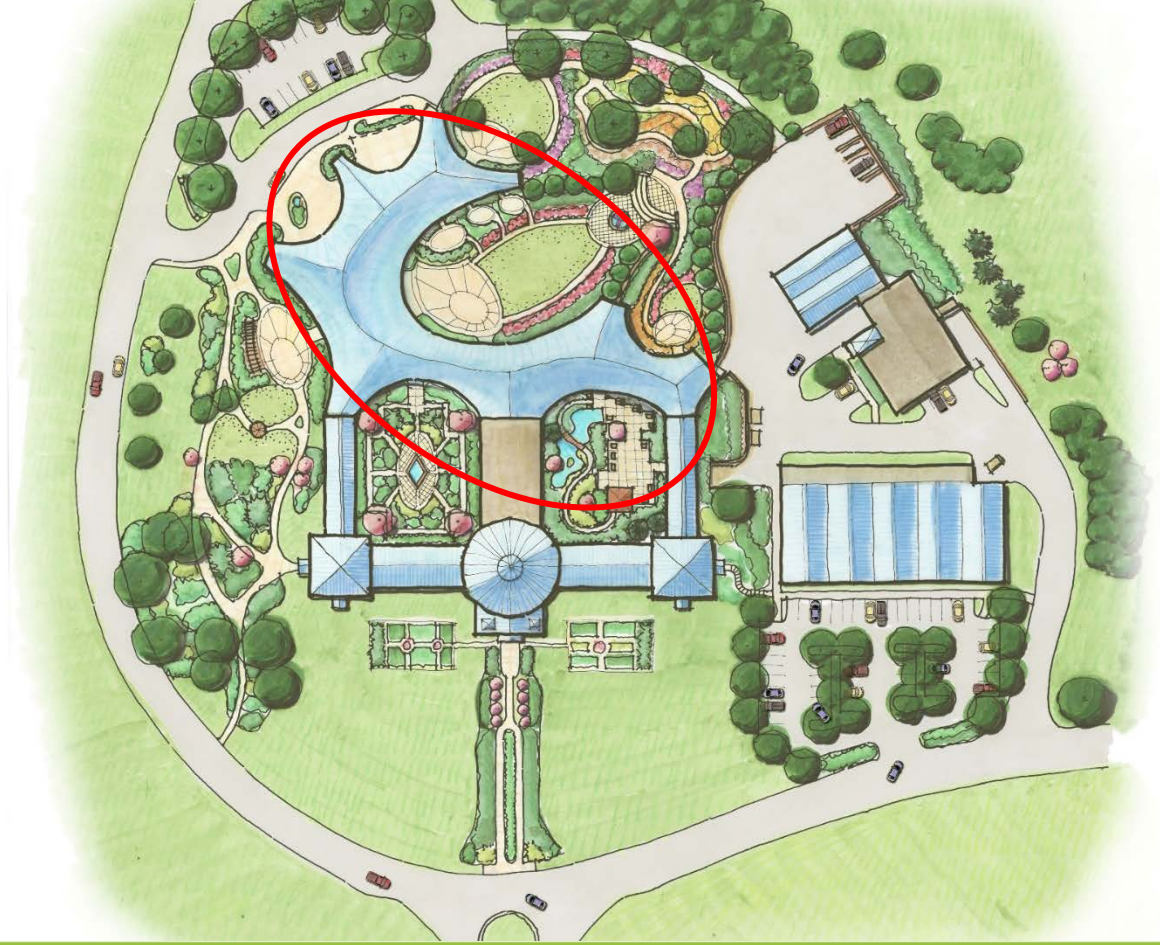
Master Plan Components

1. Historic Conservatory
2. New Welcome/Event Center



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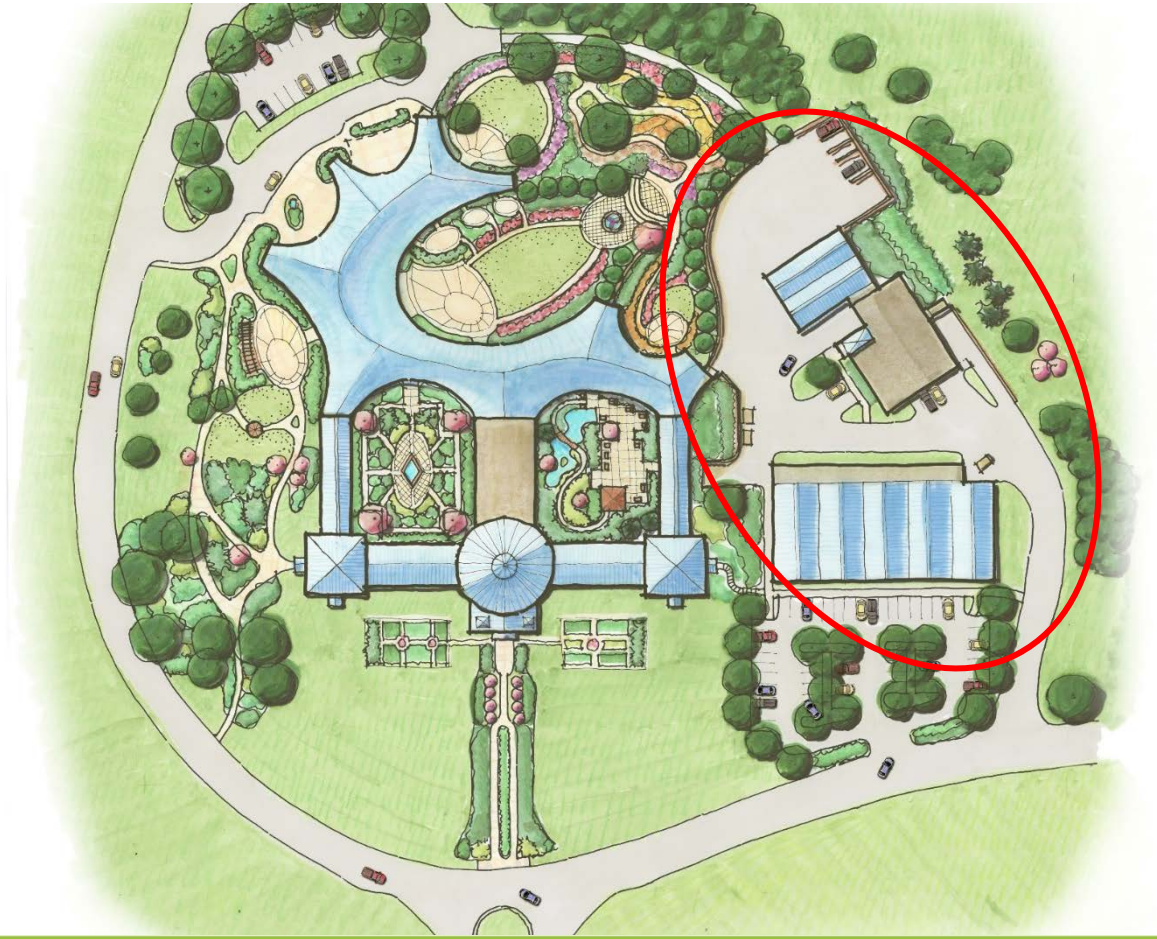
Master Plan Components

1. Historic Conservatory
2. New Welcome/Event Center
3. Production Areas



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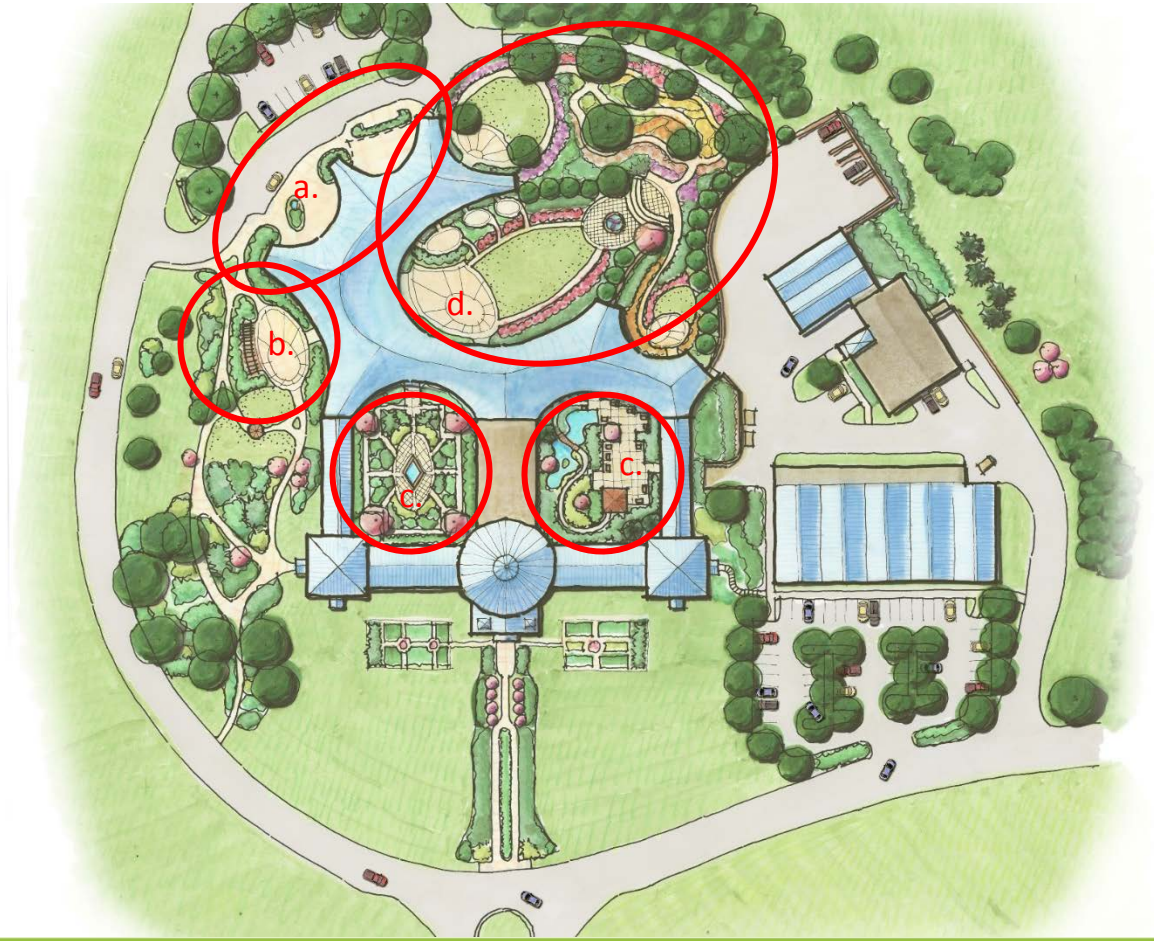
Master Plan Components

1. Historic Conservatory
2. New Welcome/Event Center
3. Production Areas
4. Related Gardens
    a. Guest Entry
    b. Café Garden/Terrace
    c. Courtyard Gardens
    d. Main Gardens



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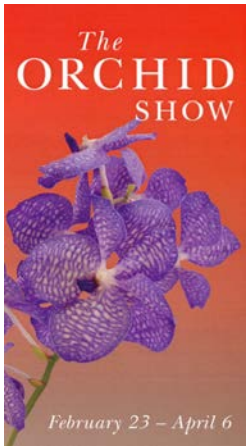
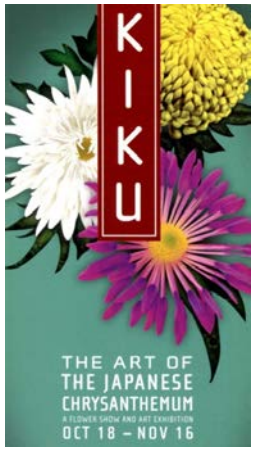
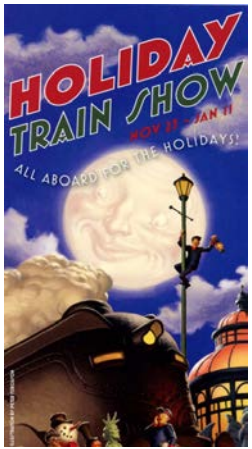
Designing for Flexibility

- Changing seasonal shows, themed events, and venues are tools to attract return visitors and investors.
- The ability to convert display space to venue / event space creates these opportunities while keeping the spatial supply chain flexible



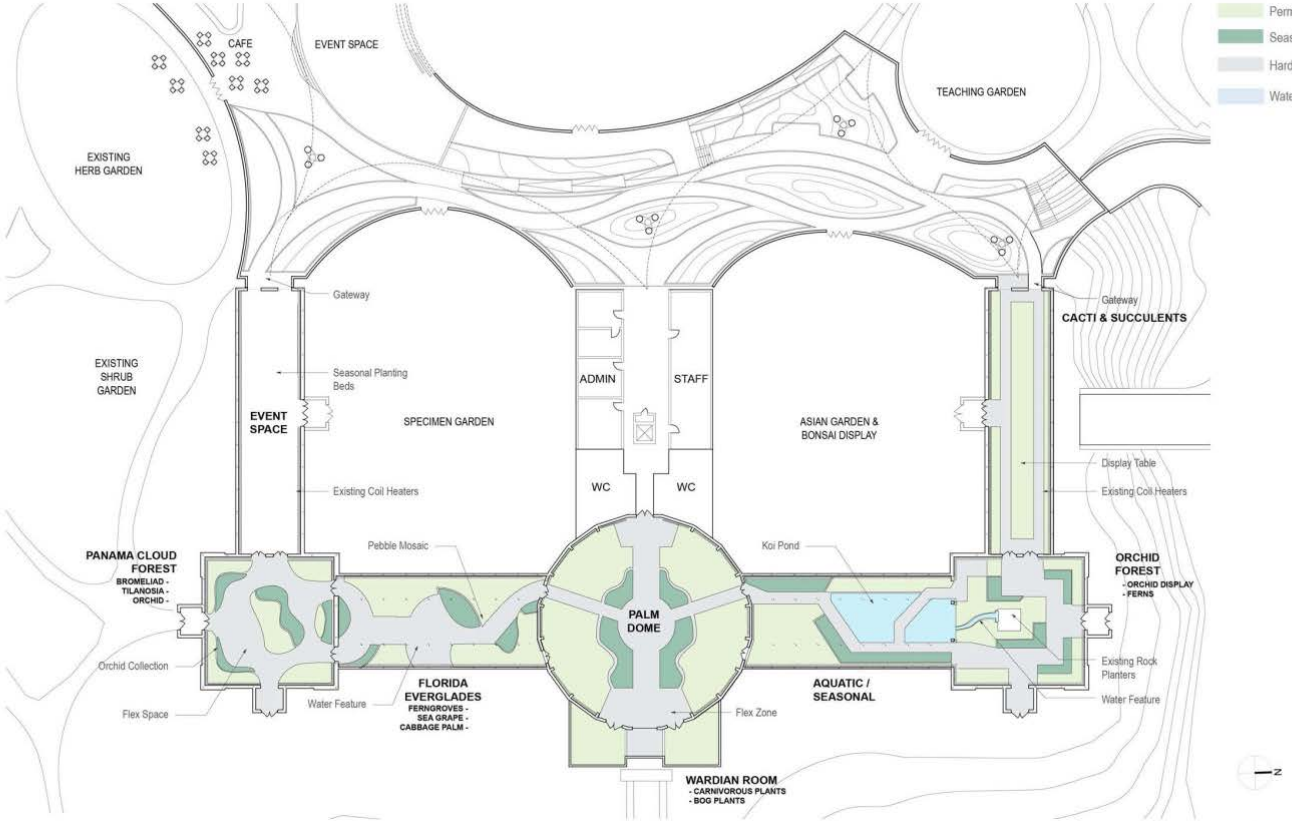




OASIS DESIGN GROUP

Existing Layout

Analyzing the designs – Rooms are analyzed to show ratios by planting typology



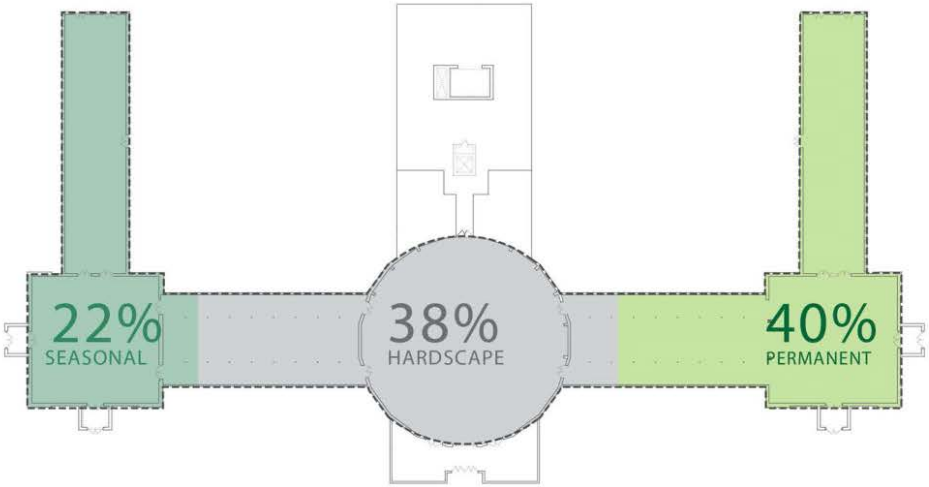
OASIS DESIGN GROUP

Existing Layout

Analyzing the designs – The conservatory is analyzed to show ratios by planting typology

Desired changes:

- More varied seasonal displays
- Less rigid program
- Fix lack of flexible spaces



TOTAL PERMANENT SPACE
6,643 SF

TOTAL SEASONAL SPACE
4,044 SF

TOTAL HARDSCAPE
6,989 SF

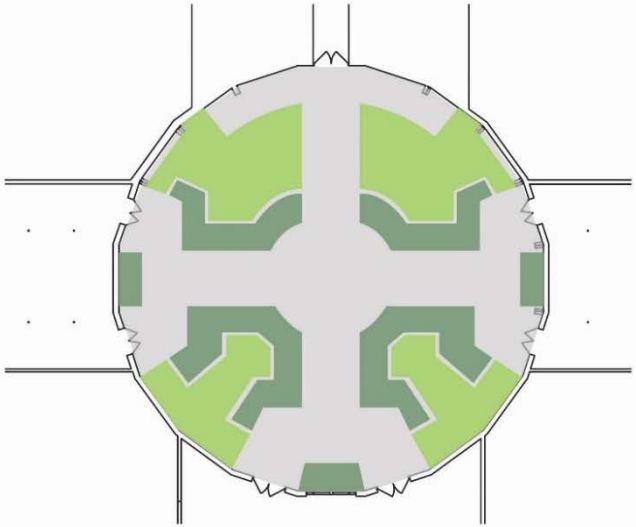
PROPOSED LAYOUT

ROOM	OVERALL SQ FT	HARDSCAPE SQ FT	PERMANENT PLANTING SQ FT	SEASONAL SQ FT	SEASONAL %	WATER FEATURE SQ FT
HOUSE 01	4605	1749	2212	644	14%	
HOUSE 02	2408	578	1010	290	12%	530
HOUSE 03	2240	965	828	380	17%	67
HOUSE 04	2270	1475	795	-	-	
HOUSE 10	2270	-	-	2270	100%	
HOUSE 11	2240	1233	739	268	12%	
HOUSE 12	2408	989	1059	192	8%	168
TOTAL	**18,440**	**6,989**	**6,643**	**4,044**	**22%**	**765**

OASIS DESIGN GROUP

Analyzing the designs – Proposed ratios are analyzed against existing ratios.

Proposed Layout

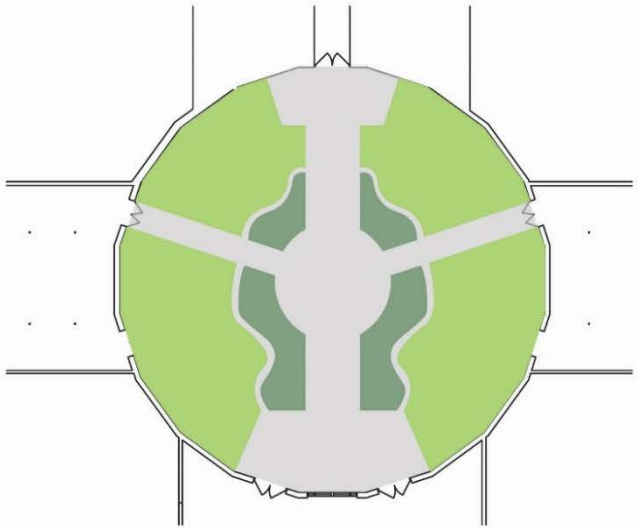


TOTAL PERMANENT SPACE 30 %

TOTAL SEASONAL SPACE 20 %

TOTAL HARDSCAPE 50 %

Existing Layout



TOTAL PERMANENT SPACE 52 %

TOTAL SEASONAL SPACE 10 %

TOTAL HARDSCAPE 38 %

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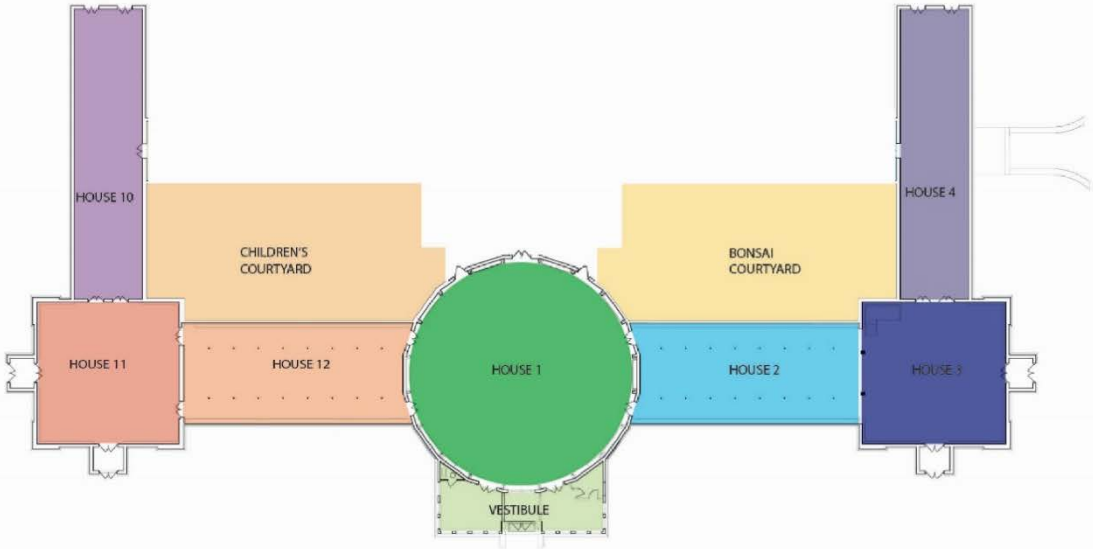
Theming the design – Developing the overall concept for the entire experience.



Bonsai Courtyard

Children's Courtyard

Vestibule: Wardian Exhibit

House 1 : Palm Room

House 2 : Aquatic Gardens

House 3 : Orchid Forest

House 4 : Desert Garden

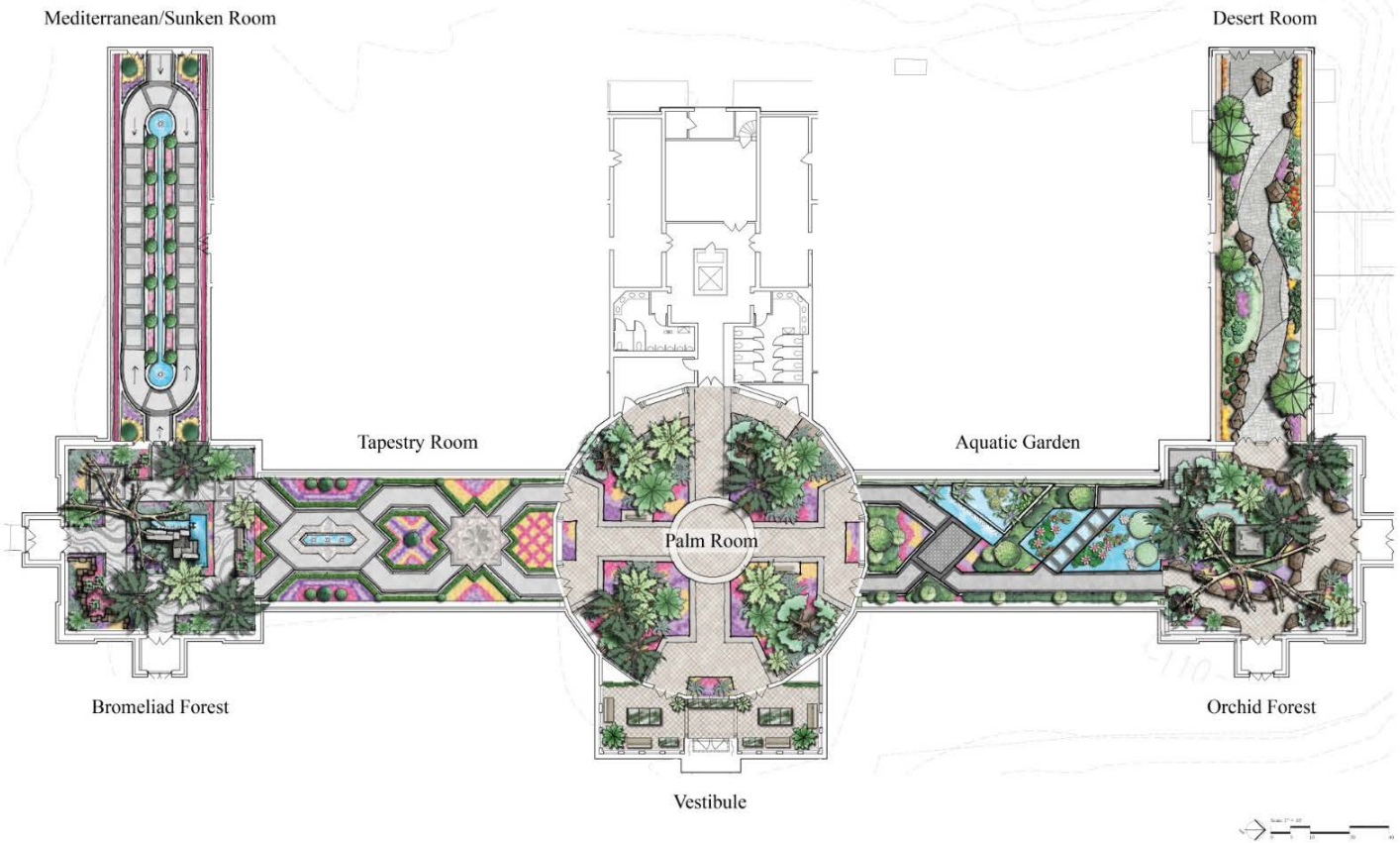
House 10 : Mediterranean/Sunk Garden

House 11 : Bromeliad Forest

House 12 : Tapestry Garden

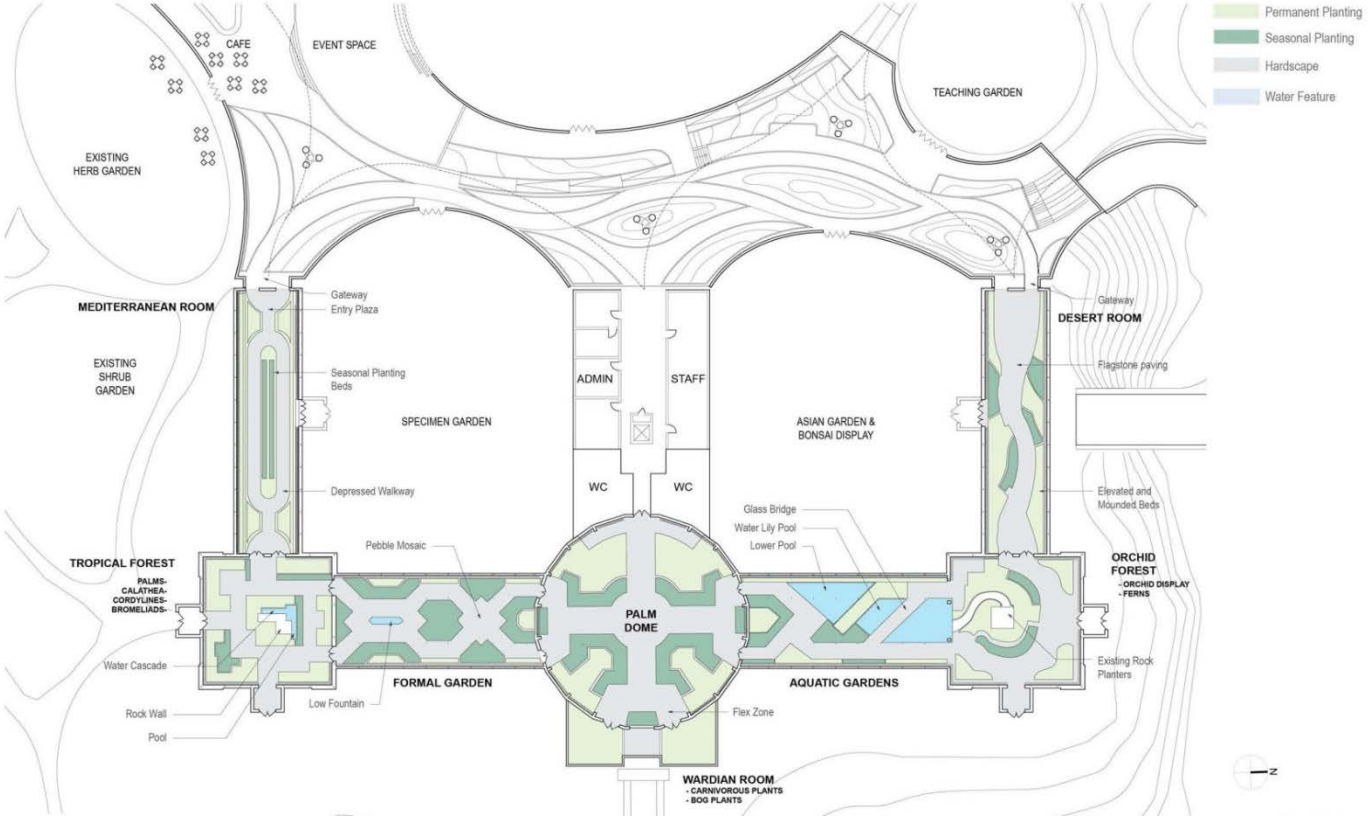
OASIS DESIGN GROUP

Proposed Master Plan



OASIS DESIGN GROUP

Exhibition Concept Plan



OASIS DESIGN GROUP

Master Planning the Glass 'Houses' – *Production and Display*

Scott C. Scarfone, ASLA
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2016 MIAMI
CHANGING PERSPECTIVES: PLANTING FOR THE FUTURE
2016 AMERICAN PUBLIC GARDENS ASSOCIATION ANNUAL CONFERENCE

Building the Future of Public Gardens Under Glass

Planning and Programming
Design to Construction

-Ryan Charek, Rough Brothers

Planning and Programing – Design Phase

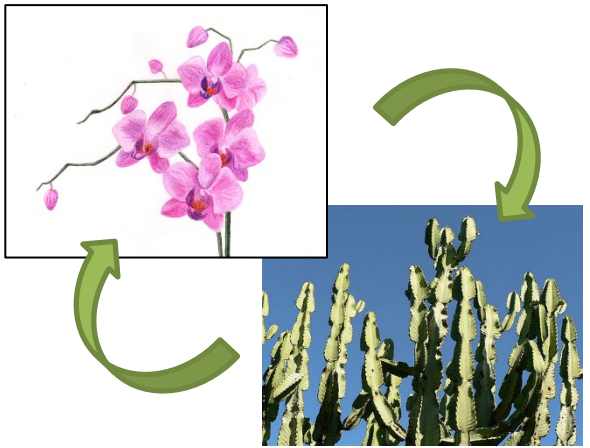
How Planning Helps Us Help You

- Expectations, pluses, minuses, optimization & Design/Flexibility
  - Spatial Relationships (free standing, abutting, height, cross flow, etc…)
  - Zone Sizing
  - Conservatory Equipment Considerations & Selections (effective lengths, cooling/heating capacities, energy efficiency, etc…)
  - Location, Location, Location (at grade, roof top, accessibility (moving of plants and maintenance), shadows, etc…)

Planning and Programing – Design Phase

How Programming Helps Us Help You

- Set Climate Expectations (equipment selection, glazing types, etc…)
  - Targeted Plant Needs
  - Conservatory Equipment Needs
  - Structure/Glazing Needs
  - Sustainable Materials/Design Needs
- Add equipment not thought of
- Built in Flexibility for a World Class Plant Exhibit



Planning and Programing – Design Phase

Complete Design for Manufacturing & Construction

- Well defined project
  - Sets Precedence of Quality & Performance
  - Generate Project Specific Specifications and Drawings
  - Identifying Optimal Start and Stop Points Between Disciplines and Trades
  - Help Eliminate Scope Gaps and Overlaps
- Design Accountability
  - Set Expectations
  - Everyone is on the Same Page Through Close Coordination with Garden's Team
  - Realistic Budget Costing and Value Engineering

Planning and Programing – Manufacturing & Construction Phase

How do we make sure what is built is to spec/design?... It All Starts with Quality Submittals

- Complete, Detailed and Project Specific
  - Proper Engineering Stamps
  - Complete Conservatory Equipment Submittals
  - Project Specific Plans
- Strong Design Team to Hold Feet to the Fire!

Planning and Programing – Manufacturing & Construction Phase

Installation Inclusion

- Regular, Experienced and Warranted Installation Crews
  - Eliminate Materials Only Nightmares
    - No Separation Between Manufacturer and installation crew
  - Unloading, Sequencing and Proper Storage
  - Complete Installation
    - Setting limits, adjusting shade drives, etc.

Planning and Programing – Manufacturing & Construction Phase

Project Management

- Site Visits By The Conservatory Manufacturer
  - Accountability for the build
  - Observation of safety procedures
  - Start up and owner training with Vendor Participation

Smithsonian Gardens

Building the Future of Public Gardens Under Glass


SITE SERVICES
540.374.9882


DEERE


JLG


JLG NFT
SUNBELT


© 2010 Europa Technologies
© 2010 Google
Imagery Date: Aug 29, 2010
38°50'41.12" N 76°56'22.77" W elev 288 ft
Eye alt 867 ft
Google


CLARK
CLARK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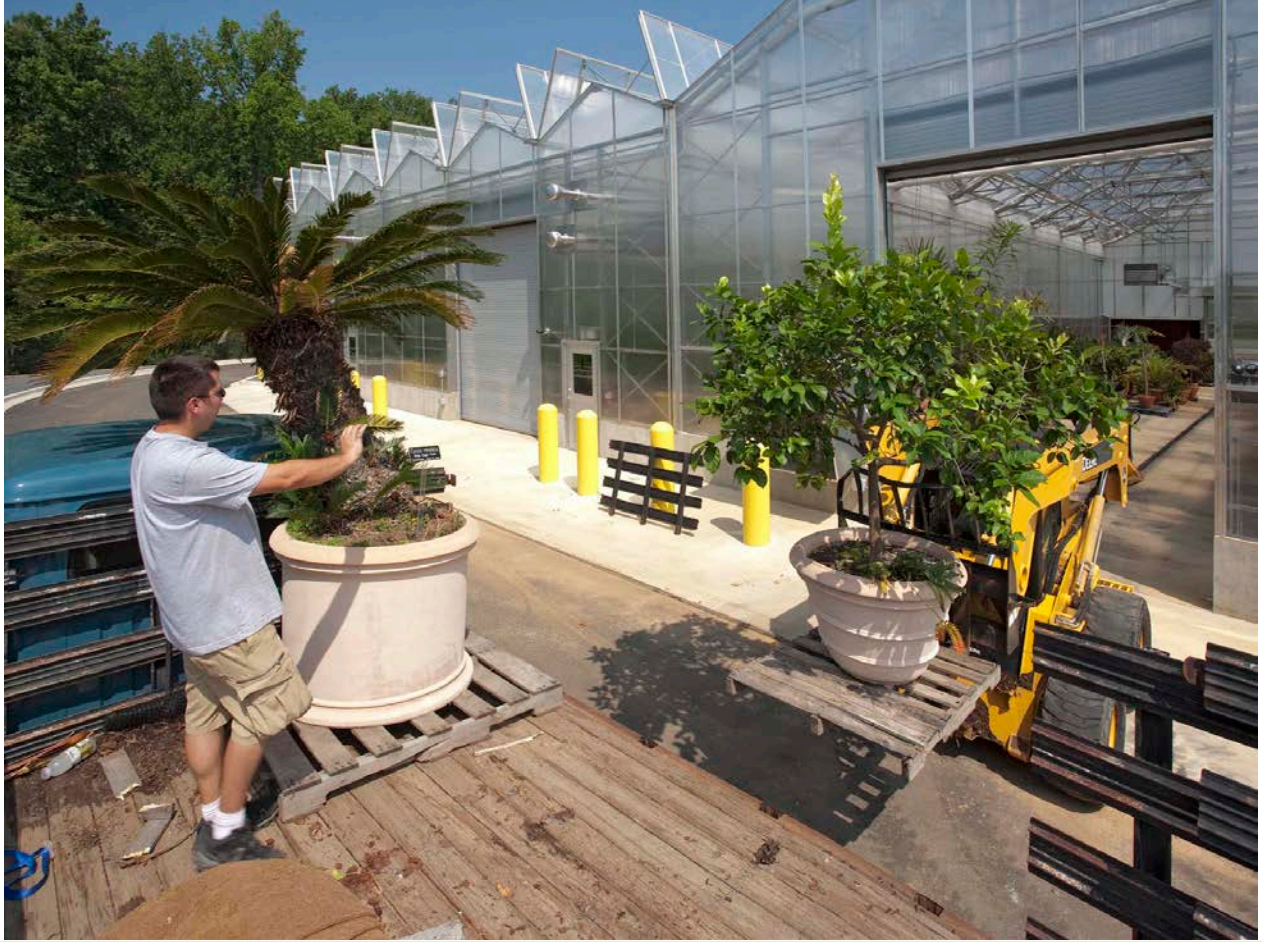


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FREER GALLERY OF ART


AFRICA
REVIEWED


MARY LIVINGSTON RIPLEY
Garden
Smithsonian Institution
May 23, 1982


Mermaid
Water


Paphiopedilum


Orchids
Interlocking Science and Beauty
Like pieces of a puzzle, each new advance in orchid research, conservation, and cultivation contributes to the larger picture of these spectacular plants.


Orchidelirium
In the 19th century, wealthy Europeans and North Americans went wild for orchids. They filled their greenhouses with species extracted from habitats worldwide, as well as newly "engineered" hybrids.
The tropical orchids that collectors brought to Europe and North America needed the natural environmental conditions of their native climates; some required heat and moisture, others cool breezes. So orchid lovers developed elaborate greenhouses to shelter their expanding collections.


LAB
A Growing Industry

Building the Future of Public Gardens Under Glass

Margie Radebaugh
Director of Horticulture and Education
Phipps Conservatory and Botanical Gardens

Phipps' Mission

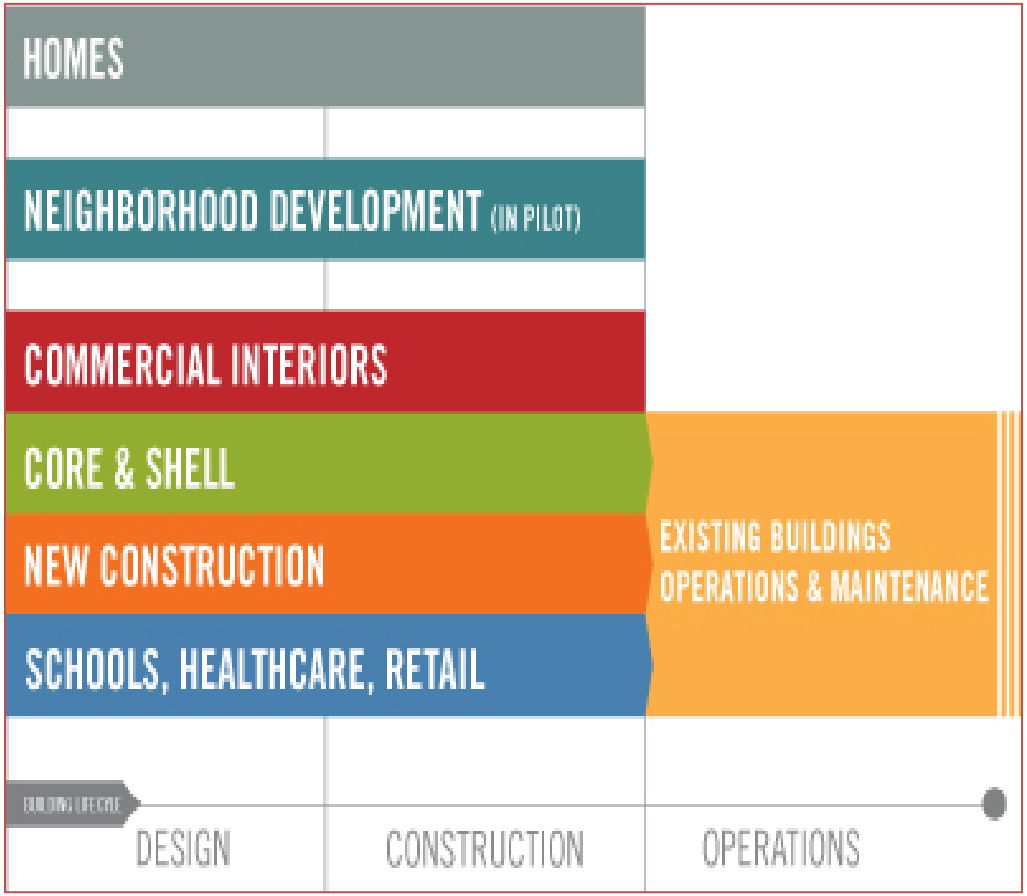
- To inspire and educate all with the beauty and importance of plants; to advance sustainability and promote human and environmental well-being through action and research; and to celebrate its historic glasshouse.

Phipps Tropical Forest and Production Greenhouses

- What features in the Tropical Forest Conservatory and production greenhouses make them more energy efficient and LEED certified?
- What might have been designed differently?
- Future plans?

Greenhouses

LEED Platinum, Existing Buildings and Operations, receiving 69 credits out of a possible 92


HOMES
NEIGHBORHOOD DEVELOPMENT (IN PILOT)
COMMERCIAL INTERIORS
CORE & SHELL
NEW CONSTRUCTION
SCHOOLS, HEALTHCARE, RETAIL
EXISTING BUILDINGS
OPERATIONS & MAINTENANCE
BUILDING LIFECYCLE
DESIGN
CONSTRUCTION
OPERATIONS

Eight greenhouse ranges are divided into 16 different growing spaces with individual settings and controls.

Greenhouse space used primarily for growing crops for seasonal exhibits

Growing edibles year round

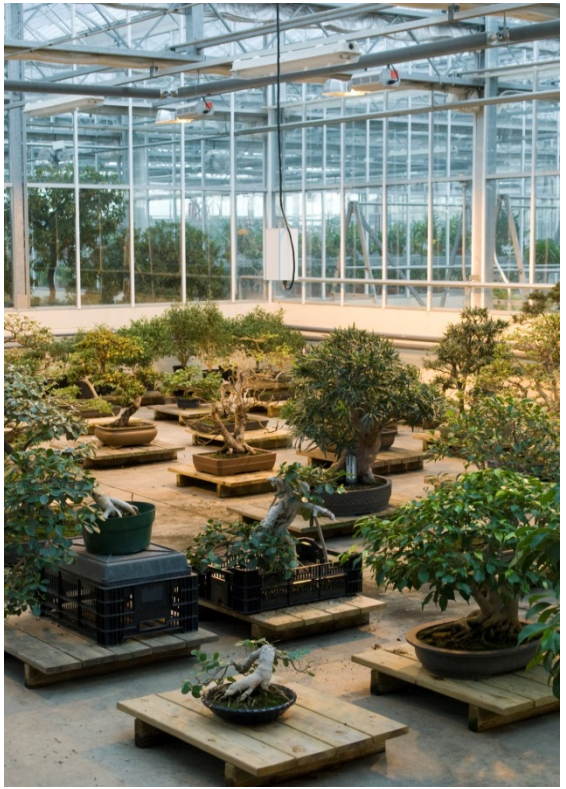
Much greenhouse space has become multiple use, based on needs of plants, rotating shows and limited space

Store shrubs for winter show with large hardy bonsai

Since we are growing for multiple shows at the same time, rotate plants to make best use of grow lights during shorter days.

Orchid Collection

Bonsai Collection



Energy Efficient Elements

Open roof system. Allows for passive cooling, eliminating use of cooling pads.

Radiant floor heating provides 80% of heat needed in winter.

Energy curtains minimize the space needing heat at night.

Greenhouse control system is run by Argus – opening and closing vents and shade cloth as needed for specific growing space requirements.

Supplemental lighting is provided by HID lights controlled by a timer and light sensitivity

- Rainwater is collected from greenhouse roofs
- Currently trialing a solar distillation system to convert sanitary water from our living building to water that matches the quality of RO.

What we might have done differently…

- Provide more nursery space.
- Quarantine area – great idea but the size does not meet our needs
- Topiary growing area – repurposed for lower light/higher humidity plants such as ferns

What we might have done differently…

- Develop a plan to capture water from the roof during design phase, including a collection point.
- Would like to be able to capture and reuse water from benches.

- Collapsible mum benches
- Wi-Fi access in greenhouses

- Quality of rack & pinion
- Do a thorough commissioning with engineers who designed the system and horticulturists who will use the system and look at performance of system and programming of control set points.
- Plan for yearly review of systems and controls.

- Think of accessibility to greenhouses
  - Weight bearing floors for heavier equipment vs. radiant floor heat
  - Placement of hoses and how they work with moving carts through
  - Spacing of aisles between moving benches

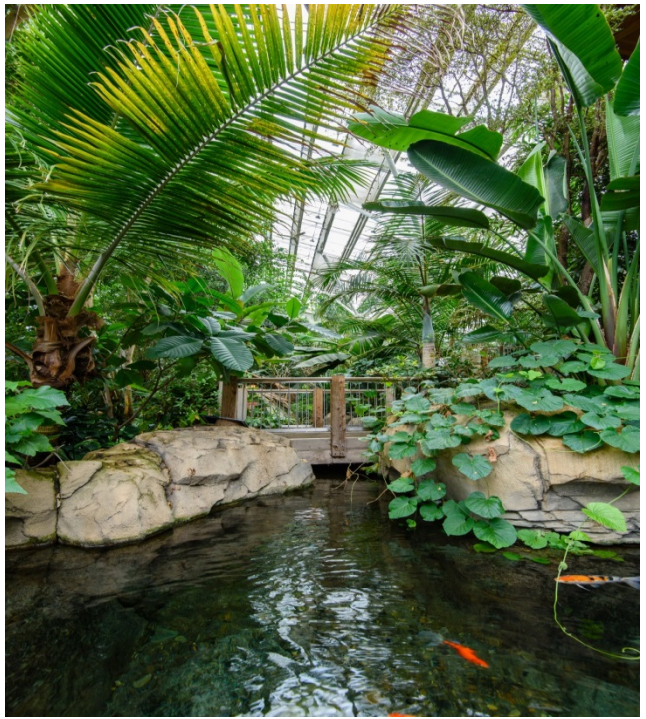
- Texturize floors to prevent them becoming slippery.
- Plan for adequate electrical current to support grow lights, planning for future as well as current need.

In the immediate future…

Growing edibles in greenhouse

- In soil
  - Leafy greens
  - Ginger
- Hydroponic
  - Greens
  - Herbs
  - Tomatoes

Tropical Forest Conservatory



Energy Saving Strategies

- Unconventional, north-sloping roof design allows for insulated double-pane roof glass, while maintaining proper light levels for growing plants.
- Inspired by open-roof greenhouse technology, half of the 12,000 sf roof opens, eliminating the “greenhouse effect” in this space.

- Energy curtains provide shade in the summer, as well as preventing radiant and convective heat loss in the winter.

- Earth tubes provide passive cooling in the warmer months.
  - Buried 15’ below grade where the ground is a constant 55^{o} F year round, cooling hot air as it travels through to the Conservatory.
  - A vacuum is created by hot air exiting the roof vents pulling the cooled air through the Conservatory.

Foot-thick concrete wall insulated on the outside.

Radiant floor heat results in minimal fin tube heating system.

Green roof over the support facilities helps to insulate the building, reduce storm water runoff and provide more space to grow plants.

- Storm water from glass roof was kept separate from the gray and black water from the building so it could tie in with a cistern.
- Water in the water features is recycled through the features.

What we might have done differently…

- Water recycling
- Capturing rainwater off of roof
- More effective waterproofing of water features
- Separate pond area water so water could be heated for tropical fish.
- Plan for accessing high points of the structure

Integrative Design Process

Elevator

Thank you.

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