celebrating adaptation

project brief | fall 2012
The Living.Lab @ Ross.Reserve will be a facility that supports research and teaching activities on living systems and will be an instrument of discovery for environmental change and adaptation.
The Ross Reserve has had legions of supporters and contributors over the years, beginning with Alton and Elizabeth Lindsey. Their unfailing vision and dedication to the mission of the Reserve has been inspirational for generations of students and researchers.
I. introduction
   The LIVING LAB Project
   Ross Reserve: History & Mission

II. the LIVING LAB
   [IN] RESERVE  location & site strategies
   PEOPLE+PLACE building & site program
   METABOLISM  building systems
   LEARNING BY DOING  construction and delivery
introduction

The Living.Lab @ Ross.Reserve

In nature, nothing exists alone.
-Rachel Carson

Our planet is facing unparalleled ecological changes. While our scientific inquiries have yielded greater understanding, we are humbled by how much we have yet to learn. Carson’s words are a call to action: we need to understand the complexities and wonders of our environment as well as our role within it. Future generations will need skills and knowledge to explore our changing landscapes and the passion and love of the environment to pursue difficult challenges.

This has been the focus of Purdue University’s Ross Biological Reserve for over 60 years. When Alton Lindsey founded the Ross Reserve, he imagined it to be a “living laboratory” -- an unparalleled place to make discoveries through field research, teaching and outreach in evolutionary ecology and conservation biology. Ross Reserve’s mature and developing forests have been studied by generations of students and community members, creating a rich heritage of research that is unique in the midwest. The Reserve is a lens through which we can connect with the natural world, promote scientific literacy, and better understand our impact on ecological systems.

We are starting a new chapter of Ross Reserve’s history as we create the Living.Lab @ Ross.Reserve. First, the Living.Lab will be a new lens to understand the Reserve, connecting us to our landscape through experiential learning. Second, the Living.Lab’s operational metabolism will actively contribute to the ecological dynamics of the Reserve. Lastly, the Living.Lab expands the community connectivity of the Reserve with additional visitor capacity while protecting the integrity of on-site research.

These facilities will enable us to touch more hearts and minds with deep and meaningful research and experience. The Ross Reserve has for six decades shown how such a foundation promotes further research, understanding, and stewardship. We hope that you will join us in the next phase of change with the Living.Lab @ Ross. Reserve.

Dr. Kerry Rabenold,
Department of Biological Sciences
PRINCIPLES

BY CONNECTING
people & place
代谢
经验

CREATING A LIVING BUILDING

AND MAKING OPPORTUNITIES
for learning by

the Living.Lab will strengthen Ross.Reserve
THE RESERVE

The mission of the Ross Biological Reserve and Alton A. Lindsey Field Laboratory at Purdue University is to integrate field research, teaching, and outreach in evolutionary ecology and conservation biology. The Reserve and Laboratory are run by the Ecology and Evolutionary Biology group in the Department of Biological Sciences, including 14 faculty. These facilities are 10km from campus in the prairie-forest transition of west-central Indiana adjoining other research areas that together form the 400ha Indian Pine Research Station. The Reserve includes 45ha of diverse mature forest bordering the Wabash River, and the laboratory provides an effective space for classes and researchers.

The Reserve’s rolling topography and diverse soils support a variety of forest types. When founded, it was a patchwork of mature and disturbed forest but has recovered to be as diverse and well studied as any forest in the midwestern US. These forests are the “living laboratory” envisioned by founder Alton Lindsey in 1948, and for many classes across the University, it clearly has embodied fundamental principles like ecological succession and conservation of biodiversity. Sixty years of forest monitoring provide a data-rich window on forest dynamics that has proven useful in planning and framing research projects. The diverse flora and fauna have been studied by generations of undergraduate, Masters and PhD students and research in the Reserve includes study of natural community composition and dynamics, evolutionary competitive strategies, resilience to anthropogenic impact, and restoration ecology. Investigations in population biology focus on sensory ecology, demography and genetics of populations, movement patterns and distributions of individuals, and impacts of exotic species.

The Reserve is also a center for the broader community to better understand the natural world, promoting scientific literacy, and understanding anthropogenic impacts on ecological life-support systems.
Undergraduates gain critical real-world insights from research and courses there, including Ecology, Evolution of Behavior, Conservation Biology, and Field Ecology that are expanding explicit study of long-term ecological processes from diverse scientific and cultural perspectives. Reserve programs have promoted inclusion of underrepresented groups in science through several grant initiatives and university organizations.

**Discovery at the Ross Biological Reserve contributes to Purdue’s dedication to experiential learning**, as the Reserve was established in 1949 to provide a “living laboratory” that long anticipated recent calls for interdisciplinary environmental research. Founder and eminent ecologist Alton A. Lindsey recognized the importance of an intact ecosystem as a focal point for ecological study by scientists at all levels and from many disciplines, and for six decades the Reserve has been such a focal point.
In the sixty years since its inception, the 45-hectare “living laboratory” of Ross Reserve has inspired thousands of students. It has been a principal focus for 30 PhD dissertations, 120 scientific publications (85 in the last 20 years), more than 60 Masters and honors theses, and hundreds of independent undergraduate studies and class projects including K-12 teacher training.

The Living.Lab @ Ross.Reserve will be the nexus of this activity, with facilities that integrate into and improve the Reserve’s ecosystems and change our role from observer to active participant within a dynamic system. The facility will close loops on site and will adopt the Living Building Challenge framework as a way to determine the efficacy of its systems. The construction and operation of the facility will itself be a multi-disciplinary learning opportunity as its creation is integrated into curriculum across the Purdue campus. The Living.Lab will coevolve with the site and provide a dynamic learning environment that will become the next legacy of Ross Reserve.
[IN] RESERVE

By definition, a reserve must maintain controlled access to preserve its flora and fauna for study. This creates an interesting paradox for a facility whose purpose is to welcome visitors, researchers and students. The Living Lab creates a new model for this interaction by becoming an interpretive threshold to the site that improves the site’s integrity while enhancing the visitor experience. The general public experiences the site’s successional landscape narrative through new indoor and outdoor classrooms and controlled trails. The addition of a caretaker residence provides both curatorial staffing for the facility and an additional threshold to maintain the Reserve’s integrity. Research activities have been organized to maintain access to the Reserve acreage, while the general public’s limited access ensures better conditions for undisturbed observation and experimentation.
DESIGN BRIEF

Flexible space for teaching, with access to technology and equipment.

Space for researchers to work on short and long term projects.

Space that could accommodate overnight stays by visiting researchers and scientists.

Living area for a graduate student “ecologist in residence”.

Exterior/interior transitions that experientially and physically connect building and site.
The Living.Lab connects people to place by inviting them to become active participants in the stewardship of their environment. Just as a biological organism seeks homestasis using feedback loops to adjust to changing conditions of its environment, the architecture frames and captures site forces such as stormwater, wind, and plant communities. The architecture will connect us to things that are often not integral to our buildings and provide dynamic systems that we can adjust to our environment. For example, the building’s dynamic enclosure systems enable inhabitants to create microclimates through varying degrees of enclosure. The architecture creates a permeable boundary between inside and outside, creating multiple layers of occupancy and a changing relationship between the visitor, the building, and the landscape.
ENERGY FOR SPACE CONDITIONING

A R-40 walls
B R-60 roof
C R-30 floors

Adopt Passive House strategies
Airtight, highly insulated walls, roof and floors, with minimal thermal bridging.

A Phase change wall system
for transfer of energy
B Sliding microclimate walls
for insulation, shading & wind blocking
C Indoor/outdoor sleeping loft

A Phase change wall system
for transfer of energy
B Hydronic slab for targeted heat
C Solar thermal source with storage
D Air exchanger

A Openings for natural ventilation
B Ceiling & exhaust fans
C Ground ventilation earth tubes
D Split system dehumidification & cooling for hottest days

note: all active systems are electric to meet the LBC ban on combustion
METABOLISM::energy

The Living.Lab manages its resources by conceiving of a building metabolism of energy, water and nutrients. Like a living organism, a building and its occupants have a metabolism that regulates inputs and outputs of its resources. The Living.Lab accounts for the site’s energy and resource flows as part of this metabolism and is designed to balance flows by closing loops on site where possible.

CONDITIONING. Since building conditioning and operations account for far more energy use than construction or demolition, the Living.Lab will minimize its long term footprint and will meet the Living Building Challenge for net zero energy performance through a three part passive-to-active strategy. First, the building will have a high performing thermal envelope. Second, the building will use current solar income for heating and electricity and will heat the occupants, not the space. Lastly, the building will combat summer heat and humidity by using natural heat sinks and ventilation, with active dehumidification and cooling systems as backup for only the most unbearable days or populous events.
**PHASE CHANGE MATERIALS**

The tiles, when composed into a wall, have the equivalent thermal mass to a 6” concrete wall. The sequence shows phase change material undergoing transition from clear to white opaque.

Images and research by Prof. Dale Clifford, Carnegie Mellon University

**ENERGY FOR ELECTRICAL USE**

Estimated PV potential: ~34,000kWh/y  
Estimated PV use: 10,000-15,000kWh/y  
Variables: equipment selection and frequency of use

**ANTICIPATED APPLIANCES**

- refrigerators [2]  
- microwaves [2]  
- dishwashers [2]  
- washer  
- stove.oven  
- computer  
- outdoor lighting  
- security system  
- wifi  
- TV/sound system  
- projectors  
- research equipment  
- hot water/heat backup  
- fans and ventilation
METABOLISM::energy

ELECTRICITY. While electrical demand can be lessened by selecting efficient equipment, total demand depends in large part on the frequency and intensity of use of the equipment and visible feedback technologies will be incorporated to help occupants monitor usage. With the rapid upgrading of lighting, motor, and control technologies, all installations will be easily accessible for future upgrades. Similar to conditioning strategies, natural daylighting has been maximized to minimize lighting and plug loads.

Electric power is provided from the site’s current solar income, as processed through photovoltaic panels, with grid backup. The design maximizes possible areas for PV installations to allow for incremental additions or a diversity of system types.

PHASE CHANGE MATERIAL. Organically derived phase change materials (PCMs) are effective in passively mediating daily temperature ranges within buildings by serving as thermal storage devices. As the material changes phase, significant amounts of latent heat is absorbed (melting) or released (freezing) contributing to passive temperature balance in the building interior. PCM use in buildings is an area of emerging research and this project will offer opportunities for material and biological science research for the university and with partner institutions.
A Blackwater collection
B Blackwater to landscape
C Greywater collection
D Greywater to landscape

roof area
1,800 SF
may collection
3,010 gal

sinks [4]
washer [1]
shower [1]
The Living.Lab, like all living systems, needs water and nutrients to thrive. One of the most direct resource transfers between building and site is through the exchange of water and nutrients. Often this occurs outside of the perceptual boundary of the building--water enters in pipes, waste exits much the same way--both are processed in a remote location. The Living.Lab will close these loops on site, harvesting rainwater and using living systems to create drinking water to support the human inhabitants. The Living.Lab will then release water and nutrients in a way that supports and connects it to the landscape as a closed loop system.

Systems are scalar, and are designed to match appropriate sources to uses. Rainwater will be cleaned through plant filters and stored for potable use. Greywater and blackwater will be processed on site at a level appropriate for the level of contamination of each. Since permitting and design of greywater systems has yet to be formalized in Indiana, the Living.Lab could serve as a demonstration project and will be an opportunity to work with Purdue University’s Agricultural Extension office on research with statewide relevance.
PHASE ONE
Construction of the water module.

PHASE TWO
Construction of roof structures create an outdoor classroom. Construction of outdoor classroom/panel structure allow for mobile panels for flexible enclosure.

PHASE THREE
Construction of enclosure, conditioning and power systems.

PHASE FOUR
Completion of site improvements to serve max occupancy.
The Living.Lab will offer robust learning opportunities for Purdue students and the West Lafayette community even before it has been completed. Much like a barn raising rallies a community around a common goal, the construction of the Living.Lab will engage departments and disciplines from across campus, showcasing their knowledge, providing opportunities for research, and giving students a chance to learn through firsthand experience. The building will also engage a larger community in its search for resources from the region, whether in the form of building systems, materials, technologies, or even living resources like native plant cultivation. It will create opportunities for Indiana based innovation as new applications for regional materials and products are developed and showcased in the Lab.

The Living.Lab design allows for distinct systems to be sourced, and constructed as resources become available. This will create greater opportunity to integrate into an academic schedule with clear collaborative mandates. The Department of Biological Sciences has begun this effort with the hosting of a public presentation and charrette to kick off the project design, followed by a semester long course on related topics including faculty, staff and students from the colleges of Science, Technology, Agriculture, Engineering, and Liberal Arts.

**SEMINAR TOPICS FALL 2012**

- Ross Biological Reserve Living Laboratory project: goals and progress
- Purdue’s Solar Decathlon project
- Sustainable building strategies on the Purdue campus
- The Living Building Challenge
- Campus Master Planning: Planning and Sustainability at Purdue
- Economic analysis of “green” buildings
- Landscape Architecture: Sustainable Sites Initiative
- High Performance Buildings Research in Architectural Engineering
- Interior design and green building
- Building Investment Decision Tools
- Designing the educational message of a “green” building
- Ross Biological Reserve Living Laboratory project: progress, plans and next steps
- Green Certification Programs

**LEARNING BY DOING**