UNIVERSITY of NOTRE DAME
School of Architecture

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Environmental Stewardship through Research and Design

PROJECT 3:
THE NOTRE DAME LINKED EXPERIMENTAL ECOSYSTEM FACILITY (ND-LEEF)
PHASE 2 RESEARCH & EDUCATION CAMPUS

A COMPREHENSIVE MASTERPLAN REVISITED

PROJECT INTRODUCTION:

In the spring of 2008, faculty from Notre Dame's Department of Biological Sciences submitted a proposal to the University's Strategic Academic Planning Committee (SAPC) for enhanced support for interdisciplinary research and education focused on sustaining "ecosystem services and human well-being"[1], known as The Notre Dame Environmental Change Initiative (ND-ECI). It was one of five Strategic Research Investments funded by the University.

Part of the ND-ECI proposal to expand current interdisciplinary research in climate change, land-use, invasive species, and freshwater ecosystems necessarily involves the development of a state-of-the-art, near-site, intermediate-scale research facility where Notre Dame Faculty can engage in specialized research and experimentation that will expand Notre Dame's current abilities to contribute policy and technology solutions to improve the environment and human welfare[2]. In addition to hosting research and experimentation conducted by Notre Dame Faculty, the facility will ultimately become a premiere center for critical environmental research and education, attracting visiting scholars and the community, alike, to engage in the transformative research happening there.

The Notre Dame Linked Experimental Ecosystem Facility (ND-LEEF) is located in close proximity to campus and bridges the large gap that exists between Notre Dame's on-campus laboratory facilities (considered "bench-scale" experimental facilities) and its remote Experimental Research Centers ("full scale" research environments), like the 7,500 acre UNDERC-East, located on the northern border of Wisconsin with Michigan, and UNDERC-West, which spans over a million acres in western and central Montana[3]. ND-LEEF sits within the roughly 400 acre St. Patrick's County Park which is located on the northern border of St. Joseph County, Indiana and Michigan, approximately 5 miles north of the Notre Dame campus[4].

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[1] As stated in the research proposal submitted to the University SAPC by ND-ECI Director and Professor of Biology, Dr. David Lodge; reference: G. Lamberti (Chair, ND Biology and Project Steering Committee Director 2008-2012), LEEF-ND Presentation to the Board of Directors of the St. Joseph County Parks. November 16, 2010.

[2] Ibid.

[3] To learn more about the University of Notre Dame's Environmental Research Centers (UNDERC), see: http://www.nd.edu/~underc

[4] See: http://environmentalchange.nd.edu/programs/nd-leef/ for more information about Notre Dame's Environmental Change Initiative (ND-ECI), press, and a description of ND-LEEF.

Multi-Phase Approach, One Comprehensive Master Plan:

The first phase of ND-LEEF involved the development of a comprehensive master plan for the novel indoor-outdoor experimental facility that includes linked aquatic ecosystems (both naturally occurring and constructed) in the form of wetlands, freshwater ponds and streams, sovereign and linked terrestrial ecosystems, experimental staging areas, a wireless sensor network, and site infrastructure to simultaneously support ND-LEEF experiments and broad-scale community outreach initiatives: K-12 and continuing education, tours, workshops, and both public and private events. All of the Phase 1 components included in the master plan are now in place, including two full research watersheds, experimental laydown areas, a terrestrial research plot, and The Morrison Family Education and Outreach Pavilion, an outdoor classroom (see construction photos and site plan provided).

The second phase of the master plan – the completion of 10 additional watersheds and the addition of a formal research and education campus – will further support the pioneering experimental facility (the linked ecosystems and allied sensor network will be singular in the world) with exhibition, laboratory, classroom, collaborative workspaces, and faculty and administrative services. Funding for the development of Phase 2 currently involves efforts by Notre Dame's Development Office and potentially other private and institutional funding sources.

Per the proposal submitted to the ND-ECI, some of the potential applications and proposed uses of the new experimental facility are as follows[5]:

1. To conduct realistic-scale field experiments in global change biology that uniquely integrate responses of the terrestrial, wetland, and aquatic ecosystems.
2. Test new water treatment technologies, including wetlands
3. Test real-time wireless-networked water quality monitoring technology
4. Grow plants and rear animals for use in laboratory and field experiments
5. Support classes with experimental facilities needed (to develop) new labs
6. Facilitate outreach activities with local schools and community groups
7. Attract world-class researchers and educators to Notre Dame and South Bend for studies and sabbaticals

Primary Project Goals and Considerations:

The comprehensive campus master plan and any structures designed for the new facility must fully integrate the needs and objectives of *both* of your clients, Notre Dame and St. Patrick's Park (and by extension, the public, who as tax payers own the land being developed for this endeavor). Looking beyond Notre Dame's goal to advance critical environmental and climate change research, the facility is intended to be a model education and outreach facility, fostering enhanced educational programming at all levels while increasing visitorship (and revenues) to the county park system. Accordingly, and as an embodiment of the Catholic mission of Notre Dame (to care for one another *and* all of God's Creation), the LEEF facility – any and all of the capital improvements to the Park that are involved in its fulfillment will be a model for truly sustainable and durable design and an enduring example of environmental stewardship. This may be achieved with the following goals in mind[6]:

[5] The anticipated uses and goals articulated here were taken directly from the funding proposal for the LEEF-ND Facility submitted to the ND-ECI by the LEEF-ND Steering Committee in the spring of 2010.
[6] List of goals adapted from the AIA's 2015-2016 Council on the Environment (COTE) Student Design Competition proposal, "Ten Sustainability Measures".

- **Resource efficiency** through innovative programming and the reduction of any unnecessary square footage
- **Identity and sense of place** that promotes community interaction while educating the user about the environmental strategies employed
- **Biolclimatic and passive design** responses to local climate, sun path, prevailing wind patterns, seasonal and daily patterns (including responses indicated in building plan, section, massing, location, orientation, shading, etc.)
- **Incorporation of on-site renewable and alternative energy strategies** in addition to ways that the design fundamentally reduces energy loads for heating/cooling and lighting, especially at peak demand**.
- **Integration of natural systems and technologies** to promote daylighting, passive ventilation, indoor air quality, access to views and connection to nature
- **Site water management strategies** that capitalize on renewable water sources, water-conservation techniques (landscaping and building design strategies), and water re-use strategies
- **Selection of materials** that promote durability and human health and meanwhile consider the broader life-cycle impacts of materials and methods chosen.
- **Adaptable/ flexible design** and materials that promote long-term use, flexibility, durability, and adaptive re-use potential

Meanwhile, the goals and concerns of both primary stakeholders (ND and Park) must be thoughtfully and equally weighed in the development of the master plan and Phase 2 (and any future phases). Among the goals and concerns to be considered simultaneously and met in the design of the new facility:

ST. PATRICK'S PARK:

Goals:

1) Potential for resource sharing (maintenance equipment, personnel)
2) Potential to satisfy long-range infrastructure goals (Park's), including:
   a. **Addition of a new access road from Kenilworth Drive (and potential decommissioning of a segment of Laurel Lane/ existing entry road)
   b. Potential for shared parking closer to the 9/11 Memorial
   c. Addition of new classroom, exhibition, and public program space
3) Potential for facility to serve as a new gateway or Welcoming Center for the Park

Concerns:

1) Location and size of overall facility, potential displacement of Park activity (i.e.: walking and cross-country skiing trails, etc.), and natural habitat.
2) Proximity of new infrastructure and structures to existing structures, like the 9/11 Memorial, in terms of possible encroachment
3) Proximity and size of new permanent structures, with respect to:
   a. Ease of access between existing park structures and new
   b. Architectural continuity, both in size and character, with existing Park buildings and regional, historic architecture
4) Ease of access to facility by park visitors and, equally, safety and security of visitors

NOTRE DAME:
Goals:

1) To build an active partnership with St. Patrick's Park, the county park system, and the public.
2) To maximize the impact of the research while minimizing site impact at all levels of design (infrastructure, physical footprint) by optimizing use of existing natural and man-made features of site, such as:
    a. Existing infrastructure (utilities, roads, storage structures; trees, waterways, native vegetation)
    b. Proper building orientation, massing, and arrangement
3) Construction of novel linked aquatic and terrestrial ecosystems to existing drainage courses, whether man-made or natural, that channel to the St. Joseph River (see Phase 1 watersheds).
4) Construction of a state-of-the art research and education facility that will support:
    a. Experimentation at a manageable scale to address important global change issues
    b. Broad-scale community outreach and education, including the ability to enhance information exchange by launching real-time web-based environmental data
    c. Greatly improve ND's ability to compete for external funding for related research and experimentation in these areas
    d. **The broadest possible vision for the facility and its future potential uses**
5) Integration of passive technologies and principles of design that will result in the creation of a model, state-of-the-art research facility that truly embodies sustainable design and environmental stewardship

PROJECT SITE:

At the outset of the project (2009), several sites for the ND-LEEF facility at St. Patrick's Park were considered. The project Steering Committee (ND), the Director of St. Patrick's Park, and the Board of Directors of the St. Joseph County Park System ultimately agreed to the initial development of an approximately 30 acre section of former farmland that sits immediately east of Laurel Road and is bounded to the south by the property line dividing Park property and land owned by the Brothers of the Holy Cross. The plot is bisected (roughly) by an existing drainage channel and could be bound to the north by the future proposed Park Entry Drive at the intersection of Kenilworth and Adams Roads and the current entry to the Park from Laurel Road (see Phase I masterplan).

The Park, the Steering Committee, and the Park's leadership identified the ND-LEEF site as uniquely suited to support the specialized research planned for the facility for the following reasons:

1. The Drainage Channel:
    a. The presence of a naturally-occurring water course across the breadth of the site provides a unique opportunity to link the constructed ecosystems directly into a natural ecosystem (the purpose of the experimental ponds is to test the impact of water treatments on linked habitats);
    b. The drainage channel is linked to a chain of natural and man-made ponds that ultimately collectively outfall into the St. Joseph River

c. A sophisticated sensor network will be installed throughout the facility to track real-time data from the experiments and will be extended to monitor water quality and data along the entire watercourse
d. Such a system of linked and sensored constructed and natural ecosystems will be the first of its kind in the country and likely the world, providing the researchers at the facility with the opportunity to engage in cutting-edge and novel experimentation

2. Proximity to Existing Park Infrastructure and Facilities:
   a. Locating the facility near the existing park offices and public programming space will encourage visitors to the Park to visit the new facility and vice-versa
   b. Potential to share amenities, like parking, for the new facility, and the 9/11 Memorial
   c. Potential for facility to act as a gateway or Welcoming Center for the Park.
   d. Park Rangers can monitor the facility site during routine patrols (whereas a more remote site may require additional security measures)

3. Character of the Land:
   a. Flat (little to no natural grade change)
   b. Suitable soil composition for construction activity proposed
      1) Sand, gravel
      2) Water table at 3'-0" below grade
   c. Land was recently (within the last 5 years) released from agricultural use so the ground cover over much of the site – native grasses, low scrub, and saplings – is relatively young and not yet fully established
   d. Trees:
      1) There is an existing line of trees along the western edge of the site and along both sides (north and south) of the drainage channel.
      2) A tree survey has not been performed to determine the size or species of the existing trees on the site, but conservative measures should be taken to maintain as many significant trees as possible.

NATURE INTERVENES:

In the fall of 2014, after the conclusion of Phase 1 construction and substantial completion of The Morrison Family Education and Outreach Pavilion, Park visitors and naturalists witnessed the potentially historic arrival of two adult bald eagles who began breeding behavior in a former red tail hawk nest perched high above the first watersheds constructed at ND-LEEF. Bald eagles are our national bird and while no longer protected by the Endangered Species Act, they are specifically protected by the Bald and Golden Eagle Protection Act. As such, human activity is necessarily limited in areas where protected species are found and, importantly, in locations and times of year when those species are reproducing. In May of 2015, St. Joseph County welcomed the first eaglets born in the county in recorded history, one in the nest high above ND-LEEF and the other at Potato Creek State Park.

Per the National Bald Eagle Management Guidelines, human activity should be kept to a minimum within 300' of the nest between the months of December and August and heavier activity, including construction, cannot occur within 600' of the nest during the same time period. Furthermore, no development should be constructed within 600' of the nest unless there was existing precedent (similar

size and scope development) present within 600' of the nest BEFORE the eagles first started nesting at the site.

As a result – and in order to advance Notre Dame's research objectives and broader goals at ND-LEEF – the project stakeholders are considering additional viable sites for Phase 2 within the 300+ acre Laurel survey area. Therefore, your proposed masterplan for Phase 2 must consider these guidelines in the location of all permanent construction, though you may elect to construct additional watershed and field research infrastructure during the off-season.

INTERDISCIPLINARY RESEARCH AND DESIGN:

ND-LEEF is intended to be a model facility for the advancement of critical environmental change research related to land use and global change biology. Accordingly, the parent facility designed to support this important work should be planned and executed in the most environmentally responsible way possible – from the guiding Master Plan, to design of the buildings, and the materials and methods employed in their construction and operation – so that the facility, itself, becomes an enduring *and* didactic example of environmental stewardship.

In support of the vision of ND-LEEF – to maximize the impact of the research while simultaneously minimizing the overall impact of the new facility on the natural environment, i.e.: "light touch" – you should endeavor in your design of the facility to integrate inherently durable and sustainable principles of architecture and urbanism at every opportunity (see pages 2-3). Strongly consider the mantra: Optimize with passive and amplify, only when necessary, with active means (A. Buccellato).

One of the ways that we will seek to understand and advance our knowledge of high performance building design is through collaboration with your engineering studio-mates. Together, you will work in pairs to incorporate feedback from prevailing building energy analysis tools into your master plan and building design process. Through on-going collaboration, the project teams will arrive at an optimal building design (Project 3b), one that performs exceptionally well in its context, for its purpose (client/ cultural) and that exceeds industry-standard energy performance goals (total annual energy consumption) for the building type. This tight, iterative process is meant to encourage the design teams to consider, from the outset of the design process, the impact of building orientation, massing, materiality, etc., on operating energy use, and enable informed decision-making about design compromises and trade-offs.

***Refer to the Appendix for the energy performance criteria and targets for your comprehensive building design and the list of deliverables that you are responsible for producing for your mechanical engineering counterparts**.

**** Refer to the Course Syllabus for overarching project objectives and pedagogical goals.**

PROJECT PROGRAM:

Existing Phase I Components, to remain:

Watersheds (Linked Experimental Ecosystems): 2
- Freshwater pond (1 ea.)
- Freshwater stream (2 ea.)
  (with controlled connections between aquatic and terrestrial components)
- Wetland (1 ea.)

} *Ref. diagram/ constructed*

Other Constructed Aquatic Components:
- Water Supply Reservoir(s) 1
- Well Head 1

Constructed Terrestrial Plots: 1

Outdoor Experimental Staging Area (approx. 2000 SF)

¼ (min.) of the staging area should be covered to store cattle tanks used for experiments

** See Site Plan for existing temporary experimental staging area; this can be retained and incorporated into your design or removed/ relocated.

Temporary Parking Lot (10 cars including at least one handicapped and van accessible spot)

Temporary Access Road (gravel)

** See Site Plan for the location of the existing temporary access road; this can be retained and incorporated into your design or removed/ relocated.

Sensor Network Field Hub (1) and Sub-Station Locations (up to 14 through Phase II)

Phase II Components, Field Science Infrastructure:

Watersheds (Linked Experimental Ecosystems): 10
- Freshwater pond (1 ea.)
- Freshwater stream (2 ea.)
  (with controlled connections between aquatic and terrestrial components)
- Wetland (1 ea.)

} *Ref. diagram/ constructed*

Important Considerations:

1. In order to minimize the number and activity of mechanical pumps to circulate water through the linked components, the watershed module was designed to naturally flow from reservoir to pond, from ponds to wetlands, and finally from wetlands into the drainage channel, using a minimum pitch of 1%

2. Spacing between ponds, plots, etc. should accommodate primarily pedestrian circulation and light vehicle traffic, as well as bypass streams.

Other Constructed Aquatic Components:
- Water Supply Reservoir(s) 1
- Well Head 1

Constructed Terrestrial Plots: 2, min.

Storage & Research Barn (4000 SF; gross) and Experimental Staging Areas:
- 3 bays to accommodate large earth-moving & maintenance equip (approx. 500 SF ea.)
- Indoor Experimental Staging Area and equipment storage (550 SF min.)
- Temporary Offices (3) for Facility Manager and Admin. Staff + Storage (120 SF ea.; 400 SF total)
- Sensor Network Lab & Equipment Storage (Phase I) (200 SF)
- Flexible Workspace/ Conference Rooms (2) (200 SF ea.)
- Men's Bathroom, Shower, and Locker Facilities** (approx. 180 SF)
- Women's Bathroom, Shower, and Locker Facilities** (approx. 180 SF)

** Consider providing access to Men's and Women's Facilities from both inside and outside the Storage Barn

Mobile Weather Station Laboratory (shipping container) – Identify Primary Location

Phase II Components, Research and Education Facilities

The facilities designed to support research and education activities on the ND-LEEF campus are to be designed to accommodate and support the following personnel and program:
- 8 Primary Researchers
- 2 Visiting Scholars
- 4 Visiting/ Graduate Research Assistants
- 1 Facility Director (full-time)
- 1 Facility Manager (full-time)
- 1 Public Programming Coordinator (part-time)
- 2 full-time Facility Administrators
- 1 Facility Administrative Assistant (shared)
- University of Notre Dame undergraduate & graduate-level field biology coursework
- Continuing Education and Public Outreach Programming
- Academic Conferences, Seminars, and Private Events

Research and Education Facilities: **42,000 SF**; gross approx.**)

**** Gross SF includes estimated 40% of net total SF typically dedicated to mechanical equipment, circulation, restroom facilities. This estimate is conservative and subject to the configuration of the building(s) relative to the incorporation of EOC, which may necessarily increase total building footprint.**

Minimum Programmatic Requirements – R & E Buildings:

Gallery & Exhibition Space (2,000 SF)
- Exhibitions, Flexible Classroom Space, Tours and Facility Events (public outreach, private)
- Welcome Desk/ Information Kiosk

Research Laboratories (10) (1000 SF ea)
- 1-2 of the Labs can be located inside the Greenhouse (see below)
- Research Laboratory Storage & Supplies (200 SF ea)
  (Two labs can share support space, but spaces must be directly accessible to both labs)
- Research Assistant Offices (10); adjacent to/ inside Labs (120 SF ea)

Seminar/ Classrooms (2) (600 SF ea)
- To accommodate 30 students each

Lecture Hall/ Large Conference/ Classroom (1) (1200 SF, approx.)
- May be tiered/ auditorium style or flexible configuration**

Faculty Offices (10) (120 SF ea.)

Small Conference Rooms/ Flexible Workspaces (4) (250 SF ea)

Administrative Services:
- Ground Floor Administrative Desk (50 SF)
- Facility Director's Office (175 SF)
- Facility Director's Conference Room (250 SF)
- Facility Manager's Office (150 SF)
- Administrative Offices (2) (150 SF ea)
- Storage & Administrative Supplies (100 SF)

Men's & Women's Restroom Facilities (separate) *

* Must be fully accessible and designed to accommodate typical building occupancy and all code requirements

Additional Terrestrial Experimental Areas:
Large-Scale Terrestrial Plots
- Could be in the form of a Garden Forecourt for the Research and Education Facilities
- Natural vegetation and terrestrial staging

Greenhouse (1, minimum): (4,000 SF; gross)
- Storage/ Preparatory Staging Area(s)
- Men's and Women's Restroom Facilities
- Optional: "In-house" Laboratory Space (1-2)

New Entry Drive to Park (see St. Patrick's Park Master Plan for approximate location); consider potential to decommission current entry (Laurel) lane above rotary.

New Public/ shared Parking Lot (60 cars; including requisite number of handicap accessible spaces)

IMPORTANT PROGRAMMATIC CONSIDERATIONS FOR THE RESEARCH AND EDUCATION FACILITIES:

1) The number of buildings to accommodate the Research and Education Facilities and the number of floors (overall building height) is to be proposed by the designer, although 2 stories above-ground is anticipated. Special attention should be paid to the physical footprint of the facility, and therefore its efficiency in plan, the coordination and distribution of services, and the effective integration of passive methods.

2) Location of mechanical equipment, ductwork, restrooms, janitorial closet(s), telephone/ fiber-optic/electrical closet(s), elevator shafts and access, fire rated stairs and points of access and egress are to be included on each floor.

3) Special consideration should be given to the location of "back of house" services (i.e.: maintenance services, loading, trash collection) relative to the location of the facilities on the site, balancing ease of access to and visibility of those services.

4) The geotechnical survey revealed superb soils (sand and sandy loam) and the level of the water table is just 3'-0" below grade (which will need to be considered in foundation design and sub-grade construction).

REFERENCES: (SIMILAR EXPERIMENTAL FACILITIES AND BUILDINGS)

Annis Water Resources Institute (ANRI), Grand Valley State University
Location: Muskegon, Michigan
http://www.gvsu.edu/wri

Shell Fisheries Center, Auburn University, Department of Fisheries and Allied Aquacultures
Location: Auburn, Alabama
http://www.ag.auburn.edu/fish/facilities/index.php

Kellogg Biological Station (KBS), Michigan State University
Location: Richland, Michigan (Gull Lake)
http://www.kbs.msu.edu

Olentangy River Wetland Research Park, The Ohio State University
Location: Columbus, Ohio
http://swamp.osu.edu

Fisheries and Illinois Aquaculture Center, Southern Illinois University
Location: Carbondale, Illinois
http://fisheries.siuc.edu/facilities.htm

Virginia Commonwealth-Rice Center, Virginia Commonwealth University
Location: on the James River (between Richmond and Williamsburg), Virginia
http://www.vcu.edu/rice

United States Geological Service, Columbia Environmental Research Center (CERC)
Location: Columbia, Missouri
http://www.cerc.usgs.gov
(see select photos on course website ARCH 41121/ Sec 3)