FLOW

THE MAKING OF THE OMEGA CENTER FOR SUSTAINABLE LIVING

BOB BERKEBILE + STEPHEN McDOWELL + LAURA LESNIEWSKI
FOREWORD BY DR. JOHN TODD

BNIM

Authors
Bob Berkebile, Steve McDowell, Laura Lesniewski
Foreword by Jonathan Todd

Book Design
BNIM Architects. *Designer* Beena Ramaswami. *Project Coordinator* Erin Gehle

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Project Team
Architect
BNIM Architects Steve McDowell. Laura Lesniewski. Brad Clark. Sarah Hirsch. Ramana Koti
Civil Engineer
Chazen Companies, Jim Beninati
Construction
David Sember Construction. David Sember
Ecological Design
John Todd Ecological Design. Dr.John Todd. Chloe Starr. Conor Lally. Kim Robinson. Jonathan Todd
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AT THE OMEGA INSTITUTE FOR HOLISTIC STUDIES
RHINEBECK, NEW YORK

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ABOUT BNIM

BNIM is one of the most significant design firms working to redefine practice in the realm of green architecture today. As early pioneers in the arena of sustainable design, BNIM continues to shape the national and global agenda for responsible architecture and design excellence. Established in 1970, the firm has emerged nationally as a leading resource for established methodologies, innovative technologies and cutting-edge research in architecture, planning, landscape and workplace design. Our process is deeply rooted in the concept of integration, where clients and collaborators work together to create buildings and spaces that embrace the Triple Bottom Line—a balance of people, planet and prosperity.

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FOREWORD BY DR. JOHN TODD

BNIM

Foreword

DR. JOHN TODD
John Todd Ecological Design | From a talk presented at the Water for Life Conference | October 24, 2008 | Omega Institute

Water.
Water and Life.

One of my favorite places to go is where you have a very slow moving waterfall and the side of a rocky cliff that is covered with mosses. I don't know if you have done this but, in the woods, you can feel the water dripping down and flowing through the mosses. If you look at mosses under a dissecting microscope, they are amazing architectures for intercepting small amounts of water and transforming the water, and themselves, in the process.

If you lick that water, at the base of the waterfall, you get the experience of what water can be like. That's it. There's nature at work purifying water.

Right now, typically, in a city like Burlington, Vermont there are between twelve and fourteen chemicals – for all kinds of purposes – applied to the drinking water before you get it. What you get is a sterile product with certainly dubious drinking water quality. And it really represents a failure of how we think about water.

When one compares the moss versus the chemical trucks backing into the water purifying station on the waterfront in Burlington, you see there are these two realities, two utterly different realities.

One is the intelligence of nature solving one of the most complex problems without any negative side effects. The other is creating a legal liquid with external, detrimental forces that extend far beyond what we can imagine.

In the 21st century, the ecological sciences have reached a point where we moved in and began to decode nature's teaching – and apply them to our problems in every way. This can work at any scale, including the household. What will be important about the synthesis of the architecture and Eco Machine™ at the Omega Center for Sustainable Living is that it will allow us insights into this: what we hope will be an ecologically defined age in which the highest order of our efforts is the stewardship of water. ∞

Introduction

STEVE MCDOWELL

> It is the pervading law of all things organic and inorganic,
> Of all things physical and metaphysical,
> Of all things human and all things super-human,
> Of all true manifestations of the head,
> Of the heart, of the soul,
> That the life is recognizable in its expression,
> That form ever follows function. This is the law.
>
> *Louis Sullivan*

The human body is what it needs to be. It is wide in the places that organs reside, where nutrients are processed, offspring originate and the heart and lungs process oxygen.

The body is sleek and muscular where needed. Arms and legs provide propulsion and mechanical ability for sustaining life.

Every living human is more than sixty percent water held together by interconnected tissue, organs and structure. Its organs have integrated responsibilities that work in concert to maintain life and radiate beauty.

Form ever follows function.

The Omega Center for Sustainable Living (OCSL) is a body that is given form by the structure of the architecture of the building and its surrounding wetlands and landscaped gardens.

Like other living organisms, the OCSL is mostly water. The facility is a microscopic part of the water system that gives life to all things living on the Earth. Without water the building and its landscape would not exist.

The building and landscape serve a noble purpose: water that has been used by humans in daily life passes through the landscape and building undergoing very specific processes that remove all nutrients, solids and impurities yielding clean fresh water that is returned to nature via the aquifer. That water then returns to the cycle of life and serves the needs of New Yorkers downstream and beyond.

Form ever follows function.

Each decision regarding the design of the OCSL was weighed to meet the purpose and mission of the building and landscape. Five million gallons of water pass through the building and landscape each year. Lagoons designed to clean the water through natural processes occupy nearly half of the building. Plants thrive with their roots submerged in the water and leaves and flowers capturing sunlight that is directed through south windows or the overhead tracking skylights. The building plan and sections are closely integrated to fulfill the functional and experiential needs of each space. The two main volumes—the Eco Machine™ room and Classroom—are connected to the smaller north services building by an

interstitial lobby space. Surrounding the interior spaces are landscaped wetlands, a shaded terrace and stepped gardens.

The long axis is aligned to harvest sunlight. It faces south though angled slightly easterly to direct views away from outdoor yoga spaces. This decision was tested to ensure that the performance of the photovoltaic panels would not be compromised. Precise light levels are required for the plants to thrive — 30,000 Lux. The tall glass south wall fills the volume of the building with solar energy throughout the year. The overhead skylights precisely aim lumens of energy upon the leaves of the plants throughout the year.

Water moving through the lagoons is a source of warmth or coolness depending upon the season. Well-insulated concrete floors, lagoons and walls harvest and store the waters' energy, providing comfort and building efficiency. Passive solar heating, high-performance glazing and rain screen wall systems reduce heating demands without sacrificing comfort. Reclaimed naturally aged cypress cladding provides a protective and beautiful skin for the rain screen and thermal envelope. The building design relies on operable windows and the coolness of the lagoons of water and concrete mass. All lighting systems, HVAC equipment, pumps and other equipment are extremely efficient and right-sized, which minimizes energy demands. The roof acts as a fifth façade — it harvests daylight, facilitates collection of solar energy, sustains native plants and protects the interior environments.

A control-system monitors and measures the building conditions, allowing systems to only operate when needed, which further reduces energy use throughout the building. The building is a living building—it harvests its own energy, cleans its water, gives back more than it uses, mimics nature and embodies its own sense of beauty.

A few years ago the notion of a building that harvested its energy from the sun and cleaned its own water using nature would have been considered super-human, to use Mr. Sullivan's words. But perhaps a more accurate descriptor is super-nature. The OCSL is super-natural. Clean water is the focus of the building. The design model is nature — the beautiful flowers, plants, the sun, earth and microorganisms at work across the world that are intrinsically recycling water for reuse.

The OCSL is an example of manmade systems — the building and constructed landscape — helping nature to expedite its processes. In return, nature is an active and engaged participant in the building: sunlight, plants, soils and bacteria remove impurities and solids to create clean water; the sun provides all the energy (and a little more than is needed) to operate the building and facilities via photovoltaic panels. The unused energy is fed back into the local energy utility—super-nature.

Since the first concept of sustainability emerged within architecture, there has been considerable debate about the relationship between sustainability and design excellence. Each must coexist for either to be achieved. One can imagine the symbiotic relationship between the ideas of beauty and climate positive buildings. The OCSL was designed to illustrate this symbiotic relationship; to perform by giving back resources rather than consuming through carefully constructed experiences that are beautiful and enduring. In the end, if the OCSL can touch each person's senses richly and positively, provide mental and intellectual fulfillment and delight all while being deeply rooted in nature and the ecologies of the site, it will have helped to settle the debate.

The OCSL is a product of a fact-based design process and approach that carries the project through intuitive | scientific | experiential stages that involve hypotheses, testing and conclusion. Our design process began with intuitive ideas that were measured using scientific tools and models in order to predict ultimate performance and behaviors. Tools, such as building information modeling software, allow us to predict and communicate the experience to our clients and future users. Each layer of the building and site—structure, daylighting system, landscape, building program and many more—is evaluated, designed and integrated as part of the whole.

This project is one example of how science, measurement, and anticipation of building behaviors have furthered the notion of design so that, in a true sense, form ever follows function. The design of this building emulates the metamorphosis that our firm has gone through over the past decade. For BNIM, the metamorphosis has been a steady progression towards an ideal balance of beautiful form and efficient function. The journey has ultimately led us to find the symbiotic relationships between beauty and high performance that are required for sustaining and improving life for humankind and natural ecologies. ∞

.

I like to think historians will look back on this decade and say it was the beginning of a Renaissance – a time when the understanding of the interdependence of all life became a blueprint for living; a time when individuals, organizations, and cultures around the world woke up and took stock of what really matters.

Being optimists at heart, we at Omega Institute look at the crises of our times and we see opportunities for a reexamination of human values and ways of living. Since it seems that it's human nature to make big changes only when confronted with big challenges, we have the chance – now more than ever – to move from an old paradigm of exploitation to one of sustainability and creativity.

How do we do this? How do we resist becoming overwhelmed or pessimistic or frightened? First of all, it helps to suspend a cynical worldview long enough for a new vision to emerge. We need hope in times of change. We need skills like flexibility, tolerance and inner strength.

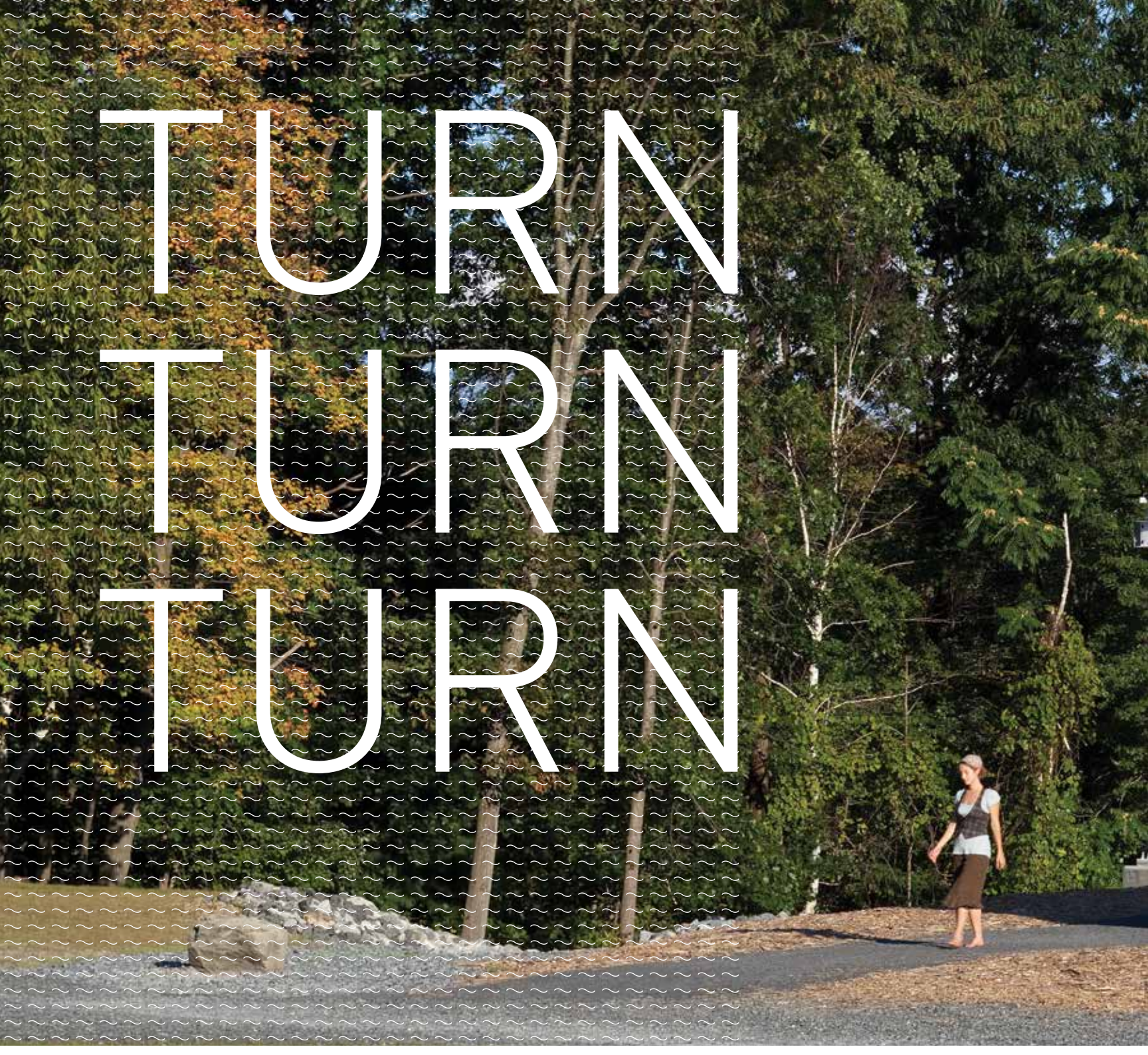
And we need each other.

At Omega, you will find others with a passion for positive change – people co-creating a more hopeful future through everyday choices and more mindful ways of relating to each other and the world. Our mission is to be a resource for that future. For thirty years, we have offered holistic learning experiences with the world's most qualified and inspiring faculty – workshops, trainings and conferences that nourish the body, mind and soul, and that honor lifelong learning and personal growth.

New in 2009 is the Omega Center for Sustainable Living. The Center will be the anchor for our environmental efforts on campus. It will bring under one roof our state-of-the-art energy and waste systems, our efforts to work with area farms and organic growers, and a teaching facility that demonstrates local solutions to global problems. So, when you come to Omega, you become part of a growing community of people working together to jumpstart the Renaissance! ∞

A Vision for Omega

Message from SKIP BACKUS adapted from the Rhinebeck Campus Guide


TURN
TURN
TURN

To Everything (Turn, Turn, Turn)
There is a season (Turn, Turn, Turn)
And a time for every purpose, under Heaven

A time to be born, a time to die
A time to plant, a time to reap
A time to kill, a time to heal
A time to laugh, a time to weep

To Everything (Turn, Turn, Turn)
There is a season (Turn, Turn, Turn)
And a time for every purpose, under Heaven

A time to build up, a time to break down
A time to dance, a time to mourn
A time to cast away stones,
A time to gather stones together

To Everything (Turn, Turn, Turn)
There is a season (Turn, Turn, Turn)
And a time for every purpose, under Heaven

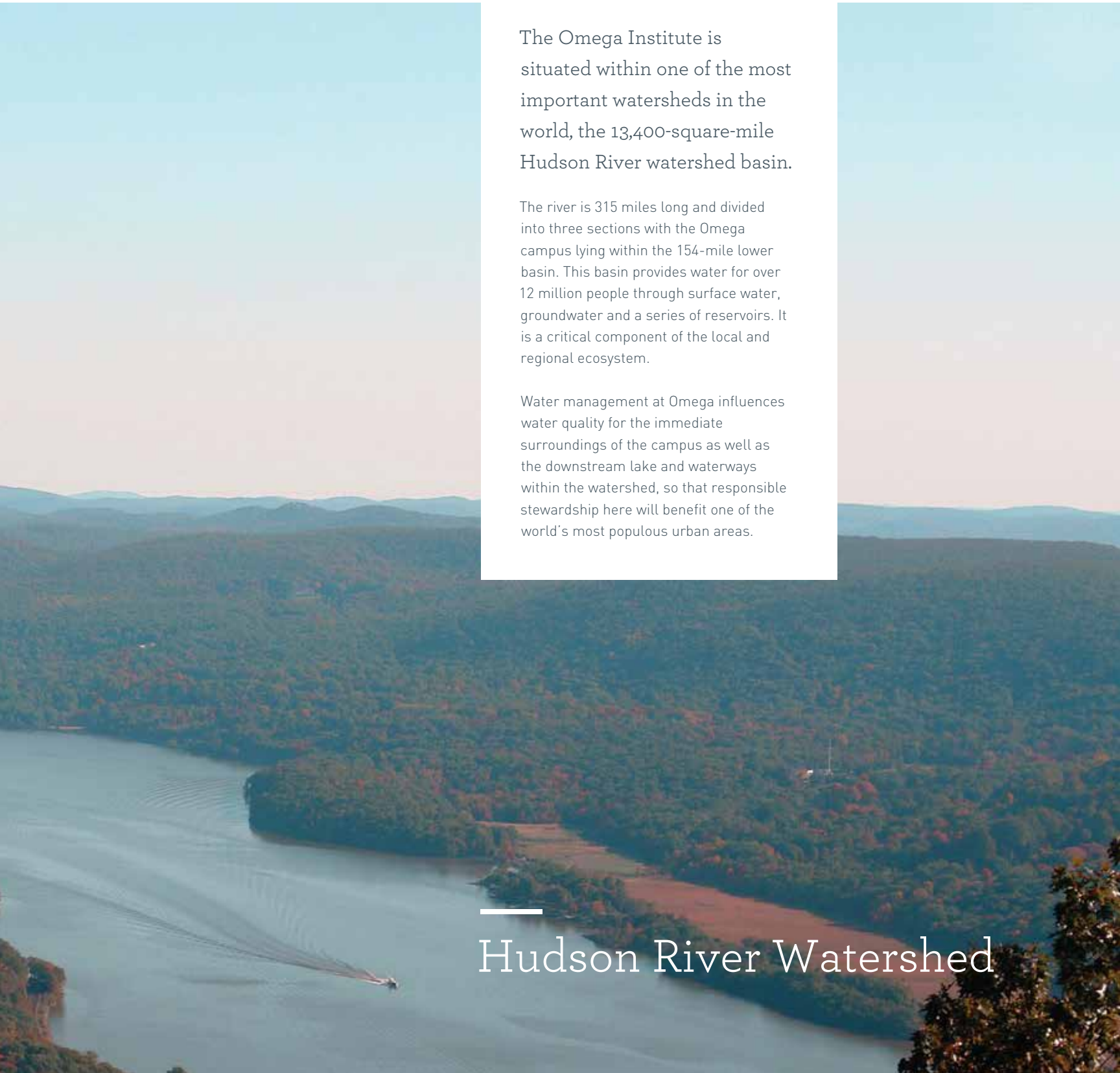
A time of love, a time of hate
A time of war, a time of peace
A time you may embrace,
a time to refrain from embracing

To Everything (Turn, Turn, Turn)
There is a season (Turn, Turn, Turn)
And a time for every purpose, under Heaven

A time to gain, a time to lose
A time to rend, a time to sew
A time to love, a time to hate
A time for peace, I swear it's not too late

Song composed by Pete Seeger in 1959. Performed live on October 11, 2007 at the OCSL Groundbreaking.


“TAKE CARE OF THE LAND AND
THE LAND WILL TAKE CARE OF YOU.”
HUGH H. BENNETT

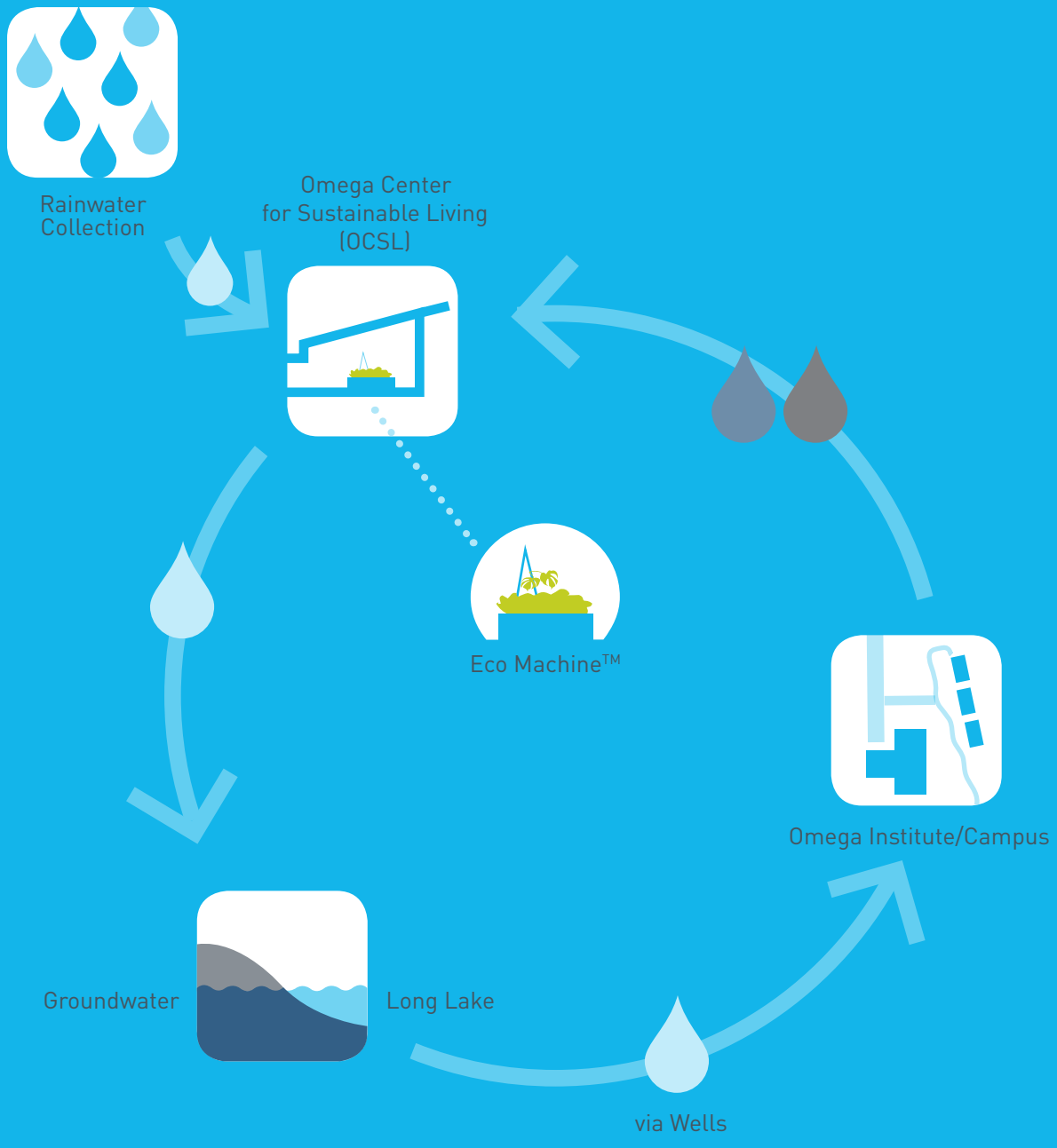


Hudson River Watershed

The Omega Institute is situated within one of the most important watersheds in the world, the 13,400-square-mile Hudson River watershed basin.

The river is 315 miles long and divided into three sections with the Omega campus lying within the 154-mile lower basin. This basin provides water for over 12 million people through surface water, groundwater and a series of reservoirs. It is a critical component of the local and regional ecosystem.

Water management at Omega influences water quality for the immediate surroundings of the campus as well as the downstream lake and waterways within the watershed, so that responsible stewardship here will benefit one of the world's most populous urban areas.



Life of Water

As the world's population approaches seven billion, the need for even greater amounts of clean water will grow. At the same time, our actions are reducing the amount of accessible clean water. It is time to change the patterns of the past, water abuse among them.

Water supply on the Omega Campus at Rhinebeck is provided direct from the groundwater via wells on campus. Prior to the construction of the OCSL, water was drawn from the wells, used for multiple human activities, then piped to a septic/leach field system along Lake Drive. The Omega Center's Eco Machine™ now returns a higher quality of water back to the earth using natural systems that see our waste as food. For potable water uses, well water is still drawn from the earth. For toilet flushing, rainwater is collected from the Omega Center's roof. For all other water use on campus, black and grey water is sent to the Eco Machine™ lagoons and constructed wetlands at the Omega Center for purification. Within the Omega Center building, and throughout the campus, low-flow plumbing fixtures have been installed to minimize water consumption, including waterless urinals in the men's restroom. By the end of this cycle that uses natural systems, cleaner water is reintroduced to the groundwater and lake.

Daylighting, natural ventilation and views are achieved through a system of operable, fixed and solar tracking fenestration. Operable windows are provided in each occupied space for both the health and enjoyment of guests, in addition to being part of the passive heating and cooling strategy for the building. Plants in the engineered biological wastewater treatment system remove carbon dioxide and other gasses while producing oxygen—indoors and outdoors. Clerestory windows ventilate the lobby, mechanical room and restrooms. Solar radiation heats the upper volume of air, and then natural buoyancy induces stack ventilation, which causes the air to push its way out of the open windows and pull in fresh, cooler air from lower windows in these spaces. Operable windows integrated into the south façade also allow for natural ventilation to assist in pushing hot air out of the building by channeling prevailing breezes that have been cooled while moving over the wetlands.

Building and site are integrated as a single system. The landscape produces a microclimate of clean air and beauty beneficial to the occupants. Water from the building feeds the plants and other living systems of the landscape. The two are visually connected by the transparency of each indoor space.

far left: A salvaged door.
left: The lobby is lit with natural light entering through a clerestory. Interior materials include reclaimed beech ceiling material, FSC-certified wood windows, urea-formaldehyde free wood beams and salvaged doors.
right: The building's design blurs the line between indoors and outdoors. The yoga studio is adjacent to a covered outdoor classroom to extend its usable area.

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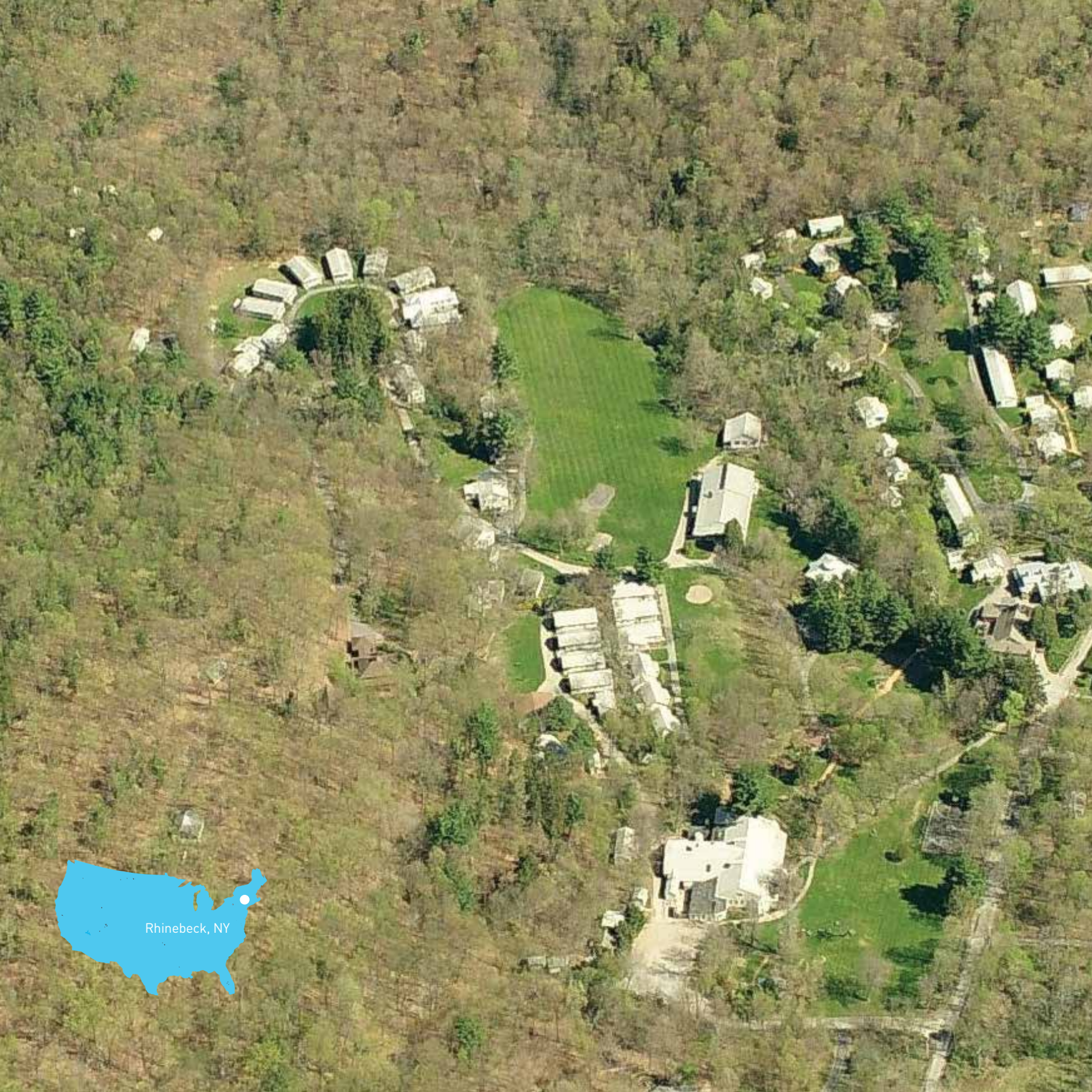
The Living Building Challenge, a program of the International Living Building Institute, is a certification program dedicated to ensuring that buildings are achieving the stringent guidelines in key areas of site, energy, materials, water, indoor quality and beauty and inspiration. Certification is based on actual performance rather than estimated performance, therefore a twelve-month verification period is required before buildings will be evaluated.


Rhinebeck, NY

History of Omega

Omega was founded in 1977 at a time when holistic health, psychological inquiry, world music and art, meditation and new forms of spiritual practice were just budding in American culture. The mission was as simple as it was large:

To look everywhere for the most effective strategies and inspiring traditions that might help people bring more meaning and vitality into their lives.

Since then, Omega has become the nation's largest holistic learning center. Every year more than 20,000 people attend workshops, retreats and conferences on its 195-acre campus in the countryside of Rhinebeck, New York, and at other sites around the country.

While Omega has grown, the mission remains the same. Omega is not aligned with any particular healing method or spiritual tradition. The programs feature all of the world's wisdom traditions and are committed to offering people an opportunity to explore their own path to better health, personal growth and inner peace.

The name "Omega" was inspired by the writings of Teilhard de Chardin, a 20th-century mystic and philosopher who used the word "Omega" to describe the point where all thought converges. This refers particularly to that point within each one of us where our inner, spiritual nature meets our outer, worldly nature. Teilhard believed that in the synthesis of these two domains of life lay the greatest challenge — and the greatest hope — for human evolution. Of his belief in the balance between world and spirit, Teilhard wrote, *"I am going to broadcast the seed and let the wind carry it where it will."*

Omega has taken on the task of helping spread that seed so that a better world for all of us can continue to take root and grow.

Omega Values

Accountability
We expect each of us to do what we say we will do, to meet commitments and be dependable and responsible.

Holism
We honor the mind, body, heart and spirit in each individual, knowing the need to balance and blend all these elements. In our programming, we encourage authenticity as a means to build trust, and as essential to the growth and development of the whole.

Integrity
In business and in relationships we conduct ourselves with honesty, fairness, truth, candor and respect. We treat others as we ourselves would want to be treated. We focus on the collective good.

Service
We value the practice of service and what it teaches us about ourselves, and our relation to others. Our participants are here to experience the world in new ways. We are attuned to and care about their experience, needs and expectations. We treat each other with similar grace.

Simplicity
We strive for clear, direct and unambiguous communication. We seek true, underlying meaning, and employ spiritual guidance in that quest. In this way, we work to make sense of the complexities of modern life.

Sustainability
We consider the impact of our actions. We advocate for fairness in the treatment of all species, make decisions for the common good and encourage activism as a means to social justice. Our facilities are grounded in the awareness of our relationship to the environment. We endeavor to have our work in the world be self-sustaining.

Teamwork
We work together, inclusively, collaboratively, with energy, intention and commitment. We keep each other informed, share what we are thinking and doing, and expect the same in return.

Welcoming
We invite people to find space here, to feel safe, to create community, to feel at home and find nourishment. Our environment is nurturing, relaxing, stimulating and inspiring.

WHATEVER YOU DO,
OR DREAM YOU CAN DO,
BEGIN IT.

BOLDNESS HAS GENIUS,
POWER AND MAGIC IN IT.
BEGIN IT NOW.

GOETHE

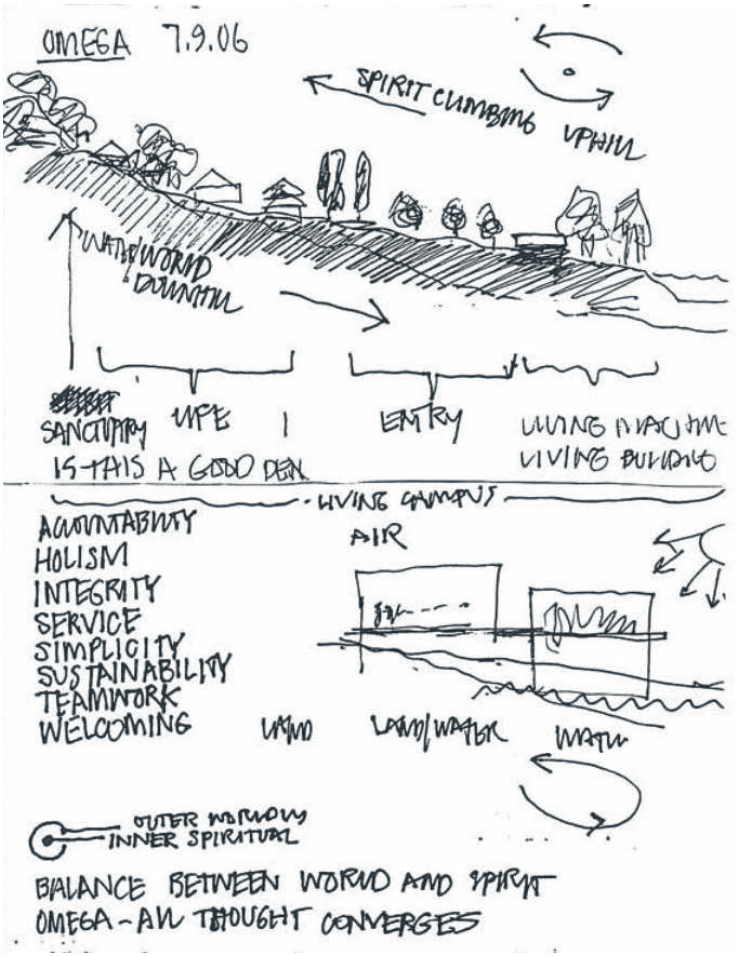
Project Background

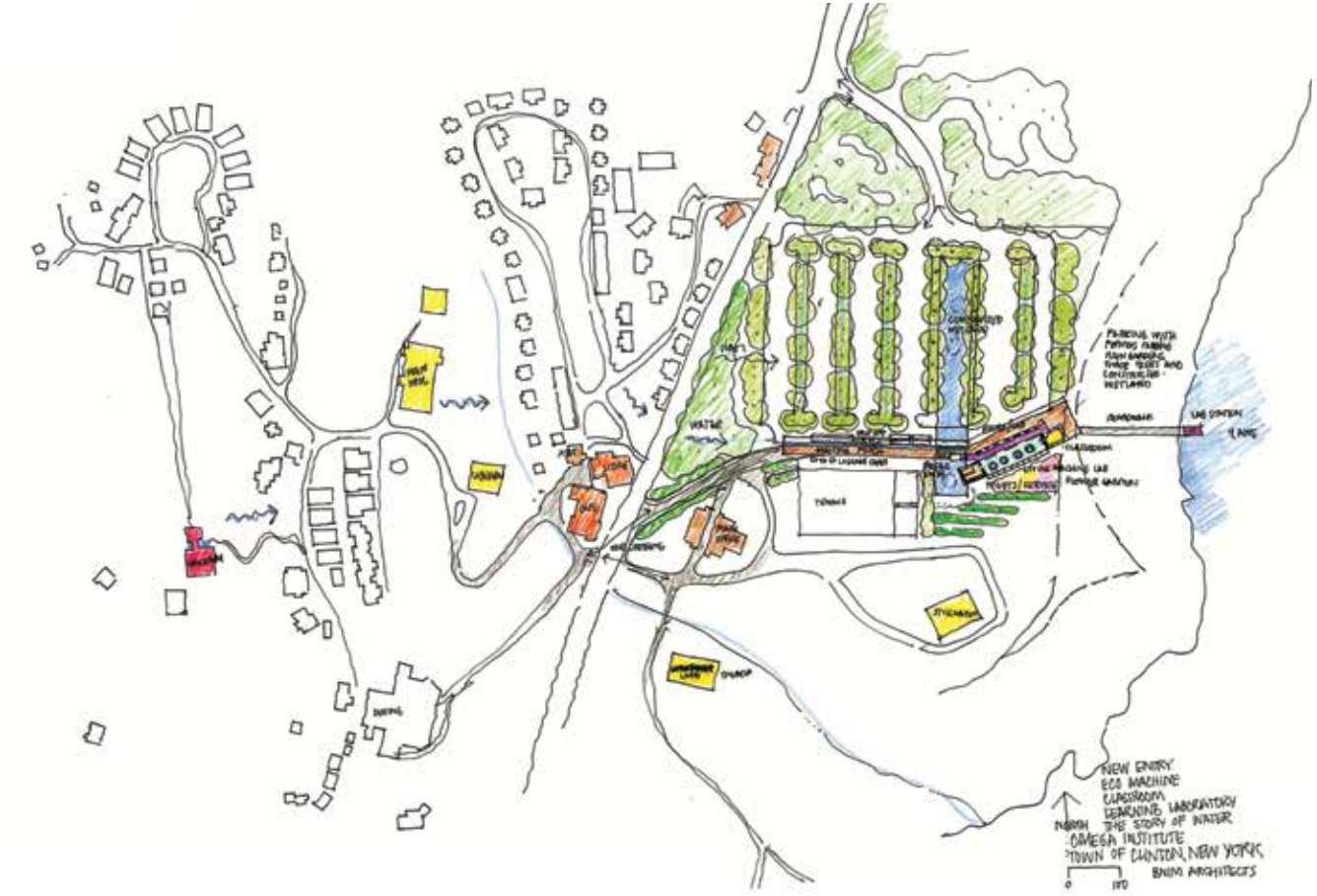
Omega generates a significant quantity of wastewater daily. The previous waste disposal system, made up primarily of leach fields, was constructed in the 1950s by the previous owner. The age of the fields, coupled with Omega's desire to achieve greater control over the amount of water used daily, contributed to the need to develop an alternative to the conventional disposal methods.

After careful consideration, Omega decided on an alternative state-of-the-art filtration system. After reviewing all the standard options, one unique alternative was found to be both efficient and educational. Developed by Dr. John Todd, the Eco Machine™ is based on the same natural science as estuaries – nature's own water filtration system. The system involves the use of plants and natural bacteria to break down waste byproducts and purify the water. This filtration system reflects Omega's commitment to environmental stewardship, and moves toward its goal of reducing water consumption and returning clean water to the ecosystem. Through it, Omega will be able to provide irrigation for its gardens and implement a grey water recovery system, greatly increasing the amount of water that can be reused.

Beyond the wastewater filtration system, the OCSL also acts as a pedagogical tool in teaching sustainable design and construction. Omega and the design team adopted the Living Building Challenge as a guide towards achieving true sustainability in the design and construction of the facility. Educational workshops are designed around the ecological impact of the filtration system as well as our profound relationship with water. Omega plans to invite:

- area school children to learn about water purification and wetland composition during field trips and on-site classes;
- university students to use the facility as an eco-lab, modeling alternative wastewater treatment solutions; and
- visitors from surrounding communities to view a working model that demonstrates improved wastewater treatment efforts.





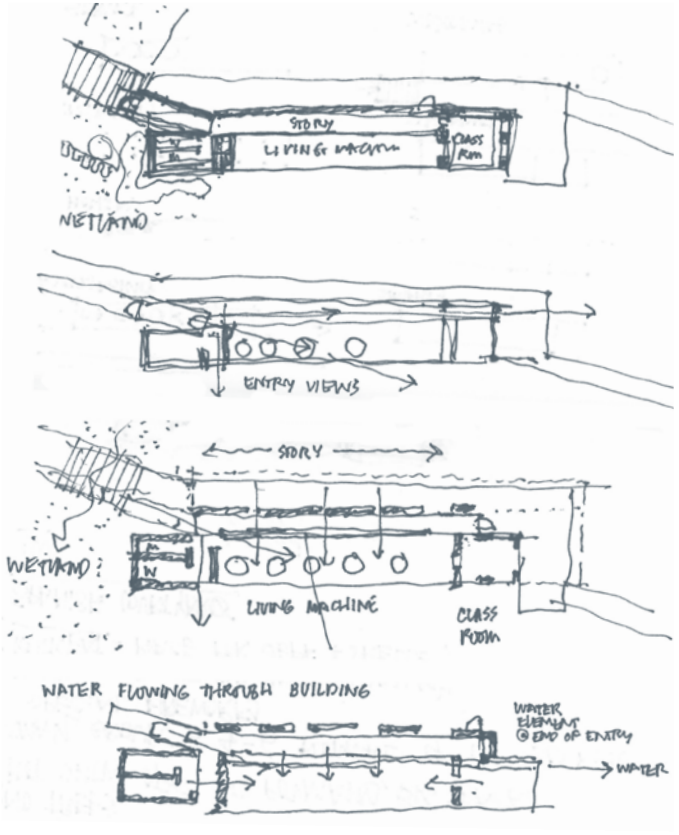
EARLY SITE PLAN

Early Design Ideas

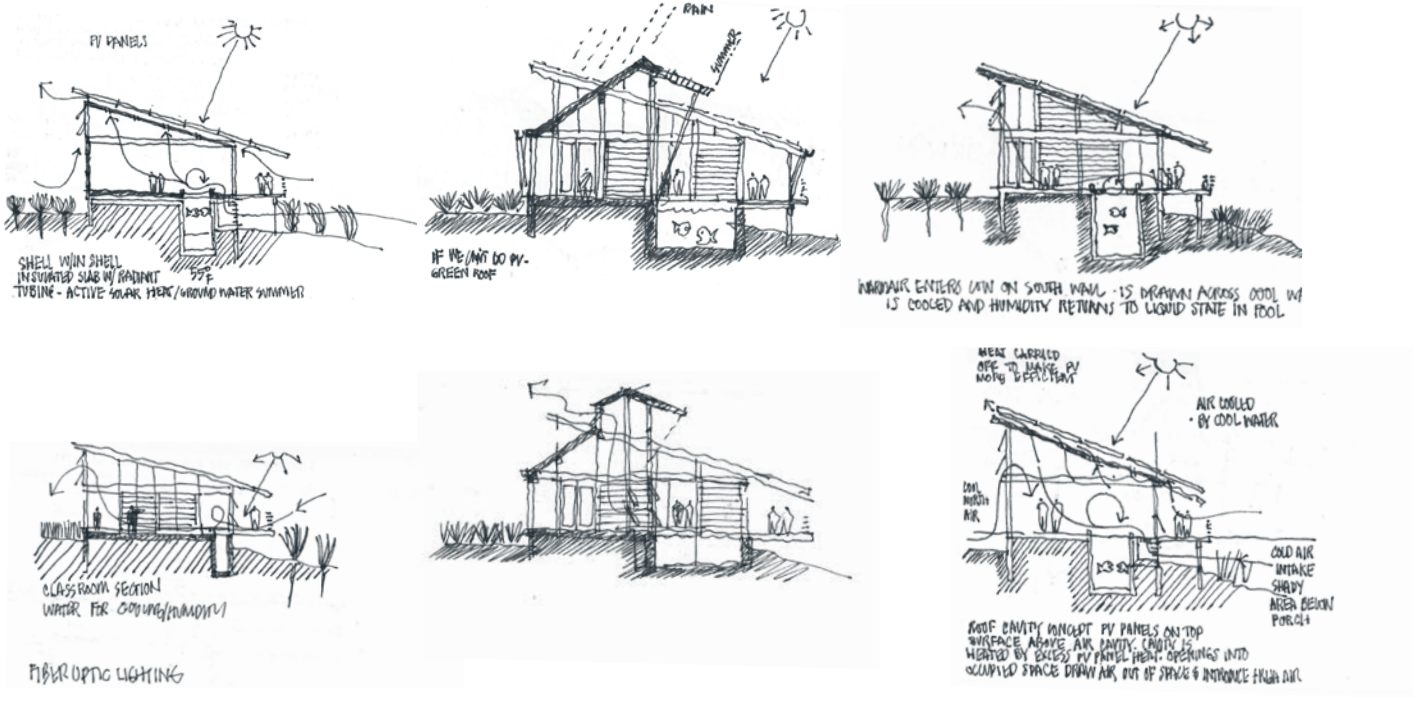
The program was simple yet very important. Equally important was the opportunity to improve the first impression of the campus through the conversion of parking lots into gardens and creating a compact building dedicated to water. The team gathered during its first visit to the site and developed the site plan and original building concept, which remained intact throughout the entire process.

The location of the building on the site comes from a desire to link the sanctuary at the "top" west edge of the campus with this new building. Use of water at both locations, both functionally and symbolically, help make this connection. Though the two buildings are not directly linked, they form the ends of an axis that runs through the campus. Locating the OCSL along this axis, which starts at the Omega campus entry point – the parking lot and administration building on the east side of Lake Drive – proved an important step in making this connection to the rest of the campus.

The orientation of the building comes from both this primary campus axis as well as a response to optimizing solar orientation for the building. In this case, a long east-west axis for the building allows more control over access to sunlight and heat gain.

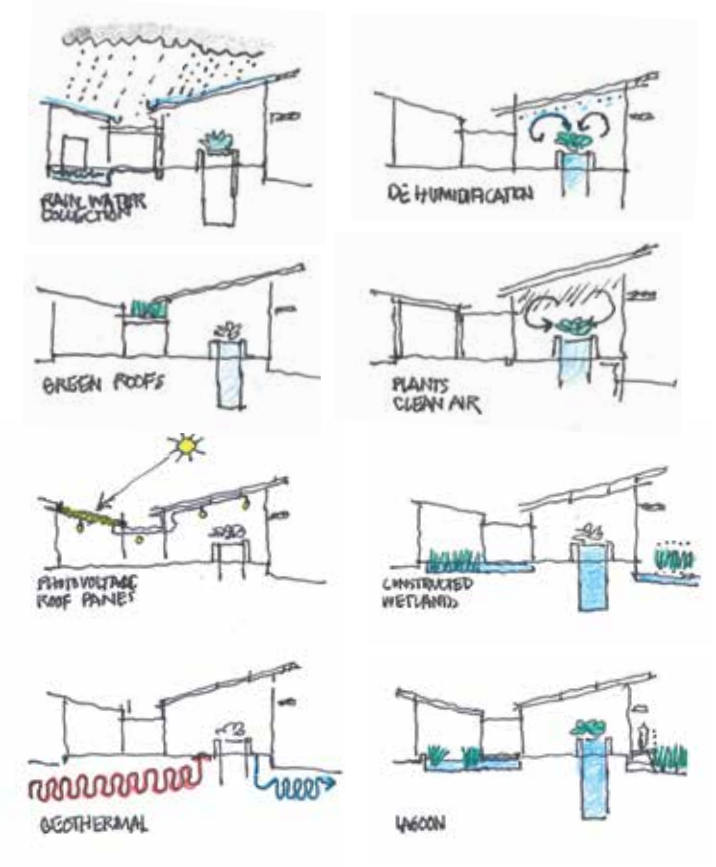


EARLY BUILDING CONCEPTS



The roof slope on the main building was reversed as a result of information concerning solar energy needs for growing plants. In this case, the scientific process superseded our initial intuition for the massing and orientation of the building forms.

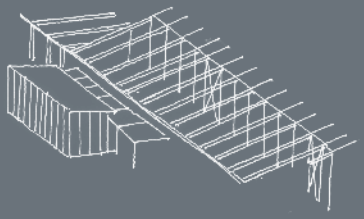
Layers of Design



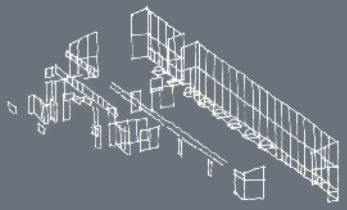
APPROACH

Though the most obvious function of this facility is to house an ecological wastewater treatment system, OCSL has also become a powerful demonstration of transforming Omega Institute's vision and values into the form of an integrated landscape and building that serves the campus both functionally and pedagogically.

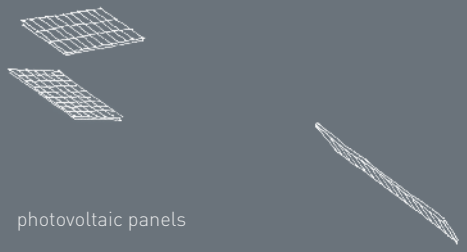
One way that we approach the design process is to acknowledge the many layers that make-up any building so that we can explore how best to integrate those layers into the most appropriate and high-performing building possible. By understanding the opportunities inherent within each layer or system, we can create a design that integrates each layer into a coherent whole, with each layer mutually beneficial to the others. The goal is to create a building (or campus or community) that is in balance— for optimal performance, interconnectivity and support of its owner's mission.



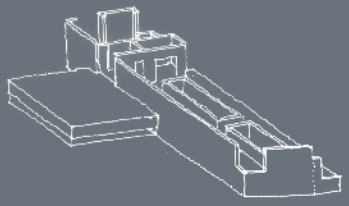
structure



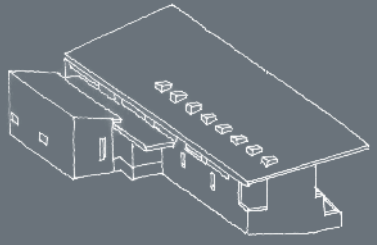
windows/fenestration



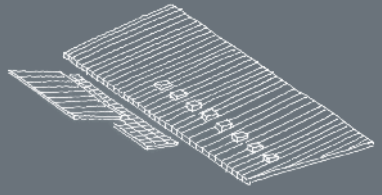
photovoltaic panels



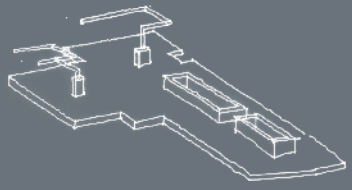
thermal mass/concrete



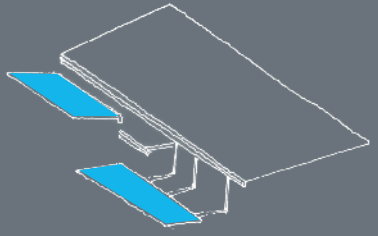
rainscreen/envelope/insulation



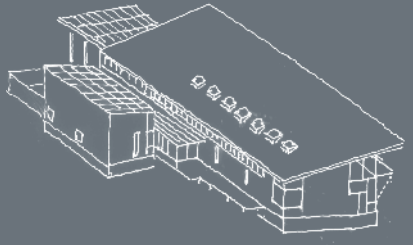
green roof



heating/cooling



roof/water



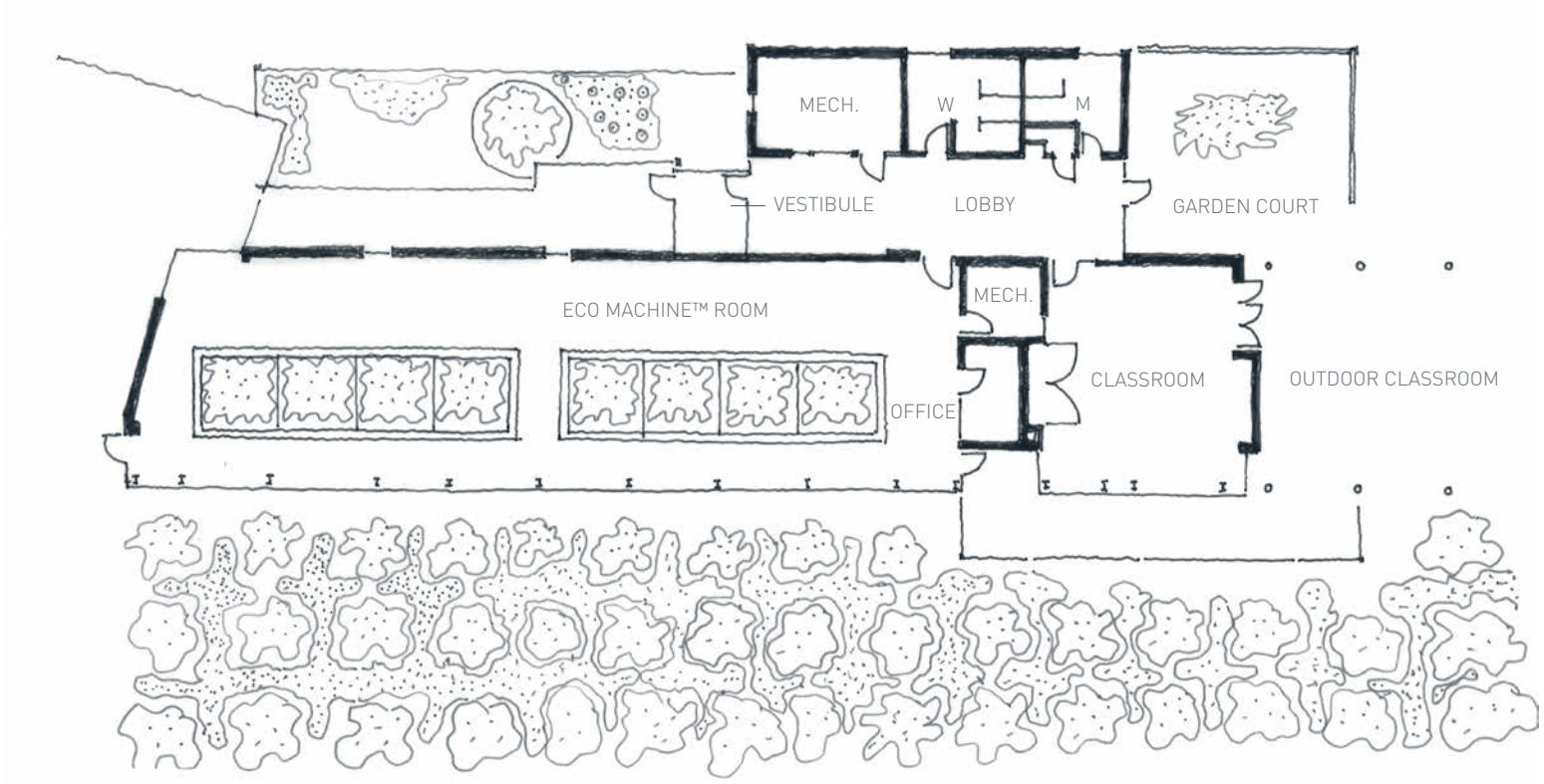
building

Design Development

The OCSL is comprised of two primary spaces, the Eco Machine™ room and classroom. The classroom supports many programs on the campus, including yoga. The Eco Machine™ room has an important function: it harnesses sunlight; fosters the water plants that are critical to cleaning and reclaiming the water; and houses the cellular lagoons that process and purify water.

Early in the process of discovery leading to the design of the OCSL, we confronted questions regarding the warmth and coolth of the water passing through the building while it is being cleaned — was temperature friend or foe? We asked questions, such as "What impact would the embodied energy and humidity have on comfort during the very cold winters or hot humid summers?" It was answering that, and other questions, that led us to simple, elegant solutions in the architecture, landscape, structure, lighting and other layers of the facility.

Integrated design is an iterative process. Intuitive suppositions early in the design led us to employ a sloped roof in the building section, which was high on the north and low on the south. It provided a place for the photovoltaic panels, allowed cross ventilation and readily provided sunlight to the plants growing in the lagoons. Luminous lux, or the notion of illuminance and luminous emittance, changed our approach. Deeper investigation revealed that the plants needed a light saturation point of 30,000 lux in order to flourish. The discovery that the intuitive design strategy did not achieve the required daylight, led us to do more research and adapt our models and tools to achieve the desired result for the performance of the space. Understanding that the light saturation point for the plant species being targeted for the greenhouse meant that we could limit summer sunlight, and thus heat, in the greenhouse – balancing human comfort without compromising the productivity of the plants. The solution was tall glass on the south for harvesting sunlight during the winter and summer, and a much lower north wall. Tracking skylights above the lagoons precisely aim solar radiation to the plants below. In the end, the building is simpler and more elegant. It embodies less material and resources in its building and operations.



FLOOR PLAN

0 4 12 24 ft

Role of Reclaimed Materials

Using reclaimed materials is one of the purest ways to build green, and an important consideration for Living Building certification. To discover the most effective ways to incorporate these materials into the OCSL design, BNIM and OCSL looked to PlanetReuse, whose focus is linking reclaimed materials with the design community. PlanetReuse insists that a great deal of building material headed to landfills can instead find new life in new building projects. The OCSL is a perfect showcase for salvaged materials, and also demonstrates easily any building can take advantage of material reuse. Working with the design team, PlanetReuse identified key areas for the use of reclaimed materials. They worked with five demolition and reclamation contractors to procure and test the materials, following the sourcing radius guidelines issued by the Living Building Challenge. The company provided documentation at every step to support the certification process. Reclaimed materials within the OCSL include dimensional lumber, plywood, interior doors, beech wood paneling and toilet partitions, among others. The materials came from warehouses, schools, office buildings and other projects. Reclaimed materials typically offer 15 to 20 percent savings over new, and their use earns significant points towards LEED certification as well. Most significantly, reuse keeps tons of building materials out of landfills.

BUILDING FORM/DESIGN

The building form largely evolves from the practical need to serve the plants doing the work of wastewater treatment in the Eco Machine™, as well to provide an inviting and comfortable place for those who use or visit the building. Early research revealed that typical greenhouse design attempts simply to maximize the sunlight to the plants. This defies the desire, in this instance, to maintain comfortable internal temperatures for the workers maintaining the system and educational visitors to the facility. Recognizing that the plants used in the Eco Machine™ reach a light saturation point at around 30,000 lux – that is, the maximum amount of light they can physically use – the goal became to flatten the amount of light falling on the plants' surfaces during the summer months to this level in order to minimize the heat taken on by the space. Conversely, during the colder months of the year, the amount of light allowed to penetrate the building envelope is maximized, in order to warm, or help warm, the space.

Similar to the manner in which the building meters light for the plants' needs, the building form and layout work to meter and orchestrate a visitor's experience of the systems at work within. Thus the experience becomes that of passing through, both physically and experientially, a series of layers – each layer addressing another piece of the broader ecological puzzle. These layers of building become an articulation of a path from the OCSL campus down to the lake edge, parallel to the path the water takes from the campus, eventually returning to the ground and ultimately to the lake.

EAST ELEVATION

MATERIALITY/DETAILING

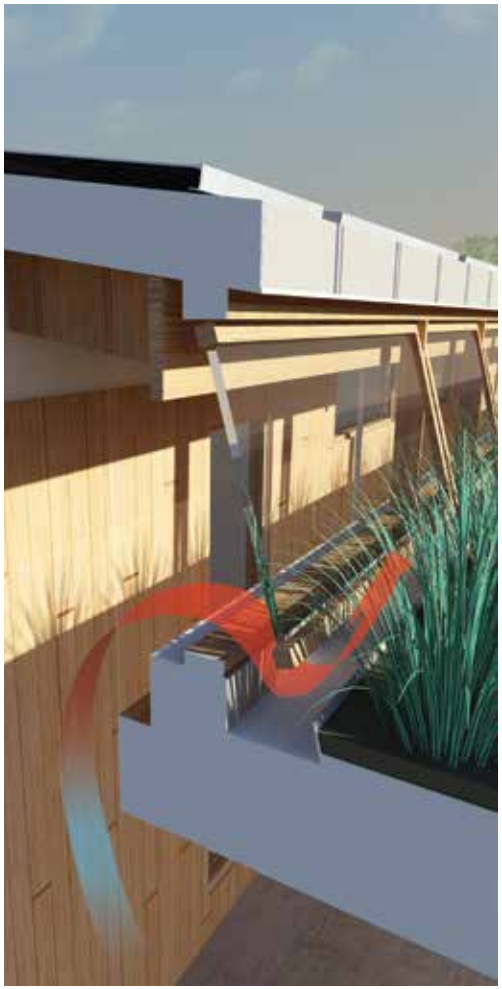
The architectural expression of materials is one of simplicity and transparency and is heavily influenced by the colors and textures of the region. No effort is made to mask the underlying nature of a material, but every effort is made to express the unique beauty of each. Overall, the strategy is to render the building as a background or a lens through which the Eco Machine™ and surrounding landscape can be viewed and understood.

NORTH ELEVATION

SOUTH ELEVATION

0 10 30 60 ft

Omega's location, in the heart of the Hudson Valley, just 90 miles north of New York City, makes it an ideal destination for group and individual retreats from April through October. Guests of Omega participate in a variety of activities from educational programs to the simple act of rest and rejuvenation. The OCSL is an active participant in Omega's mission. In addition to its role as a wastewater treatment facility that restores the local water table with purified water, it contains space for yoga studios where visitors come to participate in classes that restore the human spirit.

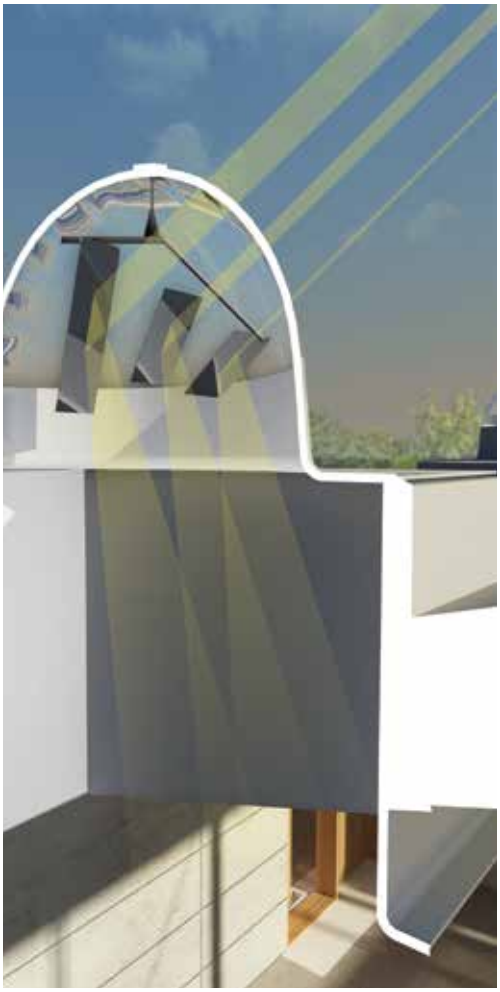


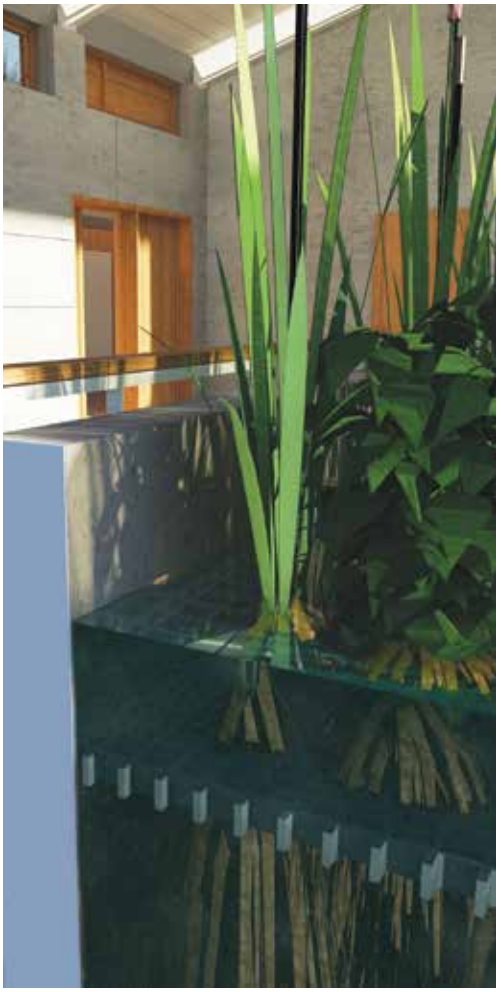
Air Flow

Clerestory windows ventilate the lobby, mechanical room and restrooms. Solar radiation heats the upper volume of air, then natural buoyancy induces stack ventilation, which causes the air to push its way out of the open windows and pull in fresh, cooler air from lower windows in the spaces.

The façade is clad with a wood rainscreen siding made from reclaimed cypress lumber. This wall system allows the building skin to "breathe" and eliminates the need for painting. Operable windows integrated into the façade allow for natural ventilation to assist in pushing hot air out of the building by channeling southern breezes that have been cooled from moving over the wetlands.

Flow. *Air. Energy. Water.*





Energy Flow

Energy flows through the building in several ways. Solar energy is captured through the south-facing windows and solar-tracking skylights, providing daytime lighting and direct thermal gain of energy stored in the building mass. Solar panels harvest the sun's energy and convert it into useable electricity for the building. Energy is pulled from the electric utility network at night and on cloudy days, while excess energy collected on sunny days is sent back to the grid. A geothermal heat pump system captures the heat or coolth from the earth's constant temperature below grade, which works in concert with the radiant floor system to warm the space on cool days. Similarly, the water that runs through the wastewater treatment train offsets the temperatures in the building when it enters the two lagoons of the Eco Machine™ Room.

Water Flow

The Eco Machine™ is on display for all to see, carrying grey water through a reclamation process. At the end, the water may be used to support the needs of the building. In this step, additional wetlands plants are suspended in aerated lagoons. In a symbiotic relationship, the plant roots act as a habitat for microbial populations that further scrub the water.

This diagram shows a distribution header in one of the wetlands cells which enables the grey water to be evenly distributed across the length of the cell. From here, the water leaches out of the chamber and flows below grade, bringing water and nutrients to the plants along the way, and eventually to a collection header on the opposite end.

OCSL Wetland Planting On Earth Day, April 23, 2009, OCSL staff and friends helped plant more than 8,000 plants in the constructed wetlands at the OCSL.


TB

The campus lies within the lower Hudson River Valley watershed basin and is located adjacent to Long Lake, part of a tributary system of the Hudson River. The site was formerly a gravel parking lot and the remnants of a dump from a previous use. It was nearly devoid of healthy biodiversity above the ground or within. The new landscape is quite the opposite. Automobiles and waste have been replaced with deep-rooted native plants, a healthy water system, birds, insects and other species. The site is pesticide- and toxin-free.

left: A close-up view of the photovoltaic array and part of the building's southern elevation.
below: A corner of the building that demonstrates the integration of materials, clerestory windows and overhangs as part of an integrated design strategy.


EXIT

Sustainable Site Approach

INTEGRATED WATER AND LANDSCAPE SYSTEMS

Every element of the Omega Center site development and infrastructure is designed to suggest a "water sensitive" relationship between the built and natural environment. The integration of water and landscape systems supports and reinforces the fundamental mission of the Omega Institute:

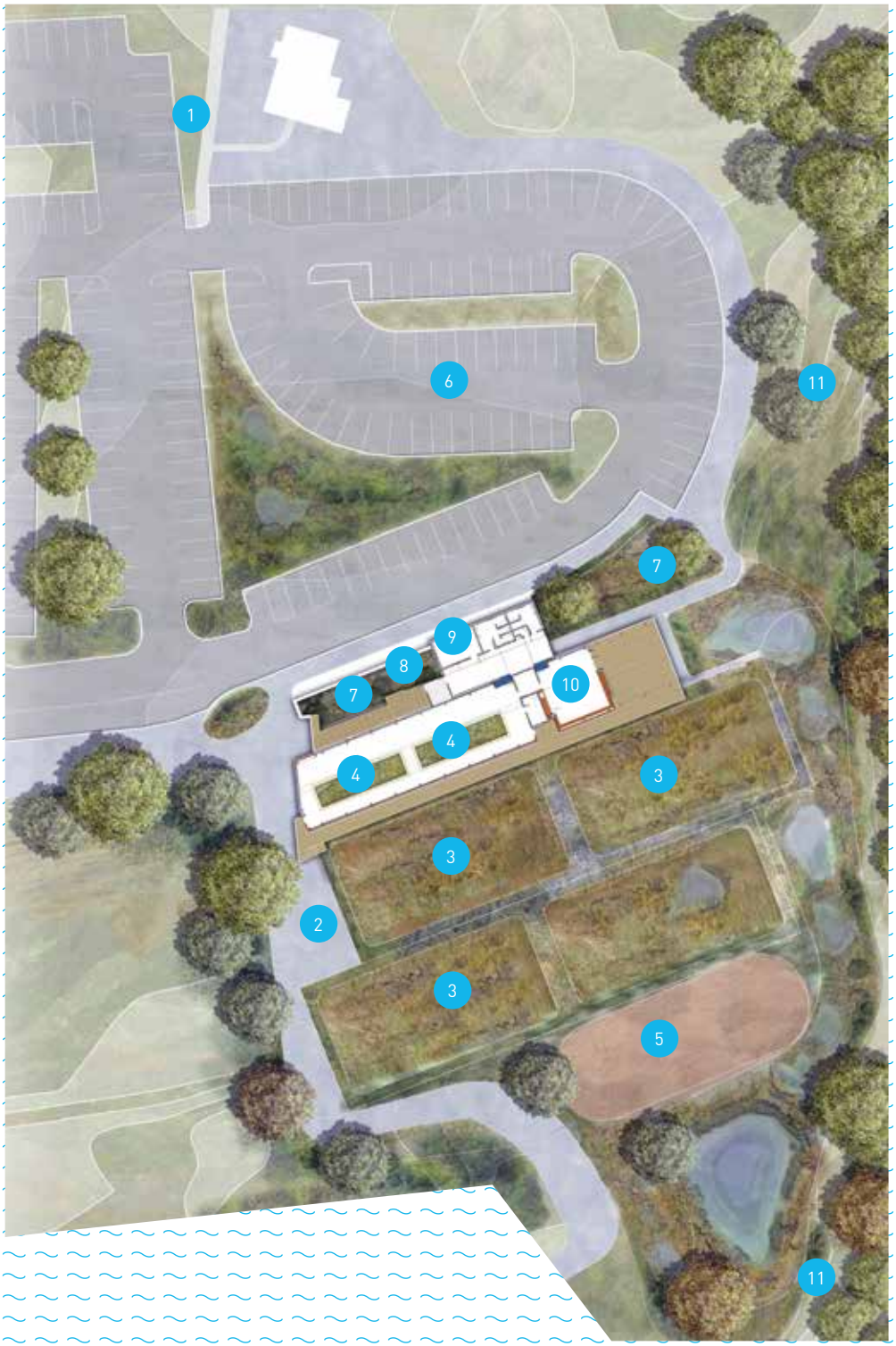
Through innovative educational experiences that awaken the best in the human spirit, Omega provides hope and healing for individuals and society.

The experience of the physical setting on campus reflects many of the core values of the Institute and the site improvements are a visible manifestation of how the experience of being at Omega is deeply rooted in these values. The landscape design is, therefore, regenerative of native site ecology, didactic in form, holistic in function, and above all, composes beautiful, inspiring landscapes within the ecological and cultural context of the campus.

Each element of the site and building is viewed with its potential for pedagogy — for its promise to impart knowledge to those who work at and visit Omega. The water-sensitive theme will be communicated in educational programming developed over time that utilizes site elements as demonstrations.

The site programming is based upon the sustainable site principles adopted by the design team:

1. Treat all water as a precious resource; never squander it as a waste product.
2. Restore health and stability to the site and surrounding landscape through the redevelopment process.
3. Utilize integrated design to achieve multiple objectives with each element.



0 20 60 80 ft

Site Plan

1 *Septic Tanks* (below grade): In this first treatment step, the majority of suspended solids settle out of the water. Naturally occurring microbial organisms living in the water work to digest the sludge that settles to the bottom of the tanks and the now partially clarified water is skimmed off into the Anaerobic Tank. **2** *Anaerobic Tank* (below grade): Here further settling and a process known as anaerobic digestion occurs. **3** *Constructed Wetlands:* Here the water flows through the root structure of wetland plants. The plants remove nitrates and reduce the Biological Oxygen Demand (BOD) – a measure of the rate at which biological organisms use up the available oxygen) and suspended solids in the water. **4** *Aerated Lagoons:* In this step, additional wetland plants are suspended in an Aerated Lagoon. In a symbiotic relationship, the plant roots act as a habitat for microbial populations that further scrub the water. **5** *Sand Filter:* This stage is the final "polishing" of the water prior to being reintroduced to the environment. Microorganisms living on and between the grains of sand are fed by any remaining organic compounds in the water. **6** *Subsurface Dispersal* (below the parking): At this stage the water is reintroduced to the soil via a subsurface network of chambers. The chambers are "flooded with the processed water and allowed to percolate into the soil. **7** *Rain Gardens:* Water shed from the building roof is temporarily detained here during a rain shower while plants work to cleanse the water of contaminants before it enters the Rainwater Cistern or is absorbed into the soil. **8** *Rainwater Cistern:* Water is stored here before being used for toilet "flushing and other nonpottable uses at the OCSL. **9** *Mechanical and Electrical Room:* This is the location of inverters for the PV system, rainwater system and equipment for the Eco Machine™. Supporting the pedagogical nature of the project, windows between this room and the Lobby expose the inner workings of the building systems. **10** *Learning Lab:* Part of the classroom, this area provides a place for visiting students (everyone is a student here) to perform tests and experiments on the water. **11** *Woodlands Restoration:* Future projects will restore the woodlands surrounding the OCSL and elsewhere on campus to their natural state.

Site Design Stategies

CONSERVE WATER RESOURCES

- Utilize landscapes that thrive without the use of supplemental irrigation water
- Harvest rainwater to supplement water needs

AVOID SURFACE WATER RUNOFF

- Reuse runoff water where practicable
- Promote groundwater recharge and evaporation rather than surface runoff
- Avoid concentration of runoff and spread rainwater over the landscape through multiple appropriate design strategies
- Manage woodlands to reduce surface runoff from undeveloped areas

AVOID SURFACE & GROUNDWATER CONTAMINATION

- Use bioretention swales, rain gardens, etc., to remove stormwater pollutants

MAKE WATER SYSTEMS TRANSPARENT

- Where water is transferred from space to space, use surface conveyance rather than enclosed pipes
- Make visible subsurface seepage from permeable pavements, bioswales, etc.
- Incorporate constructed wetlands into landscape design as a garden-like feature

Building Section Perspective

1 *Photovoltaic Collectors:* Strategically located throughout the facility, the photovoltaic collectors provide all of the buildings electricity. **2** *Metal Roof:* Made from recycled metal, the reflective properties keep the interior spaces cooler and mitigate the "heat island" effect. **3** *Constructed Wetlands:* Here the water flows through the root structure of wetland plants. The plants remove nitrates and reduce the Biological Oxygen Demand and suspended solids in the water. **4** *Aerated Lagoons:* Additional wetland plants are suspended in an Aerated Lagoon. In a symbiotic relationship, the plant roots act as a habitat for microbial populations that further scrub the water. **5** *Green Roof:* This living roof system provides additional thermal insulation. **6** *Wood Rainscreen Siding:* Made from reclaimed cypress lumber, this wall system allows the building skin to "breathe" and eliminates the need for painting**.** **7** *Solar Tracking Skylights:* These maximize the sunlight available for the plants and people working in the greenhouse. **8** *Sunshade:* The sunshade serves two purposes. First, it works to bounce sunlight onto the ceiling of the greenhouse, more evenly distributing the light. Secondly, it shades the lower portion of the window wall from direct solar exposure during the summer. **9** *Mechanical and Electrical Room:* Located here are the PV system inverters, and equipment for the Eco Machine™ and rainwater collection. Windows between this room and the lobby expose the inner workings of the building systems**.** **10** *Interior Finishes:* Wherever possible, the structural materials and other elements of the building are exposed. With extra care given to making these elements attractive, fewer redundant materials and finishes were used for the project**.** **11** *Woodlands Restoration*: Future projects will restore the woodlands surrounding the OCSL and elsewhere on campus to their natural state.


2
1
11
8
6
3
4

As a pedagogical and practical measure, interior finishes were reduced or eliminated. This honest approach helped reduce the overall embodied energy of the building and minimized potential off-gassing from various construction materials.

The landscape design is regenerative of native site ecology, didactic in form, holistic in function, and above all, provides inspiring landscapes that reflect the ecological and cultural context of the campus. There are four constructed wetland cells that terrace down the southern slope adjacent to the building. As part of the wastewater recycling/treatment process, water passes through the gravel beds within these wetlands and is gradually released into subsurface areas north of the building. The overall effect is colorful and garden-like. The diverse palette of perennial plants provides habitat for a variety of birds and beneficial insects as part of the overall landscape system. Paths provide access to these spaces for learning opportunities.

Water supply is provided directly from the groundwater via wells on campus. Aerated lagoons, one component of the system, are on display for all to see, carrying graywater through the reclamation process. At the end, the water may be used to support the needs of the building.

For potable water uses, well water is still drawn from the earth. For toilet flushing, rainwater is collected from the building's roof. Low-flow plumbing fixtures have been installed to minimize water consumption, including waterless urinals in the men's restroom. For all other water use on campus, blackwater and graywater are sent to the wastewater treatment lagoons and constructed wetlands for purification. By the end of this cycle that uses natural systems, cleaner water is reintroduced to the groundwater and lake.

top left: Eastern facade.
middle left: Covered outdoor classroom.
bottom left: Closeup of building entry.
Right: Operable windows in the south facade allow ventilation within the Classroom.

The entire building and water process use site-harvested renewable energy achieving a net zero energy system. To achieve this goal the facility had to be free of waste (volume, material, energy), organized and carefully tuned to harvest solar energy for passive heating and lighting, using the entire mass for thermal comfort. Plants growing in the interior lagoons required very precise solar energy levels on both their south and north exposures — the building section, windows and skylights were carefully designed as an integrated system to meet those needs.

left: The OCSL's south facade overlooking the constructed wetlands.
bottom: The wood rainscreen siding is made from reclaimed cypress lumber.

Building Sq. Ft.

6,250

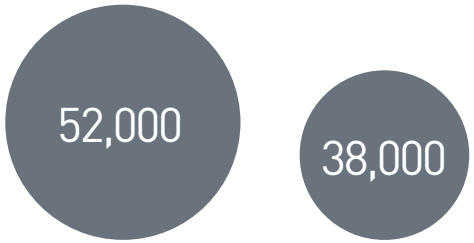
Site Acreage

4.5

Sustainability Metrics

THE PROJECT IS ON TRACK TO ACHIEVE LEED PLATINUM CERTIFICATION AND MEET THE REQUIREMENTS OUTLINED BY THE LIVING BUILDING CHALLENGE TO BECOME A LIVING BUILDING.

Water Reclamation Capacity



Maximum Design Flow

Measured Maximum Flow

gallons per day (GPD)
Estimated annual flow 5 million gallons

Rainwater Use for Toilet Flushing

40

gallons. Average Daily Demand

1,800

gallon cistern stores enough water for 45 days

Embodied CO_2

-1,387

metric tons (+/- 25%) (Estimated using buildcarbonneutral.com). The percentage of the shortgrass planting area being replaced with the wetlands plant area greatly offsets the embodied CO_2 of the construction project, which results in a negative number. Embodied carbon is the carbon released when a product is manufactured, shipped to a project site and installed.

The Construction Carbon Calculator estimates embodied carbon. This calculator looks at an entire project and takes into account the site disturbance, landscape and ecosystem installation or restoration, building size and base materials of construction.

Generation Capacity (Electricity)

2,830

sq. ft of photovoltaic panels, 211 panels in 3 arrays

134.2

Kw/day (48.53 Kw/hour max output)

Electricity Demand

132.77

Kw/day (average)

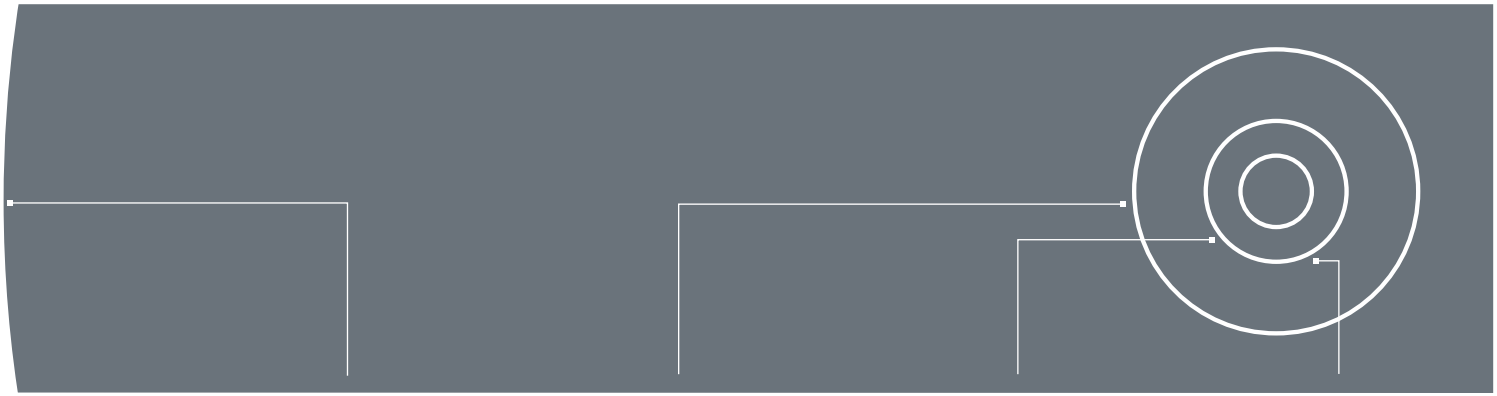
Electricity Usage

-1.43

Kw/day (average) – the building is designed to generate more electricity than it uses

Project Fact Sheet

Material Sourcing (based on Living Building Challenge)



9,000
miles
Renewable Energy Technologies (PV systems)

1,000
miles
Lightweight Materials (insulation, carpet, fabrics)

500
miles
Medium Weight Materials (wood products)

250
miles
Heavy Materials (brick, stone, concrete)

Wood Sourcing

All wood is either from FSC Certified Forest sources or reclaimed sources. Plywood roof and wall sheathing was reclaimed from the 2009 Presidential Inaugural Stage. Framing lumber was reclaimed from several deconstructed buildings in New York State.

Construction Waste Recycling and Diversion (from landfill)

99% of metal scraps recycled

99% of cardboard scraps and waste recycled

99% of rigid foam waste was reused elsewhere or recycled

99% of wood waste was shredded for mulch or stored for future use

100% of food waste was composted

100% of glass waste, paper, and plastic packaging waste was recycled

Red Materials Avoided (based on list from the Living Building Challenge)

Cadmium, Chlorinated Polyethylene and Chlorosulfonated Polyethlene, Chlorofluorocarbons (CFCs), Chloroprene (Neoprene), Formaldehyde (added), Halogenated Flame Retardants, Hydrochlorofluorocarbons (HCFCs), Lead Mercury, Petrochemical Fertilizers and Pesticides, Phthalates, Polyvinyl Chloride (PVC), Wood Treatments containing Creosote, Arsenic or Pentachlorophenol

Material Quantities (approximate)

Concrete	Gypsum Wall Board	Glass	Board Insulation	Steel	Reclaimed Wood	FSC Certified Wood
21,344 cu. ft. Volume	186 cu. ft. Volume	314 cu. ft. Volume	4,352 cu. ft. Volume	2,270 cu. ft. Volume	1,198 cu. ft. Volume	111 cu. ft. Volume
3,201,613 lbs. Weight	7,444 lbs. Weight	50,554 lbs. Weight	6,528 lbs. Weight (polyisocyanurate and expanded polystyrene)	1,123,580 lbs. Weight	52,703 lbs. Weight (plywood, framing lumber, siding, doors, trim, paneling)	3660 lbs. Weight (windows, exterior doors, glu-lam structure, roof sheathing)

Construction Progress.

















The architectural expression of materials is one of simplicity and transparency and is influenced by the colors and textures of the region. No effort was made to mask the underlying nature of a material, but rather to express its unique beauty.

INTEGRATED DESIGN

INTEGRATED DESIGN
in the Pursuit of a Living Building

In the Bantu languages of Africa there is a term "ubuntu" that reveals a posture towards humanity revealed in the phrase: "I am because we are." It suggests that, in any healthy community, no individual lives alone. It causes an individual to say, "I am not good unless everyone is good. I am not safe unless everyone is safe. And if someone is diminished (by poverty or racism or any other injustice), then we are all diminished." It is in this spirit that we acknowledge and proclaim that our acts of design and construction must likewise require a posture of interdependence with each other and with nature. The underlying current of the Living Building Challenge and the Omega Center for Sustainable Living is that we must once again seek such integrity or *ubuntu* in our lives.

INTEGRATE DESIGN

INTEGRATED DESIGN
and the Making of the Omega Center of Sustainable Living

In a truly integrated design, every element or system must perform multiple functions, as well as respond to a higher calling for simplicity and elegance, which are important attributes of beauty and high-performance. In buildings performing complex and potentially energy intensive functions, such as cleaning water, this call to integration is even more important. The OCSL is the essence of integration — the structure is the building skeleton, while acting as a beautiful part of the architecture and providing heavy mass to create comfort year round. The success of the building, and the very process used to create it, is reliant and dependant upon the success and performance of each part of the system, creating a cycle of interdependence as brilliant and pedagogical as nature itself.

Introduction

BOB BERKEBILE

THE JOURNEY TO LIVING BUILDINGS

One day, during a lunch break in my college studio, Buckminster Fuller shared a simple statement with me that has consumed much of my life to this day. It continues to inform my thinking and BNIM's integrated design approach. That day, we had been talking about the fact that architects have traditionally thought about buildings as objects or sculpture, disconnected from their environment. I responded with two examples, which I thought broke that pattern: Frank Lloyd Wright, "A home is an integral part of a landscape" and LeCorbusier, "A house is a machine for living." But Bucky wasn't convinced. He thought both were doing interesting work, but neither was thinking large enough for him.

> To make the point, he said, "Each of your design decisions either increase or decrease the vitality and potential of spaceship earth."

Immediately, I knew he was right, but I had no idea how difficult it would be to practice this philosophy as an architect. Architects are trained to work at the building scale, or occasionally at the scale of a development or city. He was, of course, promoting a systems-based approach, which makes even the scale of the city inadequate. He had in mind a much larger system that was inclusive of watershed, air-shed, resources-shed, job-shed, bioclimatic region and, ultimately, Earth.

In my first job as an architect, I found that the principals of the firm had created the type of practice that Bucky was proposing to change — a building-centric enterprise. The younger partner, Ralph Myers, was a talented, award-winning designer, but his focus was on the building as an object. The senior partner, Clarence Kivett, was an architect and would rather have been a planner or urban designer. But even though Clarence was thinking at a larger scale, he was also focusing on buildings and the spaces between buildings as an urban composition, rather than an operating system within nature. Ralph told me he was not convinced this should be an architect's concern and, even if I could convince him, he was certain that convincing our clients would be another matter altogether.

Looking back, I had opportunities to enlarge the scope of work to a systems approach on two projects in my five-year internship at Kivett and Myers (a

new master plan for our downtown and the design of the new airport), but I failed to do so. I was too busy learning about design and the process of making buildings, and too ignorant to clearly define the benefits of a systems-based approach or sell the concept of increasing the scope of work. Even when four of us left and launched our own firm, I put aside much of what I had learned from Bucky and focused my attention on creating the best design solution I could within the scope, scale, time and budget as defined by our clients. I was probably more willing to argue for a larger fee than for a larger scope of work. This approach was satisfying and brought additional work and design awards, but a decade of opportunities was missed.

It took a tragedy to wake me up. The collapse of the skywalks at the Kansas City Hyatt was my epiphany. The question that possessed me during a long night on the rescue team was, "Did I kill these people?" As that question was answered in the negative by failure analysis experts and the court system, a new reality dawned — that serious unintended consequences could result from our designs. Bucky's advice from many years before came back to mind and two new questions emerged: "What is the real impact of our designs on our clients, their community, region and planet?" and "How do we change our approach and develop new knowledge to address these issues?" As I shared these new questions with my partners, colleagues, friends and a number of experts, I quickly discovered that answers were not readily available. In fact, a quarter century later we are still working on answering these questions. But it was then that I knew it was time to integrate Bucky's systems-approach into my thinking and work.

The journey for answers led me to become the founding chairman of the American Institute of Architects' Committee on the Environment (AIA COTE). We created the committee to begin research, in partnership with the U.S. Environmental Protection Agency (EPA), U.S. Department of Energy (DOE), environmental non-governmental organizations and other professional organizations, manufacturers and stakeholders in the building industry. The research began with sick building syndrome and human health issues; it quickly expanded to broader issues of environmental design and sustainability, the results of which were published in the Environmental Resources Guide.

As we ventured beyond the building to study site, infrastructure and community, a group of volunteers suggested that we should create a much broader organization (beyond architects, engineers and environmentalists) to help address these critical issues. In April 1993, I agreed to host an exploratory meeting of manufacturers, developers, construction companies, financial institutions and others at AIA headquarters in Washington D.C. That conversation evolved over a few months, under the leadership of David Gottfried, Mike Italiano and Rick Fedrizzi, and gave birth to the U.S. Green Building Council (USGBC).

The suggestion to enlarge the conversation was exactly right. Rather than wait for AIA to set new design, manufacturing and construction codes and standards based on the results of the research, the volunteers at USGBC decided to create voluntary guidelines, which were later named the Leadership in Energy and Environmental Design Green Building Rating system, or LEED for short. Each of the LEED tools were created by a diverse group of volunteers (some experts, some not) through an open process that included a pilot phase, stakeholder review and consensus by electronic vote. It has since become the most transformative force for positive change in the design and construction industry.

In spite of its spectacular success, far exceeding our best expectations, there are a number of problems and limitations with the current set of LEED tools. Some of these were anticipated and apparent even as we were creating Version One (V1). And many were predictable as a result of the time limitations of an all-volunteer team, limited scientific information on many issues and the compromises resulting from consensus approval among a diverse membership (some

with vested interests). USGBC has, from the first conversation at AIA, always favored broad participation and progress over perfection — and it has organized for continuous improvement. While I completely agree with and have supported that approach, I was frustrated by LEED tools that see the whole of North America as one bioclimatic region, that is only slightly influenced by life cycle analysis. Worst of all, even if a project receives a Platinum certification (the highest level of performance) it can still, and usually does, have a negative impact on the environment. This level of certification merely indicates that you are doing less damage than everyone else.

BNIM was designing a national demonstration project for the National Institute of Standards and Technology (NIST) as the work began on LEED V1. There was considerable overlap between our design team and the USGBC volunteers, and the project became one of the LEED Pilot projects. There was intense debate about how high we would raise the bar with this new transformative tool. We all shared a passion for improving the environmental performance of the construction industry; the debate was about how much change and how quickly it could or should be implemented. We adopted a Latin phrase for the NIST demonstration project, partially out of my frustration with the LEED tool falling short of requiring projects to be regenerative or at least to do no damage to the environment at the highest level of certification, Platinum. The phrase was "Plus Ultra," Latin for "more beyond." As the concept evolved and we refined the idea, and as Jason McLennan and I began to write about it, Plus Ultra was replaced with Living Building.

Not long thereafter, the David and Lucile Packard Foundation engaged BNIM to design a new headquarters building for their Los Altos, California campus. As we became familiar with their work (restoring ecosystems) and ethics, we recommended that they consider creating a Living Building. In response, they funded the most comprehensive evaluation of the costs and benefits of creating such a facility to date — the Packard Foundation Sustainability Report and Matrix. The results were encouraging in all respects, especially the economic performance. It proved for the first time that moving beyond LEED Platinum was viable. As the Foundation's CFO stated, "The Living Building achieved the best net present value and was the only responsible path for the foundation."

When Jason McLennan accepted the position of Chief Executive Officer at the Cascadia Chapter of USGBC in 2005, he did so with the understanding that the chapter would continue developing the Living Building concept. He and I introduced the Living Building Challenge at Greenbuild in 2006. The day following our challenge, the board and staff at USGBC announced the Living Building Competition.

Beginning in 2006, BNIM was designing a new facility for the Omega Institute and with our clients made the decision to pursue Living Building status. Our design for the Omega Center for Sustainable Living (OCSL) won the Living Building Challenge "On the Boards" Award the next year.

Albert Einstein said, "We shall require a substantially new manner of thinking if mankind is to survive." The Living Building concept is a new manner of thinking at a critical time in human history, and it too must evolve (just as the LEED system needs to evolve) if it is to break our slumber and lead us to a regenerative future.

We are on a journey, with other projects actively engaged in the transformative potential of the Living Building concept. The Omega Center has contributed to this potential for transformation by moving boldly from theory to practice, which continues to be a collaborative dialogue of discovery.

The Living Building Challenge

THE SIXTEEN PREREQUISITES

CHALLENGES AND RESPONSES

The OCSL project team used the Living Building Challenge, (LBC), Version 1, as a guide throughout the project. The sixteen prerequisites of the LBC were reviewed and deemed challenging, yet feasible, in an early design session. Since then, the entire team (owner, designers, engineers, builders) have pushed and pulled each other and others through a process of exploring what true sustainability means, particularly within the context of a global marketplace and a local economy that does not yet have sustainability as a core value. We have been thwarted, tested, denied, questioned, frustrated and even infuriated. We have also been encouraged, enlightened, educated, humbled and inspired. We hope for a better world, and we believe we have a hand in making that happen.

On the following pages, we share with you our responses to the sixteen challenges of the LBC. Some are based on technical solutions, some on a great deal of research, some on extended conversations. All are based on a commitment to learn and a willingness to approach our work in a different way. We hope it is helpful to other teams that endeavor to push us all to true sustainability.

OUR GUIDES

As we continue our modern quest towards sustainability and a hope of restoration, we often find ourselves looking back to indigenous cultures to find a time and a place and a people whose world was once in harmony with nature. Their wisdom, in part, seems to come from generations upon generations of living in one place, long enough to learn the deep rhythms of the earth, the seasons, the native plants and animals. We examine their structures, their culture, their posture towards and understanding of all life forms. And we hear their words as those of prophets, reaching deep back into time in order to guide our future. We share here some of their words, their warnings, their insight, their wisdom.

INSPIRATION FROM NATURE

A key principle of the "Living Building" concept is to design and construct buildings that act more like flowers – that is, in such a way that buildings are both integral to and reflective of the habitat within which they exist. They rely only on the energy and water they can capture on-site. They are mutually beneficial to their neighbors. They are both functional and beautiful.

We share with you here some plants that, through their design, have something to teach us, something that might influence how we approach our designs, our behaviors, our lives. In some cases, they have a direct correlation to the prerequisites of the Living Building Challenge, in others they impart a lesson that is only somewhat related. In all cases, there is something to learn, something to consider, even if only this: that all plants in nature rely on a healthy community and buildings, similarly need to be thought of as in consilience with their neighbors.

SIXTEEN PREREQ (UISITES)

PREREQ

01

Responsible Site Selection

CHALLENGE

You may not build on the following locations:

1. On or adjacent to sensitive ecological habitats such as:
   - Wetlands: Maintain at least 50 feet, and up to 225 feet of separation
   - Primary Dunes: Maintain at least 120 feet of separation
   - Old Growth Forest: Maintain at least 200 feet of separation
   - Virgin Prairie: Maintain at least 100 feet of separation
2. Prime farmland

Let us walk softly on the Earth with all living beings great and small, remembering as we go that one God, kind and wise, created all.

NATIVE AMERICAN PROVERB

INSPIRATION / *Big Bluestem*

The way in which the Big Bluestem is adapted to the geology of the Flint Hills suggests that it has "chosen its place well." And while it has done this, it has also become a good neighbor, and a strong metaphor for how a building might better live upon the earth. By using energy and food from the earth and sky, it manages to grow and give back beauty, shelter and food to its community. Soils are thin and rock is prevalent in the Flint Hills of Kansas, where the Big Bluestem thrives. Its coarse root structure binds itself to the prairie earth – a study in the power of modesty. The cycle of its growth assimilates itself to the prairie habitat and repeatedly provides nutrients for the sustainable grazing herds of bison in the area.

RESPONSE

The entire 195-acre Omega Institute campus rests on the side of a hill in the Catskill Mountain range. The western edge of the campus is at the highest elevation and the eastern edge at the lowest. The OCSL is situated just above Long Lake on the eastern edge and thus lies at the lower edge of the campus. This allows the wastewater from the 119 buildings on campus to flow to the Eco Machine™ primarily by gravity.

Though the campus is set within a relatively rural area, the project site is close to the lake and a nearby stream, and so careful attention was paid to stream and wetland buffers during layout of the building and its extensive outdoor treatment cells. While staying clear of sensitive natural features, the OCSL's location also provides a strong and beneficial presence to the campus parking lot and drop-off area, where all visitors are welcomed to Omega.

In addition to this mindful placement of the building on the land, every effort was made to protect two local species, the Blanding's Turtle and the Northern Cricket Frog, from being adversely effected by the building and its construction.

PREREQ.

02

Limits to Growth

CHALLENGE

Projects may only be built on greyfield or brownfield sites that have been previously developed prior to December 31, 2007. Project teams must document conditions prior to start of work.

The Great Chief in Washington sends word that he wishes to buy our land. How can you buy or sell the sky? The warmth of the land? The idea is strange to us. Yet we do not own the freshness of the air or the sparkle of the water. How can you buy them from us? Every part of this earth is sacred to my people.

We know that the white man does not understand our ways. One portion of the land is the same to him as the next, for he is a stranger who comes in the night and takes from the land whatever he needs. The earth is not his brother but his enemy and when he has conquered it he moves on. He leaves his fathers' graves and his children's birthright is forgotten.

CHIEF SEATTLE, DUWAMISH TRIBE (1855)

INSPIRATION / *Rye*

With regard to the land, the first step of land and habitat restoration depends on the climate. In a north temperate zone, an initial seeding would probably be a cover crop with perennials such as rye or oats. This would last a year, allowing other longer-lasting plants to settle in. The rye, and up to thirty other species, provide a stability to the place while the next restorative step is determined. Through the diversity and robustness of this cover crop, a better chance of success is assured, as some seeds grab hold where others cannot.

RESPONSE

Omega's campus in Rhinebeck, New York was previously the home of Camp Boiberik. The OCSL is built on the area of that campus that was used as a dumping ground by the previous owner. Upon Omega's purchase of the property, the solid debris in this area was removed. Various building materials and other objects were dug up in the process of excavating for the OCSL. The selection of this site allowed Omega to transform a degraded portion of the campus into a restorative amenity that naturally treats all campus wastewater.

In addition to meeting these minimum requirements, the existing site and parking lot were designed in a manner that is restorative, transforming a relatively austere parking arrival sequence into one that begins the rejuvenating process that is expressed throughout the rest of the campus – through the Institute's educational programs, other facilities and grounds.

PREREQ.

03

Habitat Exchange

CHALLENGE

For each acre of development, an equal amount of land must be set aside for at least 100 years as part of a habitat exchange.

There is no quiet place in the white man's cities. No place to hear the leaves of spring or the rustle of insect wings. But perhaps because I am a savage and do not understand - the clatter only seems to insult the ears. And what is there to life if a man cannot hear the lovely cry of the whippoorwill or the arguments of the frog around the pond at night?

The whites too shall pass – perhaps sooner than other tribes. Continue to contaminate your bed and you will one night suffocate in your own waste. When the buffalo are all slaughtered, the wild horses all tamed, the secret corners of the forest heavy with the scent of many men, and the view of the ripe hills blotted by talking wires. Where is the eagle? Gone. Where is the buffalo? Gone. And what is it to say goodbye to the swift and the hunt, the end of living and the beginning of survival.

CHIEF SEATTLE, DUWAMISH TRIBE (1855)

INSPIRATION / *Wetland Ecosystem*

Wetland ecosystems are diverse and robust communities that do a lot of work for their neighbors. They can act as nature's wastewater purification systems and are often a natural buffer to the ebb and flow of tides and flooding. Because they reside in the interstitial spaces between land and water systems, their richness brings forth much life and vitality.

RESPONSE

The Omega Institute has been a responsible steward of their facilities and land since they moved to their Rhinebeck campus in 1981. As Omega states under their value of Sustainability: "We consider the impact of our actions. We advocate for fairness in the treatment of all species, make decisions for the common good and encourage activism as a means to social justice. Our facilities are grounded in the awareness of our relationship to the environment. We endeavor to have our work in the world be self-sustaining."

To this end, and among other strategies large and small, Omega buys their electricity from a wind farm, uses only solar power for the OCSL, uses green cleaning products and methods, runs an extensive recycling program (from paper to printers), and buys food from local and organic farmers for meals in their dining hall and café.

The design of the outdoor constructed wetlands and surrounding landscape is focused on doing the work of wastewater treatment while restoring the land and its natural habitats. In addition to this work on-site, Omega has committed to additional habitat restoration whereby 20 acres of land have been set aside in perpetuity as part of a habitat exchange program. Omega has selected Scenic Hudson as the organization who will administer this program.

Scenic Hudson is based in upstate New York and is the largest environmental group focused on the Hudson River Valley. They are "dedicated to protecting and restoring the Hudson River, its riverfront and the majestic vistas and working landscapes beyond as an irreplaceable national treasure for America and a vital resource for residents and visitors." This mission is supported by three principles that focus on: a healthy environment as a key component to economic development, a quality of life for citizens by way of access to open space and community decision-making, and the preservation of the natural environment as a source of spiritual and artistic vitality.

PREREQ

04

Net Zero Energy

CHALLENGE

One hundred percent of the building's energy needs supplied by on-site renewable energy on a net annual basis.

INSPIRATION / *Oak Tree*

Behold, my brothers, the spring has come.
The earth has received the embraces of the sun and we shall soon see the results of that love! Every seed is awakened and so has all animal life. It is through this mysterious power that we too have our being and we therefore yield to our neighbors, even our animal neighbors, the same right as ourselves to inhabit this land. My love of our native soil is wholly mystical.

CHIEF SITTING BULL (TATANKA IYOTAKA), HUNKPAPA SIOUX (1831-1890)

Consider an oak tree. Its seed either fell not far from its parent tree or was transported a short distance away by an animal, thus allowing it to grow out from under the canopy of its parent. With the rainfall and sun from the sky, and nutrients in the soil, the oak does not require any additional energy from beyond where it can reach or "see" to transform into a mighty tree. Then, at the end of its life, it is able to give back either to the soil or to another for fuel. Most plants operate at this level. Plants that require cultivation by humans, however, are not as energy-efficient, requiring importation of water and other nutrients that have hidden energy costs. Consider again the mighty oak.

RESPONSE

The first path to a net zero energy building is to minimize the required energy needs of the building. This is most effectively done through a highly integrated design team and process. The design team met as a large group on multiple occasions at the Omega campus in an effort to balance all building systems within the overall design. Beginning with the building massing and orientation, the team sought to optimize access to and control the negative impacts of sunlight entering the building. This was done by creating a narrow building footprint that runs along a primary east-west access. The south facade is the primary source of daylight into the building, with smaller amounts of glazing on the north (primarily clerestories), east and west, all in alignment with building functions.

On the south side of the OCSL are the Eco Machine™ room, the indoor classroom and a space off the Eco Machine™ room for water monitoring, all dedicated to primary building occupants. The Eco Machine™ room, which houses two large lagoons of plants that are a critical component of the waste-water treatment train, is particularly needy for sunlight to optimize the growth of the plants. Careful consideration was given to glazing location, sizing and characteristics for these rooms to optimize heat and light available from the sun. This was coupled with careful detailing of roof overhangs and canopies to the south.

PREREQ

04

Net Zero Energy

Additional windows in the lobby and other spaces of the building create comfortable spaces for the occupants to use the building during daylight hours without the use of electric lighting. In addition to careful window placement, well-insulated exterior walls and roofs help to minimize energy loads in the building.

All spaces within the OCSL use natural ventilation as a first option for space cooling. A geothermal system was installed to take advantage of the earth's constant temperature below grade to augment heating and cooling when outside conditions are too extreme for natural ventilation. Coupled with a radiant floor system installed within the concrete floor slab of the building, the OCSL is benefiting from a fairly optimized heating system.

While solar power is not the only renewable energy source available to us, it is the sole source of energy for the OCSL. An additional aspect of the building form is to provide solar access locations for the photovoltaic (PV) panels. Three locations were identified on the building that would provide beneficial access to the sun:

A. the south-facing sloped roof of the north wing of the building
B. the canopy that covers the outdoor classroom just east of the building
C. the external sunshade/canopy running along the south face of the building located mid-way on the window wall.

In each of these locations, PV panels were to be used. During construction, one primary change was made, due to the delayed installation of the south sunshade canopy. In this case, the third array for the building was relocated to a ground location south of the constructed wetland cells, which lie south of the building.

In total, 211 panels cover 2,830 square feet and provide 134.20 Kw/day with a maximum output of 48.53 kw/hour. Since the anticipated demand for the building is 132.77 Kw/day on average, the net zero energy goal was expected and has since been borne out by utility data from Central Hudson and other metering in the building for its first year of occupancy.

If sunlight is selected as the preferred source of renewable energy, as was the case for the OCSL, close collaboration with the provider of the PV system is preferred. The PV panels selected were within the 9,000-mile radius allowed by the Living Building Challenge. They were selected by comparing their cost and efficacy against other manufacturers, which is critical in a market where renewable energy sources remain relatively expense.

That said, it remains true that optimizing the integration of building forms and systems through design is the most cost-effective way to achieve a high-performance building. As they say, "The cheapest energy is the energy you don't have to buy."


B
A


B


C

PREREQ

05

Materials Red List

CHALLENGE

The project cannot contain any of the following Red List materials or chemicals.
Cadmium, Chlorinated Polyethylene and Chlorosulfonated Polyethlene, Chlorofluorocarbons (CFCs), Chloroprene (Neoprene), Formaldehyde (added), Halogenated Flame Retardants, Hydrochlorofluorocarbons (HCFCs), Lead, Mercury, Petrochemical Fertilizers and Pesticides, Phthalates, Polyvinyl Chloride (PVC), Wood treatments containing Creosote, Arsenic

INSPIRATION / *Field Pennycress*

There are some plants such as the Field Pennycress that are known for their ability to take up heavy metals into their systems. To clean up the soil, these plants are sometimes used around landfills, old mines or other contaminated areas where soils need cleaning. It is important to note that were such a plant to take up any heavy metals or serve as an adherence substrate for volatile organic molecules, all would return to the soil during the plants senescence in summer and fall. The only way to remove such contaminants from the site would be to grow these plants until just past anthesis, then harvest away the plant material and dispose of the vegetable matter in some way that does not contaminate the air or another site.

It is less of a problem to be poor than to be dishonest.

ANISHINABE SAYING

Those that lie down with dogs get up with fleas.

BLACKFOOT PROVERB

RESPONSE

As humankind's efforts at technological solutions progress, particularly in the building sciences, materials whose external costs are not fully known to us continue to be developed. Common building materials fifty years ago are now banned. It would not be surprising to learn that some of our common materials of today will be considered toxic in the future. We often ask ourselves, "What's the next asbestos?"

The Living Building Challenge suggests several common materials or components of materials that should be banned. One significant challenge for a Living Building team is to avoid these materials. Several materials noted in the Red List are relatively easy to avoid in building design and construction. Several, however, require extra effort by the team to identify acceptable solutions. In addition to avoiding these materials in general, there are particular instances when very specific building components are simply impossible to find in today's market without requiring some form of custom (and thereby expensive) manufacturing. The International Living Building Institute acknowledges this current state of the market and requires teams to document these cases, write the suppliers of the offending materials, and push the market towards more viable alternatives.

During design, the team made its best effort to identify sources of acceptable materials and include them in the specifications. Unfortunately, this is not always adequate. Due to the time lag between design and construction, some materials available during the design phase are no longer available at construction time. Additionally, though some information is provided by manufactureres during design, it is not until construction is underway when a team will know for certain that the material selected is able to match the Red List requirements. Further, in some instances, the suppliers are either unable or unwilling to share specific information about all the components of their material or system.

PREREQ

05

Materials Red List

A few of the Red List materials and viable substitute materials employed at the OCSL are listed here:

RED LIST MATERIAL	SUBSTITUTE MATERIAL
PVC | Pipe	HDPE, Cast Iron
Formaldehyde Adhesive | Plywood	Reclaimed Plywood / Lumber
Polyurethane | Insulation	Polyisocyanurate
Creosote, Arsenic, Pentachlorophenol | Exterior Wood	Reclaimed Cypress Lumber
Formaldehyde Adhesive | Glulam	Phenol-Formaldehyde Adhesive
Formaldehyde Adhesive | | Fiberglass Insulation	GreenFiber Cellulose Insulation
PVC | Roof	EPDM Membrane
PVC | Foundation Drain Pipe	HDPE
Halogenated Flame Retardants | Roller Shades	Lutron - Vela Fabric

For the project team, this requirement is further challenged by coupling the two other Materials prerequisites of Responsible Industry (07) and Appropriate Materials/Services Radius (08) with the Red List. Consider the incorporation of glued-laminated beams in the OCSL. The team could identify sources of beams that met the Red List with their adhesives and coating options; the team could identify sources that were able to use FSC wood; and the team could source glulam beams within the appropriate radius of the site. When it came down to it, there were very limited options that met all three challenges – not to mention the basic challenge of affordability.

One way to handle this in the future would be to create a national or international database of materials that meet the Red List and Responsible Industry requirements, sortable for each site location to meet the Radius requirements. Short of that, the design and construction teams are required to provide a lot of legwork to identify and update their own lists of acceptable suppliers for their project. The need to meet these three Materials requirements, and be affordable, strongly suggest that the builder to be on-board during the design process so that small-batch sourcing and costing exercises can occur as the design progresses. When this is not possible, it seems best for the design team to design and document the building "loosely" in order to accommodate material, and sometimes system, changes during construction without much headache or heartache.

The goal, of course, in the end is to create indoor environments that not only do no harm, but in fact restore the bodies and souls of their inhabitants. In response to the Blackfoot proverb, after all, who wants to wake up with fleas?


WOMEN

PREREQ

06

Construction Carbon Footprint

CHALLENGE

The project must account for the embodied carbon footprint of its construction through a one-time carbon offset tied to the building's square footage and general construction type.

INSPIRATION / *Tall Prairie Grasses*

Tall prairie grasses are excellent sequesterers of carbon dioxide, reducing the amount of greenhouse gases in the atmosphere. The loss of prairie lands in the Midwest portion of the U.S., for example, represent a significant loss of natural carbon sink capacity nation-wide. And while the restoration of tallgrass prairies remains important work, it is the virgin prairie that is the most productive absorber of carbon dioxide. While it seems unlikely that our buildings will be able to replicate this capacity for sequestration, the OCSL reminds us that a project that restores high-level sequesterers of carbon dioxide and related soil structure is doing significant work.

Only after the last tree has been cut down;
Only after the last fish has been caught;
Only after the last river has been poisoned;
Only then will you realize that money cannot be eaten.

CREE INDIAN PROPHECY

RESPONSE

The Living Building Challenge relies on the Construction Carbon Calculator (buildcarbonneutral.org) to calculate the building's carbon footprint. This calculator estimates embodied carbon by looking at an entire project – taking into account site disturbance, landscape and ecosystem installation/restoration, building size and base materials of construction. It does this simply, requiring only basic information that is available to a project team even very early in the design process.

The approximate material quantities for the OCSL are as follows:

• Concrete	Volume:	21,300	cubic feet
	Weight:	3,201,600	lbs
• Gypsum Wall Board	Volume:	180	cubic feet
	Weight:	7,400	lbs
• Glass	Volume:	300	cubic feet
	Weight:	50,600	lbs
• Board Insulation [1]	Volume:	4,352	cubic feet
	Weight:	6,500	lbs
• Steel	Volume:	2,300	cubic feet
	Weight:	1,123,600	lbs
• Wood, Reclaimed [2]	Volume:	1,200	cubic feet
	Weight:	52,700	lbs
• Wood, FSC Certified [3]	Volume:	111	cubic feet
	Weight:	3,700	lbs

For the OCSL, the project-embodied CO_2 was calculated to be -1,387 metric tons. Yes, negative 1,387 metric tons. The key for this result lies within the inherent benefits of site restoration.

The percentage of the shortgrass planting area being replaced with wetland plants greatly offsets the embodied CO_2 of the construction project, which results in the negative number.

PREREQ

07

Responsible Site Industry

CHALLENGE

All wood must be certified by the Forest Stewardship Council (FSC), from salvaged sources, or the intentional harvest of timber on-site for the purpose of clearing the area for construction.

INSPIRATION / *Cypress*

Pond and Bald Cypress trees are large trees with needle-like leaves. The heartwood contains cypressene, a natural preservative that accumulates over decades, making it highly rot and termite resistant. The older the tree, the more rot resistant the wood becomes. Cypress wood was commonly used as a building material in the south because of these characteristics. Though cypress is at times unsustainably harvested because its bark is commonly used for mulch, the reclamation and reuse of cypress wood has become common due to the longevity of the wood after it is harvested. The exterior siding of the Omega Center is cypress reclaimed from a local mushroom farm.

We must protect the forests for our children, grandchildren and children yet to be born. We must protect the forests for those who can't speak for themselves such as the birds, animals, fish and trees.

QWATSINAS (HEREDITARY CHIEF EDWARD MOODY), NUXALK NATION

RESPONSE

Wood for the construction industry that is certified by the Forest Stewardship Council (FSC) is becoming more and more accessible and affordable in the marketplace, no doubt influenced by the U.S. Green Building Council's LEED Green Building Rating System introduced to the design and construction industry in 1999.

All wood used in the construction of the OCSL is either from an FSC-certified forest or from reclaimed sources. Some of the plywood and framing materials, for example, were reclaimed from the deconstructed 2009 Presidential Inaugural stage, while the framing lumber was reclaimed from several deconstructed buildings in the state of New York. The wood doors located off the main lobby as well as the exterior rainscreen wrapping the entire building are salvaged as well.

The primary use of FSC wood is found in the exterior wood windows. Other uses of FSC wood include framing materials, glued-laminated beams, plywood and decking.

PREREQ

08

Appropriate Materials/Service Radius

CHALLENGE

Source locations for Materials and Services must adhere to the following restrictions:

Zone	Material Or Service	Maximum Distance
7	Ideas	12,429.91 mi
6	Renewable energy technologies	9,000 mi
5	Assemblies that actively contribute to building performance once installed	3,000 mi
4	Consultant travel	1,500 mi
3	Light, low-density materials	1,000 mi
2	Medium-weight, medium-density materials	500 mi
1	Heavy, high-density materials	250 mi

It is easy
to be brave from
a distance.

OMAHA

INSPIRATION / *Maple Tree Seeds*

There are five primary methods of seed dispersal among plants: wind, gravity, ballistic, water and dispersal by animals. Maple tree seeds are easily propelled by the wind and their helicopter-like seed design after they release from the tree. Acorns, by comparison, fall primarily by gravity, but are often carried away by animals to locations beyond the oak tree's canopy. Two aspects of seed dispersal are most critical. The success of a seed's chance for maturation comes primarily from the hospitality and fertility of where it lands. Is it a friendly drop site? Further, only renewable energy is used, wind or solar—either directly, in the case of maple trees seeds via wind, or indirectly in the case of animal dispersal who get their energy from food "powered" by the sun. Both are something to consider as we choose the source of our building materials. Which materials are not suitable for humid or severe cold climates? How much and what kind of energy was required to transport it?

RESPONSE

The requirements for keeping within varied radii for the different categories of materials and services were quite a challenge for the team.

As for Services, the project team was selected prior to the Living Building Challenge being issued. Though most of the team still met the radius limits, the structural engineering team was from the west coast for an east coast project. Once we committed to the Challenge, we all agreed that they would work from their home base for the duration of the project. By this point, they had already participated in full-team work sessions on the campus and so were not lacking an understanding of the place. Recent advances in multiple electronic media, file transfer methods, building information modeling and communication tools have allowed team members in dispersed locations to work rather seamlessly with each other. The most critical ingredient in these situations is communication (both protocol and habits), as well as a fundamental alignment on understanding the project goals and team chemistry, which is why this structural engineer was originally selected. This was the easy part.

As for radius limits for Materials, there were endless challenges, at times significant. We learned, for example, how much of our building supplies are manufactured outside the United States (Answer: A lot). Further, it is extremely difficult to find all common building components within a tight radius to any given project site. Layer onto that the complexity of systems (and there were many) that may be available and even assembled locally, but in fact are manufactured almost entirely in Asia or other equally distant places. Try going to a local hardware store to purchase nails that are made in the U.S. Yes, nails. As we have learned, the Living Building Challenge is less concerned about the sources of minor building components, but it has been an eye-opening exercise, which has fueled a conversation about how we might best address the sourcing of materials. Should so much energy be expended to minimize one-time transport costs (monetary and environmental) of each building material? We have found it to be a very interesting question, knowing especially that there are so many ways in which the design and construction industry could minimize waste at other levels.

As noted in the Response under Materials Red List (Prerequisite 05), the overlay of Prerequisites 05, 07 and 08 within the Living Building Challenge, plus the realistic need for affordability, continued to challenge the team throughout construction. Even that seems to understate the reality. As material procurement for the project continued, the example of glulam beams given under Prerequisite 05 could be extrapolated out for almost every major building component. At a fundamental level, this is good work. The design and construction industry should be accountable for knowing where our building materials come from and what they are really made of. It is also complex and challenging work – and potentially transformational as well, still in its infancy as the marketplace continues to move towards a more global commerce.

And so the Materials conversation continues. It is a long and complex road, with many turns that sometimes require counterintuitive decisions. As of yet, there are no simple answers, but many ways to respond for the better.

PREREQ

09

Leadership in Construction Waste

CHALLENGE

Construction waste must be diverted from landfills to the following levels:

Material	Minimum Diverted/Weight
Metals	95%
Paper and cardboard	95%
Soil and biomass	100%
Rigid foam, carpet and insulation	90%
All others (combined weighted average):	80%

Asphalt, Concrete and concrete masonry units (CMUs), Brick, tile and masonry materials, Untreated lumber, Plywood, oriented strand board (OSB) and particle board, Gypsum wallboard scrap, Glass, Plumbing fixtures, Windows, Doors, Cabinets. Architectural fixtures, Millwork, paneling and similar. Electric fixtures, motors, switch gear and similar. HVAC equipment, duct work, control systems, switches

We will be known forever
by the tracks we leave.

DAKOTA PROVERB

INSPIRATION / *Eco Machine™ Plants*

All indigenous plants are leaders in waste management. Just like animals in the wild, when they die their carcasses are recycled back into the system within which they lived. In essence, all plants offer themselves up as food at the end of the day, either to humans or animals or back to the earth. In this context, it seems an abomination for us to send wood "waste" to a landfill. That said, the plants found in the OCSL's Eco Machine™ demonstrate how an interdependent community handles waste. As human waste passes through the outdoor wetlands and indoor lagoons, the plants within that system provide habitat for the microorganisms that consider our waste as food. In all situations, we should consider first how a by-product of our systems has the potential to nourish another system.

RESPONSE

Even though the Living Building Challenge sets the goals for construction waste quite high, the owner and construction team went above and beyond these targets for managing construction waste. The following percentages capture the extent to which they carefully tracked and handled materials on-site:

- 99% of metal scraps recycled
- 99% of cardboard scraps and waste recycled
- 99% of rigid foam waste was reused elsewhere or recycled
- 99% of wood waste was shredded for mulch or stored for future use
- 100% of food waste was composted
- 100% of glass, paper and plastic packaging waste was recycled

In addition to waste from building materials on-site, even packaged lunches from construction workers were handled thoughtfully. Attention was paid to every bit. Because the Omega Institute already had a comprehensive recycling program in place, it was easier to raise the bar for this project.

The critical steps required to achieve this level of waste management include:

- a strong vision communicated clearly to everyone on site;
- a clear system that makes it easy to recycle and difficult to throw things "away";
- a clear understanding of the rules as well as an ethos and culture to implement.

In the end, if our cultural roots are deep enough, avoiding waste should be, as Paul Hawken says in *The Ecology of Commerce*,"as easy as falling off a log." If the generations before us could do it, why can't we?

PREREQ

10

Net-Zero Water

CHALLENGE

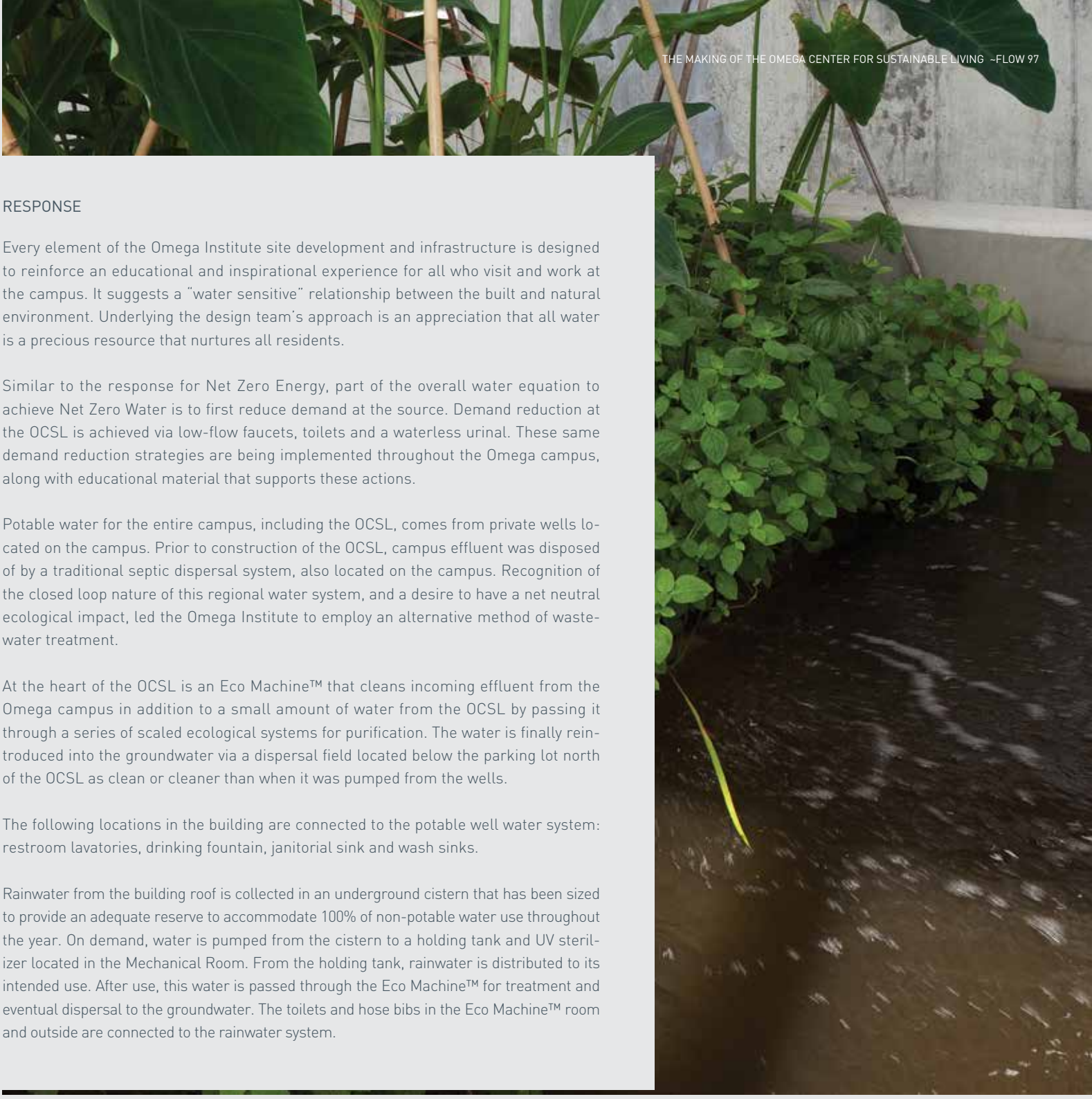
100 percent of occupants' water use must come from captured precipitation or closed loop water systems that account for downstream ecosystem impacts and that are appropriately purified without the use of chemicals.

INSPIRATION / *Cactus*

Man has responsibility, not power.

NATIVE AMERICAN PROVERB (TUSCARORA)

All plants, but for those cultivated by humans, live within a world of "net zero water" ... or they die. The cactus is a perfect example of living within the water economy of its own arid region. By design, the cactus acts as a cistern with its internal mechanism to hold water that comes in rare rain events. In healthy habitats, all plants husband water in accordance with their need.



RESPONSE

Every element of the Omega Institute site development and infrastructure is designed to reinforce an educational and inspirational experience for all who visit and work at the campus. It suggests a "water sensitive" relationship between the built and natural environment. Underlying the design team's approach is an appreciation that all water is a precious resource that nurtures all residents.

Similar to the response for Net Zero Energy, part of the overall water equation to achieve Net Zero Water is to first reduce demand at the source. Demand reduction at the OCSL is achieved via low-flow faucets, toilets and a waterless urinal. These same demand reduction strategies are being implemented throughout the Omega campus, along with educational material that supports these actions.

Potable water for the entire campus, including the OCSL, comes from private wells located on the campus. Prior to construction of the OCSL, campus effluent was disposed of by a traditional septic dispersal system, also located on the campus. Recognition of the closed loop nature of this regional water system, and a desire to have a net neutral ecological impact, led the Omega Institute to employ an alternative method of wastewater treatment.

At the heart of the OCSL is an Eco Machine™ that cleans incoming effluent from the Omega campus in addition to a small amount of water from the OCSL by passing it through a series of scaled ecological systems for purification. The water is finally reintroduced into the groundwater via a dispersal field located below the parking lot north of the OCSL as clean or cleaner than when it was pumped from the wells.

The following locations in the building are connected to the potable well water system: restroom lavatories, drinking fountain, janitorial sink and wash sinks.

Rainwater from the building roof is collected in an underground cistern that has been sized to provide an adequate reserve to accommodate 100% of non-potable water use throughout the year. On demand, water is pumped from the cistern to a holding tank and UV sterilizer located in the Mechanical Room. From the holding tank, rainwater is distributed to its intended use. After use, this water is passed through the Eco Machine™ for treatment and eventual dispersal to the groundwater. The toilets and hose bibs in the Eco Machine™ room and outside are connected to the rainwater system.

PREREQ

11

Sustainable Water Discharge

CHALLENGE

One hundred percent of storm water and building water discharge must be managed on-site and integrated into a comprehensive system to feed the project's demands.

Grandfather, Great Spirit, once more behold me on earth
and lean to hear my feeble voice.
Hey! Lean to hear my feeble voice.
At the center of the sacred hoop
You have said that I should make the tree to bloom.
With tears running, O Great Spirit, my Grandfather,
With running eyes I must say
The tree has never bloomed
Here I stand, and the tree is withered.
Again, I recall the great vision you gave me.
It may be that some little root of the sacred tree still lives.
Nourish it then
That it may leaf, And bloom
And fill with singing birds!
Hear me, that the people may once again
Find the good road
And the shielding tree.

EARTH PRAYER

INSPIRATION / *Bunchgrass*

The presence of bunchgrasses in a desert plant community suggests a healthy environment, one that has not been overgrazed or otherwise stressed. These grasses tend to have deep root structures that can extract moisture from deep within the soil whereas more shallow-rooted grasses would dry up. Symbiotically, these substantial root systems contribute to the organic carbon production within the soil.

RESPONSE

Water is the heart and soul of the OCSL project. With this facility, Omega Institute is both increasing the capacity of wastewater that it can treat as well as improve the effluent quality of the water it does treat. Omega has expanded their approach to addressing the issue of water in ways that are both personal (with signage in the restrooms of individual cabins) and public (with whole conferences focused on the global state of water and how our personal behavior/s impact it). The treatment of stormwater and building water discharge for the OCSL project is consistent with these efforts.

Integrated with the strategies employed to achieve Net Zero Water under Prerequisite 10, the landscape and building design takes a holistic approach to the handling of water. One hundred percent of stormwater and building water discharge is handled on-site by an integrated system of bioretention swales, rain gardens, constructed wetlands and other areas not requiring paving. Primary strategies include: conserving water resources, avoiding surface water runoff, avoiding surface and groundwater contamination and making water systems transparent. This overall approach handles stormwater in a way that matches pre-development conditions for up to 100-year 24-hour storm events.

All non-building areas of the site are pervious and integrated either into a comprehensive on-site stormwater management system or are part of the Eco Machine™ treatment process (in particular, the constructed wetland cells to the south the building that also capture rain). All water that is discharged from the buiding via the Eco Machine™ enters the groundwater via dispersal field under the parking lot. Rainwater captured from the roofs of the OCSL are used in the building where possible or for outdoor irrigation.

The Omega Institute is aware of their place within the Hudson River watershed and their actions regarding water are intended to be an educational and inspirational model for all other citizens of the region.

PREREQ

12

A Civilized Environment

CHALLENGE

Every occupiable space must have operable windows that provide access to fresh air and daylight.

The Wind whispered to me
Its voice echoed from the distance
Through the Ages
As I walked along the seashore
Where shattered wampum
and broken oyster shells pricked my feet
And I faced the West Wind.
“Hear me, for I am the Light
And the strength.
Fear not my leaving you
for I will always be here”.
The wind died
And a seagull flapped heavy wings
in the northern sky.
I called upon you
and you were there.
Whispering in my ear.
Native drums beat in my heart
And you hear us, you hear us.
You hear us calling to Grandfather,
And the wind shuffles the limbs
Making them dance to the beat of the drum.
And everywhere, there is a picture of you.
The Earth, the Water,
the Flowers.
We will remember
And your voice will always echo in our ears.

LORI B.J. GOMEZ, SHINNECOCK

INSPIRATION / *Hemlock*

All plants have stomata—pores, or windows if you will—found in the leaf or stem of the plant that allow for air infiltration. Carbon dioxide enters through these windows while oxygen (after photosynthesis) exits the same openings. Water vapor is also released through these windows via transpiration. Without stomata, plants would burn up. Stomata found on the back of hemlock leaves are among the most visible to the human eye.

RESPONSE

Designing the flow of air through the building was an important focus of the team. Operable windows are provided in each occupied space for both the health and enjoyment of staff and visitors in addition to being part of the passive heating and cooling strategy for the building. Low south-facing windows allow prevailing breezes to enter the building at the floor level, while high clerestory windows on the north provide a path for the air to flow up and out of the building.

Across the entire south side of the building, an expansive glazing system provides uninhibited views to the constructed wetlands and natural woodlands to the south and east, with views of the lake in winter months. Windows in other locations of the building allow the occupants to have constant visual connection to the outdoors.

PREREQ

13

Healthy Air / Source Control

CHALLENGE

All buildings must meet the following criteria:

1. Entryways must have an external dirt track-in system and an internal one contained within a separate entry space
2. All kitchens, bathrooms, copy rooms, janitorial closets and chemical storage spaces must be separately ventilated
3. All interior finishes, paints and adhesives must comply with SCAQMD 2007/2008 standards. All other interior materials such as flooring and case works must comply with California Standard 01350 for IAQ emissions

INSPIRATION / *Pothos (Epipremnum Aureum)*

Humankind has not woven the web of life. We are but one thread within it. Whatever we do to the web, we do to ourselves. All things are bound together. All things connect.

CHIEF SEATTLE, DUWAMISH TRIBE

The golden pothos is a common houseplant indigenous to southeast Asia, and frequently mistakenly identified as philodendron in stores. Both plants were found by NASA to be particularly effective at removing formaldehyde molecules from the air, a chemical found in many indoor environments, primarily through the off-gassing of materials and "cleaning agents" used within the building. Because these plants so readily absorb formaldehyde, they are considered toxic to people and animals. On-going research suggests use of these plants in the home or work environment improve the indoor air quality.

RESPONSE

The building plan is very straightforward, while still being attentive to details of air quality source control. The primary entryway includes a dirt-track system while restrooms are ventilated separately. Both the building and the entire Omega campus are non-smoking environments.

With regard to interior finishes, paints and adhesives, and as a practical and pedagogical measure, the overall strategy toward material selection for the OCSL is to reduce or eliminate all interior finishes wherever possible. The "naked" building reveals its material nature and construction in an honest dialogue with its occupants. Very little is hidden from view. This approach reduces the overall embodied energy of the building as well as minimizes the potential off-gassing from various construction materials. Where finishes were required, such as the painted steel in the Eco Machine™ Room and the walls of the restrooms, the finish material was evaluated for longevity, environmental impact and impact on indoor air quality.

PREREQ

14

Healthy Air / Ventilation

CHALLENGE

The building must be designed to deliver air change rates in compliance with California Title 24 requirements.

INSPIRATION / *Mother-in-law's Tongue*

All things share the same breath –
the beast, the tree,
the man, the air shares its spirit
with all the life it supports.

CHIEF SEATTLE, DUWAMISH TRIBE

Several plants have been studied that are particularly effective at converting CO2 to oxygen. The Mother-in-Law's Tongue, in particular, is effective at producing oxygen during nighttime hours. An increased number of these plants in a building could noticeably increase blood oxygen and reduce eye irritation, respiratory systems, headaches, lung impairment and asthma. All of these reductions suggest an increased productivity for people working in indoor spaces that emphasize the inclusion of these plants.

RESPONSE

The nature and use of the building, especially during the three operating seasons of the campus, suggest prolonged periods when the operable windows in the building can be kept in the open position. For times when that is not beneficial or preferred for various reasons, the mechanical system design provides air change rates that meet Living Building Challenge requirements.

Outside air is available through operable windows in the Classroom, Lobby, Lab and Restroom areas. In all cases, the area of these windows exceeds that required for natural ventilation.

In the Eco Machine™ Room, space is heated during winter and ventilated during summer. A radiant floor system connected to water-to-water heat pumps provides the heating; operable windows and exhaust fans provide the ventilation during summer. This space utilizes operable windows to achieve the required outdoor air for the space during all times of the year. The exhaust fans are utilized in the summer to provide additional ventilation to cool the space.

Beauty and Spirit

The project must contain design features intended solely for human delight and the celebration of culture, spirit and place appropriate to the function of the building.

Conversation was never begun at once, nor in a hurried manner. No one was quick with a question, no matter how important, and no one was pressed for an answer. A pause giving time for thought was the truly courteous way of beginning and conducting a conversation. Silence was meaningful with the Lakota, and his granting a space of silence to the speech-maker and his own moment of silence before talking was done in the practice of true politeness and regard for the rule that “thought comes before speech.”

LUTHER STANDING BEAR, OGLALA LAKOTA CHIEF

INSPIRATION / *Calla Lily*

The calla lily is a bit deceptive in both its name and beauty. It is neither a true lily (Lillaceae) nor Calla, and its simple beauty, in the form of one simple petal, belies the complex system within which it lives, interdependent with the natural forces surrounding it. The calla lilly is also a plant that is harvested from the OCSL’s Eco Machine™, bringing beauty to the Omega dining hall and special events.

RESPONSE

They say that beauty is in the eye of the beholder. But often what people are referring to is a sort of superficial beauty. Maybe style is a better word. Hair styles, home styles, car styles, fashion styles, even ways of speaking and moving, these things all pass into and out of favor more quickly than most of us can keep up with. But what about beauty that isn't so obvious? The kind that makes you feel delight or awe or astonishment, but you're not even sure why. The beauty you feel when you enter a place and it's like you've plugged into some secret source of power—the universe expands, and you suddenly have a true sense of your place in it.

Nature is the mother and midwife of this experience. As long as there have been humans, we have been manipulating our environment to ensure our own survival. Using fire, making tools, domesticating animals and plants—much of it all seemed relatively harmless until the industrial revolution about 150 years ago, when we began to truly disconnect from our environment and act out, on a world stage, our domination of the planet. In this great shift, we have forgotten the basic premise of a relationship: that there are multiple parties that have equal standing and who depend on each other.

Many of us return to nature to be reminded of this. We retreat to the woods, the water, the open spaces and majestic places that help us regain perspective, remind us that we are part of the whole, and remember that we are in a serious, healthy interdependency with the earth. We almost never retreat to a building to be reminded of this.

One of the greatest challenges in our modern life is that we spend much of our time inside buildings that are lightless and lifeless. They may be made from natural materials, but those materials have been battered and forged and shaped and painted until they are beyond recognition and even potentially harmful to those inside. The OCSL is our attempt to remedy this situation. It's our way of acknowledging our relationship to nature and our effort at helping to reconnect the thousands of people that visit Omega every year to the original, authentic, expansive truth of nature's beauty.

PREREQ

15

Beauty and Spirit

Confucius says, "Everything has beauty, but not everyone sees it." This building is an attempt to get people to see the beauty they are part of by coming in through one of the least likely doors: their own human waste. The OCSL reclaims all of Omega's wastewater using natural processes. In the Eco Machine™, plants, bacteria, algae, snails, fish, and more microorganisms than we could possibly count, clean the water that comes from toilets, showers, sinks, and kitchen facilities from across our 195-acre campus. This all takes place because some very astute scientists spent time watching nature and learning from what is already going on around us. It's a refined, closed, sophisticated, beautiful process.

But it's still about urine and feces and cosmetics and medications and all the other stuff we flush and rinse away, thinking we'll not have to deal with it again.

When Omega decided to use this "ecological machine" technology, we realized that this was too good a secret to keep. As an educational institution, we wanted to not only build this facility in a way that honored the magnitude of the natural process happening inside, we also wanted share this knowledge in a way that would delight visitors and remind them that there is no such thing as waste. We wanted them to stand in the middle of their own biological waste, witness nature assimilating it, and see the beauty in all of it.

Through the dedicated vision of innovative architects, builders, engineers, and scientists, we created a building that is full of light and space and natural materials. The building itself has an integrated relationship with nature—it captures and uses water, sunlight, and food in a way that mimics life itself. Its heart is the energy from the sun; its circulatory system, the pipes and lagoons of the Eco Machine™, moves everything around; and its digestive system, the plants and numerous other organisms in the Eco Machine™, filters and converts waste into food. It's a building, but when you walk inside there is little doubt that you are in a living organism. It reminds you that everything—all of life—is constantly in flux, always transforming from one thing to another.

Not only are you in a living organism, but the lines are blurred between where that organism stops and the rest of the world begins. The south side of the building is a large wall of windows, allowing for a seamless transition between the lagoons of the Eco Machine™ inside with the wetlands of the Eco Machine™ outside and to the woods and lake beyond the boundaries of the OCSL. Visitors find themselves smack dab in the middle of all the natural organisms that are cleaning up after them. It is impossible to be in this space and not delight in the green, life-affirming growth of the plants and marvel at the fact that another being is living off what you have discarded. This isn't just an inspirational learning tool; it's a place where people heal and repair their relationship with nature and with life. It's where people reconnect to something they may not have known was missing in their life: beauty.

ROBERT "SKIP" BACKUS
CHIEF EXECUTIVE OFFICER, OMEGA INSTITUTE

PREREQ

16

Inpiration and Education

CHALLENGE

Educational materials about the performance and operation of the project must be provided to the public to share successful solutions and to motivate others to make change. Non-sensitive areas of the building must be open to the public at least one day per year, to facilitate direct contact with a Living Building.

Upon suffering beyond suffering: the Red Nation shall rise again and it shall be a blessing for a sick world. A world filled with broken promises, selfishness and separations. A world longing for light again. I see a time of Seven Generations when all the colors of mankind will gather under the *Sacred Tree of Life* and the whole Earth will become one circle again. In that day, there will be those among the Lakota who will carry knowledge and understanding of unity among all living things and the young white ones will come to those of my people and ask for this wisdom. I salute the light within your eyes where the whole Universe dwells. For when you are at that center within you and I am that place within me, we shall be one.

CRAZY HORSE, OGLALA LAKOTA CHIEF
(THIS STATEMENT WAS TAKEN FROM CRAZY HORSE AS HE SAT SMOKING THE SACRED PIPE WITH SITTING BULL FOR THE LAST TIME, FOUR DAYS BEFORE HE WAS ASSASSINATED.)

INSPIRATION / *Cherry Tree*

The cherry tree, like many other fruit trees, teach us many life lessons. In addition to an annual provision of food for humans and other animals, it contributes to the enrichment of the surrounding soil through its droppings of leaves, petals and fruit. Through both its root and branch system, it is highly efficient in how it can thrive while remaining in one place for its lifetime, completely reliant on its environment. And then, in spring, when the cherry blossoms bloom, the tree teaches us not about efficiency, but abundance, inspiring us towards similarly generous and restorative acts.

RESPONSE

From its inception, the Omega Institute has considered the OCSL as a powerful educational tool in matters of water use, water conservation and water quality. Since early design, indoor and outdoor classroom spaces have been included in the building program, atypical for a wastewater treatment facility. This education begins with the design of the facility where building systems are made transparent. The water treatment train is exposed throughout. Only buried tanks at the start of the train and the dispersal field at the end are hidden below grade. The entire structural system, as well as solar and rainwater capture are exposed in the building's form and through minimal use of finish materials.

In addition to the building design, signage was provided throughout the campus tracking the progress and impact of the OCSL. Adjacent to the project site, key construction benchmarks were identified to the community of visitors: First Water Enters EcoMachine, Earth Day Planting, Opening Celebration, and so on. Signage within the Eco Machine™ Room tracks the flow of water from toilet to lake, and is tied to signage within each visitor bathroom, providing information about water conservation and water quality. Additional signage throughout the OCSL shares information about non-toxic materials and other key building features.

For a more hands-on perspective, tours have been provided of the building site throughout construction. Since construction completion, the entire facility has been open to the public throughout the year:

April thru mid-November:
- Seven days a week from 1:00 to 2:00 p.m.
- Guided tours on Wednesdays and Saturdays at 1:00 p.m.
- Group tours by appointment

Mid-November thru March:
- Monday thru Friday from 1:00 to 2:00 p.m.
- Group tours by appointment

In written format, a simple brochure describing the building design, and environmental features is available for all visitors. Additionally, Omega Institute maintains a website with information about the design, construction and operation of the OCSL at www.eomega.org/omega/about/ocsl/.

Authors
Bob Berkebile, Steve McDowell, Laura Lesniewski
Introduction by Jonathan Todd

Book Design
BNIM Architects. *Designer* Beena Ramaswami. *Project Coordinator* Erin Gehle

Imagery
Farshid Assassi, Assassi Productions: All images including cover and back/ BNIM: cover and back

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Sheryl Lamb
Walter Link
Stephan Rechtschaffen, MD (Cofounder of Omega)
Elizabeth Lesser (Cofounder of Omega)
David Orlinsky

Project Team
Architect
BNIM Architects. Steve McDowell. Laura Lesniewski. Brad Clark. Sarah Hirsch. Ramana Koti
Civil Engineer
Chazen Companies. Jim Beninati
Construction
David Sember Construction. David Sember
Ecological Design
John Todd Ecological Design. Dr.John Todd. Chloe Starr. Conor Lally. Kim Robinson. Jonathan Todd
Landscape Architect
Conservation Design Forum. David Yocca. Tom Price. Gerould Wilhelm. Trish Beckjord. Jason Addington
Mechanical/Electrical/Plumbing Engineer
BGR Engineers. Katrina Gerber. Erin Zirjacks. Jim Basquette
Structural Engineer
Tipping Mar + associates. David Mar. Marc Steyer
Water Systems Engineer
Natural Systems International. Michael Ogden. Erin English. Pete Munoz. Olin Christy. Rachel Arrieta

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IN PURSUIT OF A LIVING BUILDING
THE OMEGA CENTER FOR SUSTAINABLE LIVING
RHINEBECK, NEW YORK

ORO *editions*

CONTENTS

ABOUT THE LIVING BUILDING CHALLENGE

The Living Building Challenge, a program of the International Living Building Institute, is a certification program dedicated to ensuring that buildings are achieving the stringent guidelines in key areas of site, energy, materials, water, indoor quality and beauty and inspiration. Certification is based on actual performance rather than estimated performance, therefore a twelve-month verification period is required before buildings will be evaluated.

FLOW

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