KEYNOTE ADDRESS: ECOLOGICAL DESIGN

By Lauren Valle[*]

John Todd Ecological Design specializes in designing systems based on a cost-effective, renewable philosophy known as ecological design.[1] The concept of ecological design goes far beyond that of sustainable design. Sustainable design is less harmful or less impactful than conventional practices. Ecological design, also known as regenerative design or Biomimicry, is a proactive design process that aims to create the space for, and set into motion, ecological processes that mimic Mother Nature in an intentional and measured way.[2] The intention of ecological design is to find a balance between controlling an engineered system and allowing the system to be in relationship with the natural world. The goal is to enable the system to establish itself and thrive in a far more complex and sophisticated way than humans could ever imagine generating.

The practice of ecological design necessitates a radical shift from traditional practices of architecture, engineering, and design. For the past few centuries, architecture and engineering have focused on overcoming natural forces. Ecological design shifts the focus to creating the conditions for the proliferation of life, and allies itself with natural forces to make them maximally useful for meeting human needs.

Howard Odum, one of the first thinkers in the field of ecological design, said, "[t]he inventory of species of the earth is really an immense bin of parts available to the [E]cological engineer."[3] Like conventional technologies, ecological technologies are intended to do work, such as generating fuel, growing foods, transforming wastes, and regulating indoor climates. The difference between a conventional technology and a living technology is that a living technology is made up of hundreds of thousands of organisms acting with their own intelligence—microorganisms, mollusks, fish, plants, and higher life forms. In conjunction with sunlight,

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1. *About Us*, JOHN TODD ECOLOGICAL DESIGN, http://www.toddecological.com/about_us/ [http://perma.cc/ZXD8-VD4Q] (last visited Apr. 11, 2015).

2. SIM VAN DER RYN & STUART COWAN, ECOLOGICAL DESIGN 3–4, 47 (10th ed. 2007).

3. JANIS BIRKELAND, DESIGN FOR SUSTAINABILITY: A SOURCEBOOK OF INTEGRATED ECO-LOGICAL SOLUTIONS 174 (2002).

these organisms form a constantly shifting eco-system engaging in many biological processes, including nutrient-to-waste recycling.[4]

An important concept behind ecological design can be understood when one considers human urine. Human urine contains nitrogen, phosphate, and potassium at a ratio similar to that of commercial fertilizer.[5] A human adult produces enough urine to produce 50 – 100% of its own food crops.[6] However, most human urine goes into waste treatment plants and many of the nutrients in the wastewater end up rivers and waterways, causing problems such as eutrophication. Ecological design recognizes that what is often called waste—in this case human urine—is actually a resource.

These ideas were put into practice at the New Alchemy Institute in the 1970s at a 35 acre research farm on Cape Cod where John Todd and other scientists conducted a homesteading experiment.[7] In the course of the experiment, the scientists designed several closed-loop systems that produced food, dealt with waste, and generated fuel.[8] Their findings, which were meticulously documented, were eventually published and remain influential in the world of closed-loop ecological systems thinking.[9]

These early designs involved domes and clear-sided tanks. Each of these enclosures contained several different ecological systems. For example, a single dome would contain alcoves of trees, aquaculture, and gardens working together as an ecosystem. The Institute also developed designs using solar emitting, clear-sided tanks that contained fish and algae, which became the foundation for Dr. Todd's extensive work in treating contaminated waters that is the focus of this talk. These initial concepts were married together in facilities that the New Alchemists built in the 1970s such as, the Prince Edward Island Ark, which raised fish, provided heat, and treated waste, inside one greenhouse.[10]

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4. VAN DER RYN & COWAN, *supra* note 2, at 34–36.

5. *See* HÅKAN JÖNSSON, SOURCE SEPARATION OF HUMAN URINE-SEPARATION EFFICIENCY AND EFFECTS ON WATER EMISSIONS, CROP YIELD, ENERGY USAGE AND RELIABILITY 1 (2002) (noting that the fertilizing effect of human urine is comparable to that of chemical fertilizer).

6. *Fertilizing with Human Urine*, VEGANIC AGRICULTURE NETWORK, http://www.goveganic.net/article217.html [http://perma.cc/7GPT-H8LW] (last visited Apr. 11, 2015).

7. *New Alchemy Institute*, SPATIAL AGENCY, http://www.spatialagency.net/database/why/ecological/new.alchemy.institute [http://perma.cc/92H9-7BNB] (last visited Apr. 11, 2015).

8. Elise Hugus, *The Cape Cod Ark: A Study in Self-Sufficiency*, EDIBLE CAPE COD (Dec. 16, 2014), http://ediblecapecod.com/online-magazine/the-cape-cod-ark/ [http://perma.cc/H2K6-VAV9].

9. *See New Alchemy Institute*, *supra* note 7 (noting that "many of the ideas developed at the New Alchemy Institute are now seen as standard ecological design practice"); Links to New Alchemy Institute Publications, THE GREEN CENTER, http://www.thegreencenter.net [http://perma.cc/X9LG-9TC5] (last visited Apr. 11, 2015) (providing links to various New Alchemy Institute publications on closed-looped ecological systems).

10. NANCY JACK TODD & JOHN TODD, FROM ECO-CITIES TO LIVING MACHINES: PRINCIPLES OF ECOLOGICAL DESIGN 6– 7, 11, 39 (1993), *available at*

The early work at the New Alchemy Institute also paved the way for a wastewater remediation technology called the Eco-Machine, formally known as the Living Machine, which uses clear-sided solar aquatic tanks in combination with other treatment environments, such as anaerobic septic tanks.[11]The original Eco-Machine was built in Harwich, Massachusetts.[12] It treated septic waste from households and small businesses that were being stored in an unlined lagoon. The effluent in this lagoon contained 14 of the Environmental Protection Agency's ("EPA") top priority pollutants and was leaking through the sand into the water table.[13] Dr. Todd designed an ecological system composed of 14 clear-sided solar tanks that connect together to form a river, with effluent from the lagoon flowing through the system.[14] He also constructed a sidestream marsh as an additional treatment environment. He placed hundreds of forms of aquatic life into the tanks that he collected from ten different local environments.[15] After 12 days, 14 of the 15 top priority pollutants dropped below regulatory limits and the effluent met federal swimming water standards.[16] With the help of sunlight and the diversity of organisms, the eco-system within the tanks self-organized to adapt to its environment and to consume and metabolize the waste. The various biological components co-evolved with the wastewater to bring the system into stasis because that is what nature wants to do; it wants to come back into stasis; it wants to heal itself.

Another early work that Dr. Todd designed was installed on the Flax Pond, also in Harwich.[17] This project used a technology called a Restorer that co-evolved with the Eco-Machine.[18] The Eco-Machine technology is an enclosed, stand-alone technology.[19] The Restorer, in contrast, is a floating plant raft that supports masses of suspended roots, which provides a habitat for microbial communities that can metabolize and decompose nutrients and waste.[20] The Flax Pond is a 15 acre pond that was "heavily

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https://corin2e.files.wordpress.com/2013/06/from-eco-cities-to-living-machines-complete.pdf [https://perma.cc/C88F-SZJE].

11. *About Eco-Machines*, JOHN TODD ECOLOGICAL DESIGN, http://toddecological.com/eco-machines/ [http://perma.cc/WBH5-8L3Y] (last visited Apr. 11, 2015).

12. *Past Projects*, OCEAN ARKS INT'L, http://www.oceanarksint.org/index.php?id=past-projects [http://perma.cc/W8DP-76W3] (last visited Apr. 11, 2015).

13. NANCY JACK TODD, A SAFE AND SUSTAINABLE WORLD: THE PROMISE OF ECOLOGICAL DESIGN 152–56 (2d ed. 2006).

14. *Id.*

15. *Id.*

16. *Id.*

17. John Todd et al., *Ecological Design Applied*, 20 ECOLOGICAL ENGINEERING 421, 426 (2003).

18. *Id*.

19. *About Eco-Machines*, *supra* note 11.

20. Todd et al., *supra* note 17, at 426–27.

impacted for decades by leachates from an adjacent landfill and unlined septage holding lagoons."[21] In 1989, the pond was closed to recreational activities because it was contaminated by 78,000 gallons of leachate each day.[22] The pond suffered from low oxygen levels, excessive sediment, and excessive organic pollutants.

Dr. Todd anchored a Restorer on the pond in 1992 and circulated 100,000 gallons of water through the system per day.[23] The Restorer was divided into cells. The first three cells contained pumice rock and the final six cells supported two dozen species of terrestrial plants. The system used plant roots and associated bacteria to metabolize pollutants. For the decade that the Restorer was operating, the pond maintained its biological health despite the continued onslaught of pollution. Ammonia and sediment levels did not increase, the pH of sediments hovered around neutral, and dissolved oxygen increased. Most importantly, the Restorer digested about 25 inches of sediments in three years.[24]

Another important early ecological design project was a waste treatment plant treating 80,000 gallons per day of municipal wastewater that was built in 1995 in South Burlington, Vermont.[25] In this system, wastewater passed through an anoxic reactor and then into four aerobic reactors, large transparent tanks containing water and a diversity of organisms. On the surface of these reactor tanks were plant racks with suspended root growth reaching into the water column. Following the aerobic reactors, wastewater passed into a clarifier tank that also had growing plants on it. It was very beautiful. The aerobic reactor tanks were the most biologically diverse components of the system containing over 200 species of vascular and woody plants.[26] Each of these plants was evaluated for its effectiveness and suitability for wastewater treatment, its ability to tolerate sewage, the extent of the root zones, disease, and infection resistance, and ease of management. After being treated by the Eco-Machine, the wastewater met regulatory standards for tertiary treatment. The South Burlington plant also produced economically valuable plants as a bi-product and 100,000 ornamental koi fish.

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21. *Id.* at 426.
22. *Id*.
23. *Id*.
24. *Id*. at 427.
25. *Id*. at 422.
26. Todd et al., *supra* note 17, at 423.

Another important step in the development of ecological design came from a project in Berlin, Maryland.[27] This 2001 project involved a lagoon at a Tyson chicken processing plant.[28] By this time, the Restorer system that we used in Harwich had evolved into a linear design that we adapted "for use on new and existing wastewater treatment lagoons."[29] This technology combines the benefit of the small tank-based technology with the simplicity of constructed wetlands.

The lagoon held nine million gallons of effluent, with one million gallons per day cycling through.[30] We installed 12 linear Restorers—long, narrow racks containing a diversity of plants—that stretched 140 feet across the surface of the lagoon.[31] These Restorers were secured to the banks and created a serpentine, s-shaped flow of water through the lagoon. The Restorer racks contained 25 native species of plants.[32] The roots of these plants provided surface area and nutrient support for microorganism communities. The plants provided some nutrient uptake and the shaping of the racks inhibited suspended algae. The system also provided both aeration and an aerobic treatment environment.

This system was built for one-quarter of the cost of a traditional solution. Tyson looked at many other companies and chose Dr. Todd's solution because it was the most economical choice. Our ecological system reduced the electrical energy used in the lagoons by 74% and significantly decreased sludge production.[33] Previously, the lagoon had wasted sludge for eight hours a day.[34] After we installed the ecological treatment system, the lagoon wasted sludge for just one hour every few weeks.[35] This allowed Tyson to comply with wastewater regulations. It also looked very beautiful.

Next, we are going to travel around the world a bit and look at a project in China—a canal in the city of Fuzhou. Fuzhou is one of China's up-and-coming cities. It is home to six million people and when this project was built, it was disposing untreated wastewater into an 80-kilometer series of canals throughout the city.[36] The canals empty into a river. Obviously, these

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27. *Industrial Waste Treatment Aqua-Restorer: Berlin, Maryland*, JOHN TODD ECOLOGICAL DESIGN, http://toddecological.com/clients/PDFs/100623.casestudy.tyson.pdf [http://perma.cc/ARB2-KXXN] (last visited Apr. 11, 2015).

28. *Id*.

29. Todd et al., *supra* note 17. at 427.

30. *Id*. at 428.

31. *Id*.

32. *Id*.

33. *Id*.

34. *Id*. at 429.

35. *Id*.

36. *Urban Municipal Canal Restorer: Fuzhou, China*, JOHN TODD ECOLOGICAL DESIGN, http://toddecological.com/clients/PDFs/100623.casestudy.baima.pdf [http://perma.cc/ND55-3PNC] (last visited Apr. 11 2015).

canals are a health risk for the city's inhabitants. They also threaten the livelihood of fishing communities downstream.

In 2002, we installed a Restorer on one of the canals.[37] We used over 12,000 plants, including 20 native species.[38] The Restorer also had a walkway down the center, so the area became a prized recreational area for the community.[39] The project enabled the city to meet its water quality goals. For example, nitrogen levels fell below 15 mg/L.[40] There was no more floating solids, and a significant reduction in odor. The project drastically improved the aesthetics of the neighborhood.

A few years ago, an engineer from China came to work at John Todd Ecological Design who grew up on the canal in Fuzhou. She lived next to this system as a child and chose a career in ecological engineering because she had seen firsthand the impact that this kind of technology had on her community.

Back in the United States, one of our more recent projects is on the Blackstone River in Grafton, Massachusetts, and involves a canal that is quite emblematic of many American waterways.[41] The Blackstone River is considered the birthplace of the Industrial Revolution in the United States. It runs 45 miles from Worcester to Providence.[42] There are hundreds of old mills along the river, including the Fishersville Mill, which was constructed in 1832 as a textile factory.[43] This mill initially produced cotton textiles, then tool and dye, and finally lawn furniture and foam rubber.[44] It closed its doors in 1986; it was open for over 150 years.[45] In 1999, a 23-alarm fire burned it to the ground, releasing massive asbestos plumes into the air and leaving "behind toxic rubble on top of an already degraded environment."[46]

The site underwent a five year cleanup effort in which many of the materials, including two leaking underground oil storage tanks, were removed.[47] The cleanup left behind a heavily degraded canal that was

37. *Id*.
38. *Id*.
39. *Id*.
40. *Id*.
41. *Fisherville Canal Restorer, Grafton, Mass.*, JOHN TODD ECOLOGICAL DESIGN, http://www.toddecological.com/PDFs/Grafton%20Case%20Study.pdf [http://perma.cc/T5HK-YQJB] (last visited Apr. 11, 2015).
42. *The Blackstone Canal in Worcester*, NAT'L PARK SERVICE, http://www.nps.gov/blac/learn/education/classrooms/blackstone-canal-in-worcester.htm [http://perma.cc/D7PS-EJS4] (last visited Apr. 11, 2015).
43. *Fisherville Canal Restorer, Grafton, Mass.*, *supra* note 41.
44. *Id*.
45. *Id*.
46. *Id*.
47. *Id*.

choked with crude oil from the underground storage tanks. The crude oil leaches into the canal with every rainstorm.

In 2006, an interdisciplinary commission contacted John Todd and asked if the Restorer technology could be a solution for this canal. While we had experience treating many tricky contaminants and highly toxic waste, the oil was a new challenge for us. We designed a pilot study that began in 2006, in which we added cells of mycelium, or fungus, to our ecological treatment system.[48] The particular fungi strains that we used are known for their ability to "break down petroleum hydrocarbons."[49] After a year of collecting data on the pilot, we saw that it was breaking down 60 to 90% of the hydrocarbons.[50] Then, we scaled the design up.

At our greenhouse in Grafton, we have a four-part system. First, within the canal we installed a sediment digester, an HDPE pipe filled with media that is heavily laden with bacteria. This begins the oil digestion. From there, the water flows through the mycelial bins and into a series of solar aquatic tanks. Enzymes excreted from the mycelia are introduced to the waste stream and degrade the hydrocarbons as they flow through the system. Finally, the water flows back out to the canal and is sprinkled onto a Restorer, which serves as further habitat for microbes as well as functions as a chemostat for healthy organisms to incubate and proliferate as they are released back into the canal.

Water flowing through the system removes about 60 to 90% of the hydrocarbons.[51] The impact on the canals themselves is slightly harder to measure. However, we have noticed upstream and downstream effects, including 40% reductions of hydrocarbons in the sediment. We have also noticed that many indicator species have returned to this canal. This past summer we saw frogs, which cannot tolerate petroleum because it easily passes their porous skin.[52]

This is an ongoing project that we continue to investigate. In conjunction with this project, we are also hosting workshops that we call the Living Systems Laboratory.[53] We invite students from the United States and Canada to learn about and pilot ecological design projects with us.

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48. *Id*.
49. *Id*.
50. *Id*.
51. *Id*.
52. *See* KENTWOOD D. WELLS, THE ECOLOGY AND BEHAVIOR OF AMPHIBIANS 785 (2007) (noting that amphibians are susceptible to environmental degradation because their permeable skin is vulnerable to chemical agents); *Fisherville Canal Restorer, Grafton, Mass.*, *supra* note 41.
53. *Welcome*, THE LIVING SYSTEMS LABORATORY, http://wordpress.clarku.edu/fisherville/ [http://perma.cc/36BM-E8W9] (last visited Apr. 12, 2015) (providing a description of the Living Systems Laboratory).

Now, moving to a project in South Africa, we began working in South Africa about a year ago, looking at sanitation issues in some of the informal settlements that were established after Apartheid. We have been working at a settlement called Langrug, which is in the Western Cape Province outside of the city of Stellenbosch.[54] Langrug is built on a hillside, and the people there collect water in buckets to use in their houses for cooking, washing dishes, and cleaning. After they are done with their water, they take it back outside and dump it into a series of rudimentary canals or channels that flow down the side of the hill. The water flows from the canals onto the village's sports field, where it turns the field into a soggy mess. From there, the water drains into the nearby Berg River.

A lack of water infrastructure is the case all over South Africa, and the government has become interested in finding a solution. One of the driving forces behind finding a solution is the fact that fruit farmers use water from the Berg River to irrigate their crops, and the European markets that buy these crops are no longer accepting them due to high levels of E. Coli in the irrigation water. So, there is an economic incentive to deal with this issue, as well as a humanitarian incentive.

The water that flows through Langrug's channels is quite similar in its makeup, to septage effluent. It is equivalent to what comes out of your septic tank, and it is what is flowing out onto the streets. We designed a series of technologies to treat this water. First, we designed an Eco-Machine for the sports field. It is a series of 78 aquatic cells that cascade down the hill and use gravity to move water.[55] When we first arrived in Langrug, we were told that we could not design any infrastructure that used electricity and we said, "okay." Then they told us we could not use anything in the system that had any value to anyone at all, because they were worried about theft. And we said, "okay."

Under these strict parameters, we designed a system that can be constructed out of reclaimed brick and mortar produced in the community with a plastic watertight lining. There are no pumps or valves within the system. It also creates several economic opportunities for the community: both fish and cut flowers can be grown using the nutrients in the system and sold. It was especially important to that community that the system be economically beneficial. Therefore, we worked with the community throughout the design process to understand how to make that a reality.

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54. *From Missing Infrastructure to Ecological Infrastructure: Innovating in South Africa*, JOHN TODD ECOLOGICAL DESIGN, http://www.toddecological.com/eco-machines/recent_work.php [http://perma.cc/7VEV-H34U] (last visited Apr. 12, 2015).

55. *Id.* However, Dr. Todd changed the design from 87 to 78 aquatic cells after John Todd Ecological Design published this article.

The cells that make up the system will eventually fill with solids from the waste stream. When this happens, the cells can be taken offline and extra biomass, such as prunings from plants, are added to make a rich soil. The off-line cells can then be used to grow an economically valuable crop. After a season, the soil can be removed from the cell and finally the cell is brought back online to be used for treatment.

We also designed a series of tree wells, arboreal soil makers, and micro-wetlands that are upstream from the Eco-Machine that essentially turn these gutters and canals into gardens, using the nutrients in the effluent to grow plants. This low-impact, living, and cost effective method of treating wastewater will add a lot of soil, plants, and trees to a settlement that currently has almost no soil and is almost all hard-pack. It also gives the village an opportunity to raise fish within the system, as we discussed earlier.

We are hoping to see this system built in 2015. It is a radical approach to infrastructure. Langrug is a community that is going from zero infrastructure to ecological infrastructure. The community is happy that their children will no longer be playing in septage-quality water outside of their front doors. We have found that there is a lot of room to design from scratch in places like South Africa because they have areas that do not have the highly regulated, permanent infrastructure already in place that we have in the United States.

Back to the United States: another one of our projects is in Peoria, Illinois. Peoria sits on the Illinois River and, as is typical of a city, is highly developed. Around 2007, EPA told Peoria it could no longer use sewers to manage its stormwater.[56] During rain events, stormwater flows into Peoria's sewers and if the sewer becomes overloaded, the mixture of stormwater and sewer water is released into the Illinois River in what is called a "Combined Sewer Overflow (CSO)" event.[57] The conventional solution that EPA recommended was to build a 12 foot diameter underground pipe that would take all of stormwater to the city's waste treatment plant five miles downstream.[58] This was going to cost the city $500 million. The city

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56. Thomas Bruch, *Greater Peoria Sanitary District Continues Tug-of-War with EPA over Combined Sewer Overflows*, JOURNALSTAR (Aug. 18, 2013, 12:01 AM), http://www.pjstar.com/article/20130818/News/308189897 [http://perma.cc/7TXV-G8Y7].

57. *See Combined Sewer Overflow*, CITY OF PEORIA, http://www.peoriagov.org/public-works/combined-sewer-overflow/ [http://perma.cc/RR5Q-EJ5H] (last visited Apr. 12, 2015) (describing what occurs when there is a combined sewer overflow).

58. Peter Kenyon, *Green Surge Threatens CSO Storage Solution*, TUNNELTALK (Jun. 19, 2013), http://www.tunneltalk.com/Discussion-Forum-19June2013-Investigating-the-future-of-deep-storage-tunnels-in-the-USA.php [http://perma.cc/MB99-B968] (noting that "[f]or the best part of two decades, deep storage tunnels and CSO interceptor systems have formed the central spine of projects that many of the largest cities in America and sewer districts have been obliged to adopt as part of a

decided to look for alternative solutions that could not only solve their problem but also bring benefits and new life to the community.

To deal with their CSO problem, rather than building an expensive underground pipe, Peoria has decided to implement "capture and infiltration technologies." The city is going to build infrastructure such as bioswales, rain gardens, and plant-filled boulevards and use permeable pavement techniques to capture its stormwater and infiltrate it into the ground in place so that no stormwater is entering the sewer system. We became involved in this project because Peoria wanted to know how ecological design could fit into its already green plans. Peoria is an up-and-coming city—it is the world headquarters for the Caterpillar Corporation—and it wants to take good care of its many assets.[59]

There is a lot of empty and unused space on the Peoria waterfront, so we designed a whole series of technologies that stretch along the entire waterfront. These include a five-mile-long Restorer and ecologically-designed public amenities such as a public swimming pool filled with river water that is treated by an Eco-Machine, rather than chlorinated potable water. The Restorer can serve as a back-up technology to the "capture and infiltrate" technologies and can treat CSO water, should a CSO event happen. At all other times, it will treat Illinois River water. It also creates an "urban wilds" that provides recreational opportunities within the city. We have not built this project yet, but I bring this up as an example of how ecological design can be integrated into an entire cityscape and how we can think on a large scale using this approach.

Dr. Todd has been saying a lot lately that he feels like his work is finally coming out of the wilderness. He has been doing this work for going on forty years and, though the projects have been beautiful and successful in their mission, ecological design has yet to be adopted by the mainstream. Now, in the midst of our awakening due to climate change and the severe ecological damage our civilization is responsible for, people are starting to understand that ecological design is one of the ways forward. Ecological design can serve us both in the creation of new, resilient, and living infrastructures that benefit humans and the natural world, and also for the healing and remediation of degraded environments, of which there are so many. I would like to further this thought by saying that I hope that in the

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nationwide program to reduce overflows of foul and polluted water into the rivers, creeks and harbors of the nation").

59. *County Board: Sustainability Plan*, PEORIA COUNTY GOV'T, http://www.peoriacounty.org/countyboard/sustainability-plan/ [http://perma.cc/E85D-KKUT] (last visited Apr. 12, 2015) (noting that Peoria County received an award for its environmental protection efforts).

process of reimagining and recreating our built world with the tools of ecological design that we are heading toward a new wilderness. I hope that we can become re-enchanted with nature's logic. We can re-learn to live as a part of, next to, and within the biological life processes that we belong.

We can create a world for ourselves where our stormwater goes back into the ground; where we have in place massive in situ remediation projects on rivers and streams that remediate persistent legacy contaminants; where we treat microbes and mycelia as powerful allies; where our lands and waters are coming back to life; where we produce food locally with recycled nutrients; where each neighborhood has its own wastewater treatment plant that children love to play near because it is a beautiful garden.

I believe we truly can build a world where human infrastructure can be a part of a regenerative living system instead of a gray, lifeless, concrete system. And I hope this gives you a good, hopeful foundation for the rest of the day. There are some amazing solutions out there and this work can only grow. If you have any other questions, feel free to email me at Lauren@toddecological.com and thank you very much.