Clean Cut Quarterly

# NJARNG Sustainability Newsletter

***In collaboration with Rowan University***

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IMAGE: NJ.GOV

## *Where are the stars?*

They're still in the sky, but light from urban areas is making it difficult to spot them. Read all about it on **page 1**.

IMAGE: NOAA

How seaweed may hold the key to capturing carbon. See **page 4**.

Cleaning up NJ one brownfield at a time. Story on **page 6**.

IMAGE: EPA

# Bright Night Skies

*By: Parth Patel*

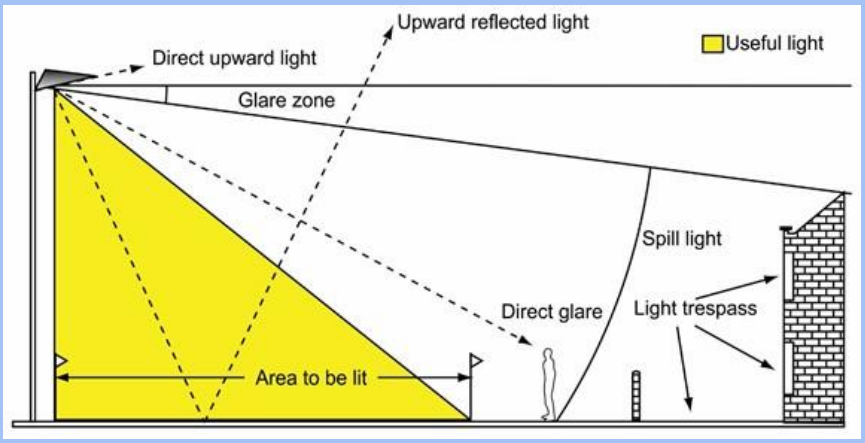
Over the past 20 years, the night sky has become more and more clouded with artificial light produced by the towns and cities of modern society. Because of this light pollution emanating from the built environment in urban areas, it is becoming increasingly difficult to see the stars in the night sky.

The issue of light pollution is garnering more attention because it not only impacts humans and other animals, but it is a clear example of the inefficient use of energy.

## The Wrong Direction

Light pollution is the consequence of light emitted by an outdoor fixture not being used for its intended purpose. According to the International Dark-Sky Association, approximately 13 percent of household electricity goes towards outdoor lighting and, of that, 35 percent of the outdoor lighting is not properly utilized to light its intended target. Light shining upwards contributes to light pollution and light shining outward is known as light trespass. Both of these result in the undesired illumination of non-target areas. Since a lamp consumed energy to light those unwanted areas, it is clear how the presence of light pollution is a direct result of wasted energy.

The figure illustrates the pathway that light takes after it leaves an outdoor light fixture. With improperly shielded outdoor lighting (including bulbs with no shielding), light is both directed upward into the sky and creates a zone of bright glare. A secondary contributor to light pollution is the light reflected upward from surfaces like the ground . Properly shielding outdoor light fixtures can reduce the illumination of the night sky, making it possible to see the stars again in a bustling city.




NYSERDA

*An illustration of light pollution and trespass.*

## Disturbing Life's Rhythms

Humans as well as most wildlife depend on their circadian rhythms, or the body's natural sleep cycle, to determine when it is time to rest. The circadian rhythm can be easily disrupted when exposed to too much light, specifically, blue light. Too much exposure to blue light can also cause problems such as eye strain, blurred vision, and headaches. Blue light is emitted from most light sources but the amount of blue light may vary. Unfortunately, most of modern technology emits blue light in amounts that can be detrimental to human health. The cloudy lit skies can potentially exacerbate these issues.

Wildlife such as insects, reptiles and birds are also affected by light pollution in the night skies. Reptiles such as turtles are having trouble making it to the oceans after hatching due to street and city light. The nocturnal migration of birds also is interrupted by to the illumination of the night sky. It is estimated that millions of birds die annually due to light

**'Light' continued on page 2**

pollution, often due to collisions with tall buildings. City officials and residents of Philadelphia are working together to prevent the deaths of migrating birds through the "Lights Out" initiative during the migratory seasons. Most recently, the city lights were turned off from 12am to 6am on April 1.

### Ideal Conditions

The Bortle Scale is a way to determine the ideal sky brightness to see the Milky Way galaxy in the night sky. Currently, one-third of the world's population can no longer see the Milky Way or any stars in the sky. The Bortle Scale is divided into nine classes. Classes one through five provide ideal conditions for the stars in the night sky to be visible, while classes six through nine have conditions in which stars are impossible to see. It is ideal to have a Bortle Scale of five and lower to benefit life on earth and to see the stars. New Jersey, along with other population dense states, are typically class four and higher on the Bortle Scale.

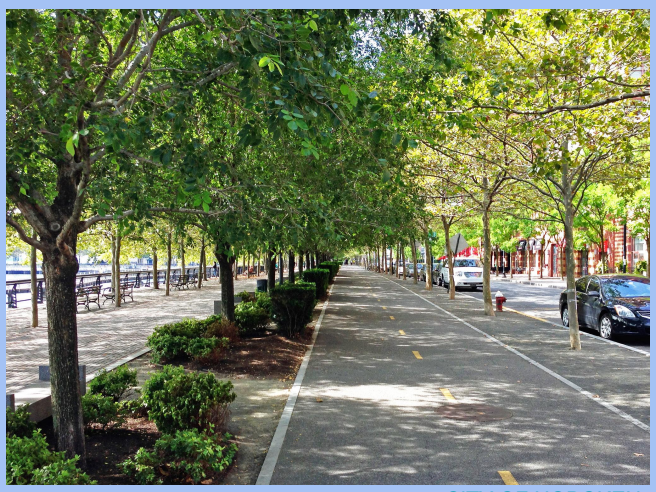
While not ideal, there are many locations in New Jersey away from city centers where you can still view the night sky in some of its glory. There are several amateur astronomy clubs around the state with resources on their webpages on where to plan your next stargazing trip. ■

# High Tide in Hoboken

*By: Maximilian Husar*

Approximately 53,000 New Jerseyans reside in the City of Hoboken, a small plot of land that abuts the Hudson River with glorious views of the Manhattan skyline. While the waterfront location attracts many to Hoboken, it is its proximity to the water that increases its vulnerability to disastrous flooding.

In 2013, the city first proposed the Green Infrastructure Strategic Plan to better manage overflowing stormwater and prevent future flooding. Since then, the plan has remained a very critical blueprint for Hoboken, especially since it has been ravaged by storm surges. A particularly damaging storm surge accompanied Hurricane Sandy when it made landfall on the shores of New Jersey on Oct 12th, 2012.



CITY OF HOBOKEN

*The waterfront in Hoboken.*

### Murky Waters

Flooding is not only inconvenient, but is very harmful to wildlife and people. Fast flowing flood water picks up everything in its path, including garbage and other toxic materials. Flood waters carry agricultural chemicals (such as fertilisers and pesticides), paint, petroleum products (such as gasoline or diesel fuel) into the habitats of wildlife, poisoning both flora and fauna. For people, walking in flood water should be avoided—it contains chemicals and pathogens (sometimes from raw sewage) that can lead to skin rashes or disease.

**'Flooding' continued on page 3**

Flooding washes out roads and halts traffic, damages buildings, disrupts the economy, and exposes hazards that can harm the city's infrastructure. Not to mention that driving in flooded water can have deadly consequences when the driver misjudges the depth of the dark floodwater.

## Zones

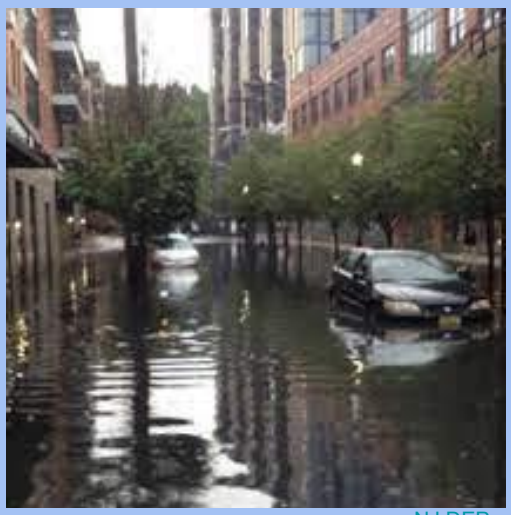
The Hoboken Green Infrastructure Strategic Plan was implemented to address all of the threats associated with floodwater with the use of stormwater management, small eco-friendly projects, and mapping.

The first major step in addressing the flooding problem was to map out the two square miles of Hoboken. This mapping was conducted to classify multiple zones within the city. For each zone, different solutions were offered to help the area achieve resilience. The zones were determined by soil type, bedrock, and topography. The three zones are:

- Grey - Shallow bedrock. Water runoff in these areas can be reduced by constructing green roofs and performing rainwater harvesting.
- Green - Deep bedrock. These areas should plant rain gardens and install permeable pavement.
- Blue - Low elevation. Water retention in these areas can be provided by basins and redeveloped wetlands.

## Making Headway

With access to new information and data, proposals have been considered to tackle flooding in Hoboken. This also cultivated the development of the Rebuild by Design (RBD) competition. The RBD competition is a program that showcases various long-term solutions that focus on green infrastructure. One specific solution that was proposed by a team of scientists in Europe was the "Resist, Delay, Store, Discharge" strategy. RDSD can be broken down as "(R) hard infrastructure for protection against storm surges; (D) series of Green Infrastructure (GI) for the delay in the runoff; (S) storage areas for excessive rainfall across the City; and (D) discharge pumps." The main reason why many of these ideas have not been implemented is because people are unsure on how to accommodate different settings and governing policies. A shortage of funding has also been reported.



NJ DEP

*Drivers attempt to cross a flooded street in Hoboken.*

Another issue that plagues further progress is that the mapping phase still needs to be refined. Simply put, there is a lack of data that is preventing the modeling of the complex real conditions. According to researchers at the Stevens Institute of Technology in Hoboken, the framework needs "datasets such as sewer networks, available from water agencies and additional coastal stations based on location of sewer outflows." Collecting this data is important so that more effective projects to mitigate flooding can be designed and implemented.

For the past eight years, Hoboken has put forward many plans to prevent floods. In addition, they also took interest in revitalizing their city with green infrastructure like rain gardens. Although arguably not enough progress has been made to completely solve the city's flooding problems, the Green Infrastructure Strategic Plan is a prime example on how a local government can be involved in working on a recurring obstacle with strategic and sustainable practices. It would be worthwhile to see these ideas become a reality.■

# The Sponge in the Carbon Sink

*By: Brandon Reyes*

Since the year 2000, global annual carbon dioxide ($CO_2$) emissions have increased by about 12 billion tons, largely due to the increased burning of fossil fuels and cement production. Emissions have been steadily increasing since the industrial revolution and have only been disrupted by the COVID-19 pandemic in 2020, which caused the reduction of public gatherings, a decrease in the use of fuel-burning cars, and the suspension of many business operations.

Because of the rapid change in energy use in 2020, global $CO_2$ emissions were temporarily reduced by 7 percent. However, despite this short period of decrease, as more cars have returned to the road and big businesses commence regular operation, the high level of $CO_2$ in the atmosphere will persist. The problem is long-lived because any $CO_2$ that is released today will remain in the atmosphere between 300 and 1,000 years. With the continued burning of fossil fuels, cement production, and land-use changes, the earth is on track for irreversible climate change which will impact generations of living organisms.

## The Importance of the Ocean

The ocean is host to a vast ecosystem of creatures that make up about 80 percent of Earth's biodiversity. With oceans making up approximately 68.5 percent of the Earth's surface area, a significant amount of the pollution in the atmosphere is actually absorbed by the water. The ocean is actually a giant carbon sink—absorbing about 31 percent of annual $CO_2$ emissions from the atmosphere.

While this may sound only positive, there is a downside. The $CO_2$ absorbed by the water undergoes a chemical reaction that results in an increase of hydrogen ions. These ions increase the overall acidity of the water, making it more difficult for sea creatures to survive.

NOAA

*Kelp, a common marine plant, can sequester carbon.*

Not only are those that dwell beneath the surface of the ocean affected by rising ocean acidity, but humans and animals on land are also affected. We source a large amount of our food from the ocean, according to the National Oceanic and Atmospheric Administration (NOAA), in 2017, fishermen in the U.S. alone reeled in 9.9 billion pounds of fish and shellfish. The health of the ocean is also important because it is a resource to discover and source ingredients for new medicines.

## A New Leaf: Seaweed Aquaculture

Carbon sequestration, a class of strategies to capture and store carbon, is a promising method of absorbing $CO_2$ that can be applied on land and in the oceans. For marine applications, scientists have been finding ways to combine seaweed aquaculture (e.g. the cultivation of aquatic plants) and carbon sequestration. Seaweed naturally grows rapidly and is able to capture the carbon from its surroundings. The $CO_2$ remains in seaweed biomass until it either sinks to

**'Seaweed' continued on page 5**

the ocean floor with other dead organisms as what is known as “marine snow”, or until it is harvested by humans in which it can be processed or stored. Seaweed aquaculture beds (SABs) are a way that Asian-Pacific regions have dealt with carbon accumulation in the oceans. A study conducted in 2014 has shown that with the popularity of SABs expanding, over 780,000 tons of carbon is absorbed annually in this region alone.

A couple of hours north of New Jersey in Maine, kelp seaweed farms are already in full operation. These large aquaculture farms have already had a positive environmental impact with respect to carbon sequestration. One startup company, Running Tide, set the goal to scale their operations to sequester billions of tons of $CO_2$ (for reference, the EPA estimates that a typical passenger vehicle emits about 4.6 tons of $CO_2$ annually).

Utilizing marine plants to act as Earth’s carbon sponge in addition to other efforts to reduce overall carbon emissions, increasing pollution in the air and oceans may finally be slowed. ■

# BIM Basics

*By: Thomas Julian*

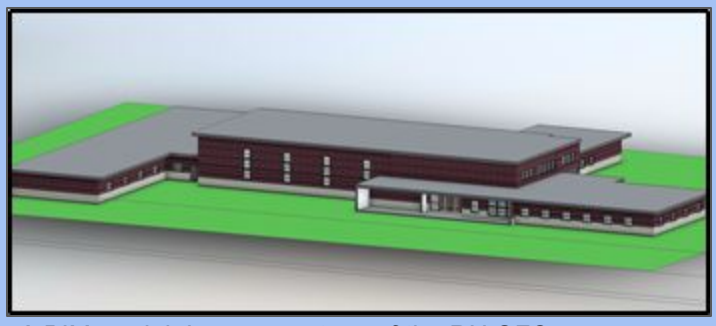
The design and construction of buildings once relied on detailed hand drawings by architects and engineers. With the proliferation of workstations, this industry standard soon became computer aided design (CAD), where software was used to generate drawings and plans. In more recent years, Building Information Modeling (BIM) has transformed the way new building projects are designed and constructed. But as a reality-capture tool, BIM is also used to create models of existing buildings, to help in their maintenance and operation.

## BIM for New Construction

BIM is not a software—rather, it is a process that uses a suite of software to create and manage informational data during all phases of the project lifecycle. In the most common applications, BIM is used to track a new project from the beginning design stages to the operational maintenance after completion. During the design stage, architects, engineers, construction teams, and stakeholders can collaborate on the model. Here, they can assess specifications and properties that may be critical to the design and maintenance of the building. Once the design stage is complete, BIM data can be used to assess material cost, inventory, properties, and more to minimize risk and wasted budget. Finally, the completed model is passed to the building owner, where maintenance and refurbishment/retrofits can be sustained.

## BIM for Existing Buildings

At the Rowan University Sustainable Facilities Center (RU-SFC), BIM is being used to create high-resolution three-dimensional models of existing NJARNG buildings. During the summer, an intern goes to the sites to capture scans using a FARO laser scanner. During the academic year, engineering clinic students import those scans into Autodesk ReCap and Revit to create 3D models. The models include the building envelopes and sometimes visible mechanical systems. This modelling allows for old buildings built before BIM existed to now have a corresponding digital model. Accurate floor plans, simulations, renderings and more can be obtained from BIM. The ultimate goal is for DMAVA to use the BIM models to help maintain and repair building systems. ■



*A BIM model. Image courtesy of the RU-SFC.*

# Reuse the Unused

*By: Earnest Daniel III*

A brownfield is previously developed land that is now vacant or underutilized. Before brownfields are reused or redeveloped, the potential presence of hazardous substances, pollutants, or contaminants must be investigated and mitigated. In the U.S., there are an estimated 450,000 brownfield sites that range in size from 0.25 acres to over 200 acres. Cleaning up these sites so that they can be repurposed will help preserve land that was never previously developed (greenfields), saving it from development. Additionally, communities affected by unsightly or polluted brownfields can be reinvigorated by the introduction of new business or the development of recreation areas.

NJ DEP

*Keasbey Woodbridge Brownfield Development Area*

There are many uses for brownfields sites after they are cleaned and redeveloped. In 1995, the U.S. Environmental Protection Agency (EPA) introduced a program to clean up brownfields. Since then, the EPA has provided nearly $1.6 billion in grants. New Jersey created its own Brownfield redevelopment task force in 1998. Many municipalities in New Jersey, such as Trenton, Camden, Newark, and Atlantic City have been awarded grants and loans to use toward brownfield clean up.

## Giving Cities New Life

In addition to the environmental and aesthetic benefits, the economic importance of redeveloping brownfields has gained increasing support, and more funding opportunities have been established. By granting incentives for redeveloping and reusing brownfield sites, cities can attract more companies to an area and in turn this can generate more jobs. According to the EPA, “over the years, the relatively small investment of federal funding, from both public and private sources, leveraged more than 160,000 jobs.” Here in NJ, the former Commissioner of the Department of Environmental Protection (DEP) Catherine R. McCabe remarked that “remediating brownfields turns burdens into opportunities. By cleaning up contaminated properties and replacing them with valuable assets that benefit New Jersey’s communities, we create new paths for economic growth.”

A reused and redeveloped brownfield can lead to a multitude of avenues of profit or well-being of the community. In New Jersey, the EPA has selected the New Jersey Economic Development Authority (NJEDA) for an $800,000 loan grant. This grant will be able to provide loans and sub-grants to get cleanup started in brownfield sites around the state. These sites will be turned into housing, recreation zones, health facilities, social services, and commerce opportunities. The Hazardous Site Discharge Site Remediation Fund provides grants for 75% of cleanup costs of designated sites. Another benefit is that brownfield reductions can increase the tax base, leading to more funding for local schools, roads, and local programming.

Not only can brownfield cleanup sites attract more streams of revenue, but they can increase public health and safety. They remove hazardous contaminants from communities. When they are redeveloped for recreational use and into open areas, a new area for people of the community to get out and enjoy the outdoors. ■

# Meet the Editors

## Earnest Daniel III

*Mechanical Engineering, Senior*

Ernie's early fascination with design led him to study mechanical engineering in college. In the Resiliency Clinic at the Rowan Sustainable Facilities Center, he was introduced to the Environmental and Civil engineering disciplines. During his free time, Ernie is very involved with fitness by going to the gym and competing for Rowan's Track & Field team.

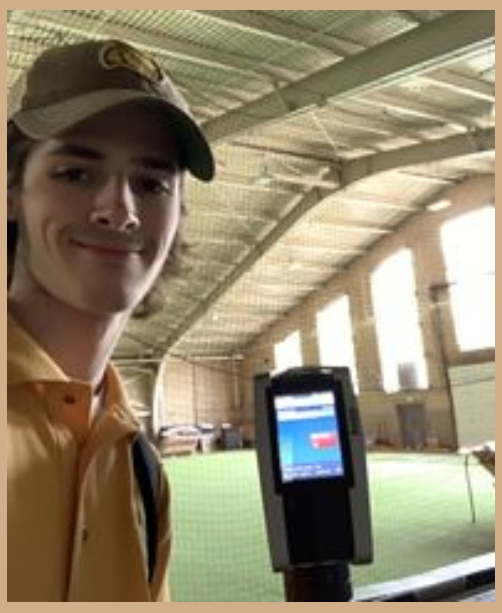
## Maximillian Husar

*Civil & Environmental Engineering, Junior*

Maximilian has always been interested in environmental issues as well as green infrastructure. When he's not busy with classes, his hobbies include watching movies, listening to music, and biking. Maximilian hopes to gain experience through a summer internship and enroll next year in graduate school to pursue an advanced engineering degree.

## Thomas Julian

*Civil & Environmental Engineering, Junior*



Tom's drive to expand both his knowledge and creativity inspired him to pursue civil engineering. His curiosity for new topics (such as BIM) has also encouraged him to apply for graduate school, with hopes to continue to advance his engineering education after graduation. In his free time, Tom enjoys playing guitar, watching sports, and improving his overall quality of daily life.

# Meet the Editors

## Parth Patel

*Civil & Environmental Engineering, Junior*

Parth has big ambitions, one of which is to make the world a safer place that can be inhabited as long as possible. Motivated by the daily climate disaster headlines, Parth wants to pursue a career that serves a larger purpose than him: to create a sustainable future for many generations to come. A future in which our children's children have no worries about the state of their planet. Parth hopes that his passion for environmental engineering and the sciences (and his work in Resiliency Clinic) is a step towards achieving this.

## Brandon Reyes

*Civil & Environmental Engineering, Junior*

Brandon has always had a passion for building and being creative. He has always dreamed of becoming an engineer in order to turn his passion into a career. He plans on pursuing this path into structural engineering to build more efficient and eco-friendly infrastructure. In his free time, he enjoys photography, Philadelphia sports, and is an avid car enthusiast.

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Learn more about the Rowan University Sustainable Facilities Center **here** or scan our QR code!

SCAN ME

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