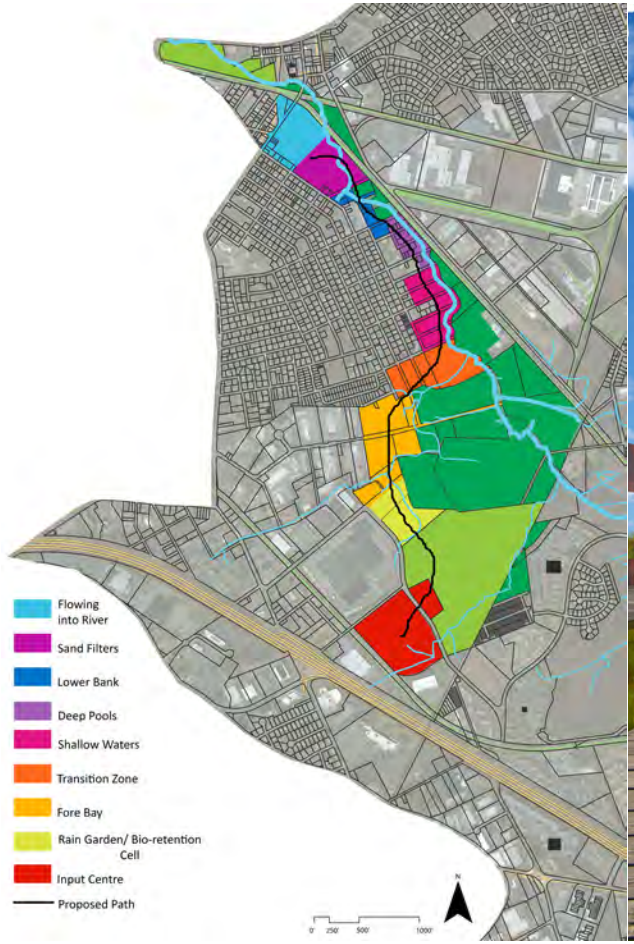
RE-ENVISIONING
The Lower Raritan Watershed
RUTGERS UNIVERSITY GRADUATE GEODESIGN STUDIO
WITH THE LOWER RARITAN WATERSHED PARTNERSHIP



RUTGERS UNIVERSITY DEPARTMENT OF LANDSCAPE ARCHITECTURE

PROFFESSOR DAVID TULLOCH

2014 GEODESIGN STUDIO :

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Front Cover Images: Miloni Mody and Jenny Burkhalter

INDEX

FOREWORD

Heather Fenyk
Lower Raritan Watershed Partnership

The studio presented a mix of provocative, visionary and actionable design proposals for the unique and pressing issues of our Lower Raritan Watershed.

Tekla, Justin and Miloni directly addressed the legacy of problems inherited from unchecked industrial practices and land development. Their designs, ranging from Tekla's retrofit of an out-of-sight out-of-mind landfill to a multi-use cultural icon, to Justin and Miloni's green infrastructure improvements for industrial and commercial sites, suggest fresh approaches to inherited pollutant loading and prompt us to think creatively about watershed restoration.

Kara and Jacqui looked at population and land use trends to predict development impacts, inferring potential transportation demands in one case, and identifying strategies for local sourcing of foodstuffs in another, both presenting us with a vision of how we might better integrate water resource considerations in long range watershed planning.

Han and Xiaoxia re-imagined housing unit and commercial density to advance ideas of habitat and open space preservation. They urged us to not just focus on prioritizing open space categories, but to integrate habitat management in all development projects.

Finally, Jenny encouraged design interventions that integrate education and outreach, naturally promoting watershed stewardship, and the cultivation of a societal "water culture."

Taken singly these interventions treat symptoms including impaired surface water quality, overextended water supplies and wastewater, flooding, erosion and loss of habitat.

Taken together, and combined with the considerable data gathering that served as the foundation for the designs, these interventions give fresh energy to the

idea of creating a strategic watershed management action plan for the Lower Raritan Watershed.

It is abundantly clear that:

-We need a plan for coordinated approach to water resources restoration, including clean-up, stabilization and enhancement.

-We need a plan to move us toward a measurable reduction of our impervious cover, particularly in areas of habitat sensitivity.

-We need a plan to bring about better stormwater management coordinated from a watershed perspective.

-We need a plan that addresses concerns that did not emerge from the presentations, concerns like dam removal to expand and improve habitat for fish, and a plan that considers oversight of railroad bridge maintenance and repair.

-We also need a plan for monitoring programs, water quality data and modeling that characterize ambient water quality in the Lower Raritan, helping to account, for example, for point and nonpoint sources of phosphorous and nitrogen at the subwatershed level from which we can develop targeted TMDLs to treat problems like the algal bloom that flowed on the Raritan for several weeks this summer.

Any strategic plan for the Lower Raritan Watershed should take stock of what is currently being done in the watershed, and it should identify best management practices. The studio work provides a lot to build on for such an effort. There are many other important initiatives to build on as well, including:

-the significant partnership development work of the Sustainable Raritan River Initiative;

-the recent County-led sewer service area mapping exercise that examines sewage treatment capacity in relation to potential build out scenarios; and

-the impervious cover reduction action plans coming out of the Rutgers Cooperative Extension Water Resources Program.

We also have a template document of sorts to guide us – a 2002 draft Lower Raritan Watershed Management Plan, a project overseen by the New Jersey Water Supply Authority. Development of this document, which is still remarkably relevant, was a huge effort of dozens of stakeholders coming together over a period of two years to frame out goals, objectives and strategies for watershed management in our Lower Raritan Watershed.

Some say that the fact that this plan is not in place today reflects a lack of political will to see it realized. This is, in part, true. But we see successful examples of coordinated watershed management around the state that illustrate a key component in development of any strategic plan for the Lower Raritan Watershed – the social will to effect such a plan.

So much of the groundwork has been laid. It is time for Lower Raritan Watershed stakeholders to demonstrate their social will.

In 2015 our Lower Raritan Watershed Partnership will be in the field coordinating volunteer water quality monitoring and watershed clean-ups. We will be partnership building and conducting outreach through activities with arts organizations like New Brunswick's coLAB Arts, the Raritan Headwaters Association, the Rutgers engineering department, and NoWaterNoLife. We will also begin to shape up a Board of Directors and to work on a strategic plan that maps out our vision to 2020. This will be our first step toward identifying what a coordinated approach to water resources restoration and watershed management for the Lower Raritan Watershed might look like. It is an ambitious vision that will take tremendous time, energy and commitment

and we will need many partners to make it a reality.

Many thanks to David Tulloch and the Graduate GeoDesign Studio for their hard work this semester, and for the energy and commitment they demonstrated in challenging us to "re-envision" the Lower Raritan Watershed.

We invite you now to consider how you will be a part of this visioning effort going forward – as committee members, Board Members, volunteers and watershed champions – and ask that you join us in 2015 as we continue to "re-envision" our Watershed.

Connections Within the Watershed

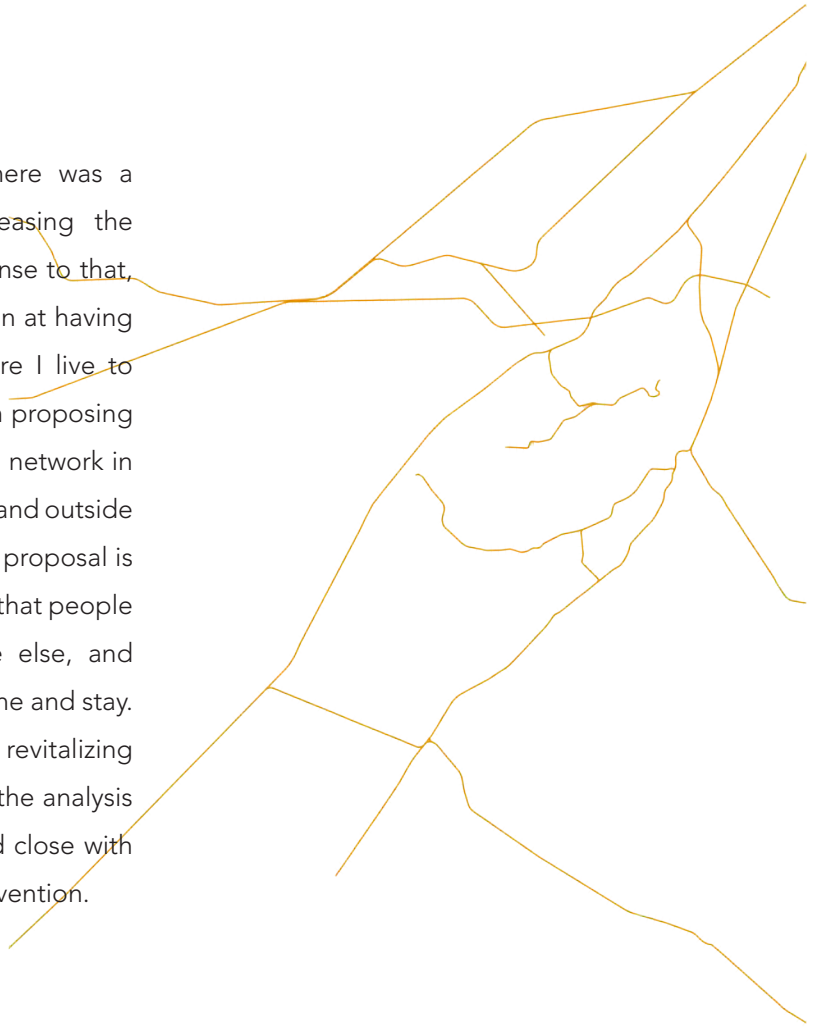
AUTHOR: Kara Lugar **LOCATIONS:** Bound Brook, South Plainfield, Raritan Center, New Brunswick, Monmouth Junction, Freehold

CONCEPT: Expanding Mass Transit

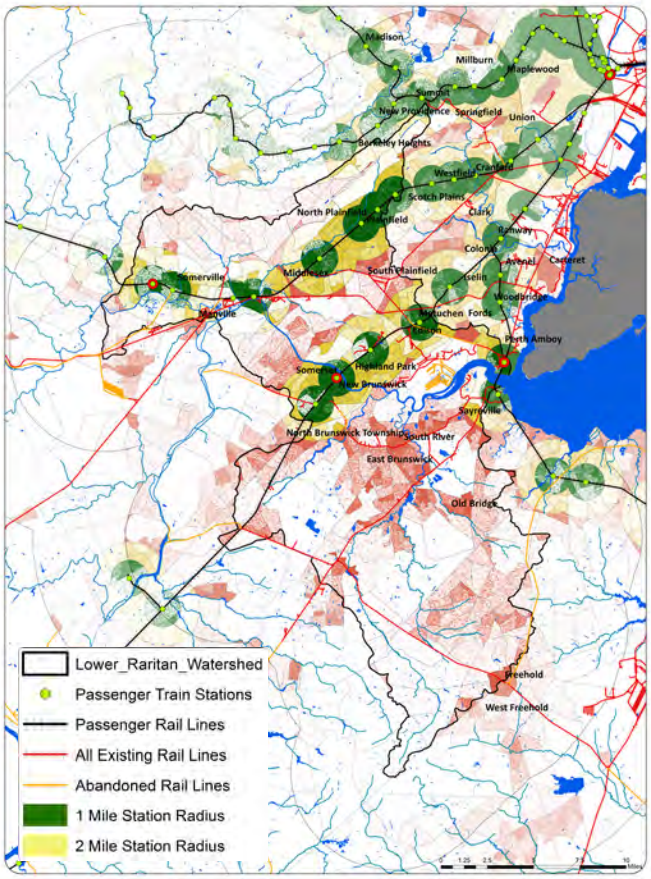
As we learned during our inventory, the Raritan River corridor and it's surroundings were a historic genesis point for a network of railroads for both freight and passengers that connected New Jersey to the rest of the nation. The expansion of the road system and the affordability of automobiles led to a shift away from rail transit and simultaneously encouraged the sprawl not only of housing but also of commerce and industry. Now, it's practically impossible to conveniently travel in this area without relying on a car.

Anyone on the roads these days though can see that the number of vehicles currently using the road network has far exceeded their capacity. Several studies nationwide have shown that merely adding more lanes to an existing highway is not effective at reducing congestion. The alternative is a mass transit system capable of moving people where they want to go without requiring a car.

During our October charrette, there was a heavy emphasis placed on increasing the availability of mass transit. In response to that, and partly due to my own frustration at having no mass transit options from where I live to New Brunswick, I chose to focus on proposing the expansion of the passenger rail network in order to connect points both within and outside of the watershed. My goal with this proposal is to make the watershed less a place that people travel through to get somewhere else, and more a place where people can come and stay. Today I'll explain my proposal for revitalizing the passenger train network, show the analysis that led me to that conclusion, and close with an illustration of my proposed intervention.

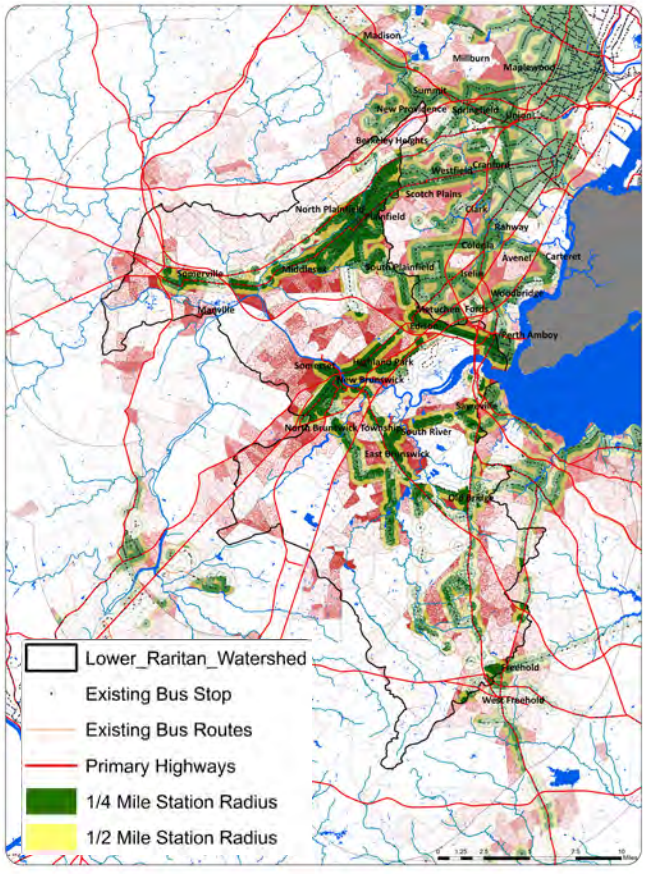


To begin with, I looked at the existing passenger rail system and bus lines to identify areas that are being served and areas that aren't. The larger green circles show a one-mile radius of existing stations, the yellow shows a two-mile radius. The smaller circles illustrate a ¼-mile and ½-mile radius from existing bus stations. Buses tend to be used more for local transportation than long-distance travel, and larger communities like New Brunswick are reasonably well served by bus lines. Longer-distance services such as the Mega-Bus and Trans-Bridge Lines are popular, but have limited availability in the Lower Raritan region. The bus system can't be ignored as a key piece of the mass transit network; they are frequently how individuals to get between train station and destination, and bus routes are as flexible as the availability of roads. However, trains have the potential to move many more people, much farther distances, much more quickly and economically than buses, so I chose to focus on expanding the passenger rail service. Factoring in pollution and unstable fuel prices, trains could reasonably be considered more ecologically sustainable in the long run as well.



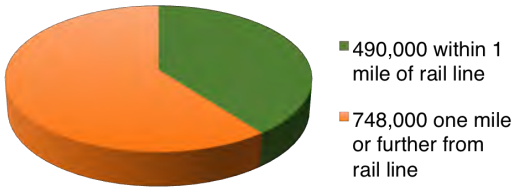
359,000 within 1 mile of rail station
438,000 live 1-2 miles of rail station
606,000 further than 2 miles from rail station

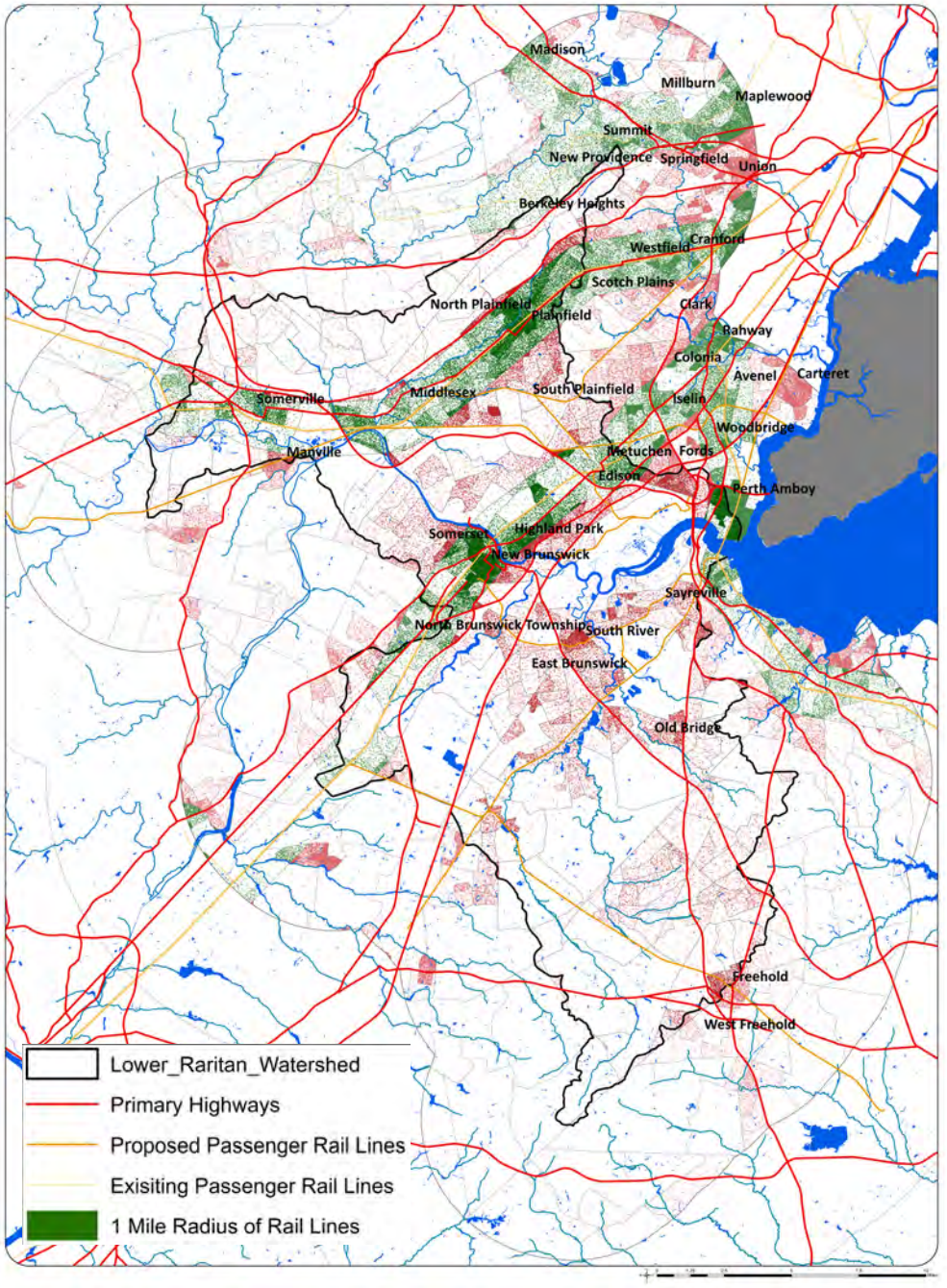
641,000 within 1/4 mile of bus stop
650,000 within 1/2 mile of bus stop
732,000 farther than 1/2 mile from bus stop



At present, there are only two NJ Transit rail lines that primarily serve the northern half of the Lower Raritan Watershed, and a piece of a third line that crosses a small portion of the watershed at the mouth of the river. The US Census population densities clearly show a clustering near these existing lines. Currently though, all of these lines are oriented out of the watershed, aimed more at accessing Newark and New York rather than encouraging people to stay within the region.

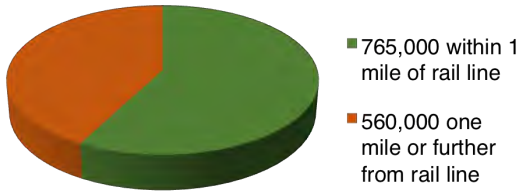
According to the North Jersey Transportation Planning Authority's Regional Plan 2040, one of the primary goals for the entire Northern New Jersey region is to repair and expand the passenger rail system. The goal is reducing road congestion while still accommodating projected population growth and commercial expansion.

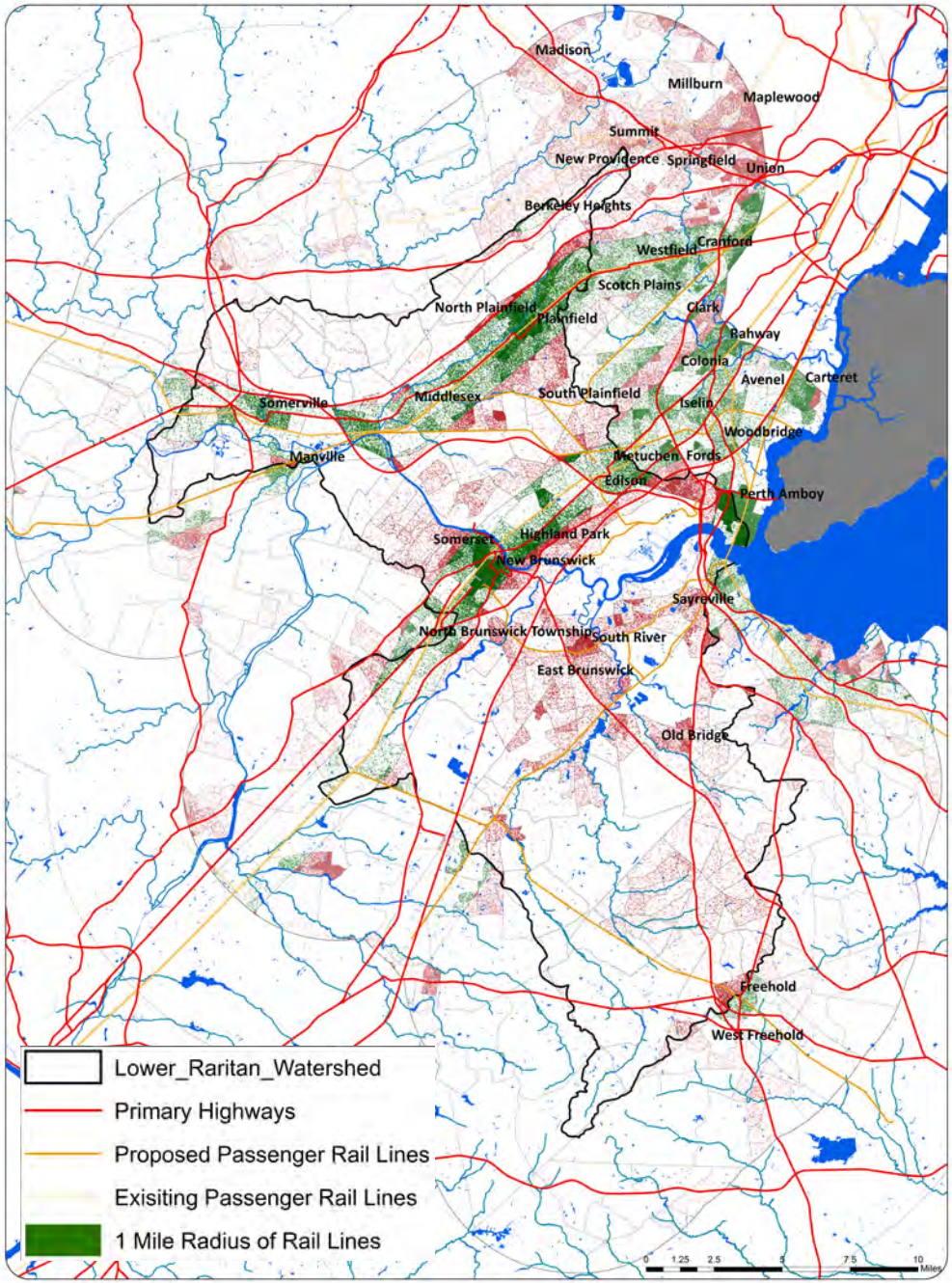




For my own proposal, the key was to begin identifying areas of industry and commerce and relating them to areas of heavy residential development. Overlaying both with designated smart-growth areas began to clarify what areas might benefit most from an expanded rail system.

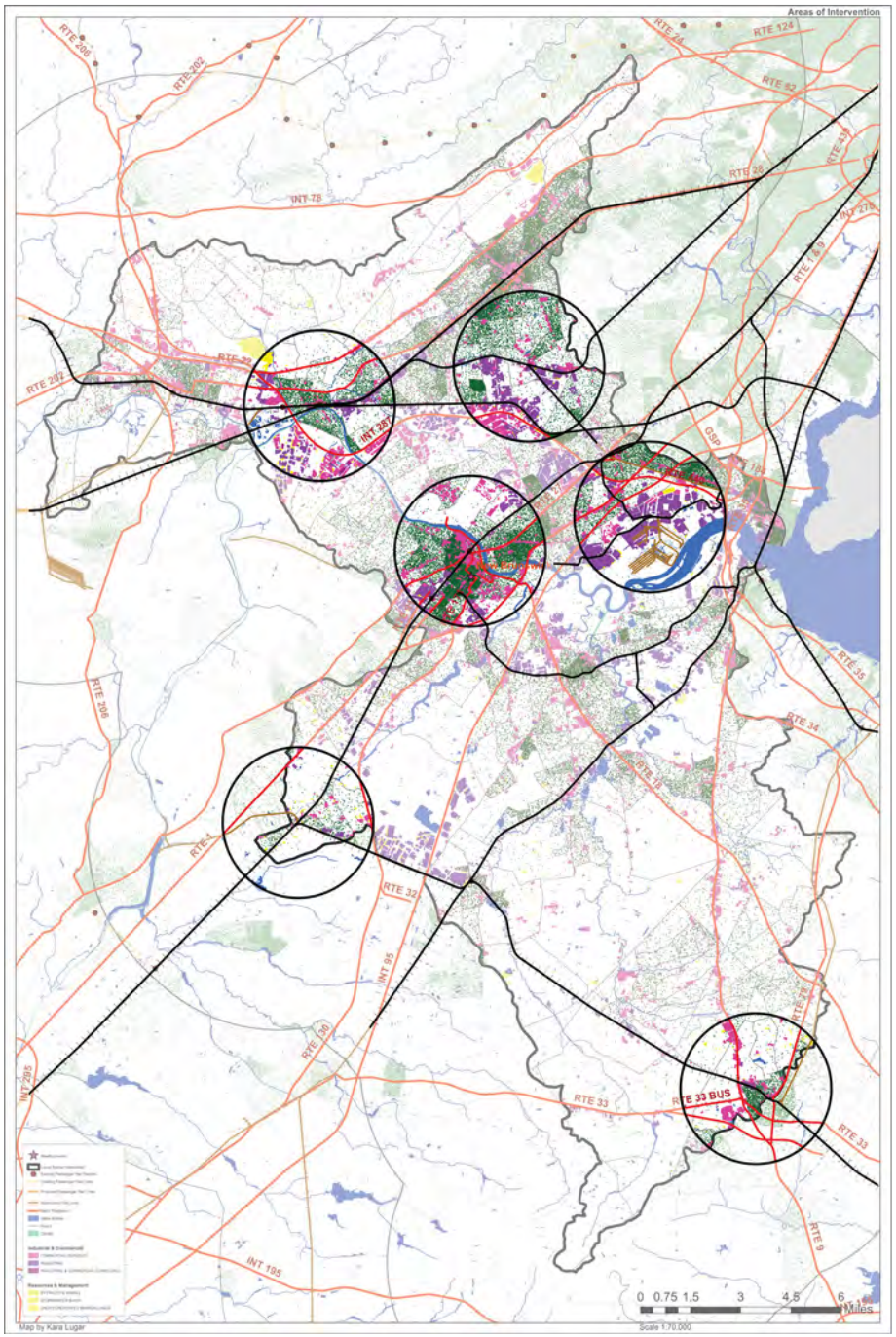
For practicality, my proposal begins with converting existing freight rail lines to dual-purpose passenger and industrial use, and reactivating abandoned lines where possible. Once these lines are established, it will become more feasible to identify missing connections and acquire the land needed for further expansion. Ultimately, my goal is better connectivity within the watershed, linking people with where they want to go without the inconvenience of rush-hour traffic.





Using the analysis of population densities surrounding existing rail transit, it became possible to identify the communities and employment centers that are not presently served by passenger trains. Overlaying this with the existing network of freight rails, I was able to narrow down the intervention locations to those places where a high population density overlapped with existing railroad or transit right-of-way. I also took the into account existing resources like wetlands, forests, and open space, trying to encroach as little as possible into undeveloped areas.

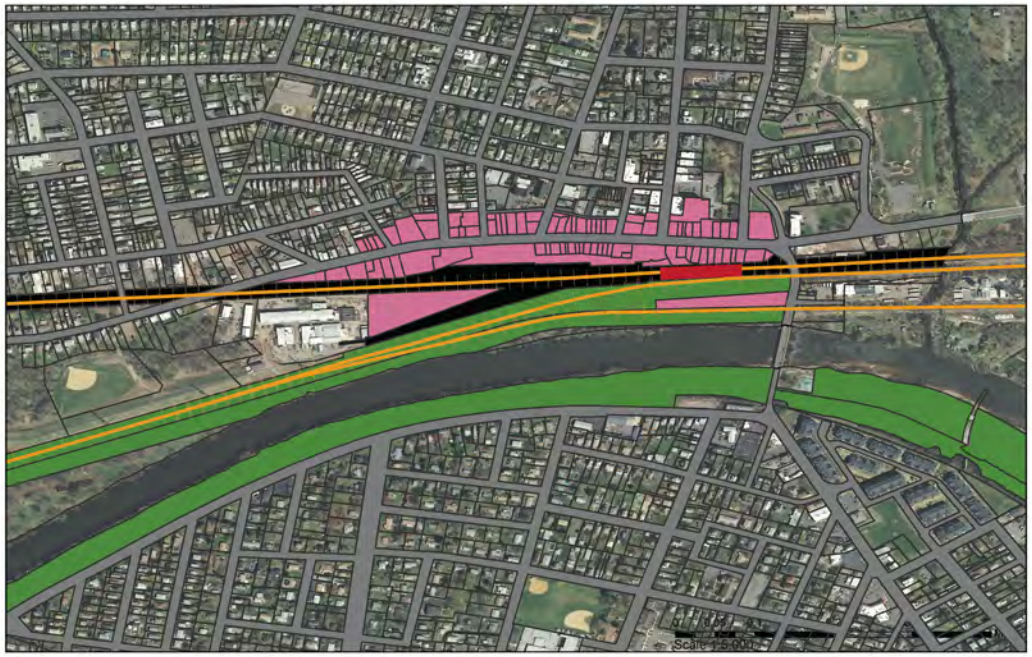
The criteria outlined in the analysis showed 5 key outlying points of intersection: Bound Brook, South Plainfield, Raritan Center Business Park in Edison, Monmouth Junction and Freehold, with New Brunswick at their center. Each of these locations is either a residential area or an employment center, and each is well sited to serve as a transit hub for the surrounding area.



According to the **New Brunswick** Development Corporation (DEVCO), New Brunswick is planning to further expand the existing transit village surrounding the train station. 'The Hub' is a densification plan consisting of tower block buildings that mix retail with academic, residential and office spaces. As a designated Urban Enterprise Zone, businesses at this location will receive state and local tax exemptions and qualify for the 'Grow NJ' business incentive program. (http://www.thehubnewbrunswick.com)

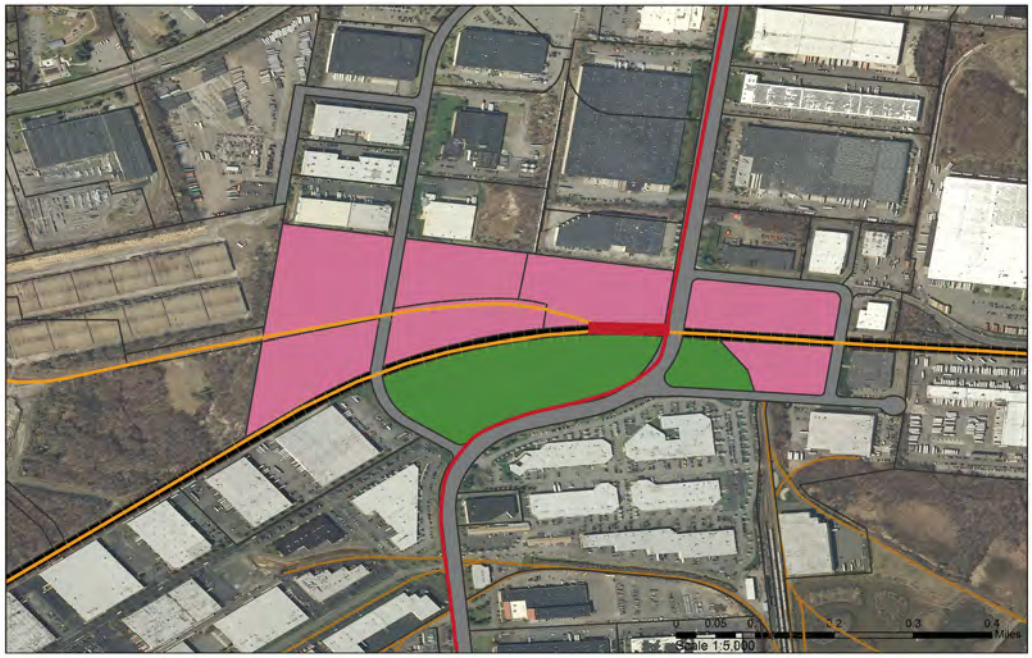
(http://www.thehubnewbrunswick.com Image courtesy of DEVCO

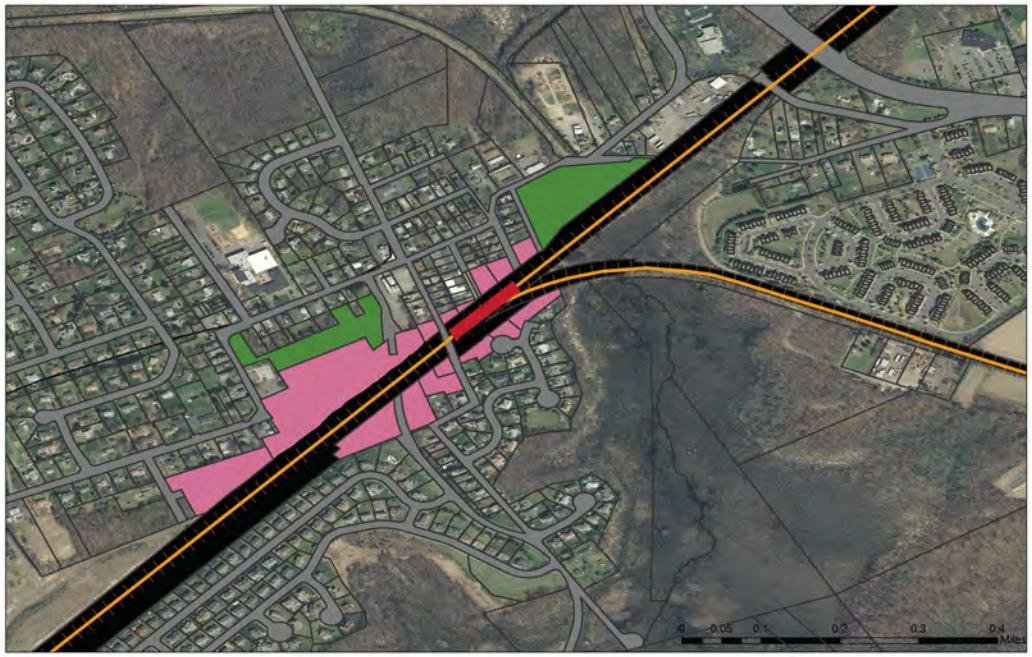
In the northwestern part of the watershed, **Bound Brook** has a high proportion of residential areas, as well as being close to community centers like Somerville, the shopping center at Bridgewater Commons, and recreational opportunities at Duke Farms and Duke Island State Park. The pink in these diagrams indicates where densification would center adjacent to the station, creating a walkable transit hub. The green indicates potential areas for protected open space.



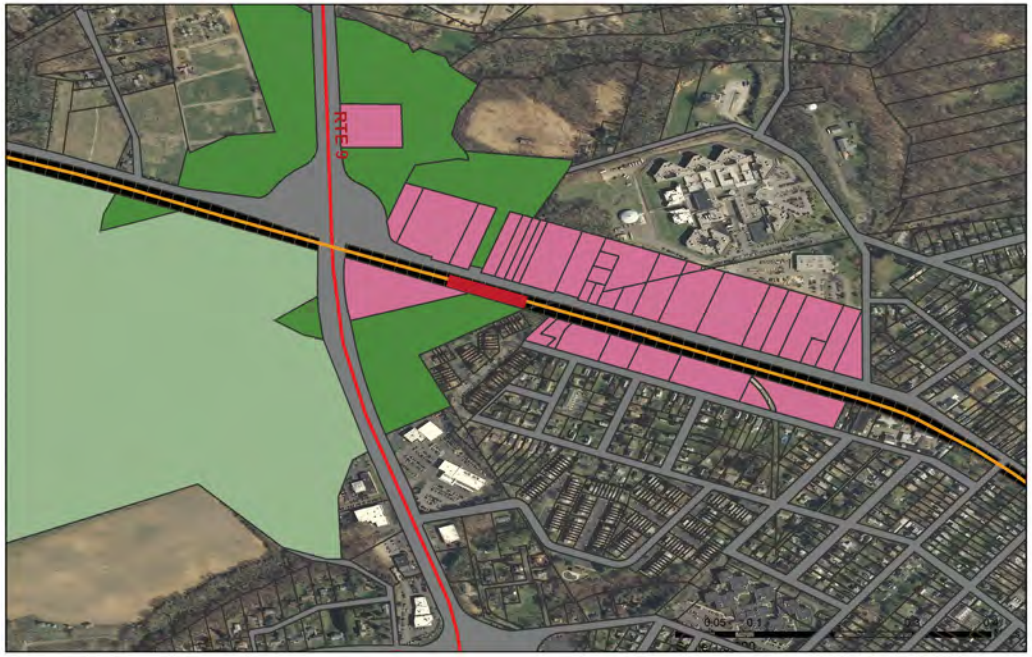
South Plainfield links the significant residential area around Plainfield with a mixed commercial and industrial center. The existing rail line also creates a key linkage point to other industrial centers.

Raritan Center Business Park in Edison currently has no residential zoning, meaning that those who work, shop and visit the center must travel there by car or limited bus access. At over 2300 acres, there are more than 100 buildings housing over 3000 tenants in approximately 13 million square feet of building space. A conservative estimate from US Census data puts the number of jobs in Raritan Center above 30,000 making it a key employment center for New Jersey.





Monmouth Junction is already situated along the Northeast Corridor Line. Expanding rail service along the existing freight spur further links the residential communities in this area to the current network.

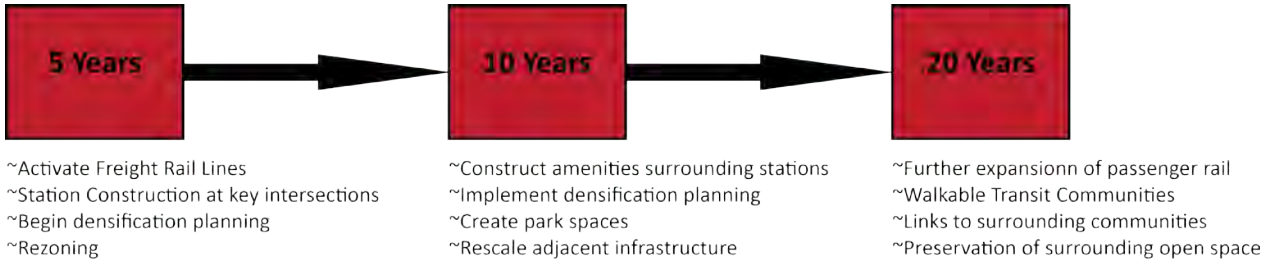


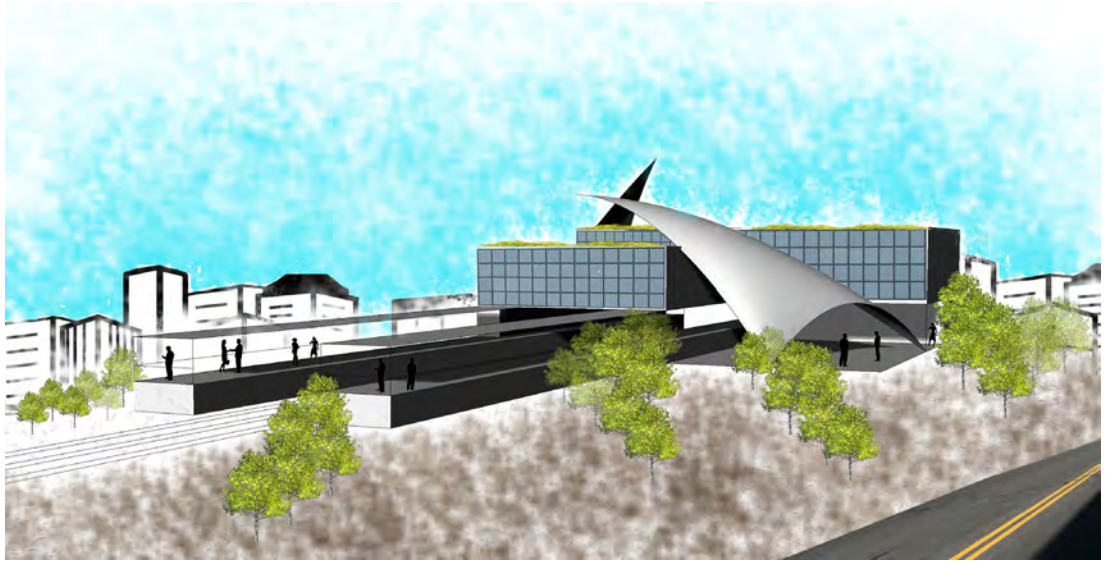
A new rail line from Monmouth Junction to **Freehold** opens new transit opportunities to a previously unserved community. Where Route 9 crosses the existing rail line would create convenient vehicle access in the short term, and offer a potential route for an entirely new line in the future as vehicle traffic declines.

Breaking the interventions into phases allows planners and municipalities to plan for the massive level of change proposed by the introduction of a railroad. At the five-year mark, the watershed can plan the reconstruction and activation of and extended train-rail network, and construct a multi-purpose station. Beginning the planning phase for densification at this point will allow municipalities to acquire land for expanded businesses and high-density residential units.

At ten years, the construction of a main station stop allows the inclusion of amenities aimed at serving riders, raising property values and building up the local economy surrounding each transit station. As ridership grows, development strategies can be implemented in response to higher demand for business space, amenities and residences.

After twenty years, the transit network can feasibly be expanded to the point where road use is significantly diminished, while still accommodating population growth. Densification strategies surrounding each rail station will also allow population expansion without further compromising surrounding open space.





An expanded transit network links communities to each other within the watershed, making the Lower Raritan region more than just a crossroad on the way to someplace else. As part of unifying the watershed into a single larger community with a shared resource, each proposed transit location also shares a symbolic connection. Just as the river links a critical resource, mass transit connects people and places. If the road network can't handle the traffic volume we see today, imagine what it will be like in the future if no alternative is made available.

While it's hard to predict accurate numbers, the US Census Bureau points to a rough estimate of 12 million people living in New Jersey by 2050. That's only 35 years from now, and the lower Raritan region is at the center. Combined with the need to protect open space, habitat, recreation and educational opportunities, the expansion of rail transit is an increasingly necessary option for transportation, connecting residents to jobs, to communities and to open space as part of a sustainable future.

Water Culture

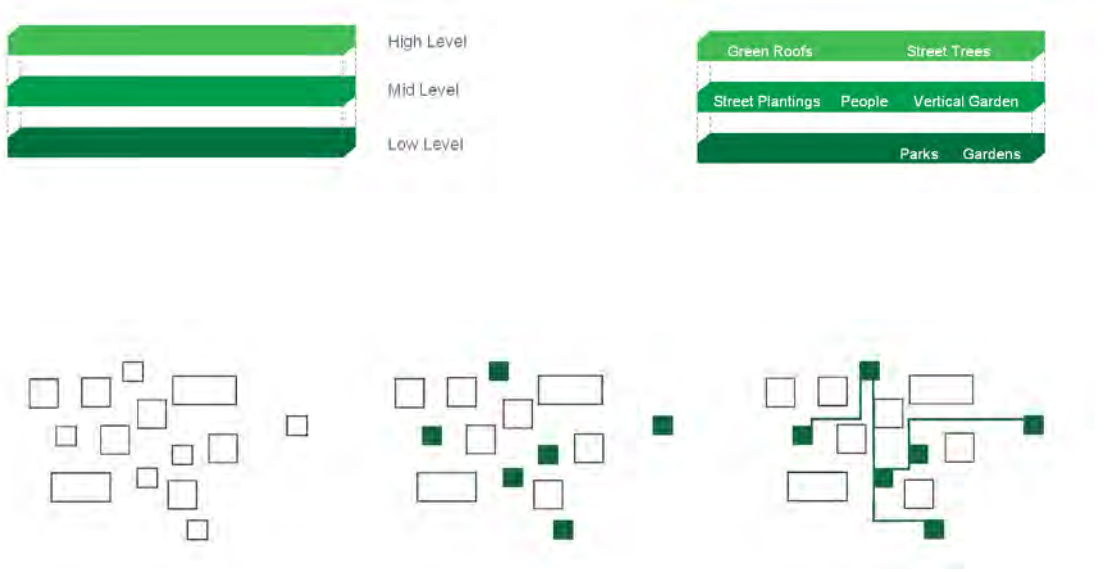
AUTHOR:
Jenny Burkhalter

LOCATIONS:
Plainfield, NJ; Perth Amboy, NJ; New Brunswick, NJ; Manalapan, NJ

CONCEPT:
Education and exposure

This proposal seeks to answer the question: How can we get people to think about the watershed?
Through education and exposure, the communities will learn about the histories and ecologies of the watershed, inspiring and creating stewards of the landscape. The designs weave education in various forms so that a new waterculture can emerge.

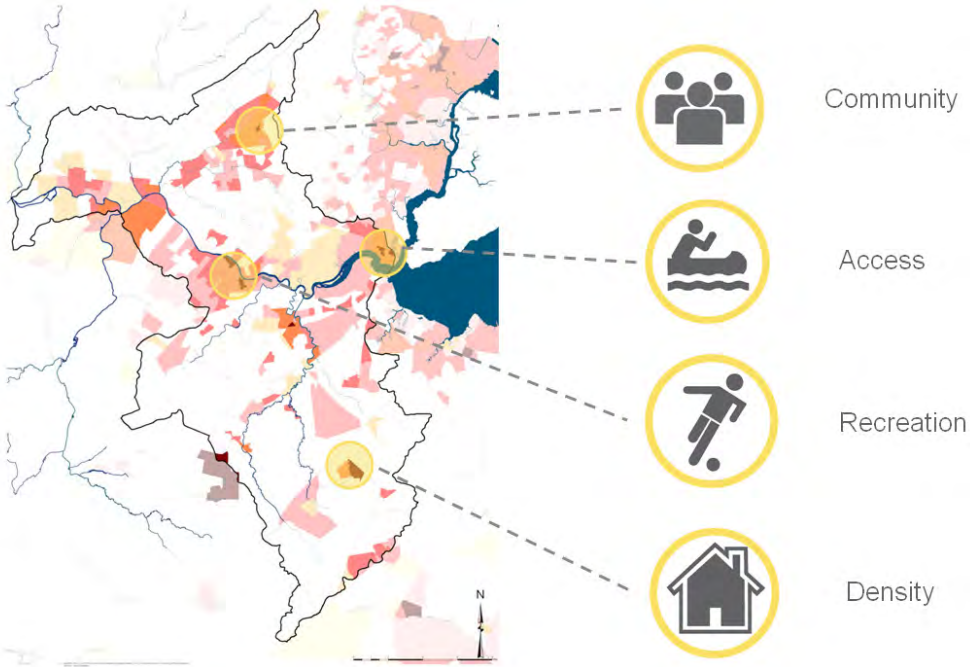
The conceptual framework is based around linkages. These links could be physical - such as street trees- or ephemeral- such as people. The opportunities for linking people and places together were examined at the ground level, through parks, gardens (vacant lots), the mid level (street plantings and the circulation of people), and the high level (green roofs and street trees).



This diagram illustrates taking small spaces of opportunity Turning them into an asset for the community, And linking them together.

The social vulnerability analysis informed the target areas for the proposal. The range of vulnerability, as shown in a gradient, was based upon five separate criteria. Median income, the percentage of renters, population density, the percentage of unemployment, and median age were overlaid to produce the areas of highest social vulnerability.

The areas chosen to initiate the interventions were listed as the most vulnerable. Each site will focus on a different design intervention based on the character and culture of the area.



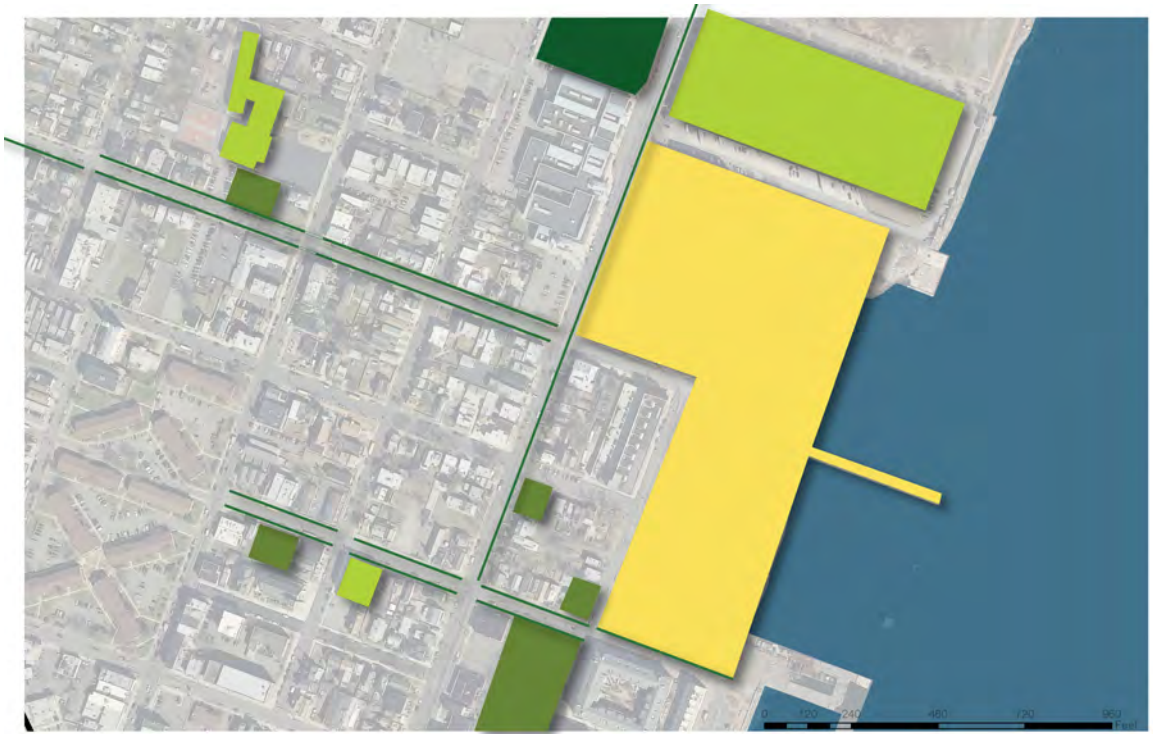
For example, in Plainfield, NJ a vacant warehouse, located on South Avenue, could be turned into a community center. Murals or other art educating the community about the watershed and its ecology could be commissioned for the center and events such as farmers markets, live music, and exhibitions could take place here as well. The warehouse could also be fitted to include offices or house a new aquaponics system to produce revenue.

T he map to the right illustrates a historical stream taken from an 1884 topographic map. Because of the current density, daylighting the stream (or uncovering it to return the stream to its natural state), is not appropriate. Instead, members of the watershed can hold an annual HUMAN RIVER WALK where everyone wears blue, and walks a portion of the former stream learning about its history.

In Perth Amboy, a discovery park could be created at the intersection of Washington Avenue and Rector Street providing residents access to the water.

Platforms can be created to let the community become immersed in the salt marsh. These can be used during field trips from the surrounding schools in conjunction with lesson plans and also as a way for the Lower Raritan Watershed Partnership to monitor the health of the water.

Industrial remnants could be used as a reminder of the sites past and the structures as well as the changing topography could be constructed to enhance views and create excitement while walking through the park.



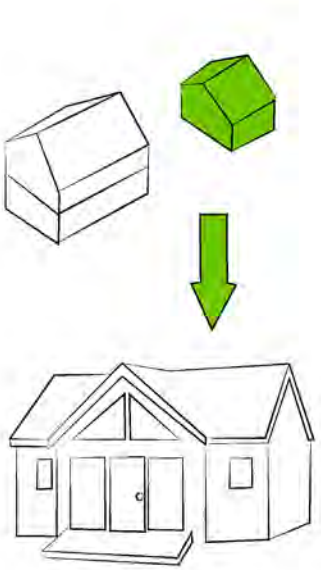
In New Brunswick, vacant lots like this one on Jersey Avenue, can be turned into areas that are appropriate for their surrounding context and culture.

This lot borders a residential and commercial area could be turned into a soccer field lined with plantings. When I went there, there were 3 little boys playing soccer in their yard across the street, so I'm sure they would appreciate a soccer field right outside their front door.

Proposed Design
Existing Green Space
Green Roofs
Street Trees
Vacant Lots

In some areas of the watershed, suburban sprawl has taken over. This area of Manalapan NJ has a current density of XXDwelling units per acre. Rezoning to allow for accessory dwelling units can be useful in increasing density and preserving the areas "in-between".

Accessory dwelling units are small, self-contained living units. They can be helpful in providing a second income if rented out and also provides a safe place for elderly family members to "age in place". This is a special concern because the median age in this area of Manalapan is over 60. In the next 10-15 years there will be a lot of retirees in this area and sprawl may not be suitable for their needs.



Drawings done from models produced from Oregon's Department of Environmental Quality, Spokane City Indiana, and the "Mini-B " dwelling unit from PROSOCO.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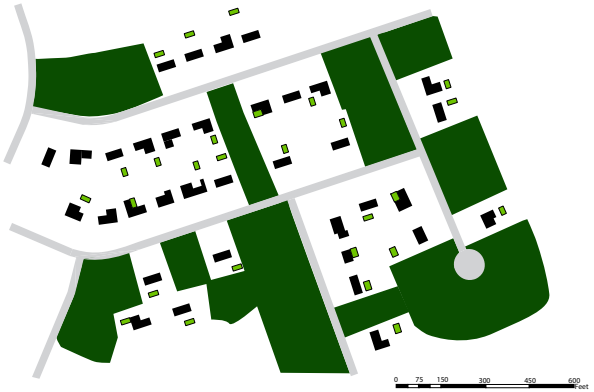
Feet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Feet

No Such Thing As Waste:
Re-imagining Active Landfills and Wastewater Treatment Wetlands

We often talk about bringing people back to the water's edge as a powerful way to inspire watershed stewardship and literacy. Yet we rarely apply that same logic to active landfills and other working landscapes. In the case of landfills, the discussion has thus far been largely focused on capping landfills and turning them into public parks. This proposal applies the logic of river accessibility and stewardship to the largest landfill in New Jersey, Middlesex County's Edgeboro Landfill. By drastically reconsidering our material streams, from product packaging to grocery store contents and household waste collection, active landfills can be transformed into the center of the community. This proposal ties watershed material collection - from composting to recycling, landfilling and wastewater treatment - with artist reuse, stewarship, education, and community entrepreneurship.

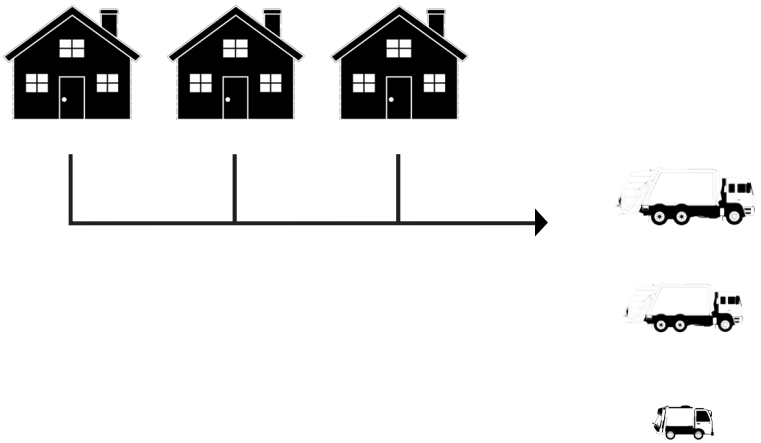
AUTHOR:
Tekla Pontius-Courtney

LOCATIONS:
East Brunswick and Sayreville

CONCEPT:
Active working landscapes are the heart of the community.

RIGHT: Re-imagining active landfills as cultural centers necessitates re-thinking our material streams and what we call waste.

HOUSEHOLD MATERIALS



COMPOST

Train and employ watershed residents as stewards of designed ecologies. Phase in localized composting.

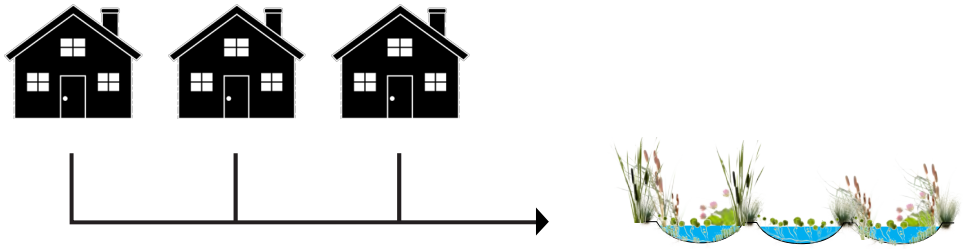
RECYCLE/REUSE

Employ artists to reuse materials and teach craftmanship and develop localized economies

LANDFILL

Legislate reduction in hazardous waste production at the industrial level

WASTEWATER

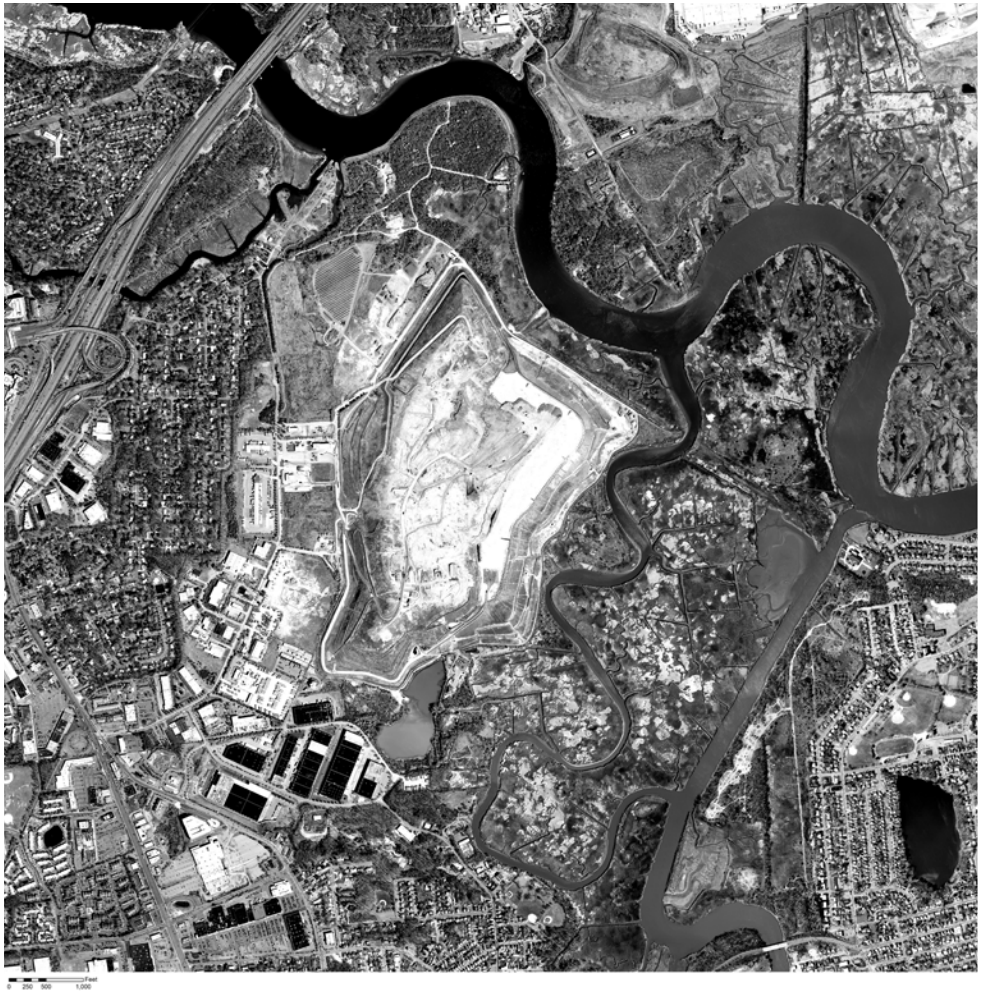


WETLAND TREATMENT

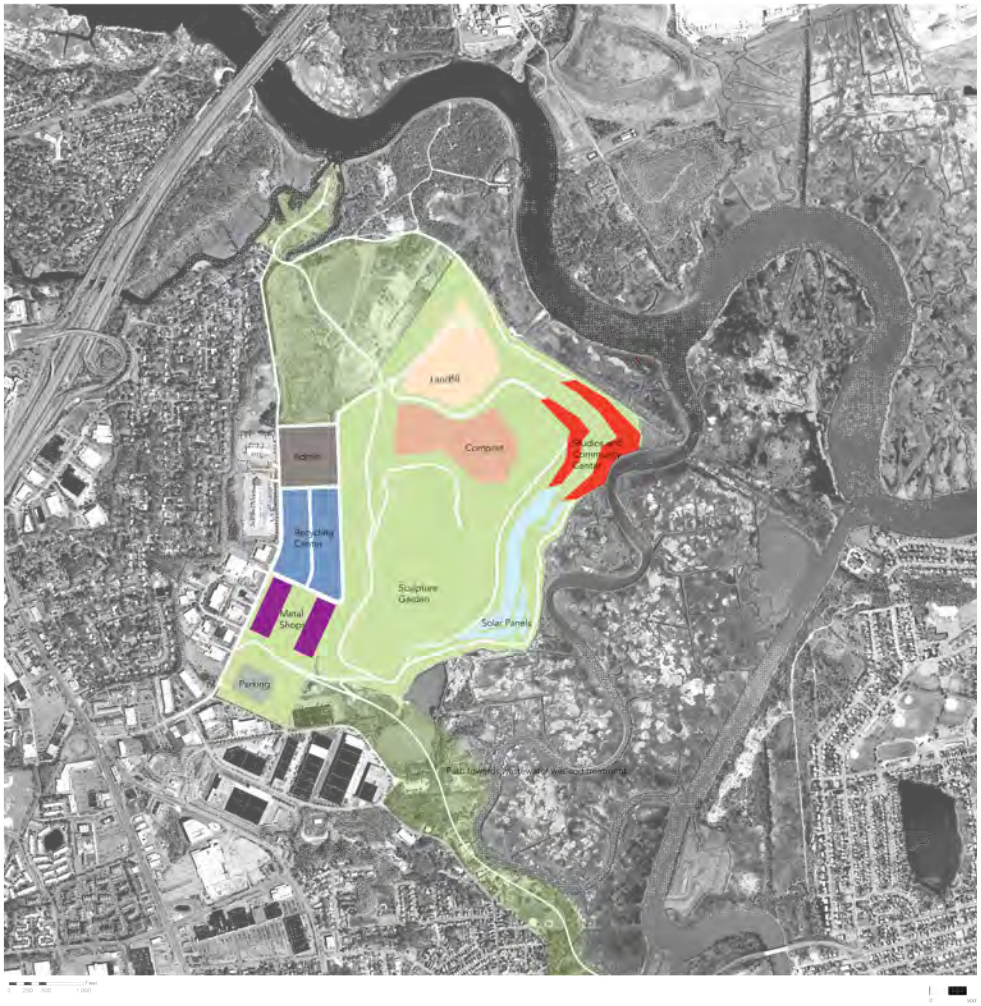
Replace aging sewer infrastructure with decentralized wetland treatment and multi-use parks

LEGISLATION

Require compostable products/components
Support reusable, and/or modular replacement components
Reduce packaging
Subsidize and require organic produce
Eliminate plastic bags; develop reusable watershed bags for grocery stores
Fund community center programs through sale of watershed bags



ABOVE: The Edgeboro Landfill is the largest active landfill in New Jersey.



ABOVE: Landfill as multi-use community center, with composting, metal and artisan workshops adjacent to recycling facilities, a sculpture park, an active landfill, solar panels and community galleries, classrooms and studios.
RIGHT: The community center within the watershed.

The metal and blacksmithing shop adjacent to the recycling facilities is a place for re-using and re-forming material.

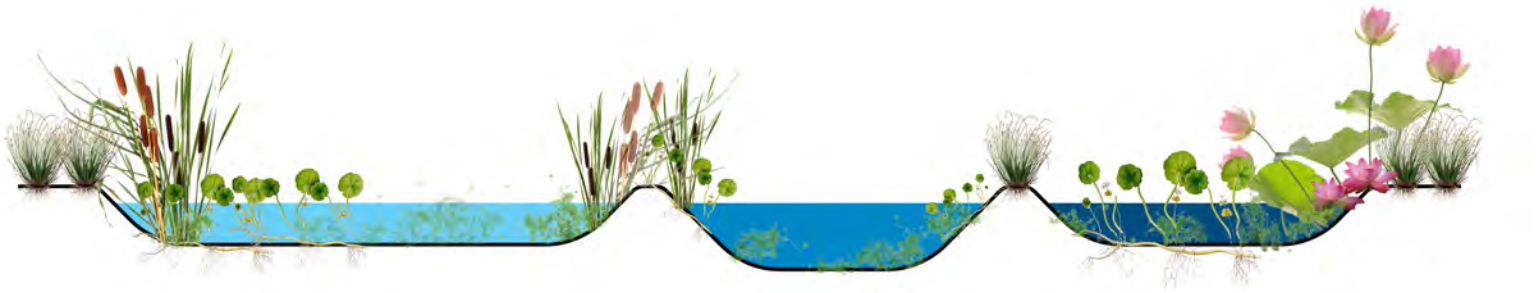
The community center on the capped portion of the landfill is a place for weaving and other artist and entrepreneur studios, galleries, classrooms and performances.

Why not develop a watershed economy based on stewardship and multi-use of our active landfills?

ABOVE and RIGHT: Students birdwatch and observe the composting of watershed organic material on top of the capped portion of the landfill.

Wastewater treatment wetlands: plan and section

A 36 hectare unit treats 5,000,000 gallons of wastewater/day. Middlesex County would need approximately 20 of these units.



ZONE 1

An anaerobic zone that is 60% vegetated.

Stats:

2.5 ft deep

ZONE 2

An aerobic open-water zone. This zone is broken up into two cells to facilitate maintenance.

Stats:

4 ft deep

ZONE 3

An additional anaerobic zone, also divided into two.

Stats:

2.5 ft deep

ZONE 4

Water is then released into a publically accessible wet meadow.

ABOVE: Wastewater wetland terraces are surrounded by wet meadows and publically-accessible paths.

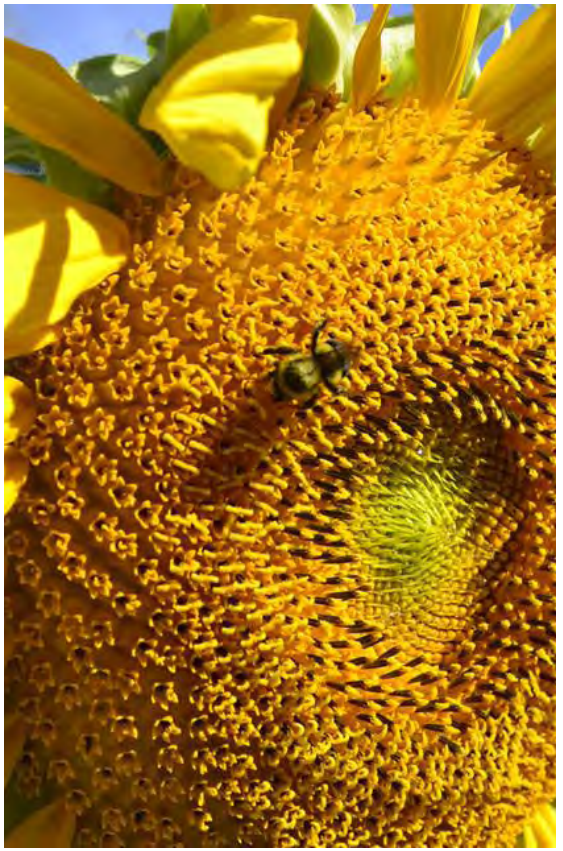
LEFT: The proposed wetlands are located on previously contaminated land midway between the Edgeboro Landfill and the existing Middlesex County wastewater treatment facility, in order to develop pedestrian-accessible linkages between active working landscapes.

Ag in the LRW

AUTHOR:
Jacqueline Abeltin

LOCATIONS:
Bridgewater, New Brunswick, Sayreville

CONCEPT:
Local, sustainable agriculture



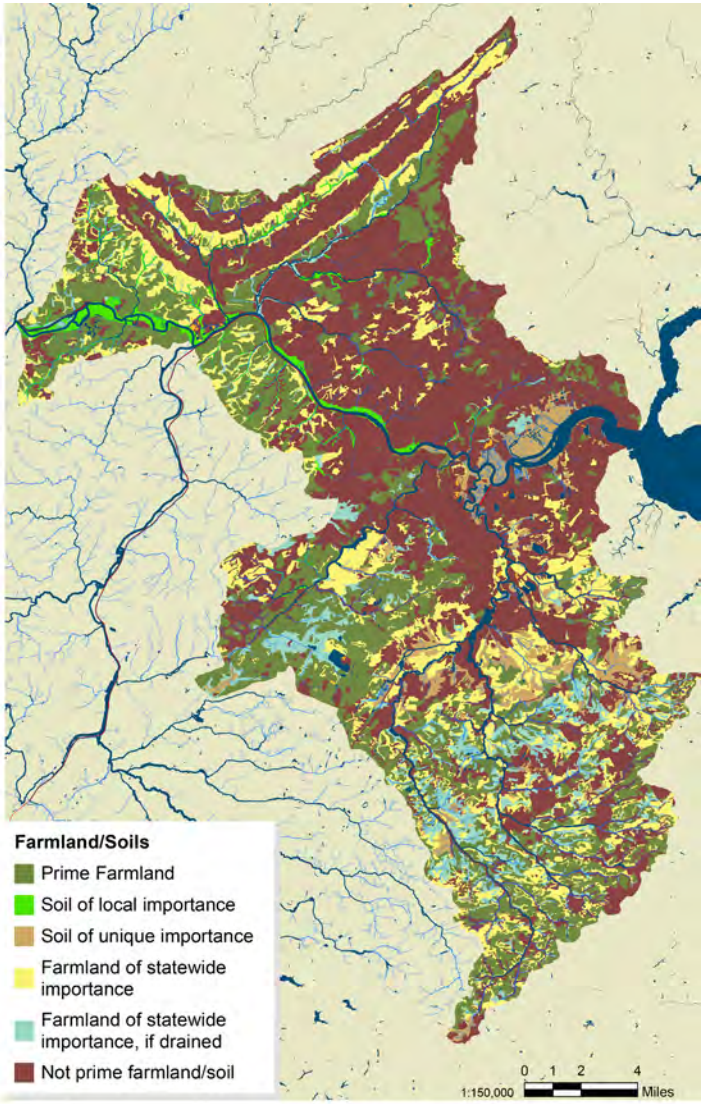
Due to urban sprawl, a significant portion of prime land to farm on has been lost to residential and commercial development. Only small pockets of highly productive soil remains throughout the lower watershed region. It is essential to preserve to protect and utilize these fertile areas to produce locally grown food using organic and environmentally sensitive methods of farming to protect the quality and the quantity of water.

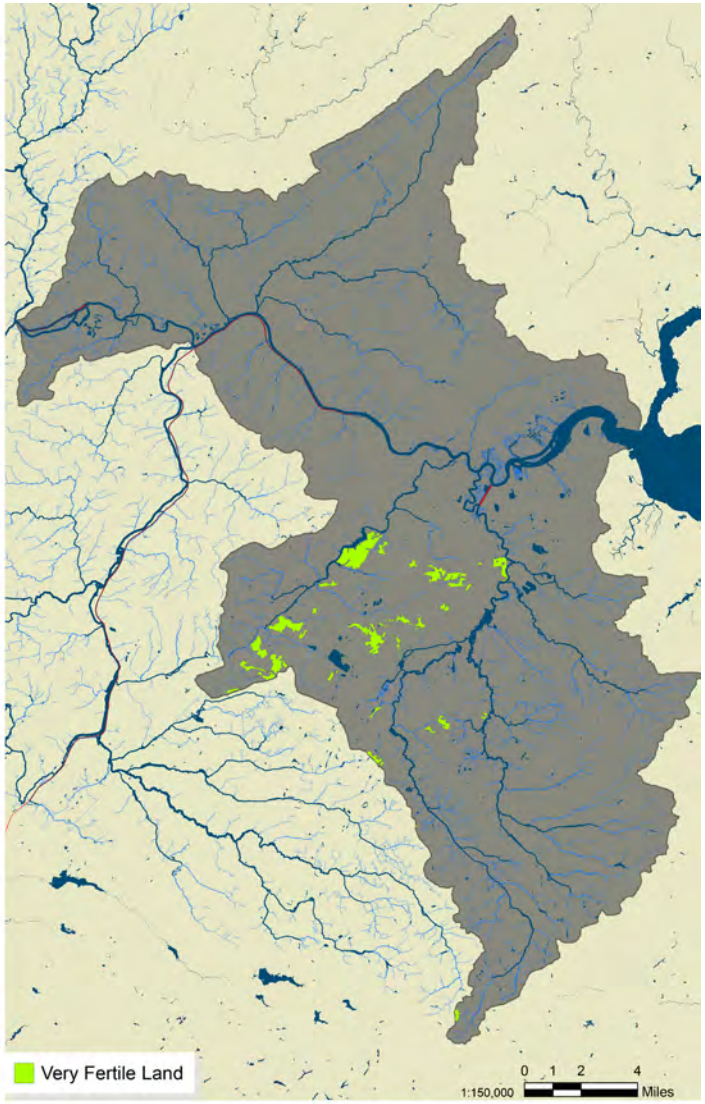
Soils designated as a local priority are soils that are deemed as a recommended flood buffer zone and an area to help control erosion and runoff. It's critical to rethink the ways in which we use this region currently in order to maximize the benefits it could offer to the river system as well as the communities that it supports.

I propose to design a system that supports the preservation of fertile soils and soils prone to erosion along the riverbanks as well as allow recreational programming to take place in suitable areas, particularly nearby residential and commercial areas.

Farmland and low density residential areas are a huge source of non-point source pollution and this can overwhelm any system designed to improve the river health. In order to reduce runoff of nitrates and chemicals, policy needs to change and new regulations need to be set. Banning the use of pesticides and herbicides and simply switching conventional farmland to organic is not enough. Organic methods of farming can still output the same load of excess fertilizer and nitrates into the water system minus the synthetic chemicals. Intelligent and responsible farming methods must be in use in order to see a reduction in polluted runoff, and this means implementing creative use of agriculture to minimize pollution, and maximize natural benefits and services from new agriculture systems.

We should be responsible for our future and how we obtain food with the rapidly growing population in the area. A significant portion of very fertile land has been built over with homes, stores, and pavement, but there are still pockets that remain. Preserving and protecting it now means saving future farmland to locally feed the people that would inhabit the watershed 30 or 50 years from now. dolumqui andus idus molupta turiore nis ut iditas quataqui vid





"70% feel an emotional or spiritual uplift from time spent in woodlands and open grassland."

"85% feel it is very or somewhat important to access natural areas quickly from where they live."

"By 2050, we will need to feed an extra 2 billion people worldwide."

Survey statistics provided by the National Resources Inventory Survey

Aquaponics

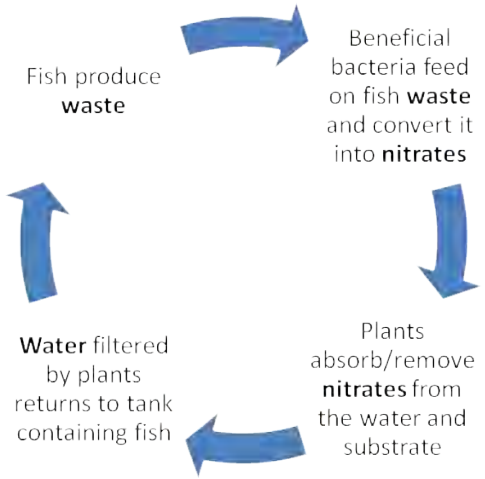
I found one solution that answers these questions, and that is the closed system practice of aquaponics. Aquaponics is an ancient farming method that combines fish farming and hydroponics to create a self-sufficient agricultural system. Practices in aquaponics range from large industrial greenhouse structures to personal hobby tanks. Aquaponics is a highly sustainable way of growing and raising both plants and fish with virtually no negative impact on the environment. The plants reliance on fish and micro-bacteria to produce the nutrients they need means that no fertilizer is needed. The fish in turn benefit from the clean water filtered through by the plants as they take up nitrates and other minerals through their roots.

Aquaponic farms can behave much like wetlands, if water from the river is taken in and filtered in a number of processes to remove what shouldn't be in it, used in an aquaponic system, and released back into the river. The process that's naturally a cycle becomes a one way system that benefits the river, and we benefit from the produce and fish harvested from the process.

Photo credit: http://growplants36.ru/

I selected a site directly on the Raritan River where an energy plant is situated right next to the Buchanan park boat launch.

Here, I'd propose to relocate and rebuild the plant to produce more sustainable, clean energy, and replace the industry with an aquaponic farm outfitted with solar energy panels to supplement energy to the operation and to the community. The farm would begin to have a positive effect as the new system takes in, filters polluted river water, and releases clean water back.



Plant Layer
(Filters the water to make it liveable for fish)

Substrate/Microbe Layer
(Beneficial bacteria converts waste to plant food)

Fish Tank
(pump takes up fish waste to substrate)

Site

Sayerville

Location is currently the site of a power plant. This is directly adjacent to the Buchanan Park Boat Launch in Sayerville and nearby residential zones. Its position on the water is not ideal. The site would do better as a large aquaponic site that can contribute to better river health rather than an energy plant that degrades it.materials that we can use in our everyday lives.

Aquaponic farm equipped with solar panels, providing cleaner energy for the operation, and the neighborhood

- Water from the river is extracted and sent through a filtering process to remove heavy contaminants such as large sediments, metals, toxins.
- Filtered water is passed through a bio-filter to remove excessive nitrates, fertilizers, and organic particles in the water.
- Some of the clean water is passed to the fish tank environment.
- Fish waste is pumped through to a hydroponic system where microbes convert fish waste into fertilizer for the plants.
- Plants remove this fertilizer from the water to promote their own growth.
- Clean water is released back into the river system.

Pthyto-Remediation

"Why use the forests which were centuries in the making and the mines which required ages to lay down, if we can get the equivalent of forest and mineral products in the annual growth of the fields?"
--Henry Ford

Sunflowers and Industrial Hemp, a variety of the Cannibis plant grown specifically for its dense, tough fibers, are two effective phytoextractors used actively in intense remediation projects mostly due to it's larger biomass and capacity to hold organic and inorganic pollutants in its structure.

Industrial hemp is particularly useful due to the number of products produced from various parts of the plant. The harvest of one mature acre of this variety equates to about 4 times the fiber you would harvest from one acre of pine species in a single year. It grows in almost any agronomic condition, aerates the soil deeper than most plants, and requires no input of pesticides, herbicides, insecticides, or fertilizers, making it one of the best phyto remediation plant species to clean up heavily contaminated sites with poor soil.

Wherever it is grown, it does a superior job of dissipating stormwater runoff. It holds soil nutrients as well as pollutants in place, preventing harmful elements from reaching major water bodies where fish and other species sensitive to pollution may inhabit.

Photo credit: http://thewatchers.adorraeli.com/

Its water purifying abilities and the numerous industrial uses it has can potentially be an attractive source of raw, bio degradable material for things like paper, clothes, plastics, construction, and bio fuel. Companies and offices in nearby cities looking to decrease their carbon footprint and source materials locally might find buying either the raw material or a finished product with hemp grown in NJ a very economical and environmentally conscious choice. In fact, up to 90% of the world's paper was made with hemp before 1883. Hemp oils are also being produced and used as an effective bio fuel alternative.

I believe cultivating hemp fields for non-consumption purposes in and around known contaminated sites and mines, along deforested, open-earth areas along the river, and in urbanized areas that previously were farmland, can recify most of the issues present in the river system, including water quality, turbidity, and nutrient load. And in return, we gain materials that we can use in our everyday lives.

Photo credit: Niki Gower

Phase One (2-3 years)

- Dredge bottom of river for heavy metals/ contaminants. Prepare a shallow pit as deep as taproots can grow and fill with polluted sludge topped with fill.

Phase Two (35+ years)

- Fields of Sunflower/Hemp planted to extract contaminants/stabilize soil over time. Harvest can be used for number of sustainable products.

Phase Three Completion

- Land becomes safe for public use.

<u>Products</u>

Bio-degradable Plastics

Construction Material

Textiles/Clothing

Paper Products

Bio-Fuel

Oil

Photo credit: Associated Press

Site

Bridgewater Township

Area in serious need for remediation, mostly due to stone/ asphalt mining operations taking place. Area also includes an outstanding brownfield. Utilizing phyto-remediation in this corridor would benefit the area while still being productive.

The soil in the area is mostly fertile with the exception of the mines and the brownfield. Consistency in soil health, and therefore water quality is the goal here.

Photo credit: Stavola, Ind

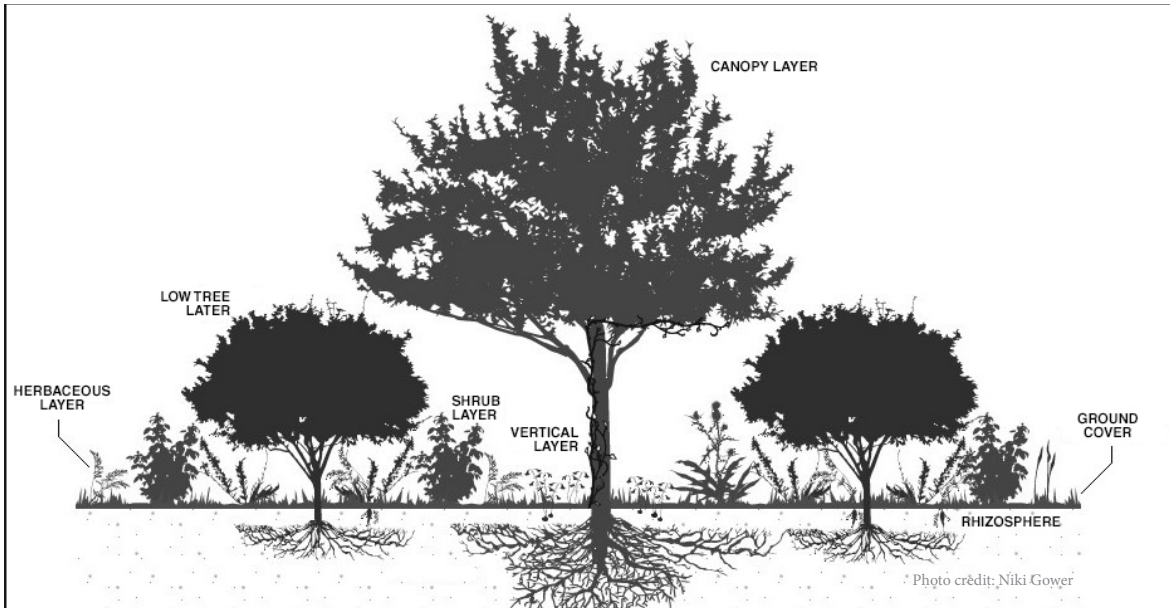
Food Forest

We often associate where our food comes from this vast open landscape of fields and sun, often some distance away from where we live, but what if the idea of our food landscape turned into a forest?

Mature forests have the inate ability to take, store, and hold large amounts of nitrates in the soil their roots grow in. The roots, given decades to grow, prevent soil erosion from occurring, maintaining and controlling the path of water flow, particularlly around streams and main tributaries of a large river.

Mature forests consist of many layers of vegetation, including nitrate fixing vines, low groundcovers, shrubs, and grasses. In a food forest, a number of species work together in a unique ecosystem to adapt, change and grow, and this includes humans in it's processes as well. These systems would do especially well in or near residential areas where access is easy, the soil is richest, and water is abundant.

With the right management practices until a food forest is mature at all seven levels, it can offer numerous benefits like organic and natural systems education and management strategies, ecosystem service demonstrations, and offer a destination for food and herb foraging activities while being almost completely maintenance free.



Site

New Brunswick

Buccleuch Park, adjacent to the Raritan, is an ideal site to introduce a food forest to the community. The park hosts an outdoor gym and fitness area along the path. To further encourage good health and well being, not only for visitors to the park, but of the river itself, installation of fruit trees, edible berry shrubs, edible strawberry groundcover patches, etc that are free to the public to pick would enhance the experiance visitors would get out of the space.

The park can go further to provide signs educating the public about trees and how a forest, any forest, benefits the water systems we all depend upon.

Outdoor Gym


Food Forest example in Buccleuch Park

Habitat Preservation

AUTHOR:
Han Yan

LOCATIONS:
Watchung Area/ Thompson Park Area/ Deep Run Preserve Area

CONCEPT:
Habitat Preservation and Human Community Development

After the class collected data and information about Lower Raritan Watershed, before we move on to the design part, we used GIS data from NJDEP to conducted suitibility analysis. My analysis started from the New Jersey landscape project conducted by New Jersey Department of environmental protection, Division of fish and wildlife, Office of natural and historical resources, based on the data sets that categorize the habitat patches by the presence of federal/state endangered/ threatened species, also spatial data of vernal habitat, we decide to create a suitability analysis for wildlife habitat in the watershed. A few other elements are considered, like the distance away from industrial/commercial and residential area, from which we find out surprisingly that nothing in the watershed is more than 1 mile away from them. We also considered the road system, for fragmentation and other risks closed to the roadways would decrease habitat quality. Therefore at last we created two suitability analyses for habitat, one shows its potential recreational value, another one favors for lowering the disturbance and maximizing its ecological functions.

Data Source:
NJDEP Landscape Project Data
Division of Fish and Wildlife
NJDEP LULC Data

New Jersey Landscape Project
LNDR

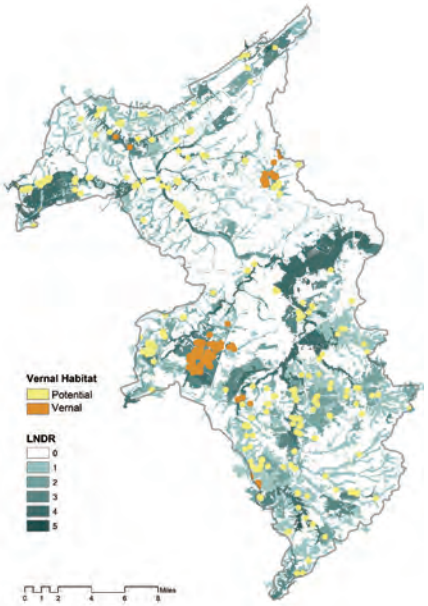
Rank 5 - assigned to species-specific habitat patches containing one or more occurrences of wildlife listed as endangered and threatened pursuant to the Federal Endangered Species Act of 1973.

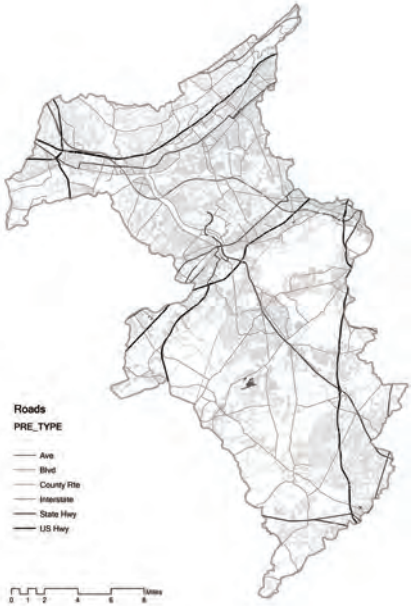
Rank 4 - assigned to species-specific habitat patches with one or more occurrences of State endangered species.

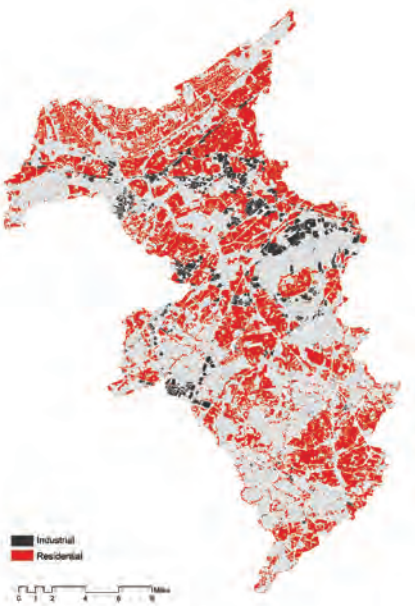
Rank 3 - assigned to species-specific patches containing one or more occurrences of State threatened species.

Rank 2 - assigned to species-specific habitat patches containing one or more occurrences of species considered to be species of special concern.

Rank 1 - assigned to species-specific habitat patches that meet habitat-specific suitability requirements such as minimum size or core area criteria for endangered, threatened or special concern wildlife species, but that do not intersect with any confirmed occurrences of such species.

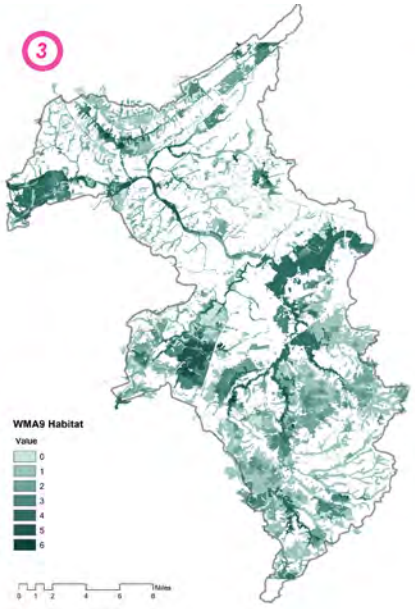

Vernal Habitat
Potential
Vernal
LNDR
0
1
2
3
4
5
Miles


Roads
PRE_TYPE
Ave
Blvd
County Rte
Interstate
State Hwy
US Hwy
Miles


Industrial
Residential


1
Distance From
Residential/Commercial/Indusrial
Value
0 Distance<0.5 Mile
3 0.5Mile<Distance<1Mile
6 Distance>1 Mile
Miles


2
Distance From
Residential
Value
0 Distance>1Mile
3 0.5Mile<Distance<1Mile
6 Distance<0.5Mile
Miles


3
WMA9 Habitat
Value
0
1
2
3
4
5
6
Miles

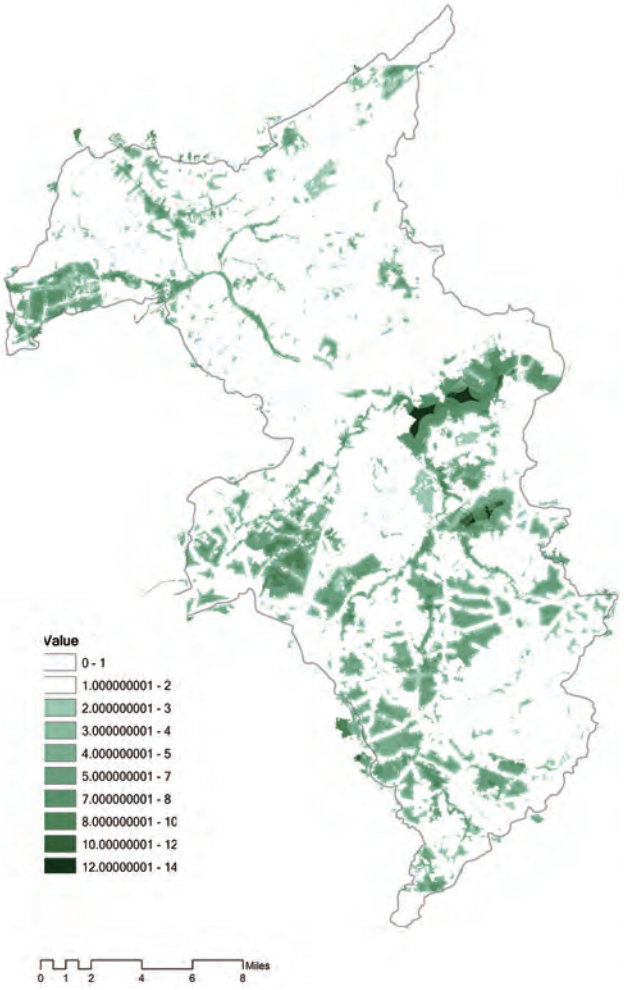

4
Distance From
Road
Value
0 Distance <500f
2 500f<Distance <1000f
4 1000f<Distance <2640f
6 2640f<Distance
Miles

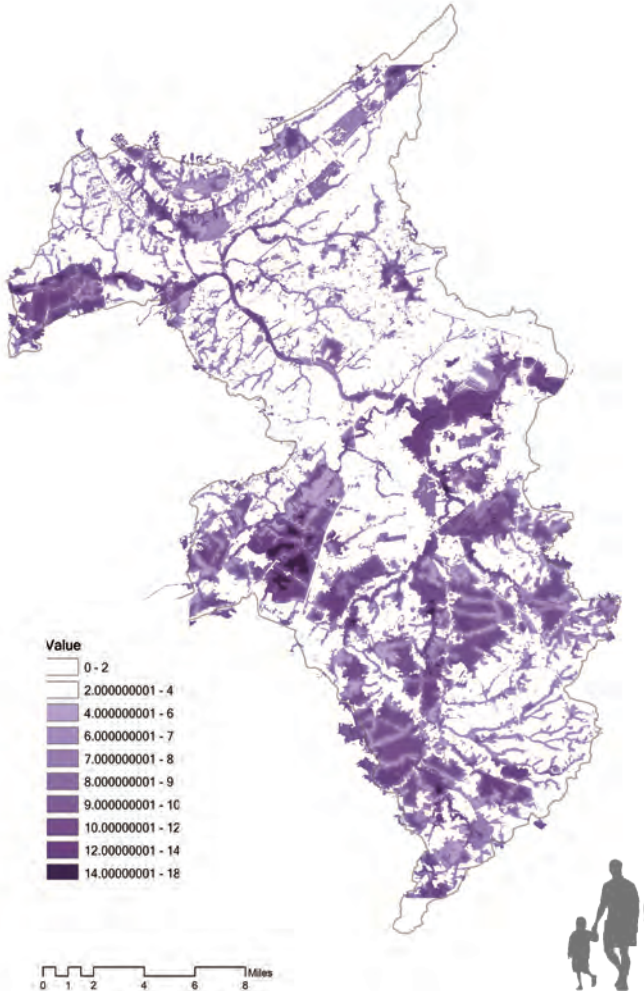
Ecological Founction Value

Ⓐ = ① + ③ + ④

Recreation Value

Ⓑ = ② + ③ + ④





Habitat Suitibility Analysis

A: Habitat Suitibility for Maximizing Ecological function

High quality of regular habitat and presents of vernal habitat
Far distance from residential, commercial and industrial area
Minimum road system fragmentation

B: Habitat Suitibility for Maximizing Recreation Value

High quality of regular habitat and presents of vernal habitat
Walking or Biking distance from residential area
Minimum road system fragmentation

Re-envisioning the Lower Raritan Watershed

RUTGERS UNIVERSITY DEPARTMENT OF LANDSCAPE ARCHITECTURE

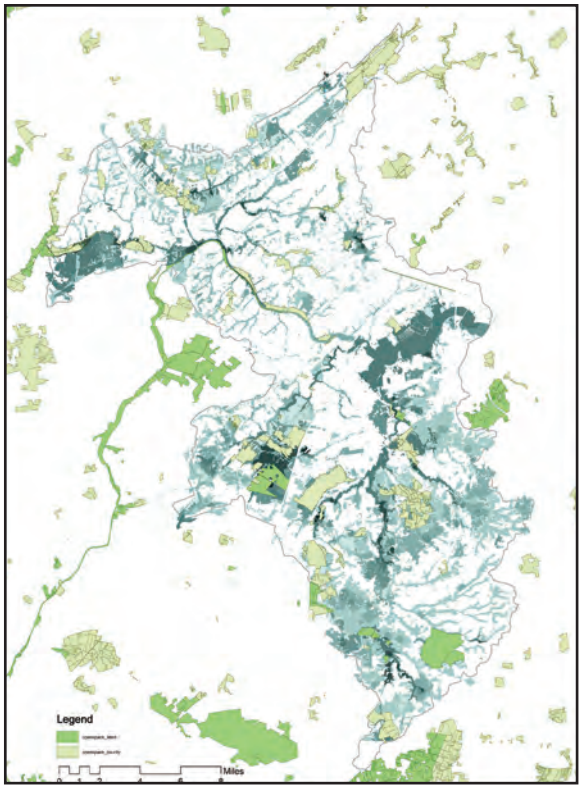
Design Concept

Using habitat restoration as a design tool to address ecological issues in Lower Raritan Watershed, for example storm water run-off, water quality, air quality. Also as a design tool to connect people to out-door open space. By proposing more green spaces with great habitat value to become preserved open space and encourage ecological restoration project at multi scales in Lower Raritan Watershed. This proposal visions the WMA9 area as an open space orientated developed area that accommodates not only human community but also other living communities to make the watershed a better ecological system.

The development strategies include inserting small patches of green space or high quality habitats in high density urban area, by increasing dwelling units in certain block that is close to public facilities like schools and commercials. Through reducing development foot print, the adjacent block may be released for green open space. In lower density development area, move housing units closer to streets and road to reduce impervious driveway area and create "Joint Backyard" effect to maximize ecological value of property.

Data Source:

NJDEP Landscape Project Data/Division of Fish and Wildlife/NJDEP LULC Data



Lower Raritan Watershed: 225,042 Acre

Existing Preserved open space coverage

State preserved: 3517.4 acres

County owned: 13026.1173 acres

Total:

16,543 acres

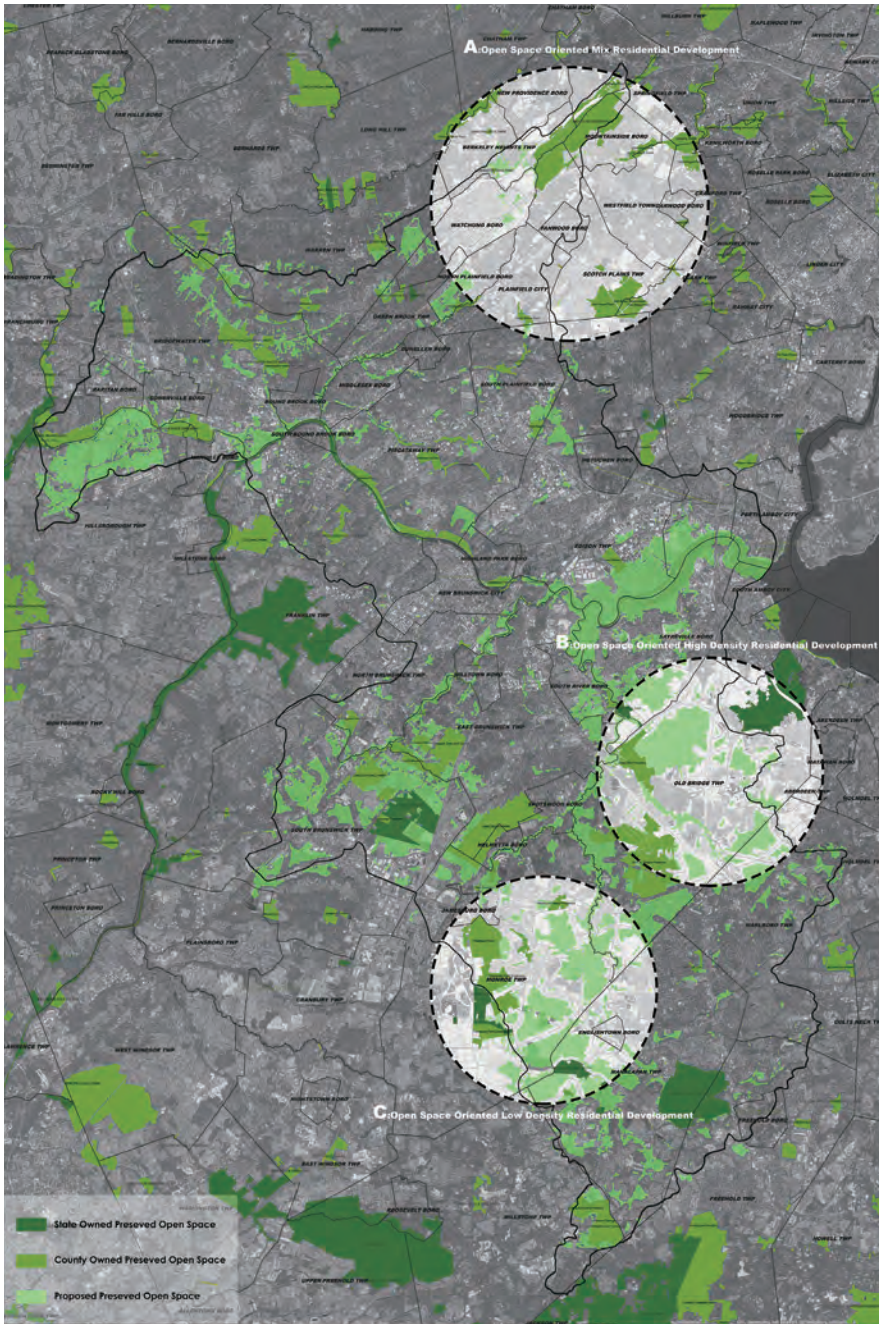
7.3% of the Watershed

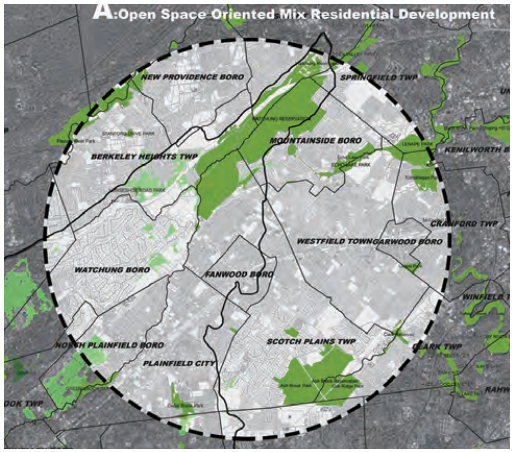
Land with Habitat Value

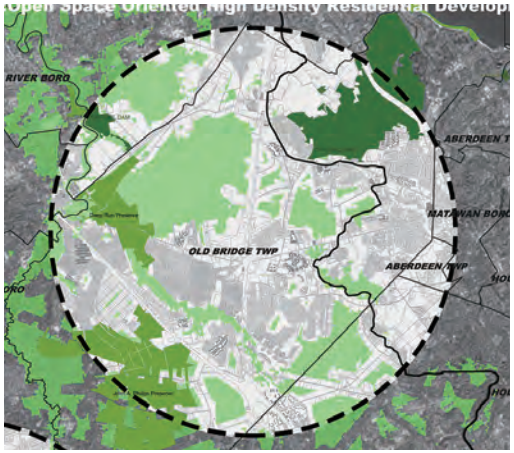
95,284 acres

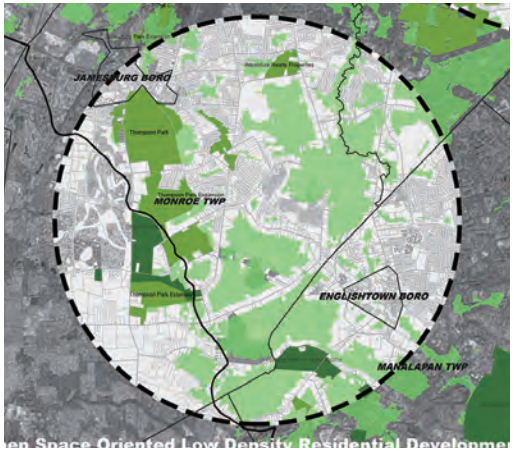
42.3% of the Watershed

Proposed New Preserved Openspace

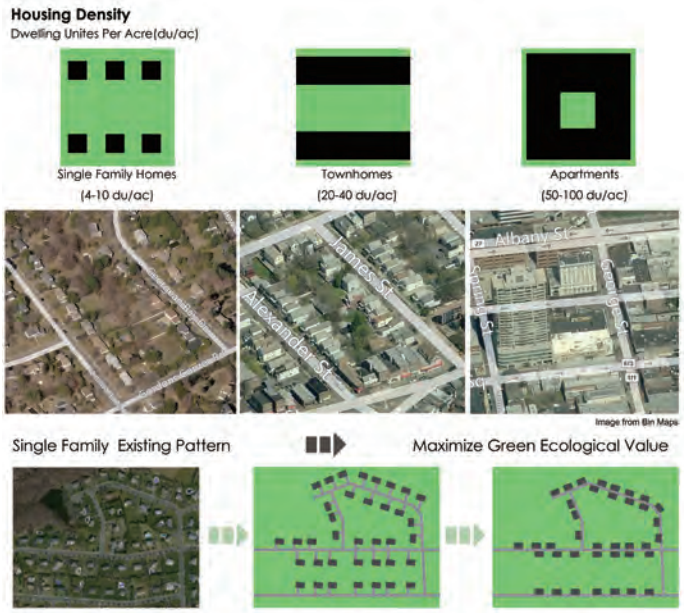








Intervention at
Site Scale



A: Watchung Area
State Owned Preserve
Proposed Preserved Open Space
Open Space Oriented High Density Apartment Complex
Urban Pocket Habitat
Open Space Oriented Low Density Single Family Closer Clustered
Suburban Joined Green Patches

B: Deep Run Preserve Area
State Owned Preserve
Proposed Preserved Open Space
Open Space Oriented High Density Apartment Complex
Urban Pocket Habitat

C:Thompson Park Area
State Owned Preserve
Proposed Preserved Open Space
Open Space Oriented Low Density Single Family Closer Clustered
Suburban Joined Green Patches

A: Open Space Oriented Mix Density Development

B: Open Space Oriented High Density Development

C: Open Space Oriented Low Density Development

Green Infrastructure Watershed Plan

AUTHOR:
Justin Hyde

LOCATIONS:
Bridgewater, Edison, and Manalapan

CONCEPT:
Regional stormwater management

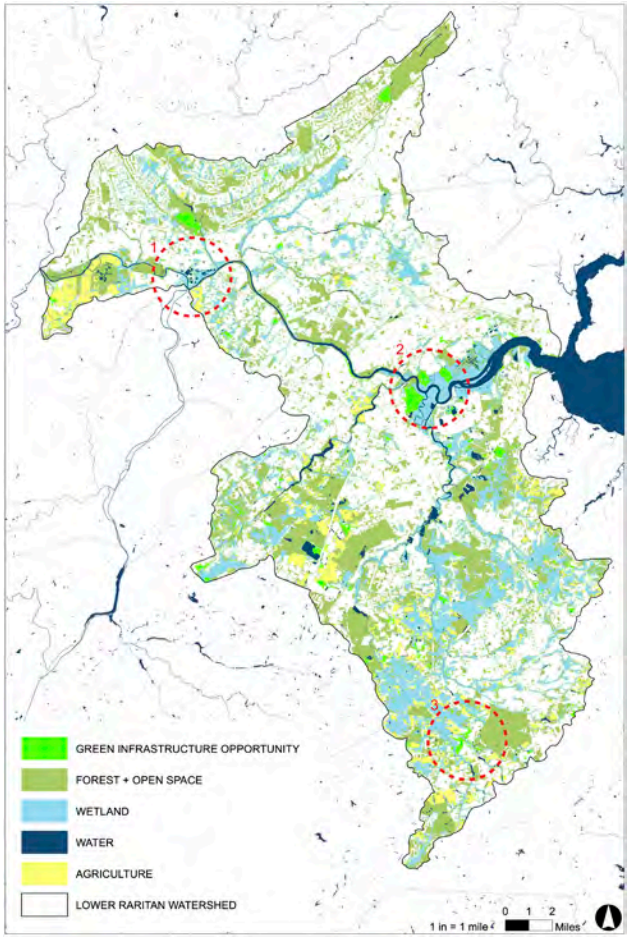
This conceptual design is about locating areas in the watershed where green infrastructure practices can work, and what these practices might look like if they were implemented.

Green infrastructure is an approach to water management that mimics natural processes in order to protect or restore a site's natural hydrology. It ranges in scope from regional to the neighborhood, from engineered to natural methods, and from practices like reforestation to porous pavement.

To begin, I identified areas where green infrastructure could be implemented by selecting areas that are classified as: agriculture, water, wetlands, and barren lands, and added buffers around them. The buffer areas can become places where specific green infrastructure practices can function.

After identifying where the opportunities are, I narrowed my search to take a closer look at three sites where green infrastructure could be implemented, based on: geographic location, classified land use, and the variety of green infrastructure practices that could work there.

The three sites are: a waste management center in Bridgewater, a warehouse district and wetlands in Edison, and a new housing development in Manalapan Township.

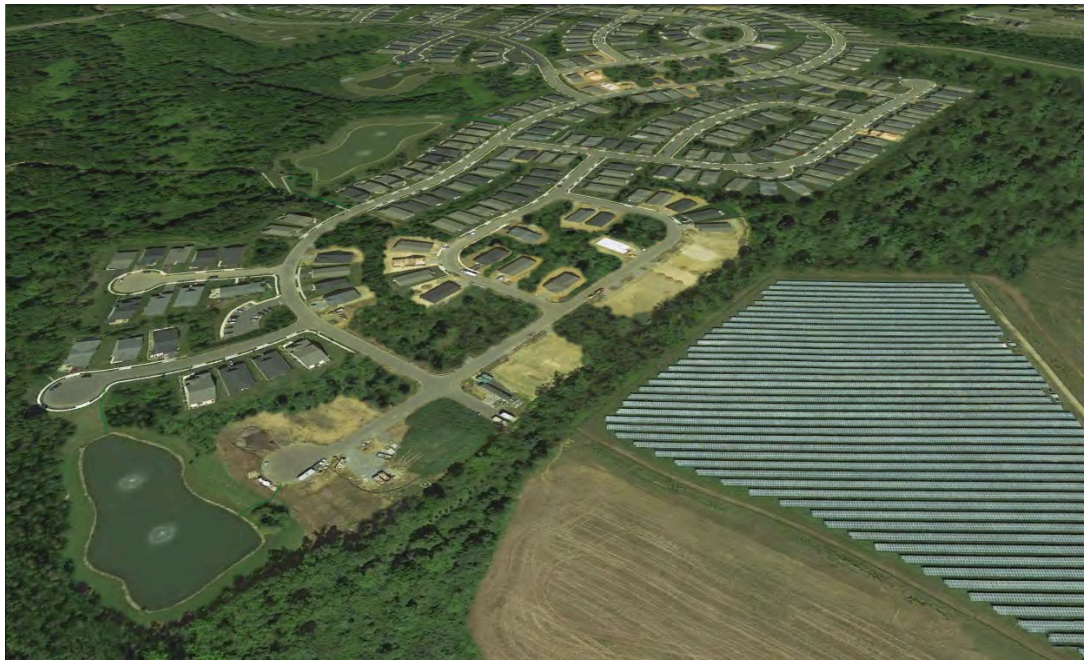


The waste management center in Bridgewater can buffer itself from the Raritan River by reforesting its scrubland. It can construct vegetative strips along the adjacent freight line and bioswales along roadways to capture leaks and absorb stormwater pollution. Holding ponds can be turned into constructed wetlands to better treat waste, and barren land can be replanted to enhance water infiltration. Agricultural land across the river can plant absorbing vegetation along its perimeter to intercept any polluted farming runoff before it reaches the river.

The warehouse district in Edison can be retrofitted with green roofs that connect to a network of roadside bioswales. The bioswales, after slowing runoff, can lead to a rain garden next to the boat launch to absorb and clean the rest of the runoff. Utilities along the river can be buffered simply with vegetation. Industrial sites in the wetlands surrounding the mouth of the Lawrence Brook can be relocated and planted over, or cleaned up to become residential open space and passive recreation.

And the new housing development in Manalapan can incorporate porous pavement and roadside bioswales that slope down toward retention ponds to treat and capture stormwater. Disturbed lands from construction can be restored with vegetation, and residential rain gardens can be incentivized to homeowners. The thin boundary between the development and the neighboring, old agriculture field with solar panels can be supplemented with reforestation. The solar panels could even be adapted to capture rainwater and reuse it for irrigation. Vegetative buffers between houses can serve dual purposes of increasing water infiltration as well as privacy between the tightly-packed homes.

Implementing some of these green infrastructure practices on compatible sites can have significant impacts relating to reduction in stormwater runoff volume and runoff pollutants. Ultimately, polluted water will be slowed, absorbed, and cleaned--leading to a cleaner Raritan River.



Stormwater Runoff Wetland Treatment

AUTHOR:

Miloni Mody

LOCATION:

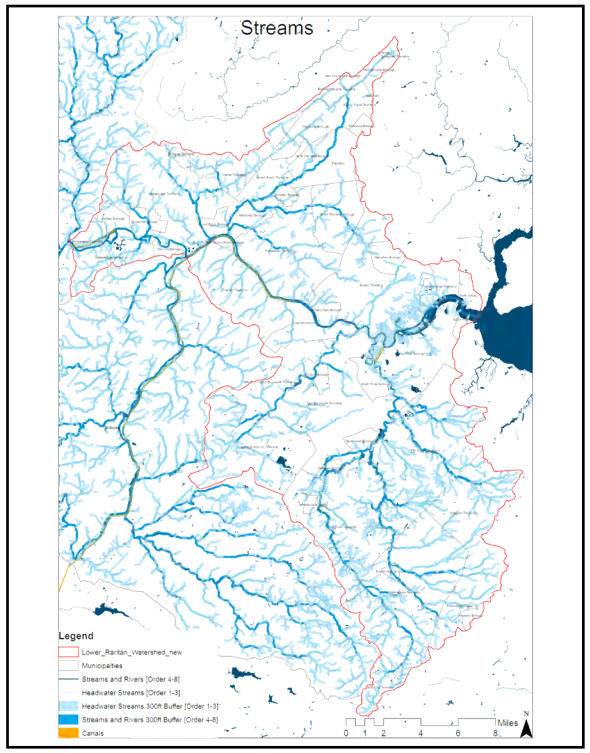
South Fork of Bound Brook watershed

INTRODUCTION AND ANALYSIS

Hurricane Irene made its landfall in August 2011. It was a Tropical Cyclone and it gave an average of 9.5" of rainfall throughout the Lower Raritan Watershed.

This event raised the question: How to handle this extra water? How to handle the stormwater runoff from imprevious surface? My proposal is trying to answer those questions.

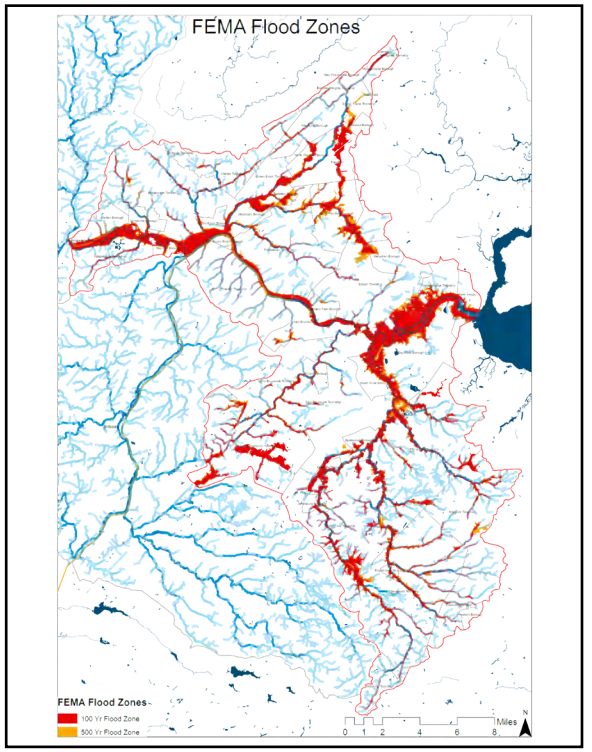
I analysed the following maps to chose an area for my proposed intervention.



Streams and Head Waters

300ft buffer to the Head waters and the Streams.

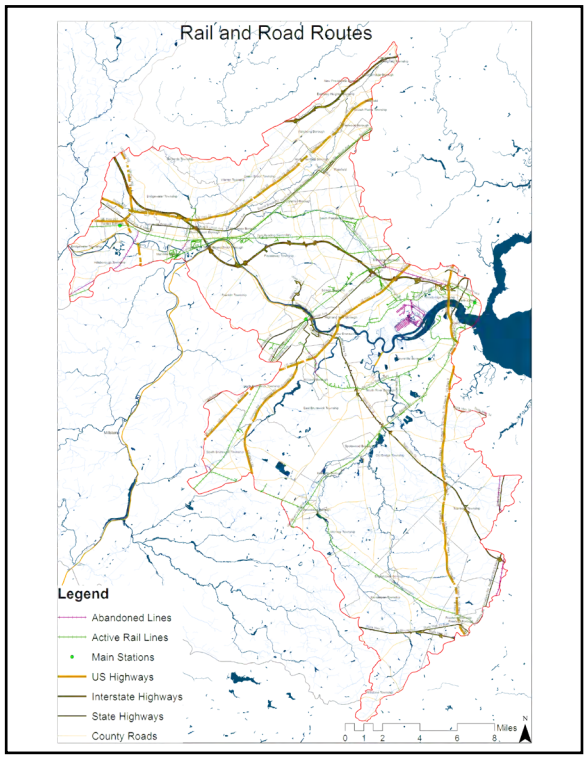
300ft buffer is suggested by DEP to maintain healthy conditions of the streams.



FEMA Flood Zones

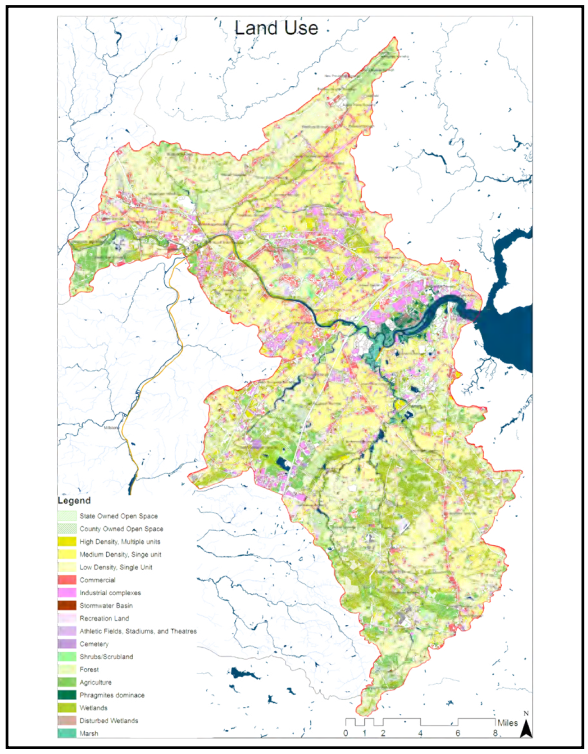
10% of WMA-09 is in 500 yr Flood Zone

2% of WMA-09 is in 500 yr Flood Zone



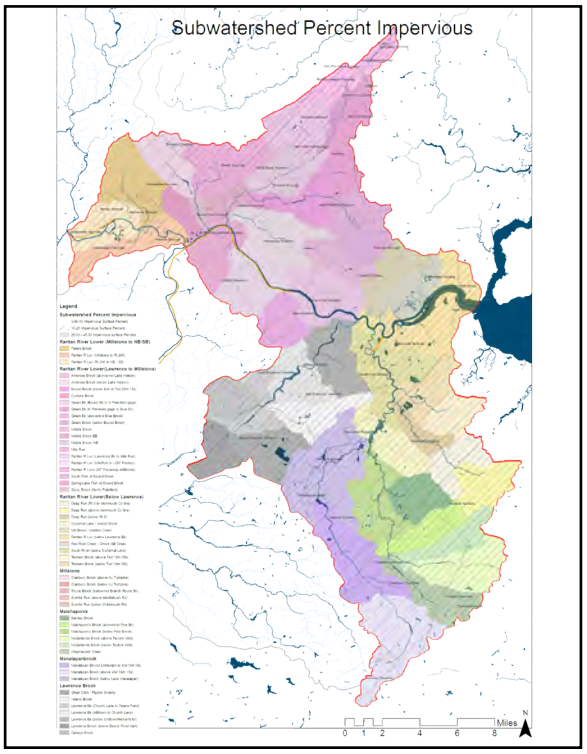
Rail and Road Routes

Major Road Routes Rt 1, Rt 9, Rt 130, Rt 202, Rt 287, Rt 18, and Rt 22



Land Use

By studying the land use pattern we realized that there is more industrialization and commercialization in the north of the watershed than in the South of the Watershed.



Subwatershed Percent Impervious

Impervious Surface Percent of Subwatershed are divided into three categories.

3.96-10.00, 10.00-25.00, 25.00-45.30.

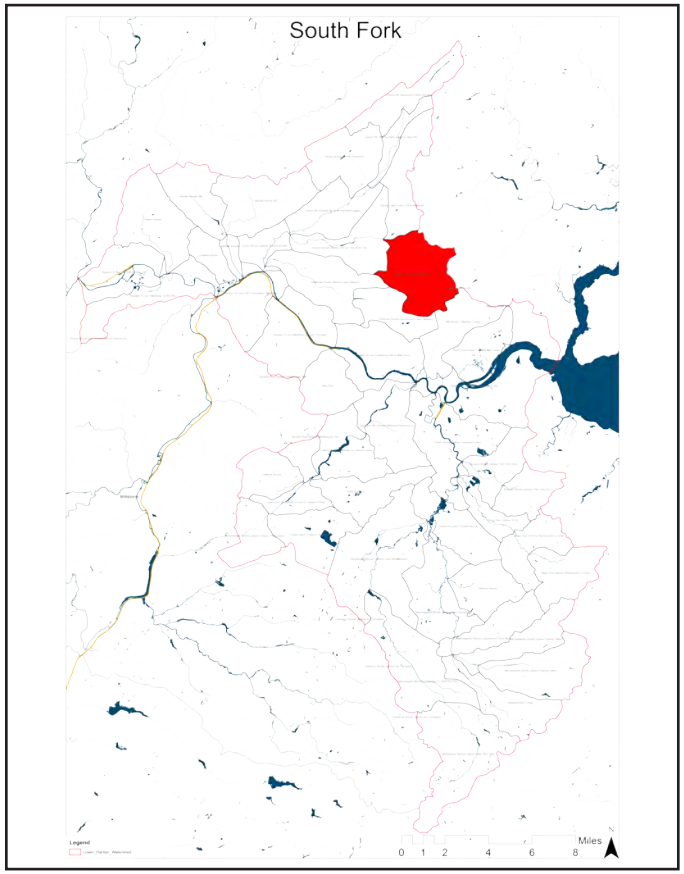
The narrower the lines the more impervious the watershed is.

SOUTH FORK OF BOUND BROOK WATERSHED

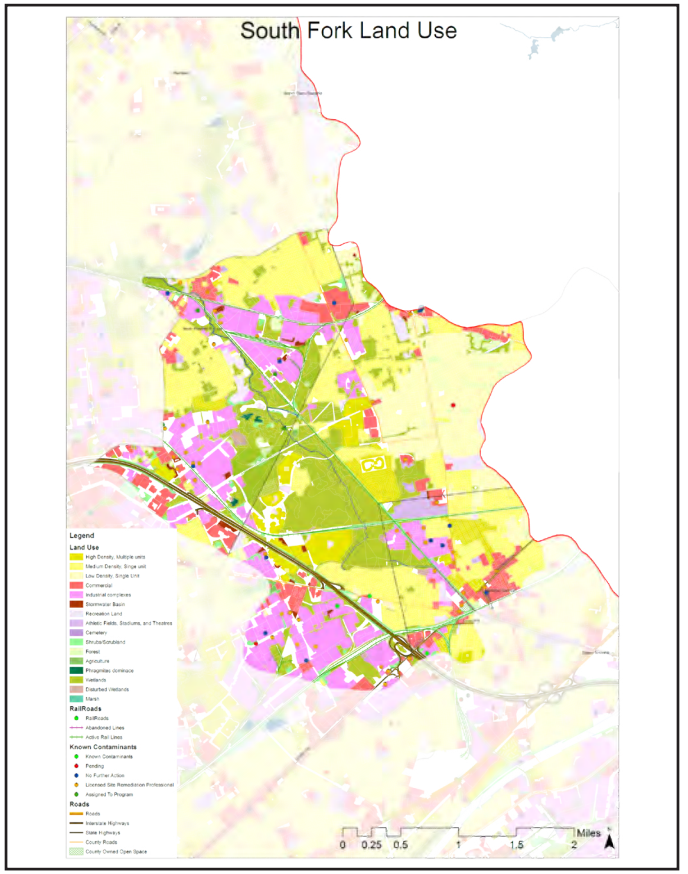
To promote planning of stormwater management at the watershed level instead of the municipality level, I chose South Fork of Bound Brook for my proposed intervention.

The goal I am trying to achieve here is how to make watershed more pervious and provide more patches open space to the community of the South Fork of Bound Brook .

The reason for choosing this watershed was that it is located in the 25-45.30% area of impervious coverage and it has the broad range of Land Use.



South Fork of Bound Brook watershed is situated in the North East of the watershed.



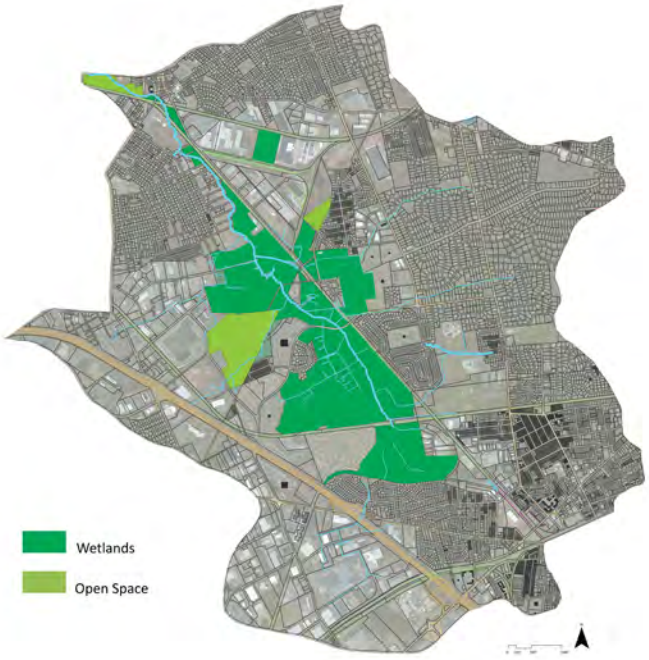
Land Use of South Fork of Bound Brook:

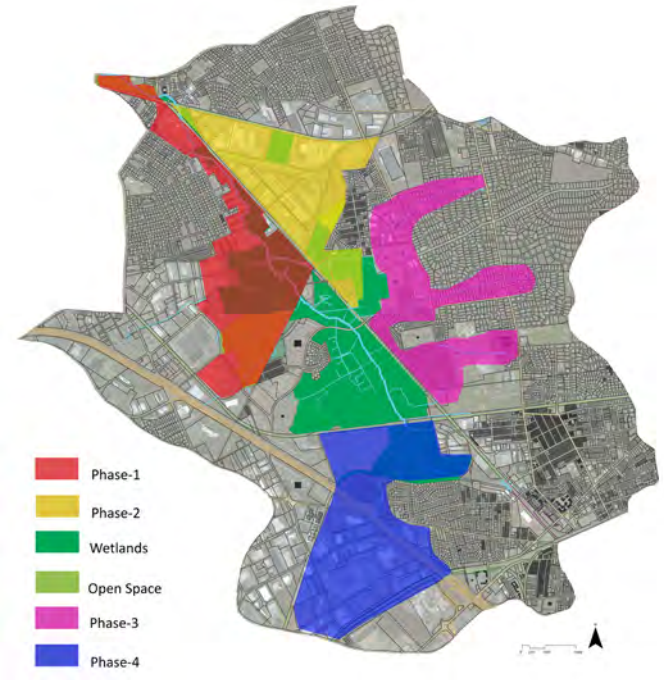
20% of the total area is the wetland.

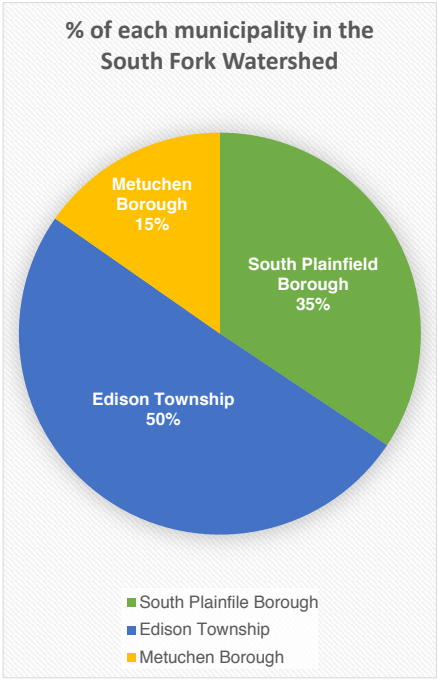
Major highway is passing through.

It has an active rail line connecting to Perth amboy.

Equal mix of residnetial and commercial land use.







Open Space and Wetlands

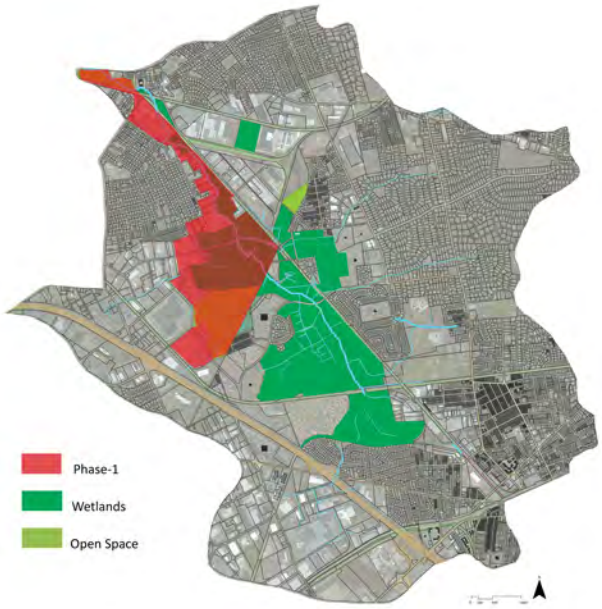
From the above shown map, you cans ee the lack of open space in the watershed.

Phasing of the Proposed Intervention

The phasing of the area began from the downstream to the Upstream. It is important to begin process of filtering water downstream rather tha upstream.

Municipalties of the South Fork Watershed

Three municipalties are having different policies of the stormwater mangement for the one watershed.

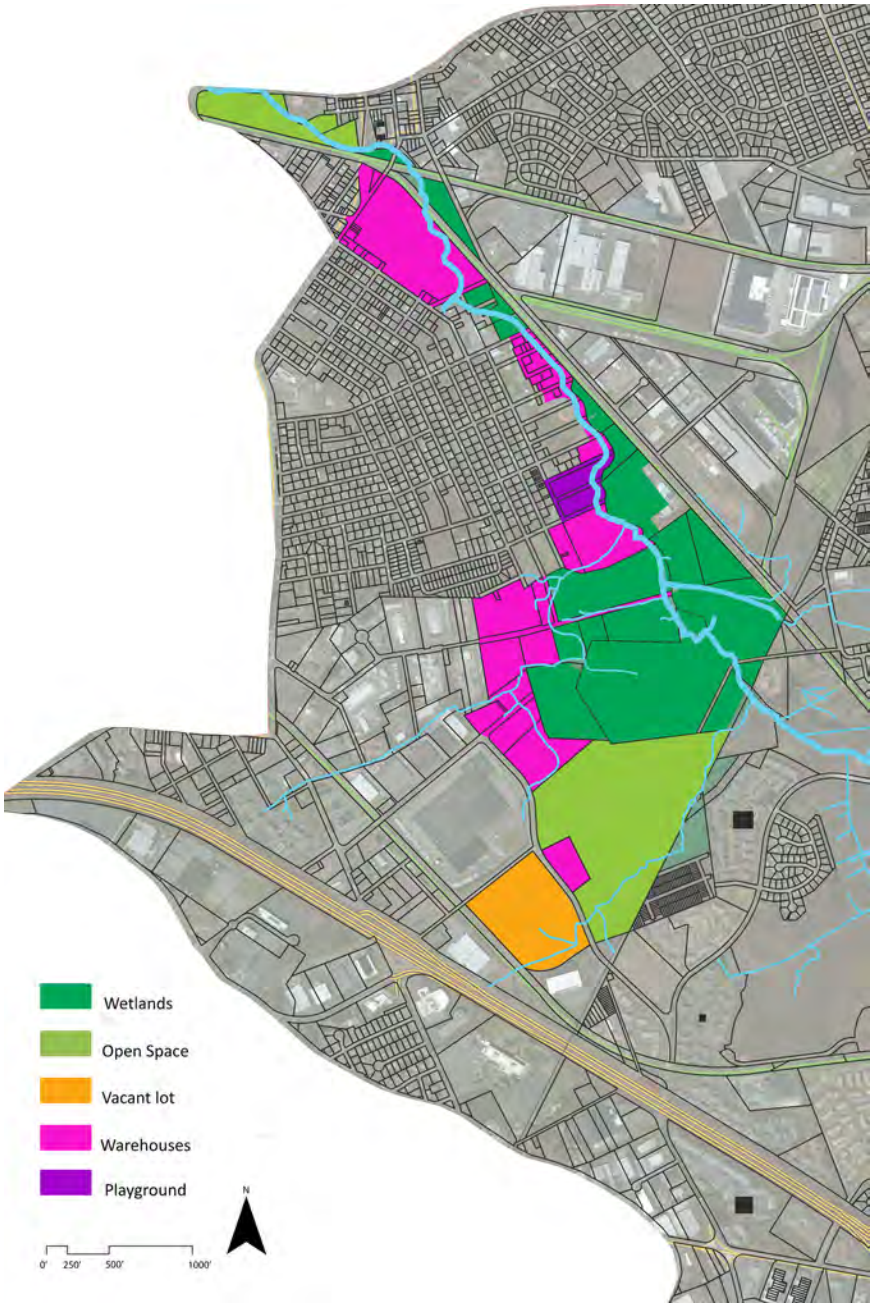


Phase-1 of the Proposed Intervention

DESIGN OF THE PHASE-1

The biggest problem of the depletion of the wetlands is the stormwater run-off. For this very reason, I propose stormwater runoff wetland around the existing wetlands and streams. Stormwater runoff wetland also lay important role in the flood mitigation system . In my proposal, I am envisioning them as both infrastructural tool as well as a recreational tool.

Existing Land Use of the Proposed Intervention of the Phase-1:
The site where proposed intervention is going to take place is largely owned by the warehouses and the play grounds.



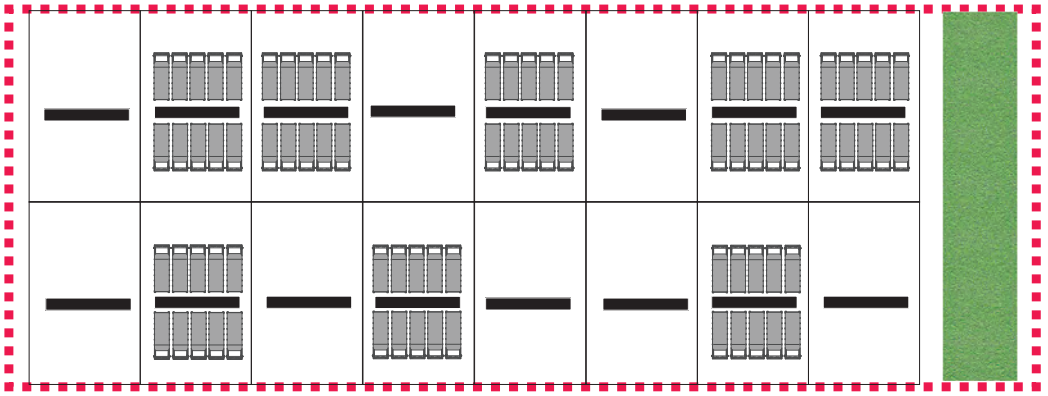
Exisiting Land Use of the Proposed Intervention of Phase-1

STRATEGY FOR THE ACCQUISTION OF THE WAREHOUSES FOR THE PROPOSED STORMWATER RUNOFF WETLAND TREATMENT:

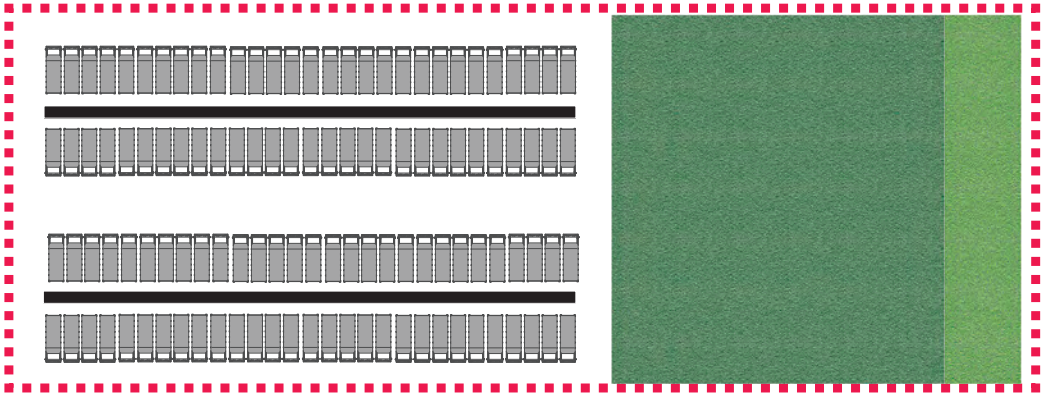
Currently, there is a row of warehouses next to each other. But not everyday every single warehouse is filled with the loaded trucks. Sometimes they are full and sometimes they are not full.

So, why don't we prupose a pattern in which there is shared platform amongst the warehouses. So they can keep turns to share their platforms..

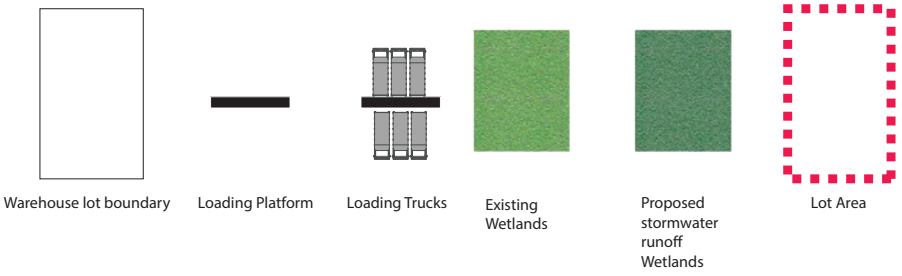
By that way, some area of the land would be free up and it could be utilzed for the stormwater runoff wetland intervention.



CURRENT SITUATION: Every warehouse have its own platform to lunload/load trucks. But most of the time they are empty.



PROPOSED INTERVENTIONS: Shared platform amognst the warehouses. So, more space can be dedicated to the proposed stormwater runoff wetlands.



DESIGN OF THE PHASE-1

The stormwater gets collected first in the rain garden, it then flows into the deep pools which is anaerobic, from then it moves into shallow water which is aerobic, and lastly it passes through sand filter and then clean water flows back in to the streams.

It takes 8 days for this complete procedure. People can walk through this process and it also provides them with the open space.

WATERHOLDING CAPACITY OF THE PROPOSED STORMWATER RUNOFF TRATMENT WETLANDS:

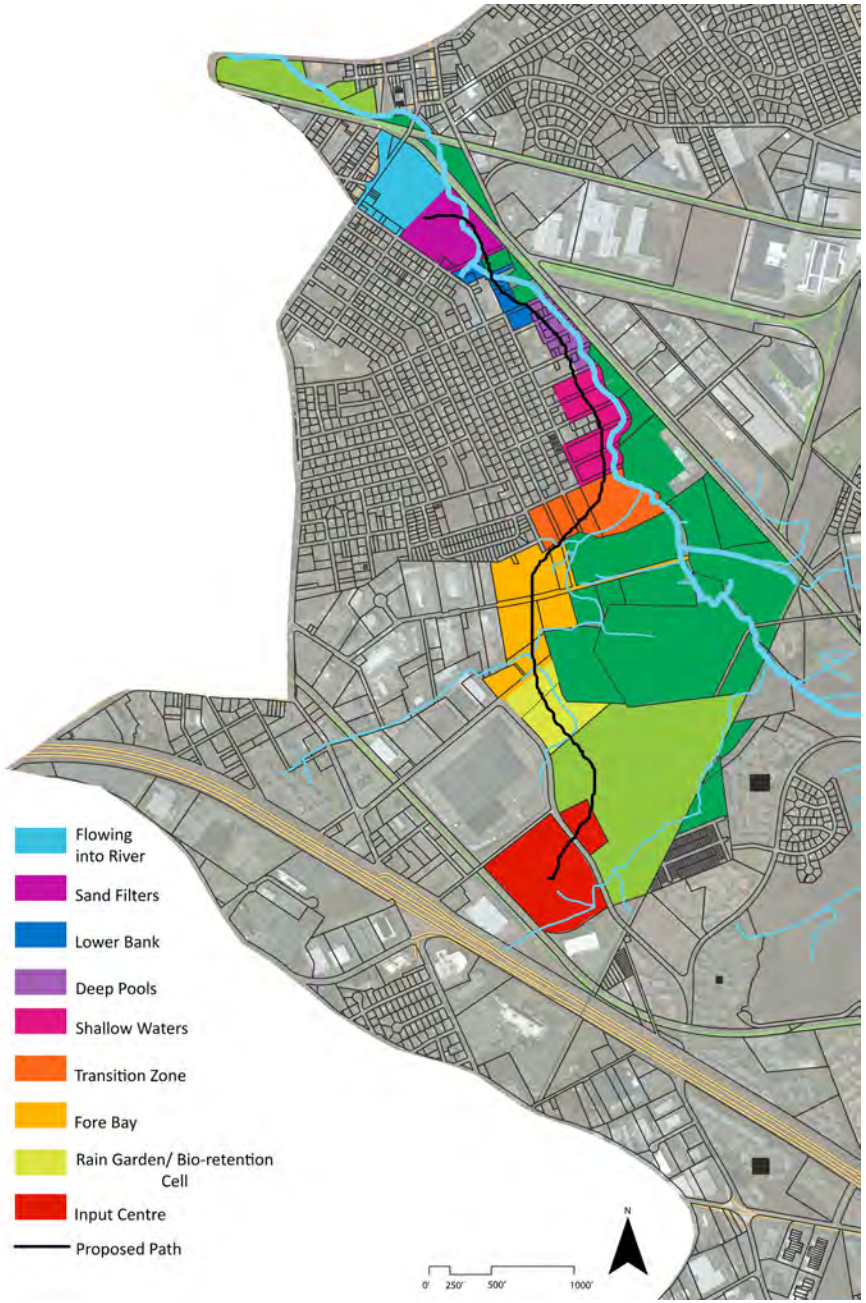
SOUTH FORK: 6039 Acres: 263, 538, 000 sq. ft

Irene Rainfall: 9.3" = 0.775 ft/event

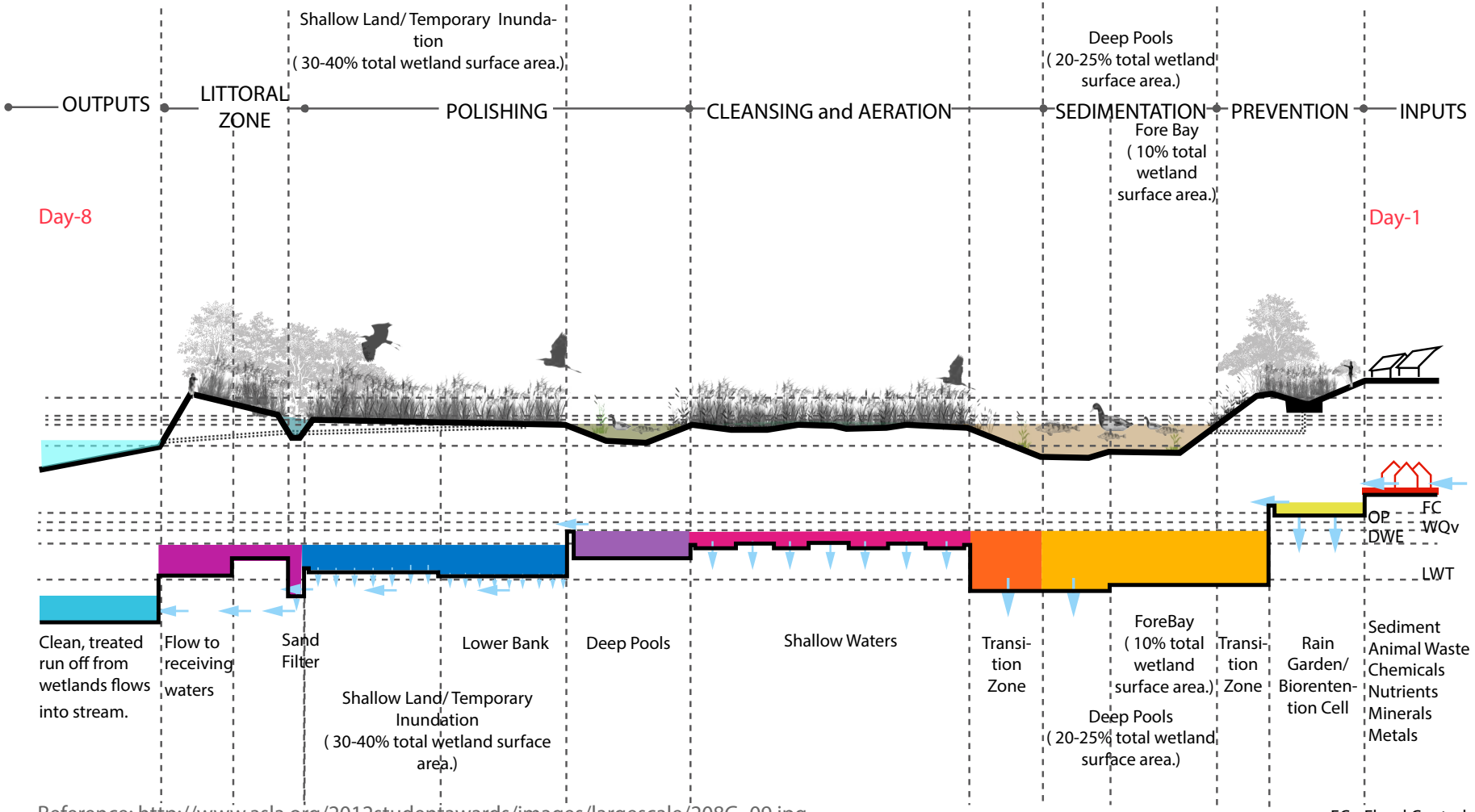
Total Storm water run-off from Irene in the South Fork: 210, 830, 400 Cu. Ft

Total capacity of the Phase -1 wetlands: 42,089 cu.ft

Total capacity of the Stormwater runoff wetlands: 16,00,000 cu. ft



Proposed Stormwater runoff treatment chambers in Plan view

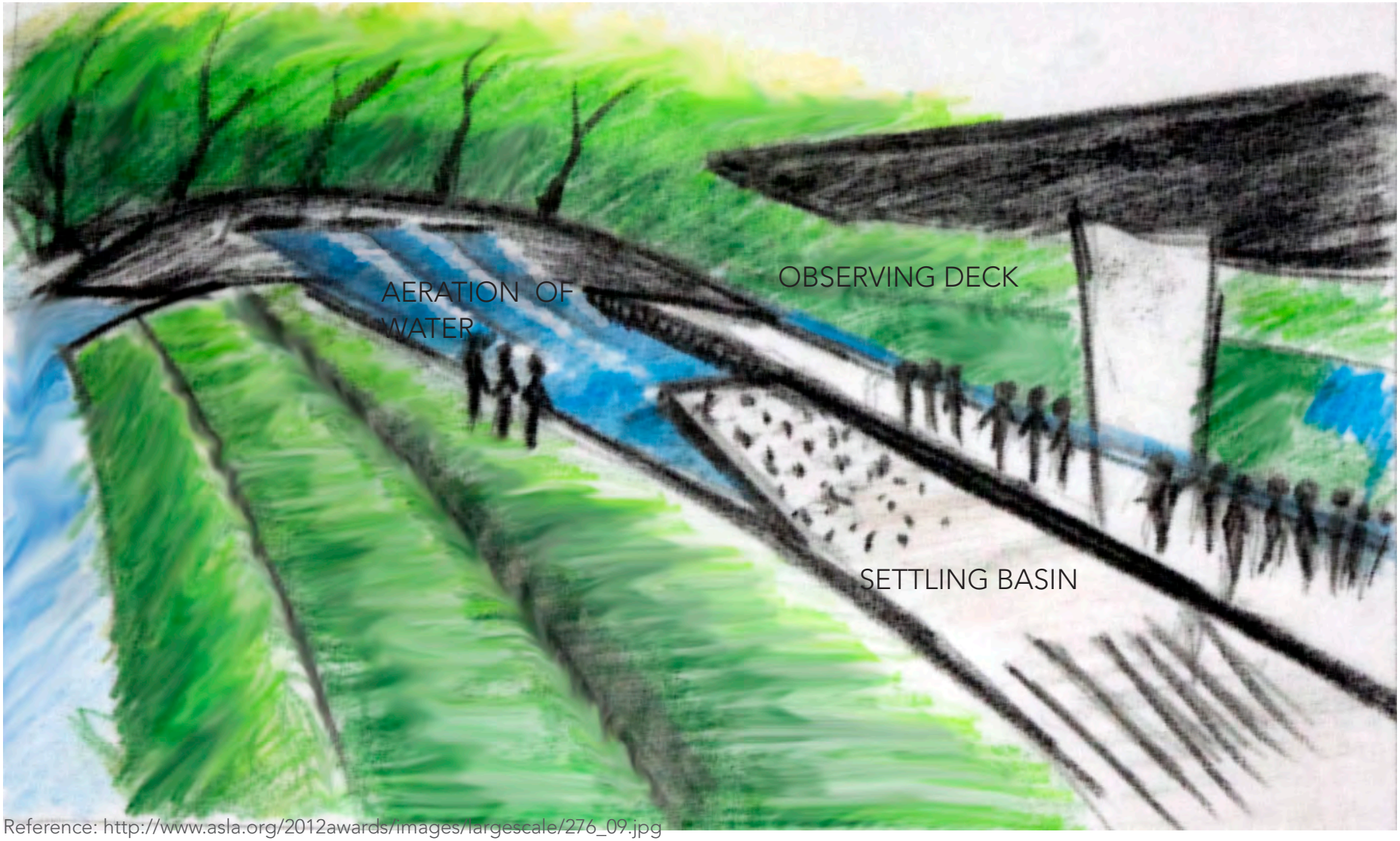


Reference: http://www.asla.org/2012studentawards/images/largescale/208G_09.jpg

FC= Flood Control
OP= Overbank Protection
WQv= Water Quality Volume
DWE= Designed Water Elevation at Normal Pool
LWT= Seasonally Low Water Table Level

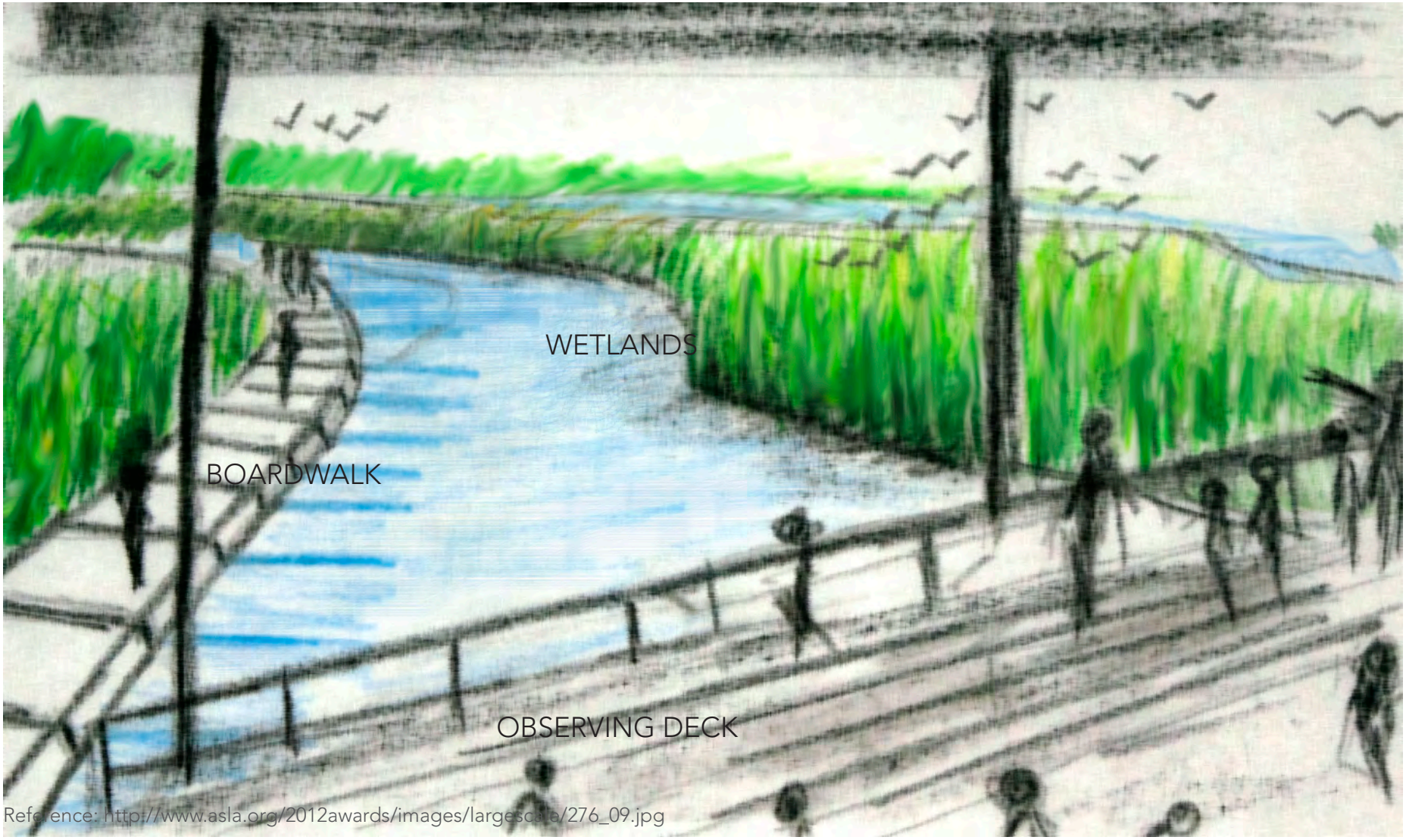
Proposed Stormwater runoff treatment chambers in Section view

DAY-1 People observing aeration and settling of solids process. It also provides with gatherin area.



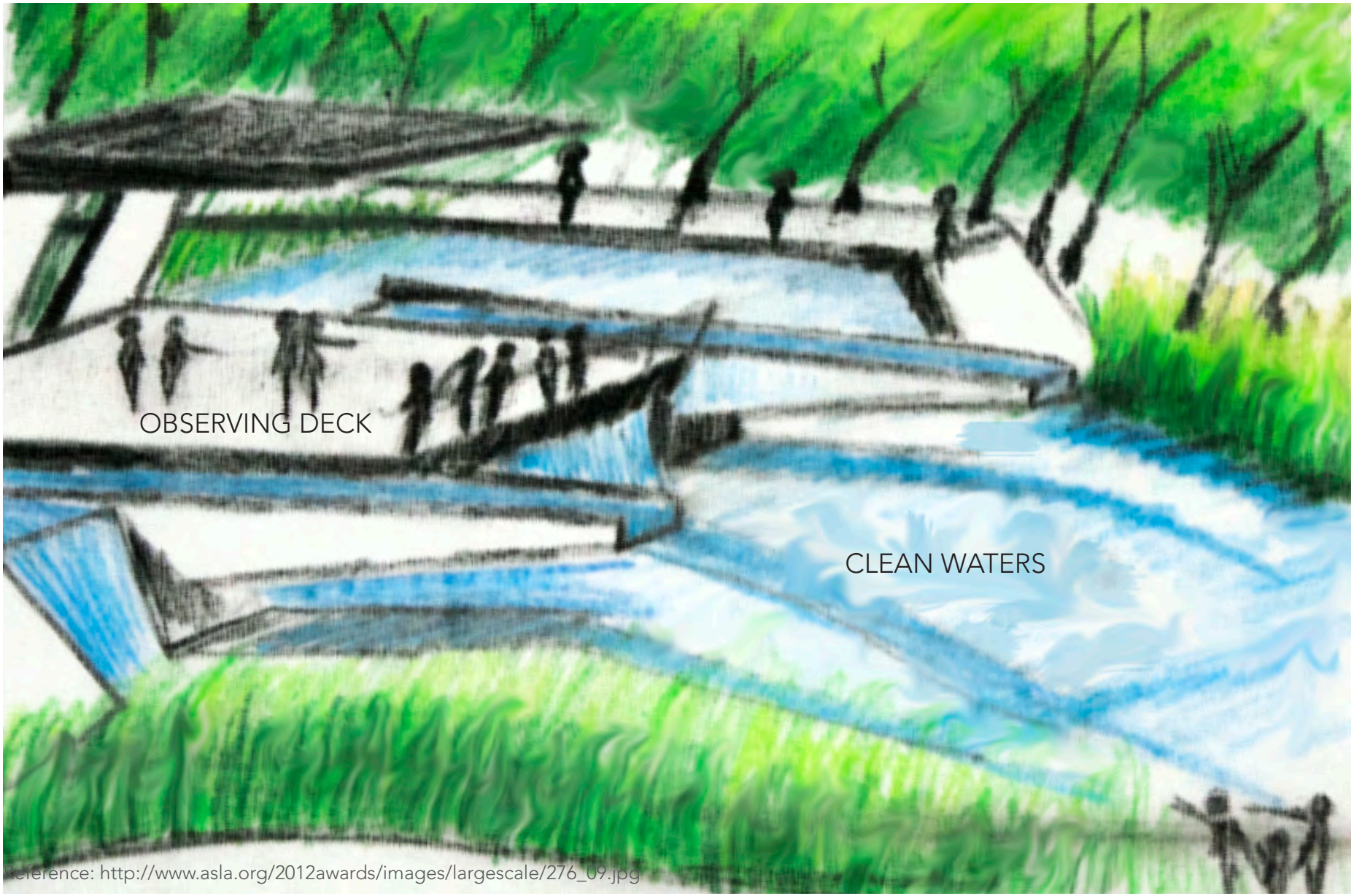
Reference: http://www.asla.org/2012awards/images/largescale/276_09.jpg

People walking through the wetlands and also providing with an overlooking area to the wetlands.



Reference: http://www.asla.org/2012awards/images/largescale/276_09.jpg

DAY-8: Celebration of the clean water entering into the streams.



Reference: http://www.asla.org/2012awards/images/largescale/276_09.jpg

This kind of the treatment can be applied at various places with the Lower Raritan Watershed. It will help us in flood mitigation, stormwater runoff, and also keeping the streams and wetlands in the healthy conditions. It will help us make watershed more pervious.