

Running Head: CAPSTONE 599A: SUSTAINABLE CITIES: RED BANK, NJ
NAGWA AWAD

Capstone 599A

Capstone: Sustainable Cities: Red Bank, NJ

Development Plan

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Table of Contents

List of Tables	3
List of Figures.....	4
Abbreviations.....	5
Executive Summary.....	7
Quick Overview.....	10
Introduction.....	11
PART 1: IDENTIFYING STAKEHOLDERS	13
Organizational Assessment.....	14
Main Stakeholders.....	15
Other Stakeholders.....	16
PART II: ANALYZING RED BANK, NJ USING SUSTAINABILITY INDICATORS.....	18
Indicators & Reason.....	18
Red Bank Progress Report.....	19
Material Conditions (3):	20
Quality of Life (7):	25
Environment (5).....	33
PART III: IMPROVEMENT PLAN, RECOMMENDATIONS & TRACKING PROGRESS	39
Housing Affordability	39
Smart Growth	40
Habitat for Humanity.....	49
Tracking Progress for Housing	50
Air Quality.....	51
Cost Benefit Analysis, Net Present Value, Health and Environmental Impact.....	52
CBA Worksheet & Analysis.....	53
<i>Mechanics: 3.58 m/s and 560 turbines.....</i>	<i>53</i>
<i>Estimated Capital Cost: \$24,200,000</i>	<i>54</i>
<i>Estimated Annual Cost: \$1,806,528.....</i>	<i>54</i>
<i>Estimated Production Cost: 3.5 cents per KW/h.....</i>	<i>55</i>

Estimated Net Profit: \$3,855,252 per year..... 55

Estimated Environmental and Health Benefits: 55

Net Present Value (over 30 years): \$39,651,172 and \$62,143,980..... 58

Tracking Progress for Air Quality 59

Human Health & Access to Medical Care..... 59

Tracking Progress of Human Health and Access to Medical Care 60

Poverty..... 60

Tracking Progress of Poverty 61

Recycling..... 61

Tracking Progress of Recycling..... 64

PART IV: TIMELINE, MILESTONES & OTHER RECOMMENDATIONS 64

 Timeline of Events..... 64

 Ordinances & Milestones..... 67

 Other Recommendations not included in Part III..... 69

Conclusion 70

Works Cited 72

List of Tables

Table 1: Details of Indexes used and their corresponding goals and indicators..... 19

Table 2: This is a “Heat Map” with corresponding key for sustainable trends per indicator. The colors on the left correspond to the Index used in Table 1. 20

Table 3: Comparison between cost of living in 2010 and 2000 and the corresponding percentage increase..... 23

Table 4: Yearly percentage increase of township salaries as a portion of the overall budget 24

Table 5: This is a “Hot Map” of prevalent disease of township residence. 27

Table 6: Results of waters tested in 2016 and 2019 showing consistently clean water..... 29

Table 7: Red Bank school curriculum for grades K-12..... 37

List of Figures

Figure 1: Red Bank hierarchical chart.....	15
Figure 2: Red Bank adaptive chart	15
Figure 3: Union leaders.....	17
Figure 4: Community education about composting.....	17
Figure 5: Poverty by age and gender	21
Figure 6: Trend of percentage of poverty.	22
Figure 7: Table 3 results graphed.....	23
Figure 8: Table 4 results graphed.....	24
Figure 9: A comparison of male and female managerial salaries	25
Figure 10: Trends of un-insured residents as a percentage of total population.....	26
Figure 11: Figures from Table 5 plotted.....	27
Figure 12: Trend of student cognitive skills in education.....	28
Figure 13: This map plots locations of underground well (in red) and the reservoir (in blue) (Tax Board, 1999).....	29
Figure 14: Comparing resident ownerships and trends with state and national averages.	30
Figure 15: History of crime by category over the last 12 years with clear improvements (City Data, 2018).	31
Figure 16: Residents by race.	32
Figure 17: Poverty by race	33
Figure 18: Wage distribution by race	33
Figure 19: AQI for Red Bank for PM2.5 and Ozone only (Airnow, 2019).....	34
Figure 20: AQI for Red Bank including CO, NO2, SO2, and Lead in addition to Ozone and PM2.5	35
Figure 21: Fish kills in the Navesink River (Goldman, 2019).....	35
Figure 22: The area in blue shows the Navesink River also known as North Shewsbury River (Tax Board, 1999).....	36
Figure 23: Planned renovations of Bellhaven Nature Preserve (Herschberger, 2019).	37
Figure 24: Trash containers in public areas, absent recycled trash receptacles and businesses are required to keep 2 receptacles (one for solid waste and one for recycling). Here we only see one. (I took both pictures with my own camera)	38
Figure 25: Graphics of Vertical Mixed-Use (VMU) and Horizontal Mixed-Use (HMU) (Complete Communities).....	41
Figure 26: West Elm in Red Bank successfully incorporated VMU in its design	41
Figure 27: Waterfront zoning.....	42
Figure 28: Waterfront residences already have parking facilities on premise.	43

Figure 29: West side is mostly apartment buildings within walking distance of the middle school and the high school..... 44

Figure 30: Zone 17 can benefit from HMU, but zoning needs to change from RD to BR-1/2..... 44

Figure 31: Zone 9 codes need to change from LI to BR-1/2 45

Figure 32: This area is mainly abandoned lots and out-of-business structures 45

Figure 33: Google earth shows zone 9’s buildable area and proximity to public transportation 46

Figure 34: Red Bank’s low SLI score is due to rail/bus station inaccessibility by foot. 46

Figure 35: Drawing of potentially adding 100 residential and 19 business units near the rail/bus station (Berlin, 2018) 48

Figure 36: Area for possible installation of 566 wind turbines which is more than 400 meters from residences 51

Figure 37: Distance from residential buildings to prevent noise pollution 52

Figure 38: Cost Benefit Analysis of installing wind turbines..... 53

Figure 39: Calculation and configuration for installing wind turbines..... 56

Figure 40: Wind conditions in Red Bank needed to calculate output 56

Figure 41: Total annual KW/h output 57

Figure 42: Calculating for 2% 30 year fixed mortgage..... 57

Figure 43: Results for human health, ecosystem and air pollution improvements due to installation of turbines (Sanchez Pina, 2019)..... 58

Figure 44: Reclamation center process solid waste and recyclables..... 62

Figure 45: Color coding to aid in recycling 62

Figure 46: Area in red is a possible location for composting..... 63

Figure 47: Recycling education graph [75](#)

Abbreviations

Abbreviation	Description
ACA	Affordable Care Act
AQI	Air Quality Index
BLI	Better Life Index
CBA	Cost Benefit Analysis
CO	Carbon
Code BR/1-2	Business/Residential Zone

Code RD	Residential Zone
Code W	Waterfront Development
CRI	City Resilience Index
DALY	Disability Adjusted Life Years
EEM	Energy Efficient Mortgage
ES	Energy Star
GBD	Green Building Design
GHG	Green House Gas
GSA	General Services Administration
HFH	Habitat for Humanity
HMU	Horizontal Mixed Use
HVAC	Heating Ventilation and Air Conditioning
KW	Kilowatts
KW/h	Kilowatt per hour
KWh	Kilowatt hours
LEED	Leadership in Energy and Environmental Design
LEM	Location-efficient Mortgage
LMI	Low-to-moderate Income Individuals
m/s	minutes per second
MLU	Mixed Land Use
mph	miles per hour
MT	Metric Tons
NJ	New Jersey
NO2	Nitrogen Dioxide
NPV	Net Present Value
OR	Oregon
PACE	Property Assessed Clean Energy
ppb	parts per billion
ppm	parts per million
SLI	Smart Location Index
VMU	Vertical Mixed Use

Executive Summary

Red Bank Township is a small town of about 12,000 residents. The town consists of young white-collar, well-educated middle income professionals. Red Bank's biggest sectors are healthcare, education, hospitality and construction. The town combines both urban and suburban living.

I sought Red Bank for my project because I continually and successfully campaign for each council member and the mayor and was well acquainted with all council members and the mayor Menna. Initially I planned to analyze the town's recycling habits, but upon further analysis, it became clear that the town was trending unsustainable due to serious underlying, but easily rectifiable, issues.

- Using sustainability indicators shows the following:
- Sustainable: education, safe drinking water, technology and public safety
- Trending sustainable: climate action and climate education
- Trending unsustainable: poverty and air quality

Town residents give it an A- (Niche, 2019) because it's sustainable in education, safe drinking water, technology and public safety. Overall, the town trends positive in areas of wellbeing indicating that residents care about the general services the town provides such as safety and education in return for a higher cost of living regardless of the environmental impact.

Improving Red Bank's problematic housing affordability using Smart Growth will improve other problematic areas of air quality, human health and poverty. Community engagement and education will improve the town's recycling rate, reduce waste and improve air quality.

- **Housing:** the high cost of housing which is about 38% of residents' gross annual wages (Hidalgo, 2018) is leading to a large percentage of apartment vacancies, abandoned buildings and abandoned lots (Shehadi, Red Bank Township, 2019). Resolving the housing problem requires changing zoning laws to allow for Smart Growth that includes Mixed Land Use (MLU), walkable neighborhoods and rehabilitation of abandoned buildings using Green Building Design (GBD). A second solution is donating abandoned lots to Habitat for Humanity (HFH) which would revitalize run-down areas and place housing within reach of Low-to-moderate income (LMI) individuals.
- **Air Quality:** for impactful improvement to air quality, the town has ample areas to install 566 wind turbines. Additionally, the improvement to air quality is significant, effectively almost eliminating emissions. It would also improve the human health Disability Adjusted Life Years (DALY). Including community engagement and education about recycling would further improve air quality by reducing waste.
- **Healthcare:** for improved access to healthcare, the town can consider settling a \$15.5M lawsuit it currently has against an area hospital (Burton, 2016) in return for guaranteed free healthcare for its citizens. Making healthcare affordable for residents would also curtail poverty.

- Gender gap: gender inequality is the main cause of poverty where the largest portion of the poor is women of productive years between the ages of 18-34 (Hidalgo, 2018). Women make 32% less than their male counterparts in every sector (Hidalgo, 2018). Red Bank can pass a resolution to enforce H.R.-7: Paycheck Fairness Act (Rep. Delauro, 2019) which would reduce gender inequality and significantly reduce poverty.
- Community & Businesses: Finally, Red Bank can reduce the amount of solid waste produced and its associated cost by restructuring the reclamation scheduling, involving the community and businesses into recycling, composting and re-use efforts and supporting town residents to making a deliberate effort to improving the environment.

All plans presented can be implemented concurrently, consecutively or as a stand-alone. But housing affordability will have the most impact.

This was truly an enjoyable (sometimes stressful) experience. Red Bank council members should be commended for their efforts. So far, they've passed ordinances to ban plastic bags, mandate green roofs and mandate storm water recharge rules for construction. The biggest victory for Red Bank was the passing of Mixed Land Use (MLU) housing ordinance and walkable neighborhoods leading to the train station.

Red Bank is currently on a positive trend as they make improvements in each area considered to be unsustainable.



Quick Overview

- ◆ Age: Settled in 1736
- ◆ Population: 12,220+/-
- ◆ Median age: 36
- ◆ Median income: \$75,114
- ◆ Top 4 occupations: Business management & finance, education, legal, healthcare
- ◆ Top 4 industries: healthcare, education, accommodations/food, construction.
- ◆ Median property value: \$369,400
- ◆ Leaning liberal. 100% democratic control.

Introduction

Red Bank Township is a quaint miniature city of about 12,000 residents (Red Bank). The downtown is a throwback to the charm of old towns with cobblestone tree lined streets. Some of the residential areas are reminiscing of Norman Rockwell's America with white picket fences. The waterfront area is a New York City-type metropolis with high rises overlooking the Navesink River. The mission statement is: Red Bank *“embodies the best of all worlds – fine arts and galleries, world class shopping, gourmet and casual dining, premier real estate properties both residential and commercial, theatres and performing arts, diverse cultures, the finest lodging and magnificent natural resources, and some of the most talented, hard-working and energetic people one could ever hope to meet”* (Visit Red Bank).

I sought Red Bank for my project because I continually and successfully campaign for each council member and the mayor, so I got to experience the town's utopian feel. Initially I wanted to analyze the town's recycling habits, but upon further analysis, it became clear that the town was trending unsustainable due serious underlying, but easily rectifiable, issues.

Using sustainability indicators shows the town to be full of contradictions. Town residents give it an A- (Niche, 2019) because it's sustainable in education, safe drinking water, technology and public safety. It's trending sustainable in climate action education and climate action. However, the town is trending unsustainable for poverty and air quality. Finally, Red Bank is unsustainable in public fund management, recycling, equality, diversity, healthcare and, most importantly,

housing affordability. Overall, the town trends positive in areas of wellbeing indicating that residents care about the general services the town provides such as safety and education in return for a higher cost of living regardless of the environmental impact.

Improving Red Bank's problematic housing affordability using Smart Growth will contribute to the other problematic areas of air quality, human health and poverty. Currently, the town fails in all those measures (Hidalgo, 2018).

Red Bank's greatest problem is the high cost of housing which is about 38% of residents' gross annual wages (Hidalgo, 2018). The housing problem is due to a large percentage of apartment vacancies, abandoned buildings and abandoned lots (Shehadi, Red Bank Township, 2019).

Resolving the housing problem requires changing zoning laws to allow for Smart Growth that includes Mixed Land Use (MLU), walkable neighborhoods and rehabilitation of abandoned buildings using Green Building Design (GBD). A second solution is donating abandoned lots to Habitat for Humanity (HFH) which would revitalize run-down areas and place housing within reach of Low-to-moderate income (LMI) individuals. But Red Bank would need to include GBD contingencies throughout this process.

Utilizing GBD reduces housing cost (Kaza & Quercia, 2018), but also improves air quality.

Additionally, for impactful improvement to air quality, the town has ample areas to install 566 wind turbines. A Cost Benefit Analysis (CBA) shows lowered electricity rates for residents and an additional revenue stream for the town. Net Present Value (NPV) also returns a positive for the town if we include a 1% yearly increase in profit. Additionally, the improvement to air

quality is significant, effectively almost eliminating emissions. It would also improve the human health Disability Adjusted Life Years (DALY).

Converting to walkable neighborhoods and improving DALY in Red Bank would improve resident human health which is currently poor. But also, the town can consider settling a \$15.5M lawsuit it currently has against an area hospital (Burton, 2016) in return for guaranteed free healthcare for its citizens. Making healthcare affordable for residents would also curtail poverty.

One of the causes of poverty in Red Bank is healthcare. But the main cause of poverty in Red Bank is gender inequality. The largest portion of the poor is women of productive years between the ages of 18-34 (Hidalgo, 2018). Women make 32% less than their male counterparts in every sector (Hidalgo, 2018). Red Bank can pass a resolution to enforce H.R.-7: Paycheck Fairness Act (Rep. Delauro, 2019) which would reduce gender inequality and significantly reduce poverty.

Improving air quality, human health and poverty in Red Bank is within reach, but the town must begin with fixing housing affordability.

Finally, Red Bank can reduce the amount of solid waste produced and its associated cost by restructuring the reclamation scheduling, involving the community into recycling, composting and re-sue efforts and supporting town residents to making a deliberate effort to improving the environment.

PART 1: IDENTIFYING STAKEHOLDERS



Organizational Assessment

To get anything done in Red Bank: an ordinance has to be presented by one of the council members have to make a motion and another council member has to “second” the motion. A first reading is voted on, residents are invited to voice concerns, the council then votes to present the ordinance for voting at the following meeting. If approved by at least a 4-2 split with the mayor acting as a tie-breaker, the ordinance is passed. The Council is a Hierarchical Network with all

six council members voting on an ordinance and the mayor and the various committees putting the plan in place (Figure 1)

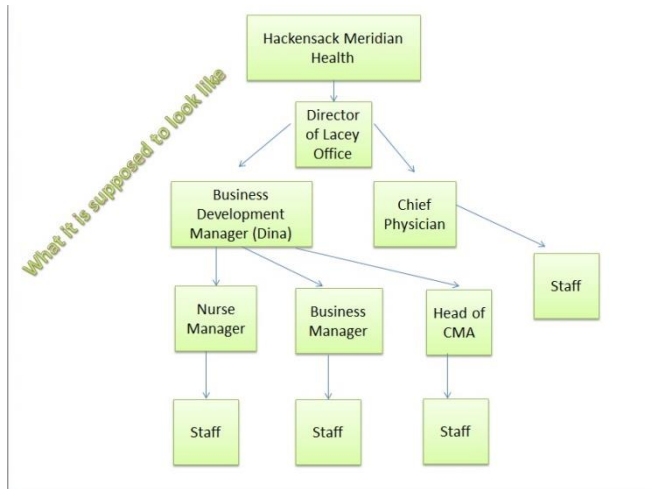


Figure 1: Red Bank hierarchical chart

However, the network is extremely adaptive in nature (Figure 2). Deals are made based on input from various interested parties. Some work in Red Bank and others work there without having voting rights.

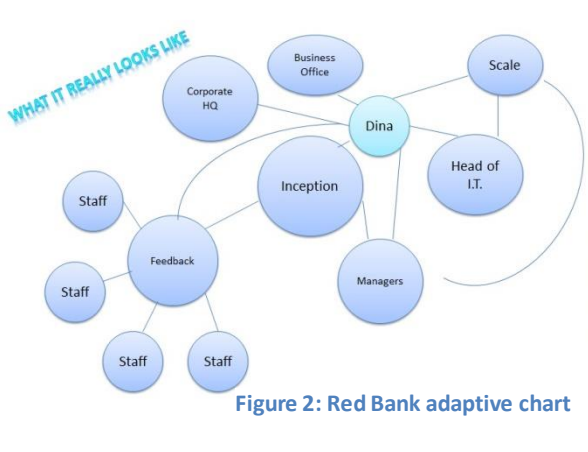


Figure 2: Red Bank adaptive chart

Main Stakeholders

Councilman Hazim Yassin: He is serving his first term. He is friendly towards business owners and works closely with unions. He doesn't care about the environment, but cares about providing affordable living conditions for town residents. He won with support from business owners and

union leaders and those are the people he wants to please. He told me if I can convince union leaders of a greener Red Bank then I would have his support.

Mayor Menna Pasquale: He is not energetic towards environmental responsibility but has to abide by the council vote. The mayor is friendly with the older members of the council and can sway their vote. He is also a respected member of the community.

Council President Ed Zipprich: He has served the longest and advises me on the likelihood a plan presented to council will be adopted or if I would need to make changes. He genuinely cares about Red Bank and is willing to pragmatically approach any problems affecting the town.

Business Administrator Zyad Shehadi: He is the town business administrator and has been instructed by the councilman and mayor to give me unrestricted access to township data. He is quick to respond to my requests with valuable data and statistical information I needed for my research. His input into areas for me to focus on has been very valuable. Zyad is my biggest stakeholder asset.

Other Stakeholders

Councilwomen Kate Triggiani & Kathy Horgan: Kate is an environmentalist and Kathy has lived in Red Bank longer than anyone on the council. They are personal friends and can vote “yes” if the argument is persuasive enough. They care more about the environment and less about unions,

business owners and township prosperity. The two members do not get along with other council members and often are on opposite sides of issues.

Union Leaders & Business Owners: This group is all male in their 50's and 60's. Most are self-made and completely uninterested in environmental issues. By far they were my most difficult stakeholders to approach. However they all share the goal of taking care of their members and their families.



Figure 3: Union leaders

The Environmental Commission: These citizen action groups keep residents informed about the environment by inviting guest speakers from other environmental groups to their monthly community meetings. The group had not accomplished much other than forming. I had presented several ideas about the structure of the meetings such as: make the meeting bi-directional that encourages participation; allow for Q&A session; make the meeting fun; selecting behavior to promote; and being prepared to address barriers (McKenzie-Mohr, 2011) which were implemented by the groups with much success.

Figure 4: Community education about composting



PART II: ANALYZING RED BANK, NJ USING SUSTAINABILITY INDICATORS

Indicators & Reason

RB is a small town without a plethora of data. I chose indicators that would give more of a comprehensive, multi-faceted report based on areas that can provide a good deal of data to make an informed and comprehensive report (Table 1). I chose indicators from the Sustainable Development Goals (SDG), Better Life Index (BLI) and City Resilience Index (CRI). I divided the report into three parts, Material Conditions, Quality of Life and Environment (Tables 1&2) because I wanted to see to choose indicators that address a specific goal, but can offer a substantial amount of data.

Index	Goals	Indicators
Sustainable Development Goals (SDG)	SDG 1: End Poverty	SDG 1.2: Reduce poverty by half according to national definition (SDG 1.2, 2015)
	SDG 5: Gender Equality	SDG 5.5.2: Portion of women in managerial positions (SDG 5.5.2, 2015)
	SDG 6: Clean Water and Sanitation	SDG 6.3.2: Good ambient water quality (SDG 6.3.2, 2018)
	SDG 9: Industry Innovation and Infrastructure	SDG 9.C.1: Access to mobile network and technology (SDG 9.C.1, 2018)

	SDG 10: Reduced Inequalities	SDG 10.2: Social, economic & political inclusion (SDG 10.2, 2015)
	SDG 14: Life Below Water	SDG 14.2: Protect marine life and ecosystem (SDG 14.2, 2015)
	SDG 12: Responsible Consumption and Production	SDG 12.8.1: Efforts on citizen education, curricula and education policy (SDG 12, 2015)
	SDG 13: Climate Action	SDG 13.2: Climate change policies integration (SDG 13.2, 2015)
	SDG 12: Responsible Consumption and Production	SDG 12.5.1: National recycling rate (SDG 12, 2015)
Better Life Index (BLI)	Housing: Housing Expenditures	BLI: Percentage of household expenses of total income (OECD, 2019).
	Education: Students' Cognitive Skills	BLI: Students' Cognitive Skills. Average score in reading, math & science (OECD, 2019)
	Environmental Quality: Air Pollution	BLI: Annual concentrations of Particulate Matters (PM _{2.5}) (OECD, 2019)
City Resilience Index (CRI)	Economy & Society: Sustainable Economy	CRI 6.1: Well managed public finances (Silva & Morera, 2015)
	Health & Wellbeing: Effective Safeguards to Human health & Life	CRI 3.1: Robust public health system (Silva & Morera, 2015)
	Economy & Society: Comprehensive Security & Rule of Law	CRI 5.3: Effective policing for safe secure city (Silva & Morera, 2015)

Table 1: Details of Indexes used and their corresponding goals and indicators

Red Bank Progress Report

No	Indicator	Target/Definition/Reference	Result
	Material Conditions		
1	Living below National Poverty Level	SDG 1.2: Reduce poverty by half according to national definition (SDG 1.2, 2015)	
2	Housing Expenditure	BLI: Percentage of household expenses of total income (OECD, 2019).	
3	Well Managed Public Finances	CRI 6.1: Well managed public finances (Silva & Morera, 2015)	
	Quality of Life		
4	Equal Women Managerial Pay	SDG 5.5.2: Portion of women in managerial	

		positions (SDG 5.5.2, 2015)	
5	Healthiness and Access to Medical Care	CRI 3.1: Robust public health system (Silva & Morera, 2015)	
6	Education and Cognitive Skills	BLI: Students’ Cognitive Skills. Average score in reading, math & science (OECD, 2019)	
7	Safe Drinking Water	SDG 6.3.2: Good ambient water quality (SDG 6.3.2, 2018)	
8	Access to Network & Technology	SDG 9.C.1: Access to mobile network and technology (SDG 9.C.1, 2018)	
9	Public Safety	CRI 5.3: Effective policing for safe secure city (Silva & Morera, 2015)	
10	Diversity & Inclusivity	SDG 10.2: Social, economic & political inclusion (SDG 10.2, 2015)	
Environment			
11	Air Quality	BLI: Annual concentrations of Particulate Matters (PM _{2.5}) (OECD, 2019)	
12	Marine Life & Ecosystem Restoration	SDG 14.2: Protect marine life and ecosystem (SDG 14.2, 2015)	
13	Sustainability Education & Awareness	SDG 12.8.1: Efforts on citizen education, curricula and education policy (SDG 12, 2015)	
14	Climate Change Policies	SDG 13.2: Climate change policies integration (SDG 13.2, 2015)	
15	Recycling Rate	SDG 12.5.1: National recycling rate (SDG 12, 2015)	

Sustainable	
Trending Sustainable	
Trending Unsustainable	
Unsustainable	

Table 2: This is a “Heat Map” with corresponding key for sustainable trends per indicator. The colors on the left correspond to the Index used in Table 1.

Material Conditions (3):

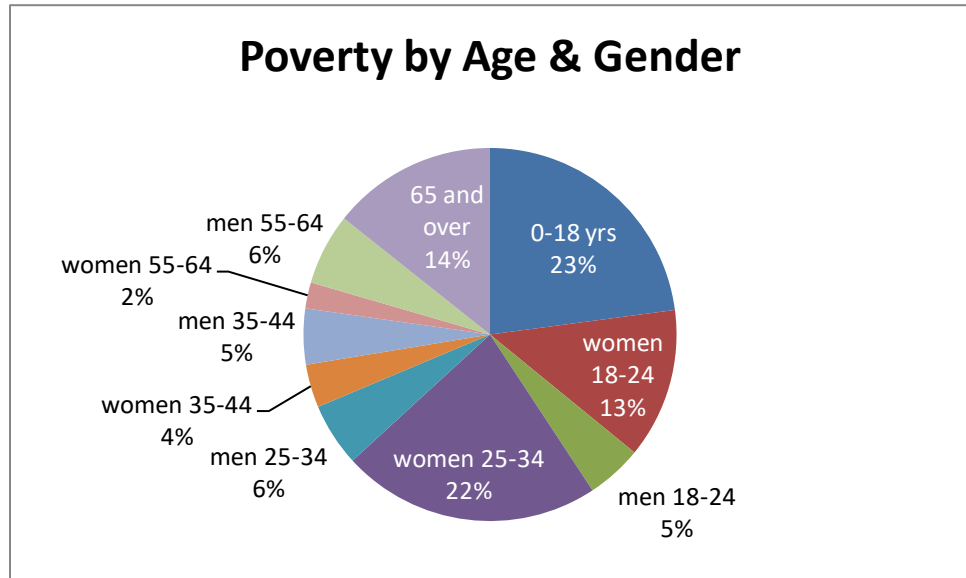
Living Below National Poverty Line (SDG1.2):

United States (US) guidelines for poverty: living on less than \$15 a day (2019 Poverty Guidelines, 2019). RB has a poverty rate of 14% (USCB, 2018). The largest two demographics are women of productive years ages 25-34 and ages 18-24 (Census Reporter, 2019) (Figure 5).

RB’s poverty rate for 2013 was 9% (USCB, 2013) and 7% in 2000 (USCB, 2000). If this trend continues, the town can see a doubling of its current poverty rate by 2030. (Figure 6).

Figure 5: Poverty by age and gender

Reasons for the high rate of poverty is the influx of affluent residents between 2000 and 2010 (37% of



current residents) (Census Reporter, 2019) that significantly contributed to gentrification and higher cost of living beyond the reach of middle and lower class residents (APP, 2019).

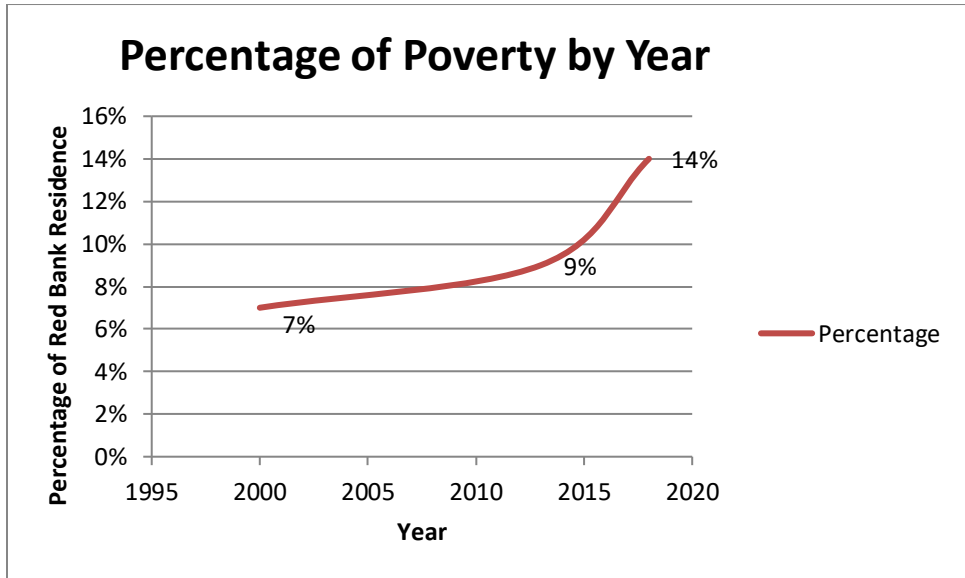


Figure 6: Trend of

percentage of poverty.

Housing Expenditure (Better Life Index: Housing):

In RB, the average monthly expenses are \$2374 for home owners and renters (USCB, 2018). Average monthly income is \$6260 (Hidalgo, 2018) which is 38% of the total, almost double the national average of 20% (Sanchez, 2019). A look-back at 2000 for which data is available, average monthly expenses was \$1015 (Hidalgo, 2018). At an average monthly income of \$3940 (Hidalgo, 2018) meant a total household expense of about 26% (Table 3 & Figure 7).

As previously stated, town gentrification has really impacted the affordability of living in RB.

Year	Home Value	Monthly Income	Monthly Expense	% of income
2017	\$369,400 (+224%)	\$6260 (+158%)	\$2,374 (+235%)	38
2000	\$164,800	\$3940	\$1015	26

Table 3: Comparison between cost of living in 2010 and 2000 and the corresponding percentage increase

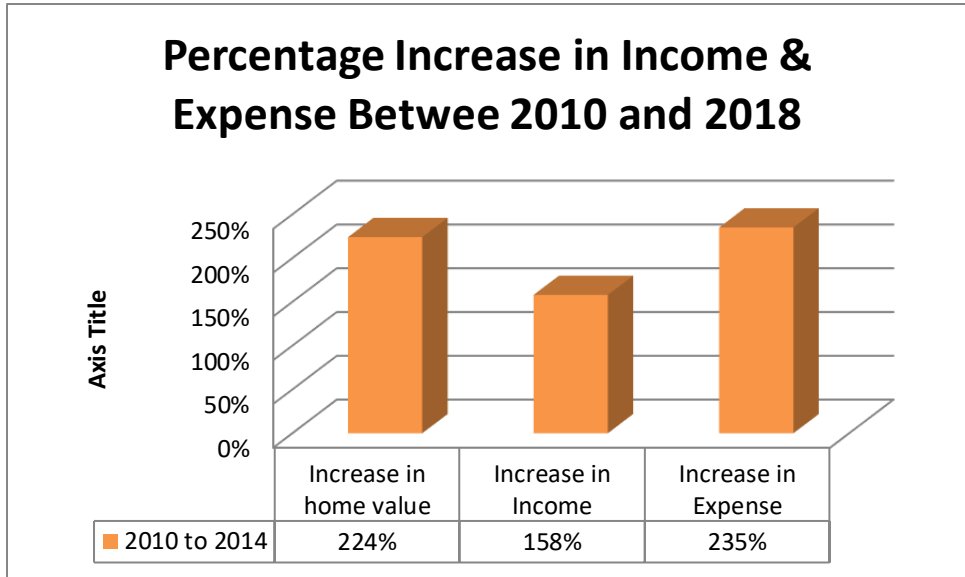


Figure 7: Table 3 results

graphed.

Well Managed Public Finances (City Resiliency Index: Sustainable Economy 6.1):

RB’s budget is transparent and posted every year except details of salaries. In 2018; RB’s revenues was \$31,609,586 and their salaries were \$9,389,246 or 29.7% of the total budget (Shehadi, Red Bank Township, 2019). In 2010, total revenue for the town was \$20,976,449 and salaries were \$2,161,681 or 10.3% of the budget (Lapp, 2010). While all other budget items are properly detailed and appear to change by about +/-1% a year, salaries seem to have tripled over the past nine years (Table 4 & Figure 8) (Shehadi, 2018 Municipal Data Sheet, 2018). Council members refuse to explain, which may be a sign of underlying mismanagement.

Year	Percentage	Revenue	Salaries
2000	10.31%	20,976,449	2,161,681
2012	15.05%	21,294,763	3,204,450
2014	23.49%	22,235,374	5,222,160
2016	26.22%	30,728,217	8,055,773
2018	29.70%	31,609,586	9,389,246

Table 4: Yearly percentage increase of township salaries as a portion of the overall budget

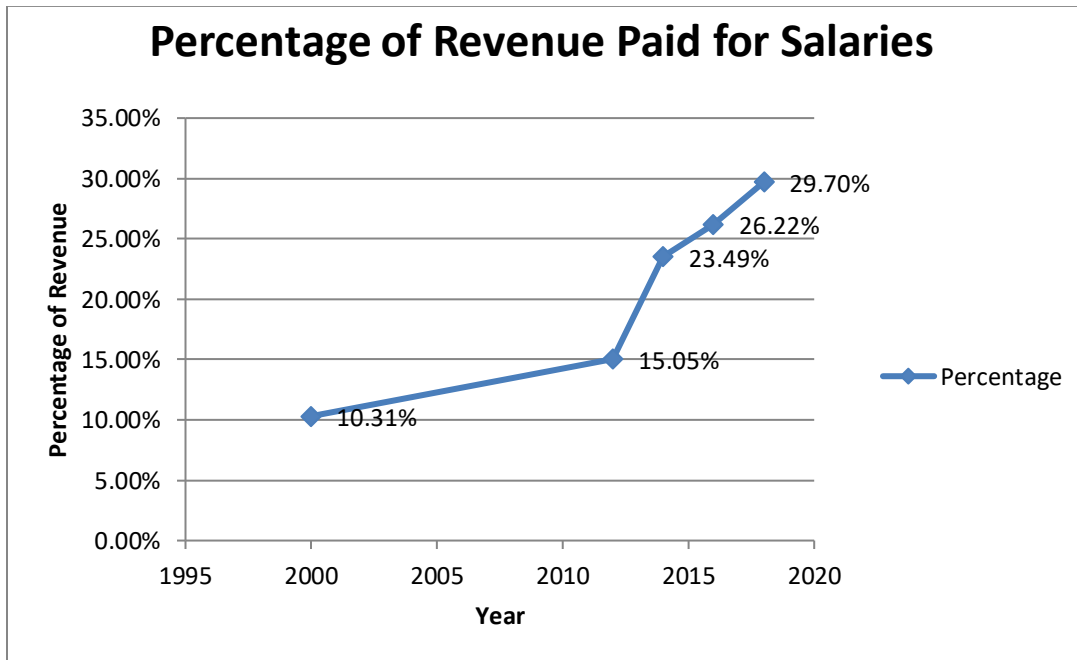


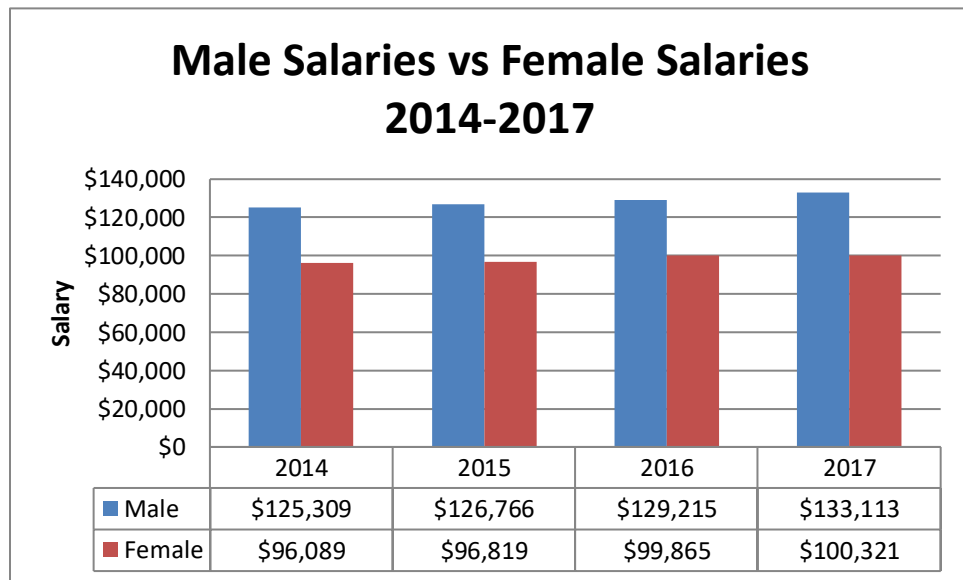
Figure 8: Table 4 results graphed

Quality of Life (7):

Equal Women Managerial Pay (SDG 5.5.2):

Figure 9: A comparison of male and female managerial salaries

While 51% of RB are women (USCB, 2018); only 25% of businesses are women-owned (Hidalgo, 2018).



Management is the second largest sector in RB at 11.2%, but with the largest wage gap at 33% (Hidalgo, 2018). Men account for 63% of manager positions at an average salary of \$133,113; while women account for 37% at \$100,321 average managerial salary (Hidalgo, 2018). Since 2014, the average male salary in management grew by 6% while the average female salary grew by 4% (Hidalgo, 2018) (Figure 9). However, female householders are double male householders at 18% and 9% respectively (Census Reporter, 2019). In government, out of seven council members, only two are women (Red Bank, 2019) which may be the reason for gender inequities.

Healthiness and Access to Medical Care (City Resiliency Index: Health and Well Being):

RB's uninsured are 25%, double the national average (USCB, 2018). An average of \$8,859 is spent by residents annually on healthcare, a 5% increase since 2017 (Hidalgo, 2018). Although the number of uninsured residents had been declining, it has since increased in 2018 by 13% (Hidalgo, 2018) (Figure 10). Yet, RB has a robust public health system with adequate access to quality healthcare including the state-funded Parker Family Health Center which offers free medical services to the uninsured (Silva & Morera, 2015).

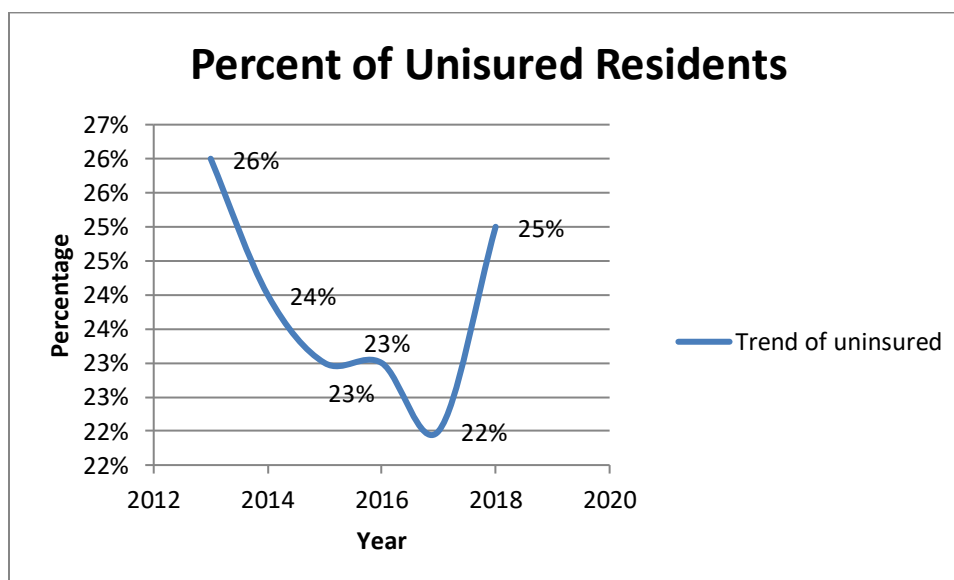


Figure 10: Trends of uninsured residents as a percentage of total population.

Three reasons make the town trend towards unsustainability. First: while the town is relatively healthy with the average age being 38 and about 47% of residents are considered healthy and diseases such as cancer are <10%; other diseases are problematic (Table 5 & figure 11). Second: the town lowered its spending on healthcare by 16% for 2018 (Shehadi, Red Bank

Township, 2019). Third: dismantling the Affordable Care Act (ACA) left more people uninsured nationwide (Galewitz, 2019).

Disease	% of Residents	Alert
Obese	37	Red
Use Cocaine	21.9	Red
Diabetes	10.6	Light Green
High BP	26.9	Red
Depression	26.9	Red
Smoke	51.9	Red
Cancer and Asthma (each)	<10	Green
0-10% ; 11-15% ; 16-20% ; >20%		

Table 5: This is a “Hot Map” of prevalent disease of township residence.

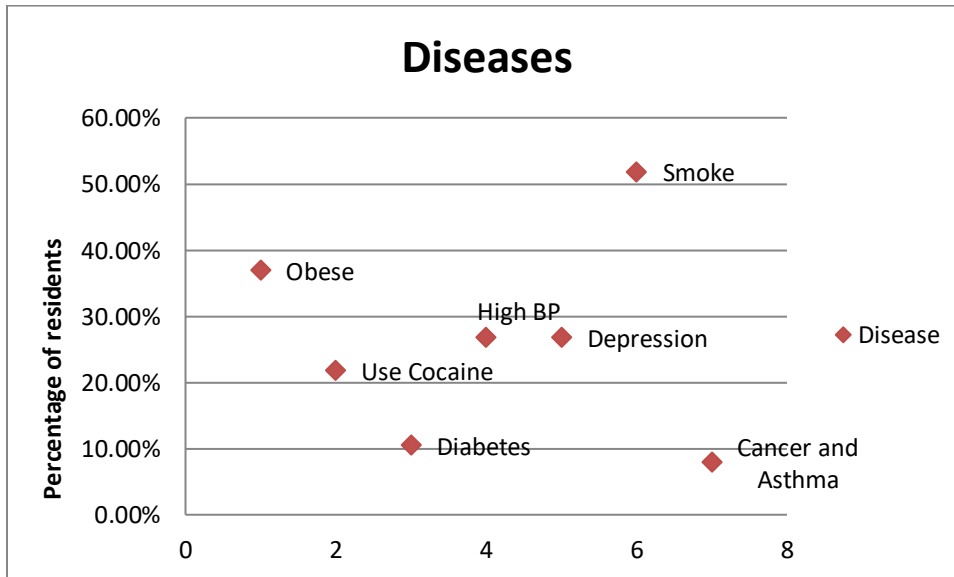


Table 5 plotted.

Figure 11: Figures from

Education and Cognitive Skills (Better Life Index: Education and Skills):

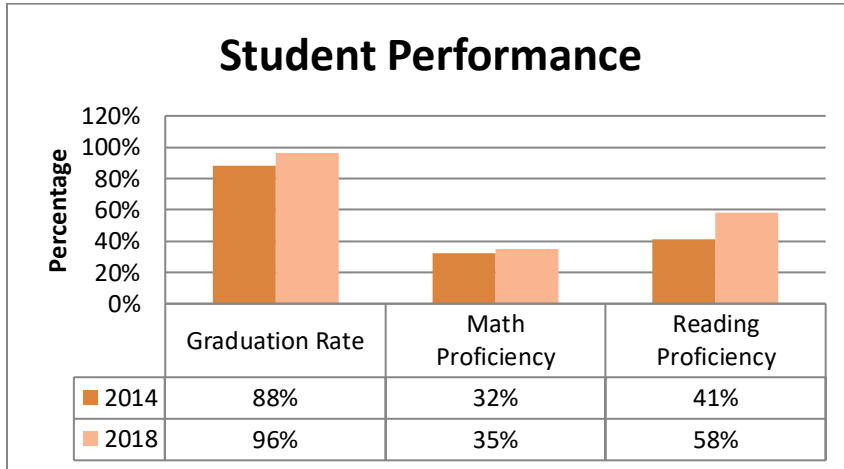


Figure 12: Trend of student cognitive

skills in education.

The Educational GINI index is 18.5 (City Data, 2018) with access and equality to adequate education. In 2018, there was an 11:1 student teacher ratio, 96% graduation rate, 35% students are proficient in math, 58% are proficient in reading (K12 Red Bank, 2018) which are higher numbers than the national average of 84% graduation rate, 25% are proficient in math and 37% are proficient in English (USCB, 2018). Comparatively, in 2014 shows there was a 14:1 student teacher ratio, 88% graduation rate, 31% of the students were proficient in reading and 42% were proficient in math (K12 Red Bank, 2018) (Figure 12). RB has consistently ranked in the top 100 schools statewide for the last three years (City Data, 2018). This positive trend can be attributed to aggressive increase in school and library funding (Folks, 2011) and a comprehensive Math, Science and English program.

Safe Drinking Water (SDG 6.3.2):

RB’s water supply comes from 3 underground wells and 1 reservoir (Rotolo M. , 2016) (figure 13). Test results consistently show clean water with minimal pesticides and metal such as

copper and lead (City Data, 2018) (Table 6). RB is fortunate to have one of the purest underwater aquifers (Rotolo M. E., 2019).

2019 (Rotolo M. E., 2019)	Nitrate 0.30 ppm (from runoff)	copper 0.06 ppm	lead 3 ppb
2016 (Rotolo M. E., 2016)	Nitrate 0.25 ppm (from runoff)	copper 1.3 ppm	lead 12 ppb

Table 6: Results of waters tested in 2016 and 2019 showing consistently clean water

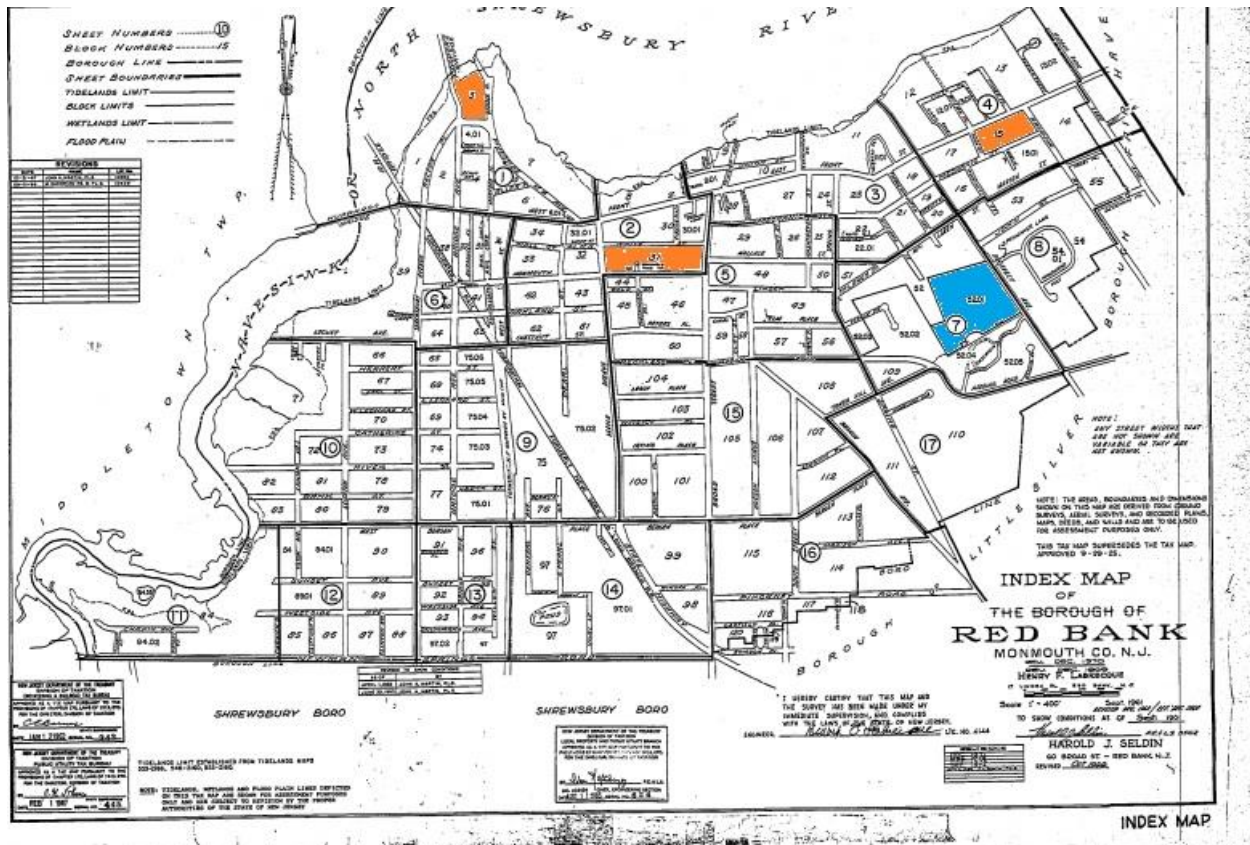


Figure 13: This map plots locations of underground well (in red) and the reservoir (in blue) (Tax Board, 1999)

Access to Network & Technology (SDG 9.C.1):

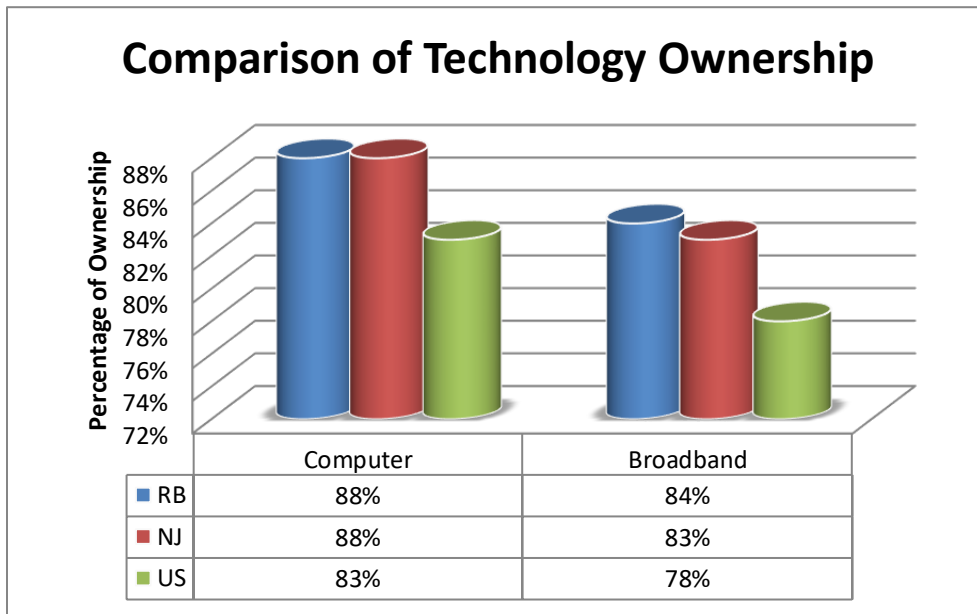


Figure 14: Comparing resident ownerships and trends with state and national averages.

About 88.4% of RB residents own a computer and 84.2% have broadband which are higher results than the state or

national averages (Figure 14) (USCB, 2018). The town has one cell phone tower, seven broadcast land mobile towers, three paging towers and 79 amateur radio licenses (City Data, 2018). About 81% of residents own a mobile phone (City Data, 2018). The public library has 22 state licensed databases and 12 computers (City Data, 2018). Three council members are in their 30’s (Red Bank, 2019) and the other members recognize the importance of connectivity. Figures for past connectivity don’t exist and analyzing trends is not possible.

On February 27, 2019 Red Bank had unanimously ratified Ordinance No. 2019-07 which states the township will construct and maintain a communication system in the municipality (Ordinance No. 2019-07, 2019).

Public Safety (City Resilience Index: Comprehensive Security and Rule of Law):

RB truly excels in public safety. Public protection accounted for 10% of the town’s budget for 2018 (Shehadi, 2018 Municipal Data Sheet, 2018) (Figure 15). RB improved public safety in every category (City Data, 2018) (graph). In addition to proper funding, community engagement activities such as “School Violence Awareness” week contribute to citizen safety (RBB k-12, 2019-2020).

Crime rates in Red Bank by year															
Type	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Murders (per 100,000)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (16.9)	0 (0.0)	1 (8.2)	1 (8.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Rapes (per 100,000)	3 (25.2)	7 (58.9)	2 (16.7)	5 (42.1)	4 (33.9)	4 (33.8)	1 (8.4)	5 (41.7)	5 (40.8)	3 (24.4)	4 (32.9)	1 (8.2)	4 (32.0)	2 (16.4)	5 (41.2)
Robberies (per 100,000)	21 (176.4)	20 (168.4)	13 (108.6)	27 (227.2)	19 (161.0)	39 (329.3)	10 (84.3)	26 (216.8)	10 (81.7)	22 (179.2)	10 (82.1)	12 (98.3)	14 (112.0)	13 (106.7)	9 (74.2)
Assaults (per 100,000)	15 (126.0)	16 (134.7)	14 (117.0)	18 (151.5)	17 (144.1)	14 (118.2)	17 (143.3)	24 (200.1)	13 (106.1)	10 (81.4)	5 (41.1)	11 (90.1)	9 (72.0)	10 (82.1)	10 (82.4)
Burglaries (per 100,000)	30 (252.0)	46 (387.4)	16 (133.7)	36 (302.9)	61 (517.0)	31 (261.8)	22 (185.4)	48 (400.3)	40 (326.6)	32 (260.6)	28 (230.0)	19 (155.6)	17 (136.0)	20 (164.1)	8 (65.9)
Thefts (per 100,000)	234 (1,966)	230 (1,937)	233 (1,947)	277 (2,331)	215 (1,822)	227 (1,917)	200 (1,685)	229 (1,910)	236 (1,927)	198 (1,613)	233 (1,914)	248 (2,031)	181 (1,448)	180 (1,477)	168 (1,384)
Auto thefts (per 100,000)	10 (84.0)	8 (67.4)	14 (117.0)	12 (101.0)	11 (93.2)	7 (59.1)	5 (42.1)	8 (66.7)	10 (81.7)	7 (57.0)	3 (24.6)	8 (65.5)	3 (24.0)	5 (41.0)	4 (33.0)
Arson (per 100,000)	0 (0.0)	1 (8.4)	0 (0.0)	0 (0.0)	3 (25.4)	0 (0.0)	2 (16.9)	1 (8.3)	0 (0.0)	0 (0.0)	1 (8.2)	4 (32.8)	0 (0.0)	0 (0.0)	0 (0.0)
City-Data.com crime index (higher means more crime, U.S. average = 280.6)	189.2	234.6	166.0	254.6	220.8	249.2	178.2	248.2	201.2	193.2	153.8	151.4	142.9	135.4	134.3

Figure 15: History of crime by category over the last 12 years with clear improvements (City Data, 2018).

Diversity & Inclusivity (SDG 10.2):

RB ranks top 15% in NJ for diversity (Niche, 2019). RB has become more diversified over the last few years; however, RB is not diversified in economic prosperity. Asians have the highest salaries in every sector followed by whites, blacks and Latinos (Hidalgo, 2018). Poverty by race shows Hispanics are the most prevalent race, but the poorest and least paid (Hidalgo, 2018) (Figures 16, 17 & 18). Only 17% of businesses are minority owned (USCB, 2018). Even the council members and administrators are 9% black and 91% white (Red Bank, 2019). This may account for such a disparity between the town's cultural background and its economic diversity.

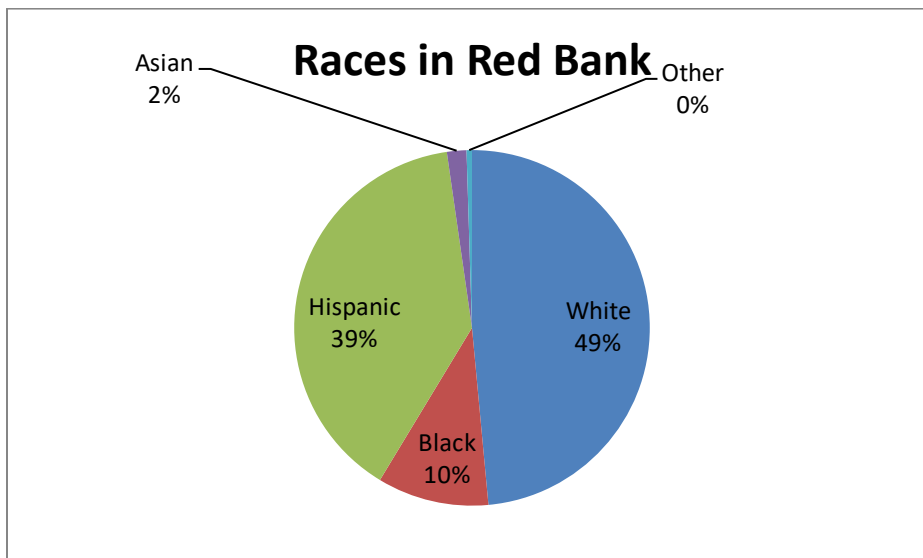


Figure 16: Residents by race.

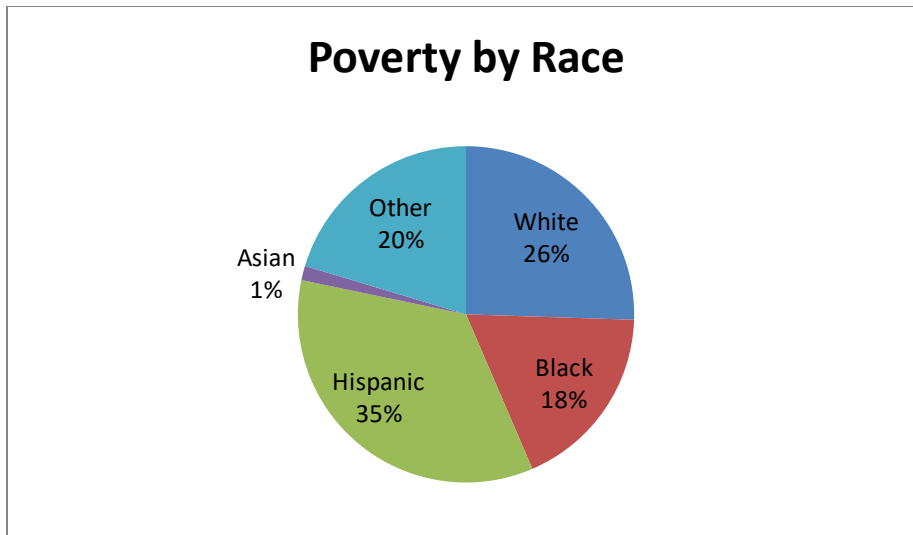


Figure 17: Poverty by race

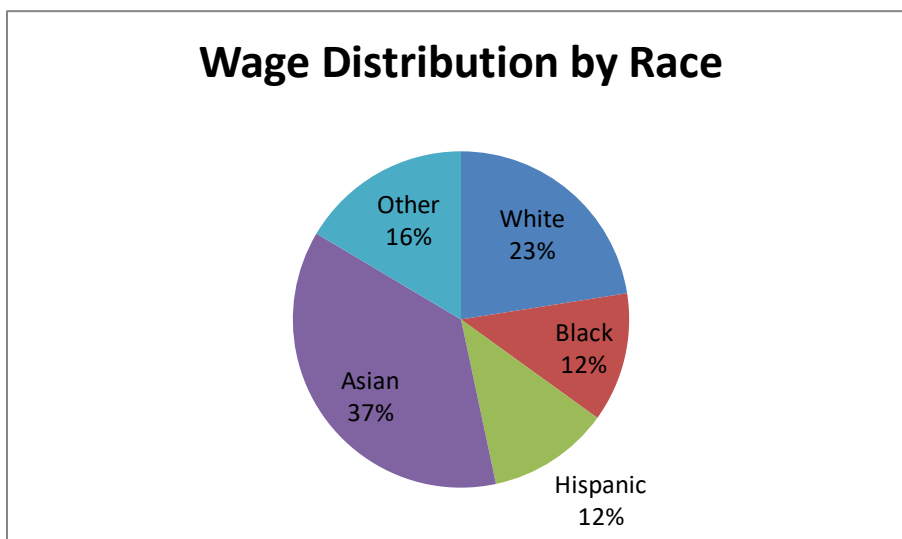


Figure 18: Wage distribution by

race

Environment (5)

Air Quality (Better Life Index: Environmental Quality):

Airnow Air Quality Index (AQI) for RB is 35 for Particulate Matter 2.5 (PM_{2.5}) and Ozone only (Airnow, 2019) (Figure 19). This is misleading because if we account for pollutants

such as Carbon (CO) emission and Nitrogen Dioxide (NO₂), AQI becomes 89.4 9 (far worse than NJ 74.2) (City Data, 2018) (Figure 20). The PM_{2.5} of (7.87 µg/m³) is equal to the state level (City Data, 2018). Despite low levels of some pollutants the volatile spikes in AQI over the last nine years leads RB towards unsustainability. This is due to lack of serious ordinances that address air quality.

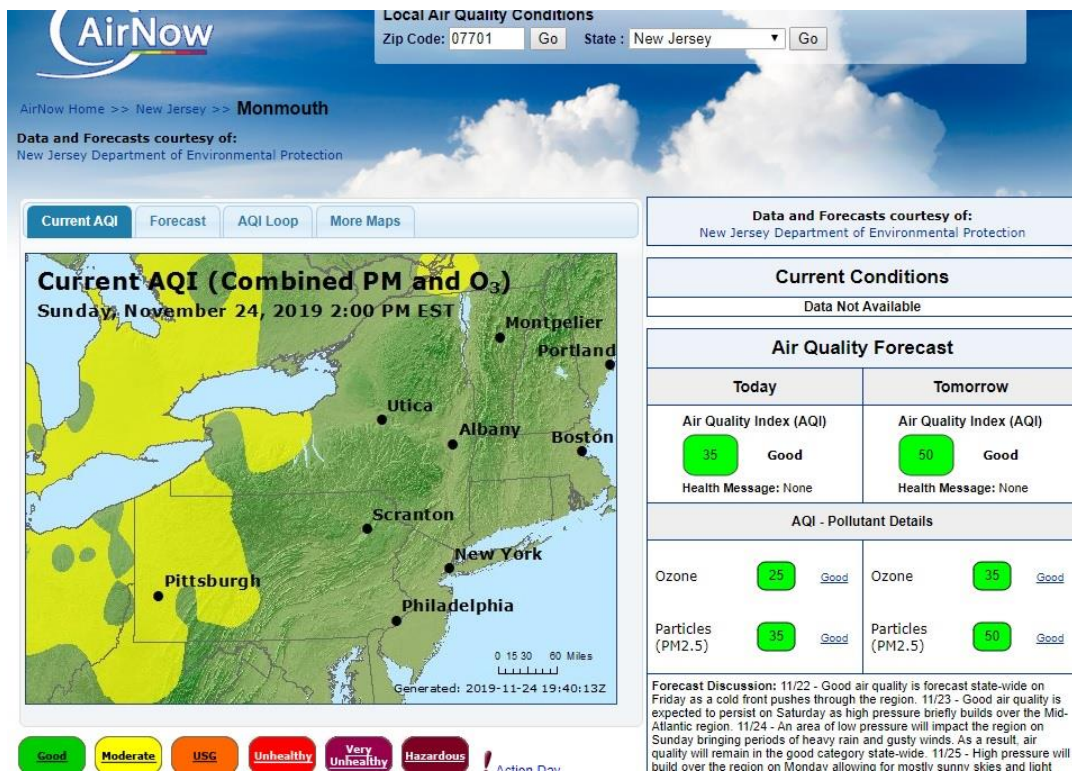
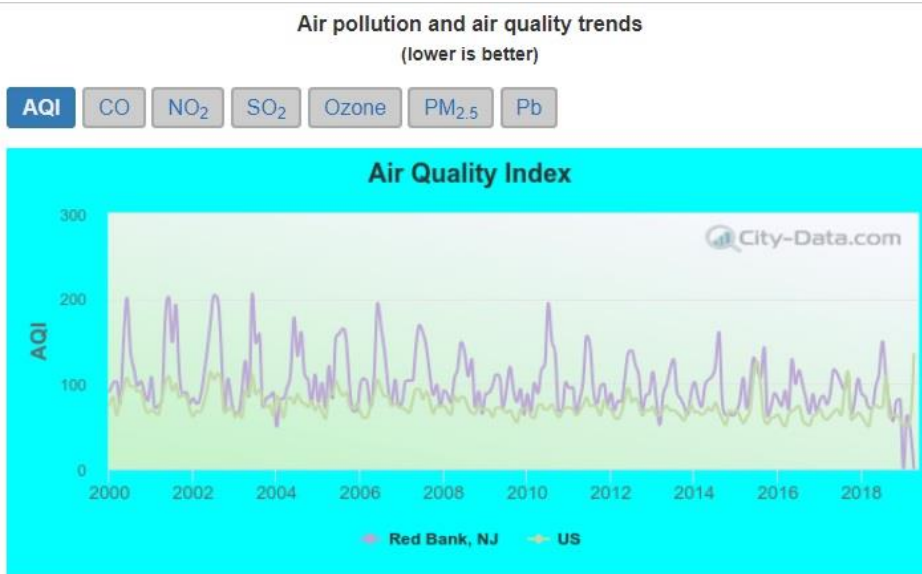


Figure 19: AQI for Red Bank for PM2.5 and Ozone only (Airnow, 2019).



Air Quality Index (AQI) level in 2018 was 89.4. This is worse than average.

City: 89.4
 U.S.: 74.2

Figure 20: AQI for Red Bank

including CO, NO₂, SO₂, and Lead in addition to Ozone and PM_{2.5}

Marine Life & Ecosystem Restoration (SDG 14.2):



Figure 21: Fish kills in the Navesink River (Goldman, 2019).

RB overlooks the Navesink River (Figure 22) and in 2018, bacteria reached their highest levels (Zimmer, 2019). In 2018, 11 out of 15 samplings found 200 fecal-colony

forming units per 100 milliliters, by comparison, in 2011: 1 out of 15 samples found fecal-colony (Zimmer, 2019). The Department of Environmental Protection (DEP) report shows that between 2012 and 2015, out of 33 sampling stations, 6 showed fecal-colony and they recommend a downgrade (Fay, Navesink River, 2015). DEP report for 2008-2011 shows that out of 33

sampling stations, 5 showed fecal-colony (Fay, Navesink River, 2012).

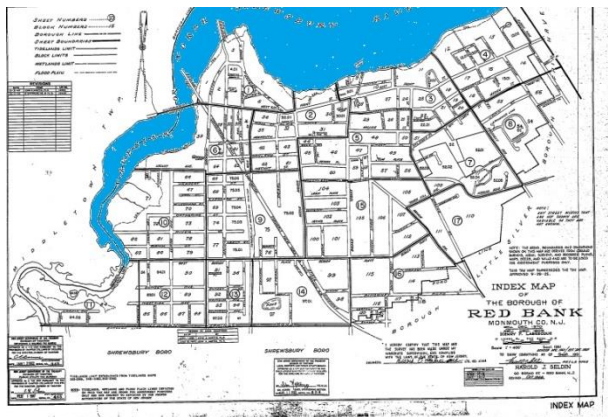


Figure 22: The area in blue shows the Navesink River also known as North Shewsbury River (Tax Board, 1999).

Reasons given by the DEP for the continual degradation are swimming, shellfish harvesting, storm water runoff, the marina and aging sanitary infrastructure (Lees, 2016).

Nitrification and soil degradation led to fish kills (Goldman, 2019) (Figure 21).

Sustainability Education and Awareness (SDG 12.8.1):

RB does a great job teaching climate change and its impact. Table shows the environment related subjects taught (Heinz, 1996-2019) (Table 7).

Citizen education takes the form of the non-government affiliated Green Team that meet with citizens once a month and host “Red Bank Earth Day” every April (Herschberger, 2019).

Progress is slow because the council has not stepped in to support these efforts.

Grade	Subject
K	Weather
1st	Weather Patterns
2nd	The Ecosystem and its Importance
3rd	Cause and Effect on Climate and the Ecosystem
4th	Climate Effects on Humans and on the Ecosystem
5th	Water and Renewable Energy
6 th -8th	“Weather and Climate”, “Stability and Change on Earth”, and “Human Impact on Earth Systems and Global Climate Change”
High School	Environmental Science

Table 7: Red Bank school curriculum for grades K-12.

Climate Change Policies (SDG 13.2):



Figure 23: Planned

renovations of Bellhaven Nature Preserve (Herschberger, 2019).

The RB Environment Commission (RBEC) advises the township council on climate issues while making sure the community is informed and engaged (RBEC, 2019). Due to their efforts, in 2018 RB initiated a large scale restoration project of the Bellhaven Nature Preserve (Figure 23) (Herschberger, 2019). This project, which is nearing completion, will improve the ecological wild life in the area, improve storm water run-off and improve air quality. The preserve is on wetlands. RBEC should be credited with engaging citizens and influencing governance.

Recycling Rate (SDG 12.5.1):



Figure 24: Trash containers in public areas, absent recycled trash receptacles and businesses are required to keep 2 receptacles (one for solid waste and one for recycling). Here we only see one. (I took both pictures with my own camera)

Rarely can one find recycling bins in public places or private businesses in RB (Figure 24). Currently, the township produces 681.57 tons per month of solid waste and 99.48 tons per month of recycled material, or 12.7% (Shehadi, Red Bank Township, 2019) which is less than half the national average of 25.8-34% (EPA, 2018). World-wide advanced countries recycling

rate is between 27% (Canada) and 63% (Austria). Some countries, like China, recycle 99% of their plastics (Lacy, 2018).

Because solid waste is picked up twice a week while recyclables are picked up every other week (Shehadi, Red Bank Township, 2019), citizens are not motivated to recycle. The township does not have any plans to address the problem.

PART III: IMPROVEMENT PLAN, RECOMMENDATIONS & TRACKING PROGRESS

Housing Affordability

Red Bank has three problems with housing:

- One: residents pay about 38% of their gross income on housing (Hidalgo, 2018), far higher than the national sustainability threshold of 30% mandate by the US (Arigoni, 2016).
- Second: income collected from taxes for the town is 45% of the budget (Pasquale, 2019) so any solution cannot reduce the towns revenue.
- Three: there is a very high rate of abandoned buildings and lots (Shehadi, Red Bank Township, 2019) which leaves the rest of the residents shouldering the balance of the tax bill.

Two solutions presented that can be used separately or concurrently:

- First: Smart Growth including rehabilitation using green building design.

- Second: Collaborating with two local offices of Habitat for Humanity.

Smart Growth

Definition: Smart Growth is a community and economic development plan to improve affordability and quality of life for low and moderate income families (NNC, 2016). It has about 15 sub-categories, but the report will focus on three.

Sub-categories:

- ❖ Mixed Land Use (MLU)
- ❖ Walkable neighborhoods
- ❖ Rehabilitation using Green Building Design (GBD).

Fortunately, Red Bank is located in New Jersey, a state that has several programs for affordable housing; its proximity to rail and bus transportation makes neighborhood walkability feasible; its high percentage of abandoned lots (City Data, 2018), creating an opportunity for Habitat for Humanity.

Mixed Land Use: Mixed Land Use (MLU) is the co-location of homes, businesses and services in neighborhoods (Moos, Vinodari, Revington, & Seasons, 2018). Vertical Mixed Use (VMU) is the co-location of businesses and services within a vertical multi-story residence and Horizontal Mixed Use (HMU) is the co-location of businesses and services within suburban-type detached homes and condominiums (Nabil & Abd Eldayem, 2015) (Figure 25). Red Bank can take advantage of both designs. Its location in NJ allows it flexibility as the state aggressively seeks to change building codes to MLU designs (Regional Plan Association, 2010).

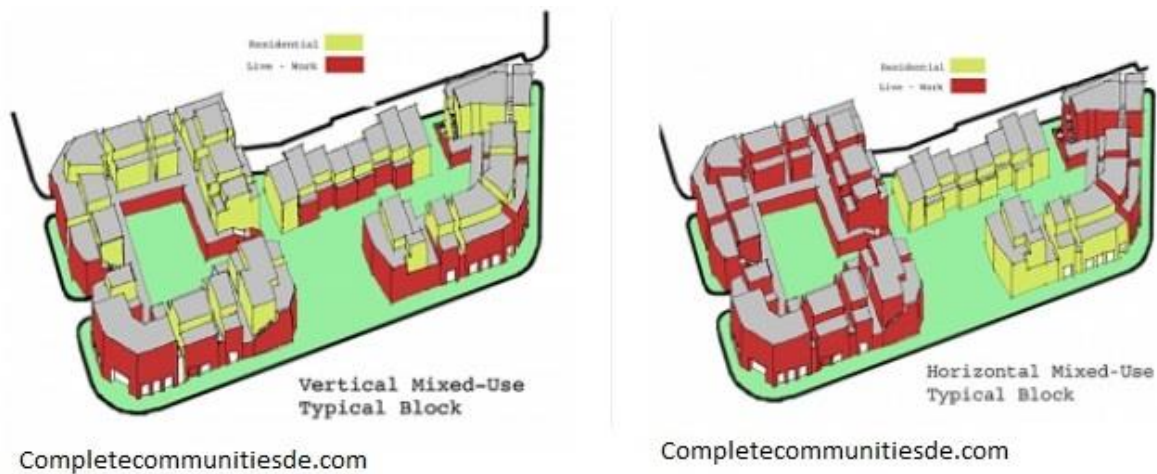


Figure 25: Graphics of Vertical Mixed-Use (VMU) and Horizontal Mixed-Use (HMU) (Complete Communities)

VMU: About 15% of Red Bank consists of luxury high rises on W Front St. (City Data, 2018).

However, about 20% of the rental units remain unoccupied costing the town and building owners thousands in unrealized profits (Census Reporter, 2019). From 2015 to 2018 the municipal tax rate had increased from 0.541 to 0.589 (Shehadi, Red Bank Township, 2019) partly due to a decrease in residential occupancy (City Data, 2018).

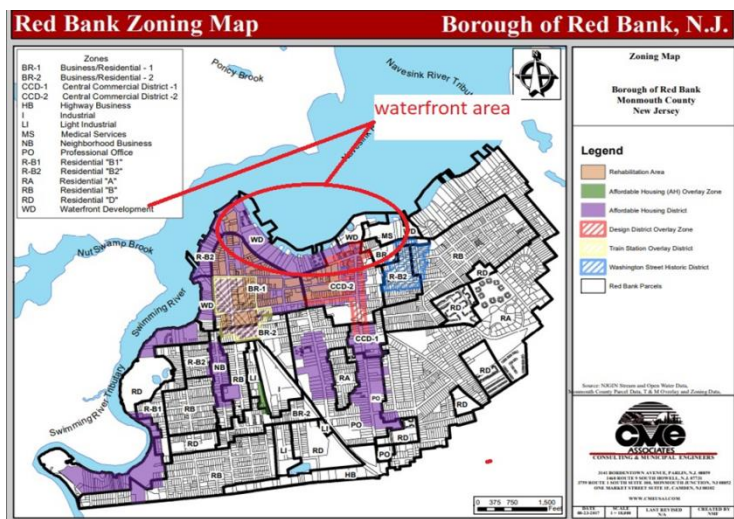
Figure 26: West Elm in Red Bank successfully incorporated VMU in its design



Only one four-story building, West Elm (Figure 26), makes use of VMU and coincidentally, it is the only building with a 100%

residential occupancy rate and an 80% business occupancy rate. The town has a successful example of VMU and would benefit greatly from taking advantage of New Jersey’s generous change to the building codes (NJNHT, 2016) in an effort to converting the remaining waterfront high-rises to VMU’s.

Figure 27: Waterfront zoning Currently



there are a total of 115 units on the water front among four rental buildings (NJ Tax Records, 2019) at an average yearly residential rental expense of \$27,600 (Census Reporter, 2019). Building owners pay about \$2,174,000 a year in

property taxes, utilities and maintenance (City Data, 2018). Their revenue including the 20% vacancy rate is \$2,715,000 (Shehadi, Red Bank Township, 2019). The area is already zoned Waterfront Development (Code WD) (Figure 27) and the buildings already have parking facilities on premise (Figure 3). Using West Elm as an example, building owners can allot the first two floors for business rentals (Figure 28) and can charge commercial rental which is higher than residential. The average unit in each building is 900 sf and allotting for a total of four units per floor across four buildings yields 28,800 sf of potential additional commercial rental income. Again, using West Elm as an example of 80% commercial occupancy rate gives building owners an added revenue of \$461,721 (28,800 sf * 80% * 1.67/sf/mo * 12 months). This can lessen

building owners' tax liability and should reduce rental expense for building residents. However, Red Bank needs to make sure the added income would flow through to tenants.

Finally, studies have shown that those in management, technical and health occupations tend to benefit most from VMU (Moos, Vinodari, Revington, & Seasons, 2018) which are the top three occupation sectors in Red Bank (Hidalgo, 2018) making this beneficial to most town residents. Studies have also shown VMU can reduce rent for occupants by about 24% (NNC, 2016). In this case, however, if building owners pass the added revenue to tenants, it would reduce their rental liability by about 15% which is still a desirable outcome (\$461,721/115 units reduces rentals by about \$4000 or about \$4,000 yearly savings/\$28,800 yearly income = 15%).

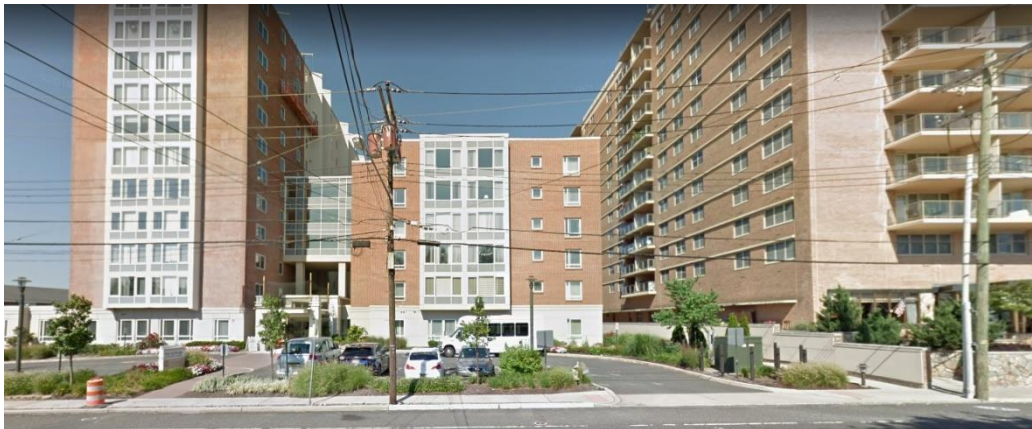


Figure 28: Waterfront residences already have parking facilities on premise.

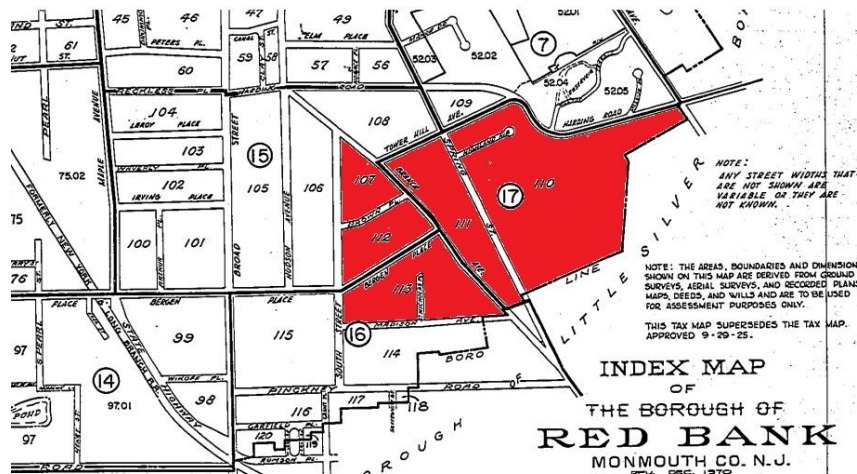
HMU: An untapped source for Red Bank is HMU on the west end and near the middle school

and the high school. Clustered around Branch Avenue and within walking distance to the middle school and



high school (Figure 30) are six apartment buildings (zones 16 and 17, blocks 107, 110-113) (Figure 29) which are currently 40% unoccupied (City Data, 2018). **Figure 29: West side is mostly apartment buildings within walking distance of the middle school and the high school**

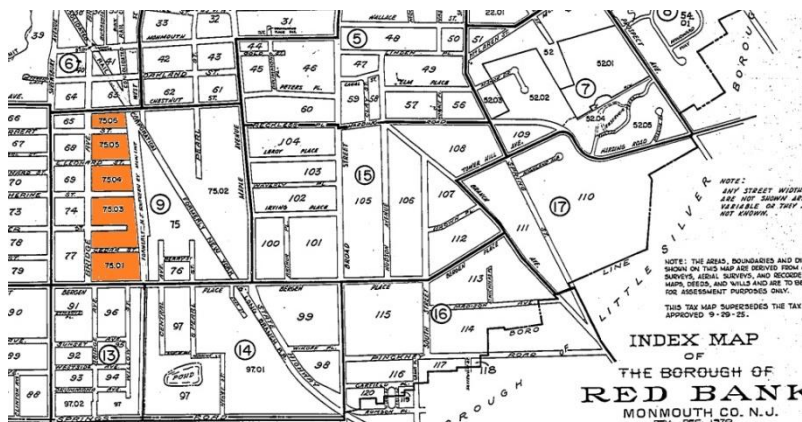
Figure 30: Zone 17 can benefit from HMU, but zoning needs to change from RD to BR-1/2



Businesses prefer to rent in HMU over VMU (Ostermijer, 2017). Red Bank needs to change zoning from Residential

(Code RD) to Business/Residential (Code BR/1-2) to allow for family friendly businesses like a convenience store, a medical urgent care unit, an eatery to establish in the area. Studies have shown that residents prefer to locate near convenience (Moos, Vinodari, Revington, & Seasons, 2018). This would increase occupancy rates for the six apartment buildings, increase rental revenue for the owner and eventually reduce rents in the area (Nabil & Abd Eldayem, 2015). Again, Red Bank would need to expand its rent control policy to include this area because rent generally eventually increases around HMU (Moos, Vinodari, Revington, & Seasons, 2018).

Figure 31: Zone 9 codes need to change from LI to BR-1/2



Walkable Neighborhoods:

Another area of potential improvement is zone 9 blocks 75.01-75.06 (Figure 31) which is full of abandoned businesses and empty lots (Figure 32).



Figure 32: This area is mainly abandoned lots

and out-of-business structures

The area is roughly 12,700 m² (136,000 sf) of prime development real estate (Figure 31). Setting aside 30% for parking, utilities, open space and side-walks leaves about 95,000 sf of buildable land. Assuming a 1600 sf two-story townhouse including garage allows for 100 residential units and about 19 business storefronts ($95,000 \text{ sf} / (1600 \text{ sf} / 2 \text{ floors}) = 119$; setting aside 19 units for store fronts leaves potentially 100 residential units) (Figure 33). Red Bank can then possibly add 100 tax paying residents and 19 commercial businesses which would add to its revenue stream. Red Bank assesses \$180 per sf for townhouse-style residential units conceivably adding \$5292 in added tax revenue per unit, or about \$530,000 not including potential income from business municipal taxes.

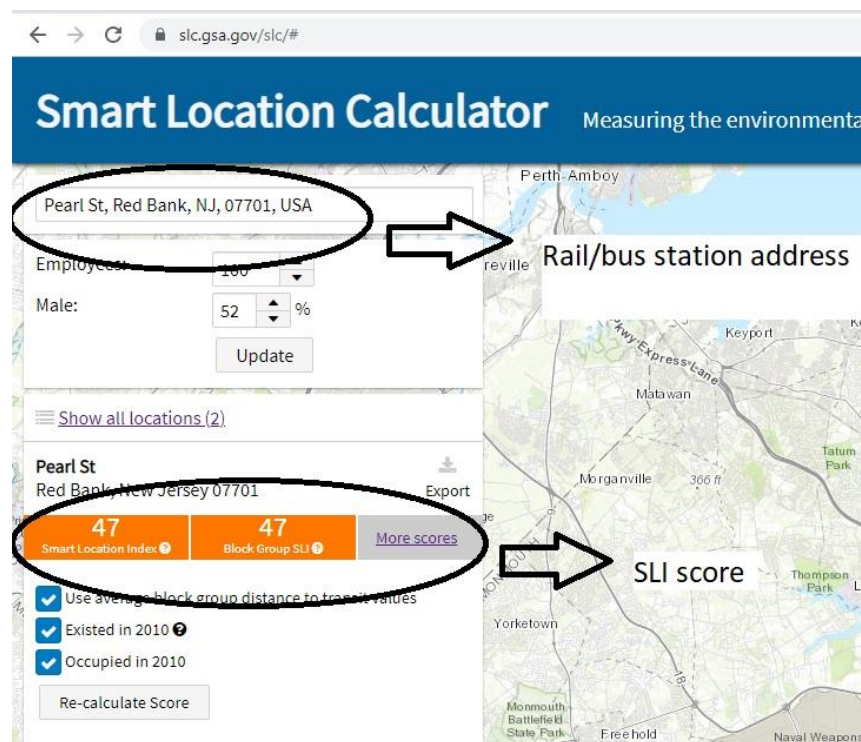


Figure 33: Google earth shows zone 9's buildable area and proximity to public transportation

Residents living in this area would qualify for a Location-efficient Mortgage (LEM).

An LEM considers household savings in transportation costs associated with living near public transport and public services (NNC, 2016). The borrower can qualify for a low down payment, low interest rate and for an increase of up to 34% of home value making affordability more attainable for homeowners (Riggs, 2016). The loan is federally backed (Riggs, 2016). In 2016, a study was conducted to determine the success of LEM and found that they placed home

ownership within reach of Low-to-moderate income (LMI) individuals (Riggs, 2016). The report looked at LMI including teachers, firefighters, minorities and young professionals whose income fell below \$55,000 per year (Riggs, 2016). The report found LEM successful only with government intervention such as federally backed loans and zoning reconfiguration (Riggs, 2016). Using the General Services Administration (GSA) “smart location calculator” interactive tool, Red Bank scores 47 for Smart Location Index (SLI) (Figure 34) (GSA, 2019) because while the town contains both rail and bus terminals, they are located in an isolated area accessible only



by car (GSA, 2019).

Figure 34:

Red Bank’s low SLI score is due to rail/bus station inaccessibility by foot.

Red Bank must then change zoning laws in Zone 9 from Light Industrial (Code LI) to Business/Residential (BR-1/2). Doing so would allow for the building of residential units close

to transportation (Figure 35). This would improve the town's Smart Location Index and allow Low-to-moderate income residents better access to Location-efficient Mortgages.



Figure 35: Drawing of potentially adding 100 residential and 19 business units near the rail/bus station (Berlin, 2018)

Rehabilitation: About 5% of 5,573 real estate properties in Red Bank are old abandoned buildings, and rehabilitation is not cost effective to bring them up to modern day codes (Gose, 2019). However, New Jersey has a Rehabilitation Sub-code which allows buildings to meet standards for safety, but not modern-day codes such as hall width, ceiling height, door clearance (N.J.A.C. 5:23-6.1, 2019). This can realistically shave 10-40% off rehab costs (Gose, 2019). During its initiation in 1999, building rehabs increased from 1.6% to 63% (Arigoni, 2016). Red Bank can use this as an opportunity, but should also include Green Building Design (GBD) to

retro-fit homes for energy efficiency. So, while the structure of the house wouldn't change, the materials used and mechanical design (such as HVAC, insulations and outdoor spaces) would be upgraded to include GBD. Additionally, rehabilitating abandoned homes using GBD would be attractive to buyers because energy star homes can reduce utility bills by \$200-\$400 per year (EPA, 2011). Also, GBD homes can qualify for Energy-efficient Mortgage (EEM) for both current home owners and potential buyers (Gose, 2019). Options through the government are Freddie Mac's GreenCHOICE green mortgage for low income families in single family homes (GreenCHOICE, 2019) and Fannie Mae's Multi-family Green financing (Capital Markets, 2019). Builders have access to Property Assessed Clean Energy (PACE) loans which typically have lower mortgage rate, longer repayment schedule and transfers to the new owners (Gose, 2019). Therefore, Red Bank needs to make sure contingencies in construction permits include adherence to Energy Star (ES) and Leadership in Energy and Environmental Design (LEED) certification. Research has shown ES and LEED certified homes owners are 32% less likely to default and they pay off their home 28% faster (Kaza & Quercia, 2018). Research also shows ES and LEED labels raise home resale values by 8% (Kaza & Quercia, 2018).

Habitat for Humanity

Red Bank currently has 121 abandoned empty lots (Shehadi, Red Bank Township, 2019). Fortunately, the town is located within a 25 mile radius of two offices for Habitat for Humanity (HFH) (Habitat, 2019). Per an interview I conducted with Tom Wescow (Director of Construction of the Plainfield branch) (Wesco, 2017) and Heather Schulze (Director of the Tinton Falls branch) (Schulze, 2017), HFH builds homes for low income families on donated

lots. They manage the funding of the project after they've identified a family in need (Wesco, 2017) (Schulze, 2017). However, the current plans they use do not include GBD (graphs). Red Bank can donate on condition the new homes include GBD similar to designs used through a successful HFH branch in Oregon (OR). OR use prefabricated homes and include solar attic fans, both fiberglass and foam insulation, skylights, tank-less water heaters (Renz & Zafra Solas, 2016) and Power-Pipe which is a drain water heat recovery system that can save the homeowner up to 40% in water heating costs (Power-Pipe). Donating land to HFH with GBD contingencies would add to the town's tax revenue and increase home values with minimal financial commitment.

Tracking Progress for Housing

Red Bank needs to look at the following indicators to track progress: annual housing expenses, resident population, home values, number of abandoned homes/lots, tax rate and tax revenue.

Currently Red Bank residents pay about 38% of their gross income for housing (Hidalgo, 2018).

The town has a 5% rate of abandoned properties and 121 abandoned lots (Shehadi, Red Bank Township, 2019). The town collects \$22.9M from property taxes which are about 60% of the budget (Pasquale, 2019). Red Bank's current tax rate is .589 (NJ Tax Records, 2019). Solutions presented are both for short term by collaborating with HFH; intermediate and long term plans involving Smart Growth and changes to zoning laws.

Air Quality

A comprehensive look at air quality/pollution shows an Air Quality Index (AQI) in Red Bank of 89.49 because Carbon (CO) emission is 0.376 ppm and NO₂ is 14.2 ppb (City Data, 2018).

In addition to GBD mentioned in the housing section, the town has a prime location to install wind turbines in a secluded area of the Navesink River (Figure 36). Wind turbines have a very small foot-print and can be installed without disruptions as long as they are at least 400 yards from residents to prevent noise pollution (Sanchez Pina, 2019) (Figure 37). They're an environmentally and financially beneficial source of electricity.

Red Bank's passage of an electricity aggregation program (Ordinance No. 2019-17, 2019) makes this project a viable option.



Figure 36: Area for possible installation of 566 wind turbines which is more than 400 meters from residences

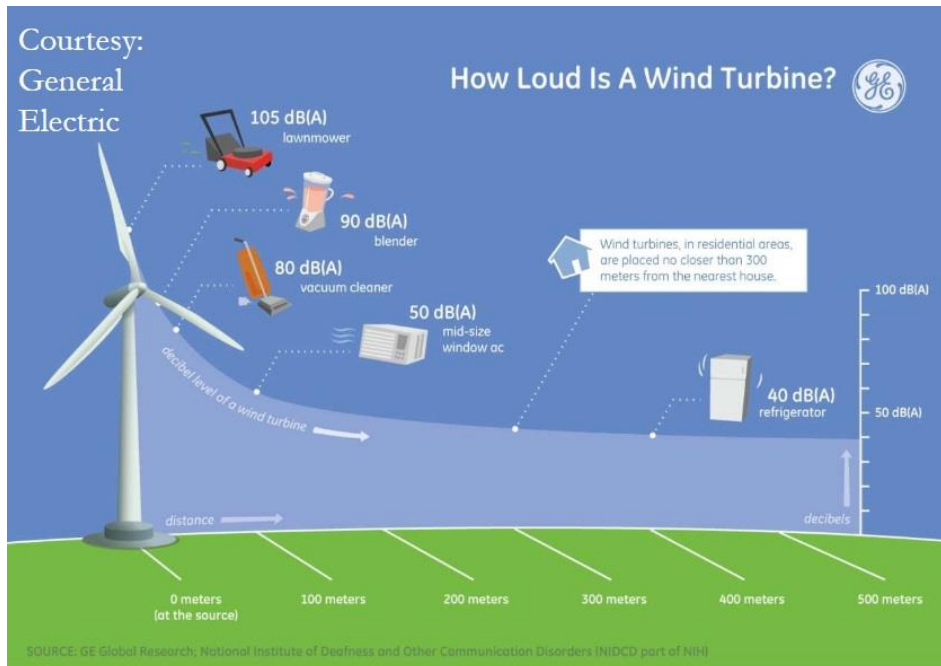


Figure 37: Distance from residential buildings to prevent noise pollution

Cost Benefit Analysis, Net Present Value, Health and Environmental Impact

A Cost Benefit Analysis (CBA) (Figure 14) and Net Present Value (NPV) show a realistic and practical option for installing wind turbines. The analysis will include cost of the project, benefit to the town residents and impact on the environment and human health.

CBA Worksheet & Analysis

The Borough of Red Bank				
Cost Benefit Analysis				
Dec-19				
Wind Turbines				
Calculating Scope of the Project				
Cost of Land		\$0.00		
Installation cost per WH		\$4.40		
Electricity output in KW		5,500		
Projected KWH output		51,470,724		
Total Project Cost		\$24,200,000.00		
			YEAR	
Benefits		Year 1	Year 2	Year 30
Direct sales at a 1% yearly increase in profit		\$5,661,780	\$5,718,397	\$7,631,224
Resource Costs		\$123,185	\$124,417	\$166,035
Human Health		535,000	540,350	721,099
	Total Benefits	\$5,784,965	\$5,842,814	\$7,797,258
Costs (Excluding Initial Capital Investments)				
Amortization Cost		\$1,080,523	\$1,080,523	\$1,080,523
Maintenance		726,000	733,260	978,538
	Total Costs	\$1,806,523	\$1,813,783	\$2,059,061
	Net Benefits (Costs)	\$3,978,442	\$4,029,031	\$5,738,197
Evaluation Metrics				
Net present value (NPV)		\$37,658,132		

Figure 38: Cost Benefit Analysis of installing wind turbines

(Figure 38) is the CBA worksheet and below is the description of how I arrived at the numbers including number of KW produced, cost per KW, cost of maintenance, and cost of amortization, human health cost and ecosystem resources saved.

Mechanics: 3.58 m/s and 560 turbines

- Determine if wind speed is appropriate: minimum threshold of 3 meters/second (m/s) wind speed year-round must be met to qualify (Sanchez Pina, 2019). Lowest wind speed is 8.0 mph. Convert mph to m/s: 1 mile = 1609 meters; 8.0 mph * 1609 = 12872

meters/h; $12,872 \text{ m/h} / 3600 \text{ seconds/hour} = 3.58 \text{ m/s} > 3 \text{ m/s}$. Red Bank qualifies for year-round turbine electricity output.

- Determine if land size is appropriate: Turbines must be placed at least 400 meters from any residences. The area designated for the turbines is $45,000 \text{ m}^2$. Realistically we can install $(45,000/80) = 560$ turbines (Figure 39).

Estimated Capital Cost: \$24,200,000

- Average electricity use per month (Electricity Local, 2019): $691 \text{ KWh} * 5573 \text{ residences} = 3,850,940 \text{ KWh}$. I will estimate for $4,000,000 \text{ KWh}$ desired electricity productions per month.
- Estimated Installed Capacity: Converting KWh to KW we get of $4,000,000 \text{ KWh}$ per month equals $4,000,000 \text{ KWh}/720 \text{ hours (per month)} = 5,500 \text{ KW}$ per day. Accounting for: de-rate factor (0.85, meaning the turbine would run at 85% capacity); altitude above sea level: 12 meters; air density 1.245 kg/m^3 (Figure 40); 15.15 mph average wind speed each month; which all affect the wind turbine performance output (Weather, 2019).

Total Energy Production: 51470724 KW/h wind calculator (Figure 41)

- Installed Cost: In the northeast installation costs \$4.4 per W (Barbose, et al., 2017). Total installed cost is $(5,500 \text{ KW} * \$4.4(1000)) = \$24,200,000$

Estimated Annual Cost: \$1,806,528

- Annual Mortgage Payment: The town qualifies for unsecured loans through New Jersey (NJ Business, 2014) and the federal government (EERE) because this is a renewable

energy project. The rate would be 2% fixed over 30 years (EERE). The annual mortgage rate is $\$24,200,000 * 0.0446 = \$1,080,528$ (Figure 42)

- Annual Maintenance Cost: Assuming maintenance cost at a rate of 3% of production cost (Sanchez Pina, 2019) $0.03 * \$24,200,000 = \$726,000$.
- Total Annual Cost: $\$1,080,528 + \$726,000 = \$1,806,528$

Estimated Production Cost: 3.5 cents per KW/h

Production cost $\$1,080,528/51,470,724 \text{ KWh} = \0.035 or 3.5 cents per KWh

Estimated Net Profit: \$3,855,252 per year

Currently electricity rate for residents is 12.6 cents per KW/h (Electricity Local, 2019). Red Bank can sell electricity to its residents at 11 cents per KW/h thereby lowering utility costs for residents and adding a revenue stream to its budget.

Net cost $0.035 - \text{revenue } \$0.11 = \$0.075$ (7.5 cents profit per KWh) * 51,470,724 KWh generated = \$3,855,252 per year.

Estimated Environmental and Health Benefits:

New Jersey's electricity mix of 50% from natural gas and 42% from coal and nuclear (EERE, 2018), converting to wind turbines as an energy source would greatly improve air quality, ecosystem and human health (Figure 43). The CO emission would drop by 19092.9 Metric Tons (MT) of CO₂Seq, Ozone (which is a reaction between NO₂, hydrocarbon and sunlight (Airnow, 2019)) depletion would drop to 1.5 KgCFC-11 (Sanchez Pina, 2019). Ecosystem resource

depletion costs saved are \$123,185. Ecosystem damages in species years saved is 358.9 years.

The Disability Adjusted Life Years (DALY) is 128 years.

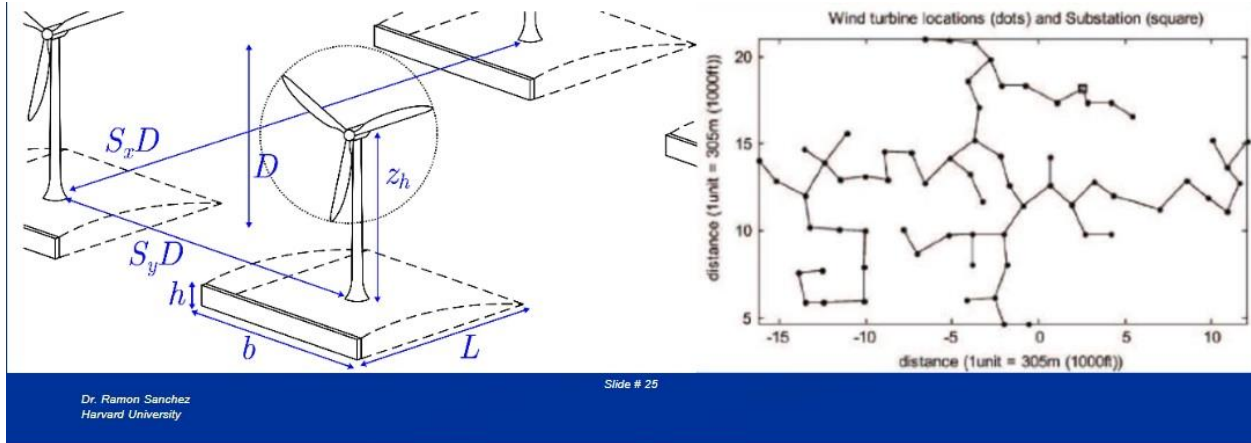


Figure 39: Calculation and configuration for installing wind turbines

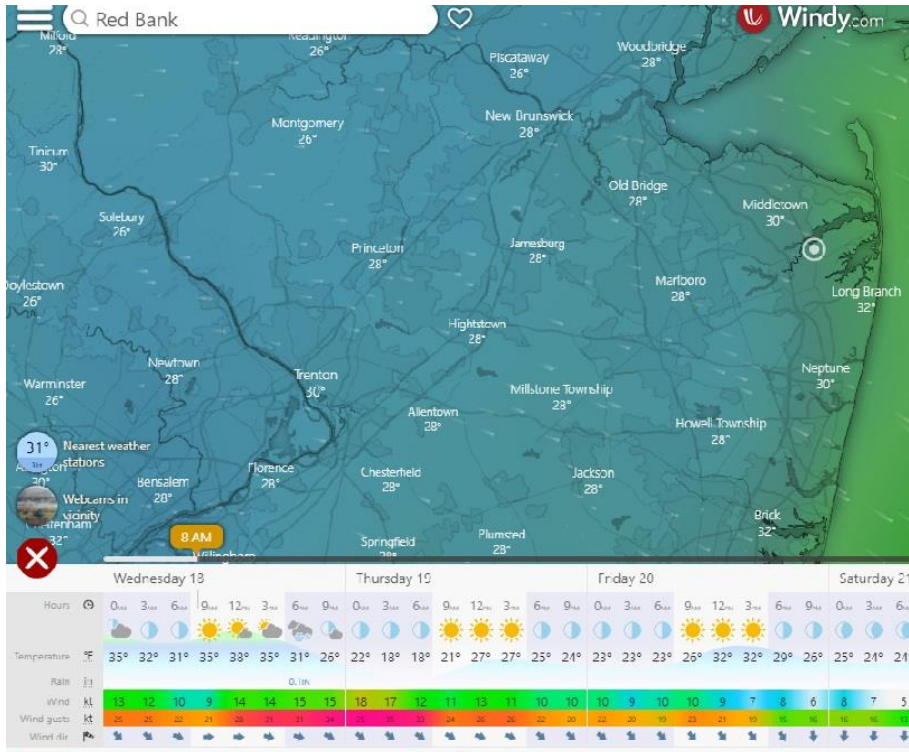


Figure 40: Wind conditions in Red Bank needed to calculate output

System Capacity in KW		5500			
Derate Factor		0.85			
Rotor diameter (m)		10			
Number of turbines		560			
Altitude above sea level for your community (meters)		12			
Altitude penalty		0.04%			
Air density (Kg/m3)		1.245			
Month	Wind speed (MPH)	Days per month	DC Capacity in kW	DC to AC Derate Factor 2018	Average Monthly kWh produced (AC)
January	18.4	31	5500	0.85	5679628
February	17.4	28	5500	0.85	4338209
March	25.8	31	5500	0.85	15657612
April	17.3	30	5500	0.85	4568402
May	13.2	31	5500	0.85	2096951
June	14	30	5500	0.85	2421085
July	12	31	5500	0.85	1575476
August	9	31	5500	0.85	664651
September	8.9	30	5500	0.85	622108
October	13.2	31	5500	0.85	2096951
November	21.1	30	5500	0.85	5098450
December	15.6	31	5500	0.85	3461308
Total Annual Prod =					51470724 KWh/year
Price per Wdc in USD	\$	4.40			
Cost of the Project	\$	24,200,000			
Operating costs as a percentage of capital costs		3%			

Using average wind speed per month, we can calculate expected annual KW/h output

Figure 41: Total annual KW/h output

B4		$f_x = 1 * ((B1 * ((1+B1)^{B2}) / (((1+B1)^{B2}) - 1)))$			
1	Annual Percentage Rate (annual interest) =	2%			
2	Grace Period (years) =	30			
3					
4	Annual Capital Costs =	0.0446			
5					
6	Annual Operating costs =	\$ 78,692			

Rate for a 2% 30 year mortgage ratio

Figure 42: Calculating for 2% 30 year fixed mortgage

Impact Category	Units	HH(yr)	ED (yr)	RC (\$/yr)	Local Electricity Mix	US National Electricity Mix	Your wind production	Wind reductions compared to Local Electricity Mix	Wind Reductions compared to U.S. National Electricity Mix
Climate Change	KgCO2	3.51E-06	1.88E-05	0	19092921.8	32221665.5	578513.2	18514408.6	31643152.3
Ozone Depletion	KgCFC-11	0	0	0	1.5	0.7	0.0	1.5	0.6
Human Toxicity	Kg DCB air	7.00E-07	0	0	4430964.2	3642703.6	580404.2	3850560.0	3062299.4
Photochemical Oxidant	Kg NMVOC air	3.90E-08	0	0	61377.7	124616.5	1844.9	59532.8	122771.6
Particulate Matter Form	Kg PM10	2.60E-04	0	0	36307.5	61616.4	1656.2	34651.2	59960.2
Ionizing Radiation	Kg U235 air	1.64E-08	0	0	23120144.9	10542478.3	100771.2	23019373.7	10441707.1
Terrestrial Acidification	KgSO2	0	1.42E-08	0	166044.3	261160.9	2421.4	163622.8	258739.5
Freshwater Eutrophication	KgP freshwater	0	4.40E-08	0	364.7	163.2	371.9	-7.2	-208.7
Marine Eutrophication	Kg Neg	0	0	0	966.1	2949.2	217.1	749.0	2732.1
Terrestrial Ecotoxicity	KgDCB Soil	0	0	0	3612.5	2060.3	71.5	3541.0	1988.8
Freshwater Ecotoxicity	KgDCB freshwater	0	2.60E-10	0	235783.5	130522.6	18422.9	217360.7	112099.7
Marine Ecotoxicity	Kg DCB marine water	0	4.20E-14	0	79193.2	47427.4	19405.7	59787.5	28021.6
Agricultural Land Occupation	m2a	0	0	0	90533.5	51838.8	11471.5	79062.0	40367.3
Urban land occupation	m2a	0	0	0	11641.2	7490.5	44988.7	-33347.5	-37498.1
Natural land transformation	m2	0	0	0	166.6	78.8	62.0	104.5	16.7
Water depletion	m3	0	0	0	72284.4	33079.8	5736.2	66548.2	27343.7
Metal depletion	KgFe	0	0	0.0715	195800.3	112670.4	724832.3	-529032.0	-612162.0
Fossil depletion	KgOil	0	0	16.07	7664687.2	10971709.7	177996.8	7486690.4	10793712.9
		Human Health	HH (DALY)		128.32	147.04	6.82	121.50	140.21
		Ecosystem Damages	ED (Sp.yr)		358.95	605.77	10.88	348.07	594.89
		Resources' Cost	RC (\$)		\$ 123,185,523	\$ 176,323,430	\$ 2,912,234	\$ 120,273,289	\$ 173,411,197
		Carbon Emissions	Metric Tons of CO		19092.9	32221.7	578.5	18514.4	31643.2

Installing wind turbines would improve human health, the ecosystem and reduce air pollutants by these amounts

Figure 43: Results for human health, ecosystem and air pollution improvements due to installation of turbines (Sanchez Pina, 2019).

Net Present Value (over 30 years): \$39,651,172 and \$62,143,980

Fixed net profit and fixed mortgage payment: $NPV = (\text{Cash flow}/(1+i)^t) - \text{initial investment}; i =$ interest; $t =$ time (Lumbreras, 2019)

$$NPV = (\$3,855,252/(1+0.02)^{30}) - \$24,200,000 = \$39,651,172$$

Variable 1% yearly profit increase and fixed mortgage payment: $NPV = \sum (t(0..n) = R_t / (1+i)^t;$
 $i =$ interest; $t =$ time; $R_t =$ net cash flow during a single period t (Lumbreras, 2019)

$$NPV = \sum (0..30) = [(\$3,855,252)/1.02 + \dots + (\$5,196,297)_{30}/(1.02)^{30}] = \$62,143,980$$

Tracking Progress for Air Quality

Red Bank needs to track Green House Gas (GHG) emission, Ozone, CO and NO₂ in addition to PM_{2.5} to get a more comprehensive reading of the town's AQI which is dangerously high at 89.4 (City Data, 2018).

Installing wind turbines would virtually eliminate air pollutants and improve AQI. It would also improve the Disability Adjusted Life Years (DALY) for human health.

Human Health & Access to Medical Care

Red Bank was on a positive trend of percentage of insured township residents until the dismantling of the Affordable Care Act (ACA) (Galewitz, 2019). An unintended consequence is the deterioration of residents' health. Increasing neighborhood walkability (previously described in the housing affordability section) would improve obesity, diabetes and depression (Azar II, 2018). Installing wind turbines (previously analyzed in the air quality section) would combat the town residents' pulmonary diseases (Sanchez Pina, 2019).

While Red Bank has the Parker Family Health Center which offers free healthcare (Silva & Morera, 2015), council members recently approved the reduction of healthcare spending by 16% (Shehadi, Red Bank Township, 2019). Also, the town is currently locked in a court case with the area hospital over back taxes owed by the hospital totaling \$15.5M plus interest accruing since 2015 (Cannon, 2019). The hospital has trauma and acute care services, separate pediatric urgent care services, and an urgent care unit (City Data Health, 2018). Red Bank should look into settling with the hospital in return for free medical services for all town residents regardless of health or insurance status. This is similar to a case in Morristown, NJ with positive outcome

(Burton, 2016). This would save the town about \$535,000 in healthcare cost (Shehadi, Red Bank Township, 2019) and guarantee access to medical care for its citizens.

Tracking Progress of Human Health and Access to Medical Care

Currently 28% of residents are uninsured, the town has a 37% obesity rate, 11% diabetes rate, 27% depression rate and 11% have pulmonary disease (City Data Health, 2018). All these criteria can be used to track the progress of Red Bank residents' health and access to medical care. Improving neighborhood walkability and air quality would ultimately lead to healthier residents. Contracting with the area hospital for free medical care access is an alternative to lack of medical insurance for Red Bank residents.

Poverty

Red Bank currently has a poverty rate of 13.8% (Hidalgo, 2018). Education level, housing and fuel affordability (Mohr, 2018), health risks (Chokshi, 2018) due to expenses related to medical care such as cancer (Boscoe, Henry, Sherman, & Johnson, 2015) and gender inequality (USAID, 2015) all cause poverty.

Education in Red Bank is strong with higher than average education levels (96% graduation rate and 43% have a Bachelor's Degree or higher) (Census Reporter, 2019). However, all other areas need improvement. Adopting the previously presented solution of affordable housing for LMI and installation of wind turbines would reduce fuel cost for residents and would solve "*Fuel Poverty*" (Mohr, 2018). Additionally, as previously discussed, wind turbines would improve DALY. Meaning, town residents would live longer without disabilities because of the improved

air quality. Thus reducing the threat of diseases like cancer would reduce a family's chances of going into poverty (Boscoe, Henry, Sherman, & Johnson, 2015).

But the greatest impact on poverty in Red Bank is the gender wage gap. Red Bank has a 32% gender wage gap (Hidalgo, 2018). Despite female householders being double male householders, 18% to 9% respectively, the largest group of poor are women of productive age between 18-34 years old (54%) (Hidalgo, 2018). Red Bank needs to pass a resolution to enforce the H.R.7 – Paycheck Fairness Act (Rep. Delauro, 2019). Key provisions of the act passed by the 116th Congress are: prohibits employers from requiring salary history during the interview/hiring process; requires employers prove that wage disparities exist for a legitimate reason; creates aid with negotiations skills for women and girls; and provides federal assistance to businesses that need help with their equal pay practices (Rep. Delauro, 2019).

Tracking Progress of Poverty

To track its progress, Red Bank needs to monitor wage disparities and female poverty levels, it also needs to evaluate incidences of diseases including cancer and it needs to monitor utility costs for its residents, especially cost of electricity.

Red Bank can virtually eliminate poverty by reducing utility costs, improving health but most importantly, eliminate gender wage gap.

Recycling

Red Bank, like many towns in Monmouth County, collects solid waste twice a week and recycled material once every two weeks for business and residential. Several potential solutions exist that can be adopted concurrently with most being budget neutral:

One (change collection schedule): for business owners, instead of paying the Waste Management Company about \$200 to empty their dumpster every month, they can contract with Tri-State Carting to place a dumpster for trash and a recycle Robo container for \$85 per month. The Sanitation Union would not be impacted if it was switched from a “twice a week for trash & bi-

weekly for recycled” to “once a week each for trash and recycling”. The town would only be replacing one of the trash pick-ups for recycling. The trucks dump at the same Monmouth County reclamation and recycling site, which would not be a major shift in their schedule (Figure 44).



Figure 44: Reclamation center process solid waste and recyclables

Two (citizen education): town residents need to be educated on prevent>re-use>recycle>recover (repurpose)>dispose and town public areas need to have a more encouraging receptacle system (Figure 45).



Figure 45: Color coding to aid in recycling

Three (waste-to-fuel): Red Bank produces only about 10 tons of solid waste daily which is too small to process waste into fuel. However, the town can send the solid waste to the closest waste-to-fuel processing center in New York State (NYSDEC) which would save the town \$557,644 in annual expenses.

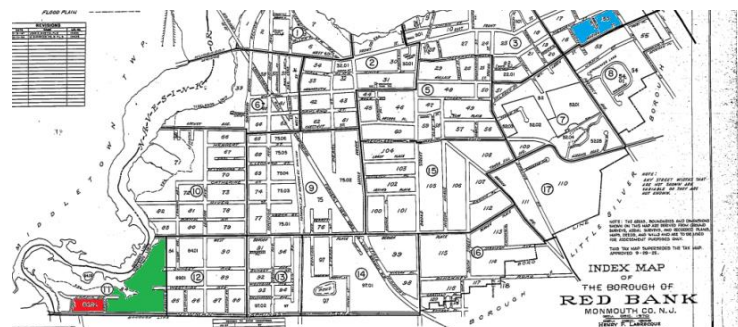
Four (composting): The township currently does not enforce the recycling program mandated by the state and does not have recycling or composting center. Assuming 25% of waste is compostable food material (USEPA, 2017) generates 2.5 tons daily. The composting to food ration is 30:1 leading to potentially generating 913 tons of compost a year (UGA, 2017).

Assuming soil density of 80 lb/ft³, 913 tons converts to 36520 cubic feet generating for the township 1,351 cubic yards. Conservatively, compost is sold for \$50 per cubic feet to farms, agricultural nurseries and environmental departments in various universities (UGA, 2017) would leave the township with additional revenue of \$64,183 (assuming a 5% annual maintenance cost: \$67,562 * 0.95). Block 84 Lots 1.02, 1.04, 62 (Figure 1)

Reuse Center:

Unlike recycling, this reuse center would encourage citizens to drop off unwanted items to the township's reuse center for consignment sales. This trend in the states has found success through

Figure 46: Area in red is a possible location for composting



Key:
 Green: Possible location for a solar farm
 Blue: Possible location for a wind farm
 Red: Possible location for composting

private partnerships. Red Bank has several abandoned commercial buildings (Figure 46) and capital costs can be kept to a minimum by repurposing such buildings. Annual operating costs are labor and commercial insurance since Red Bank can potentially generate its own electricity.

Tracking Progress of Recycling

Red Bank can track progress of its recycling efforts by looking at two data statistics. First is the amount of solid waste tonnage produced versus the amount of recycled waste produced. The amount of solid waste should decrease, and if composting and reuse efforts are successful, the amount of recycled material should decrease as well. Second, the cost associated with waste management should also decrease. Even if Red Bank opens a reuse center, the difference in reduced waste management and the operating cost of the center should still yield a net positive for the town.

PART IV: TIMELINE, MILESTONES & OTHER RECOMMENDATIONS

Timeline of Events

- ◆ June 30, 2019: I met with Councilwoman Trigiani at a cocktail event right before the annual New Jersey Philharmonic concert that is held at the Marina Park. We discussed plastic bags and Styrofoam. After several back-and-forth ideas we arrived at an ordinance

that she would be comfortable voting on and promised to submit the ordinance at the next council meeting scheduled for July 24, 2019.

- ◆ July 2, 2019: Met with Councilman Yassin and Zyad Shehadi (the business administrator) at the municipal office. It was a two hour Q&A session so that I can get a clearer picture of the internal dynamics of Red Bank.
- ◆ July 23, 2019: In collaboration with the Green Team & the Environmental Commission, we hosted our first citizen engagement session which was about composting presented by the Monmouth County Reclamation Center. Attendees agreed to get involved in initiating a petition.
- ◆ July 27, 2019: Attended a large networking event for all the business owners hosted by union leaders. I attended as Councilman Yassin's guest. I presented them with a plan about restructuring the sanitation pick-up schedule. They were open further discussion, but it had to be brought up at the county level with cooperation between the Democrat and Republican parties (Red Bank is 100% Democrat; Monmouth County is 100% Republican).
- ◆ August: Most area residents and council members were on holiday.
- ◆ September 19, 2019: Spoke at the Monmouth County Democratic Women's Caucus "Votes for Women" event. Discussed gender equality and how that leads to poverty. Most were unaware of the statistics, but promised to include it in their platform. Assemblywoman Joan Downey was present.
- ◆ September 22, 2019: Spoke at the Greater Red Bank Woman's Initiative "How Empowering Women Can Help Stop Global Warming" event at the Unitarian Church. Discussed climate action and gender equality and was able to enlist members' support

Councilwoman Triggiani and Councilwoman Horgan to shine a spotlight on the relationship between the two issues.

- ◆ October 18, 2019: Attended a roundtable discussion hosted by Red Bank council and attended by Governor Murphy (who lives in Red Bank). Discussed with business owners the importance recycling, energy conservation and gender equality would positively impact Red Bank economy and their business internal profit margin.
- ◆ November 1, 2019: Attended the Red Bank Borough Education Foundation “Casino Night” which was attended by parents, local/county/state politicians. Spoke to the parents about homeowner energy conservation, recycling and climate action. Encourage parents to contact their councilpersons and/or attend the twice-monthly council meetings. The president of the PTO promised to start a petition.
- ◆ January 21, 2020: Collaborated with Empower NJ and presented an informational session about fossil fuel and its damage to the environment. The speaker brought empty paper and pens to the event and attendees wrote letters to council members which I turned in to council.
- ◆ February 18, 2019: Collaborated with “Pay up Climate Polluters” at an interactive community panel discussion. We discussed the economic, social and financial devastation on the environment. Attendees were encouraged to log into a google form (at the time of the event) and tell their story about how climate change has personally affected them. The results were sent to council. The event was facilitated by GRBWI.
- ◆ February 2 – March 14, 2020: Met once a week (either Saturday or Sunday) with Mayor Mena and/or Councilman Yassin to discuss progress.

- ◆ March 4, 2020: Was finally allowed, as a non-resident, to present to council members, the city engineer, the president of Department of Public Works and the community a “report card” about the town, progress made so far and what still needs to be done. This was held at their regular council meeting at municipal hall.
- ◆ March 16, 2020: Everything suspends due to COVID-19.

Ordinances & Milestones

- April 10, 2019: (Before I started working with Red bank),
 - ❖ The town is forced by the NJ state to enforce “In Re: N.J.A.C. 5:96 And 5:97, 221 N.J. 1 (2015), The New Jersey Fair Housing Act” stating any housing identified by the township as “affordable housing” can only be occupied by low income persons/families (Ordinance No. 2019-18, 2019).
- August 21, 2019:
 - ❖ Ordinance 2019-36: any newly constructed building or additions of more than 5000 s.f. shall provide a minimum of 25% of the area for green roofs (Ordinance 2019-36, 2019); Motion: Councilman Yassin; Second: Councilwoman Triggiani; votes: 6-0 yes.
 - ❖ Ordinance 2019-37: “Storm Water Management and Control” shall apply to any “disturbance” of one half acre or more of land (Ordinance 2019-37, 2019); Motion: Councilman Zipprich; Second Councilman Yassin; votes: 6-0 yes.
 - ❖ Ordinance 2019-38: parking lots to add tree filter boxes, rain gardens, and one of the following, bioswales or storm water planters to control storm water recharge

(Ordinance 2019-38, 2019); Motion: Councilman Yassin; Second: Councilwoman Horgan; vote 6-0 yes.

- ❖ Ordinance 2019-41: “single use plastic and polystyrene ban” (Ordinance 2019-41, 2019); votes: 6-0 yes. Motion: Councilwoman Triggiani; Second: Councilman Yassin.

- September 29, 2019:

- ❖ Ordinance No. 2019-62: Designing of train station zoning. “Encourage a mix of Retail/commercial uses at street level with increased residential density on floors above street level to create a mixed residential and commercial neighborhood that relies predominantly on public transportation as the primary means of travel” (Ordinance 2019-62, 2019); Motion: Councilman Yassin; Second: Councilwoman Horgan; vote 6-0 yes.

- ❖ Ordinance No. 2019-63: Design standards within a designated transit village. “Continuous sidewalks along all street frontages”, “Sidewalks connecting the transit facility to key destinations are to be direct”, “Establish and maintain bicycle networks that link directly to the train station” (Ordinance 2019-63, 2019); Councilman Yassin; Second: Councilwoman Horgan; vote 6-0 yes.

- December 11, 2019:

- ❖ Ordinance No. 2019-72: “Funding for drainage improvement” (Ordinance 2019-72, 2019); Councilman Zipprich; Second Councilman Yassin; votes: 5-0 yes; 1 absent.

Other Recommendations not included in Part III

Healthcare and marine life require state and federal intervention, but the following recommendations can be adopted at the local level.

1. Reduce the number of construction permits for high-rises until a study is conducted to address the rapid rise of the cost of living. Areas affected: poverty and housing affordability.
2. 2) Enforce the NJ Equal Opportunity Compliance Monitoring Program to assure eliminating employment disparity (NJ Treasury, 2019). Areas affected: gender equality, diversity, poverty.
3. Analyze and post details of township salaries paid. Areas affected: public finances.
4. Change waste pick-up schedule from twice a week for solid waste and bi-weekly for recycle to once a week each for solid waste and recycled. Areas affected: recycling.
5. Engage the community in prevent>re-use>recycle>recover (repurpose)>dispose by posting poster in all public places (Figure 47).



Figure 47: Recycling education graph

Conclusion

This was truly an enjoyable (sometimes stressful) experience. Never would I have imagined becoming a change agent for an entire town and influencing policy towards a better future.

Red Bank is a beautiful town full of contradictions and runs the risk of becoming unsustainable if the current trend continues. The town excels and is sustainable in: sustainability education and climate action. Areas trending towards unsustainability are: poverty, diversity & inclusion and air quality. Red Bank is currently unsustainable in: public finance, gender equality, health, marine life, recycling and affordable housing.

Red Bank generates 45% of its revenue from property taxes and any realistic plan presented cannot ignore that fact. Housing affordability is within reach if the town adopts Smart Growth and collaborates with HFH. Smart Growth sub-categories of VMU can be implemented and potentially reduces housing expenses by 15%. It can increase town tax revenue by more than \$500,000 annually. Changing zoning laws in zones 9 and 17 to include HUM will have a positive outcome. An HMU in zone 9 with protections of rent control can potentially reduce rent. An HMU in zone 17 can potentially add 100 LMI units and can qualify residents for the federally backed LEM. In addition, Red Bank is fortunate to be located in NJ which has a generous rehabilitation building code that can reduce costs for builders and buyers. Using GBD gives home builders, owners and buyers an opportunity to be LEED certified to qualify for EEM which have lower rates. Finally, Red Bank can donate 121 abandoned lots to HFH stipulating they use GBD. This can immediately put housing within the reach of LMI and add to home values.

In addition to GBD, air quality can be vastly improved by adding 566 wind turbines in a secluded area in Red Bank. A CBA of this project shows an added revenue stream of \$3.8M yearly. It also virtually eliminates GHG emissions including CO and NO₂. Additionally, it preserves the ecosystem and improves DALY. Contributing to better air quality is community education about significant reduction in waste being generated by residences and business.

Improving DALY for Red Bank residents improves health, but the town is also struggling with a rise in uninsured rate. The town is currently suing the area hospital for \$15.5M in back taxes plus interest. The town can mimic Morristown, NJ and settle with the hospital in return for free healthcare for Red Bank residents. This would reduce medical expenses for residents and help reduce poverty rate.

While medical expenses contribute to Red Bank's poverty rate, its largest impact comes from gender wage gaps. Currently, women make 32% less than men and women of productive years (ages 18-34) make up the bulk of the working poor (54%). Red Bank must pass a resolution to enforce H.R.-7 which guarantees equal pay for equal work especially for women. All plans presented can be implemented concurrently, consecutively or as a stand-alone.

Red Bank council members should be commended for their efforts. So far, they've passed ordinances to ban plastic bags, mandate green roofs and mandate storm water recharge rules for construction. The biggest victory for Red Bank was the passing of Mixed Land Use (MLU) housing ordinance and walkable neighborhoods leading to the train station. Red Bank is currently on a positive trend as they make improvements in each area considered to be unsustainable.

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