FROM LANDFILL TO PARK: THE EXPERIMENT AT FRESHKILLS

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ABSTRACT OF THE THESIS

From Landfill to Park: The Experiment at Freshkills

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The Freshkills landscape has endured many different ecosystems for the last 100 years. From freshwater marshes, to landfill operations, to now park development. After over 50 years of garbage dumping for New York City, Fresh Kills was left with over 2,200 acres of waste by 2001. In 2006, after an international design competition James Corner's Field Operations landscape architecture firm released the Freshkills Park draft master plan for the site to transform the former landfill into a park. This thesis investigates the culture change for Staten Islanders, and what now becomes a community asset in the 2020s.

This thesis is a supplement to the Freshkills Park draft master plan for North Park and includes a proposed plan for an area near the Travis-Chelsea neighborhood of Staten Island. This post-industrial landscape provides an opportunity to create research plots to see what will happen to particular vegetation over time. This thesis includes a greenhouse bench study experiment to find out if locally sourced and brownfield adapted plant material will survive at Freshkills Park. The results of the bench study are then applied to

a field study to develop a design proposal for Freshkills North Park. These research plots can help guide and influence the future plant palette at Freshkills Park, with the goals of creating a process that results in a more biodiverse ecosystem. The design proposal includes living laboratories at Freshkills Park with the intention to create positive interactions at the park for locals through citizen science while simultaneously investigating the site's urban ecologies.

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Lastly, I would like to thank my family, friends, and the class of 2021 MLA cohort for being there for me throughout this master's program. It was a challenge to complete during the COVID-19 pandemic, and I would like to thank you all for helping me along the way.

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Chapter 1: Introduction

Freshkills Park is the largest landfill-to-park transformation globally, measuring at over 2,200 acres of parkland in Staten Island, New York.[1] By acreage, Freshkills Park will be almost three times the size of Central Park in Manhattan, New York, and the largest park developed in New York City in over 100 years.[2] Freshkills Park is located on the mid-western shore of Staten Island and makes up about 18% of all the green space in Staten Island (figure 1).[3] The former Staten Island Borough President states, "Among the five boroughs, Staten Island is the most suburban and treasures its small-town environment. We're proud to retain the title of New York City's greenest borough."[4]

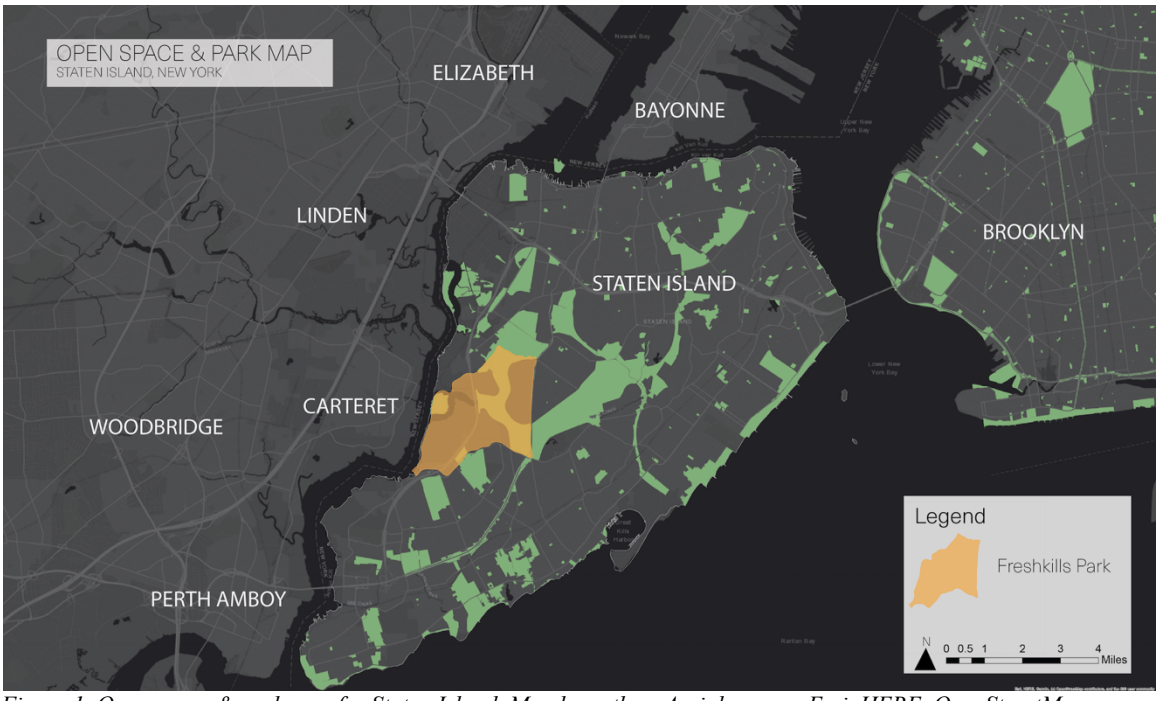

Figure 1. Open space & park map for Staten Island. Map by author. Aerial source: Esri, HERE, OpenStreetMap.

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[1] Ula Ilnytzky, "NYC Garbage Dump World's Largest Landfill-to-Park Project," AP NEWS (Associated Press, September 3, 2016), https://apnews.com/article/7c3ca5f90e144392a5f41ce2aee03733.
[2] "The Park Plan," Freshkills Park, May 18, 2020, https://freshkillspark.org/the-park/the-park-plan.
[3] Staten Island Advance Editorial, "The Borough of Parks: Inventory of Protected Staten Island Parkland Keeps Growing," silive, April 28, 2013, https://www.silive.com/opinion/2013/04/the_borough_of_parks_inventory.html.
[4] Ibid.

Chapter one will focus on this thesis's purpose, along with the history of Fresh Kills and Staten Island. Chapter two will focus on the development of the draft master plan by James Corner Field Operations for Freshkills Park and will also focus on where the park is today through observational studies. Chapter three will explore three related case studies: Liberty State Park, Brookfield Park and Gas Works Park and describe the importance of these built projects pertaining to Freshkills Park.

Chapter four will explain a greenhouse study conducted over the summer of 2020 through a fellowship with the Rutgers Center for Resilient Landscapes testing woody plant adaptation to high soil metal concentrations from Liberty State Park and Freshkills Park. This bench study would help inform if locally sourced and brownfield adapted plant material will survive at Freshkills Park. Finally, the greenhouse bench study is applied to a field study to develop a design proposal to supplement the draft master plan for Freshkills Park in chapter 5.

This thesis investigates a culture change whereby Fresh Kills changes from Staten Islanders being conceived as an embarrassingly large dump to becoming a community asset. This thesis explores Freshkills Park's future through the draft master plan that describes the 30-year plan to transform the site produced by Field Operations. This thesis also explores the site through my lens as a native Staten Islander growing up near Fresh Kills landfill. It will take more than a name change to make Freshkills Park a compelling destination for locals. I had never visited the park, despite its many outreach activities, until I started to work on this thesis. I participated in various park events through the alliance and discovered the park's beauty, realizing that it just takes that first visit to start changing my perception. This thesis is about creating a living laboratory at Freshkills

Park with the intention to create positive interactions at the park for locals while simultaneously investigating the site's urban ecologies.

The thesis aims to create a living laboratory at Freshkills Park using the results of the bench study and create a process that results in a more biodiverse ecosystem, while also bringing Staten Islanders into Freshkills Park. Some questions that are investigated in this thesis include:

- Will locally sourced and brownfield-adapted plant material survive at Freshkills Park?
- How can Freshkills enhance the existing research opportunities at the park to create living laboratories while also engaging the community through citizen science?

The methods to answer these questions include observational studies at Freshkills Park, the greenhouse bench study, literature review and case studies, resulting in the development of a design proposal for a 7-acre plot on Freshkills North Park described in chapter 5.

History

Staten Island was and still is considered the forgotten borough of New York City. Staten Island is the least populous, least dense borough and is isolated geographically from the rest of New York City.[5] In the 19th and 20th centuries parts of Staten Island were made up of large marshes and tidal creeks (figure 2).[6] Fresh Kills (prior to landfill operations) was over 3,000 acres, and over the years many parts of Fresh Kills was

[5] Martin V. Melosi, "Fresh Kills: The Making and Unmaking of a Wastescape," *RCC Perspectives* 1 (January 1, 2016): pp. 59-66, https://www.jstor.org/stable/26241345, 60.
[6] Ibid, 62.

developed for parks and other public uses.[7] Master builders of New York, like Robert Moses, proposed the idea of filling the marshes, creeks, and swaps to make use of the waterways and expand on more usable land in Staten Island.[8] Robert Moses was the city construction coordinator and commissioner of the department of parks in New York City at that time.[9]

[7] "Fresh Kills Park Project," City of New York, accessed December 15, 2020, https://www1.nyc.gov/assets/planning/download/pdf/plans/fkl/fkl.pdf, 41.
[8] Martin V. Melosi, "Fresh Kills: The Making and Unmaking of a Wastescape," *RCC Perspectives* 1 (January 1, 2016): pp. 59-66, https://www.jstor.org/stable/26241345, 62.
[9] Cornelius A. Hall, Robert Moses, and Andrew W. Mulrain, "Fresh Kills Land-Fill: A Report to Mayor Impellitteri and The Board of Estimate," Fresh Kills Land-Fill: A Report to Mayor Impellitteri and The Board of Estimate § (1951), https://freshkillspark.org/wp-content/uploads/2009/04/fresh-kills-land-fill-1951-report.pdf, ii.

Figure 2. Topographic Map of Staten Island in 1899. Source: U.S. Geological Survey, from https://ngmdb.usgs.gov/topoview/viewer/#.

In 1946, Robert Moses proposed the Fresh Kills area of Staten Island become more developed like the rest of New York City. In 1951, he proposed the development of a highway, along with public works and private development.[10] The original plan included residential development, industrial zones, and parkland and only included the landfill as a temporary solution to fill in the marshes and create more usable land (figure 3 and 4).[11] The landfill operation was estimated to last up to three years and just to fill in the marshes to develop the rest of the plan.[12] Of the original 1951 plan, only the landfill and highway were developed. A quote from the 1951 report states,

> The Fresh Kills project is not merely a means of disposing of the city's refuse in an efficient, sanitary and unobjectionable manner pending the building of incinerators. We believe that it represents the greatest single opportunity for community planning in this City. The cooperation of the Borough President of Richmond, the Departments of Sanitation and Parks, the City Planning Commission and Board of Estimate will create enough valuable new property in this presently fallow and useless area to pay the cost of the project many times over and to produce a well rounded and diversified community, practically planned, to meet the future needs of Staten Island.[13]

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[10] Cornelius A. Hall, Robert Moses, and Andrew W. Mulrain, "Fresh Kills Land-Fill: A Report to Mayor Impellitteri and The Board of Estimate," Fresh Kills Land-Fill: A Report to Mayor Impellitteri and The Board of Estimate § (1951), https://freshkillspark.org/wp-content/uploads/2009/04/fresh-kills-land-fill-1951-report.pdf, 8.

[11] Martin V. Melosi, "Fresh Kills: The Making and Unmaking of a Wastescape," *RCC Perspectives* 1 (January 1, 2016): pp. 59-66, https://www.jstor.org/stable/26241345, 62.

[12] *The Fresh Kills Story: From World's Largest Garbage Dump to a World-Class Park*, *Youtube* (Staten Island Borough President's Office, 2012), https://www.youtube.com/watch?v=3hMhWOaX_0o.

[13] Cornelius A. Hall, Robert Moses, and Andrew W. Mulrain, "Fresh Kills Land-Fill: A Report to Mayor Impellitteri and The Board of Estimate," Fresh Kills Land-Fill: A Report to Mayor Impellitteri and The Board of Estimate § (1951), https://freshkillspark.org/wp-content/uploads/2009/04/fresh-kills-land-fill-1951-report.pdf, 13.

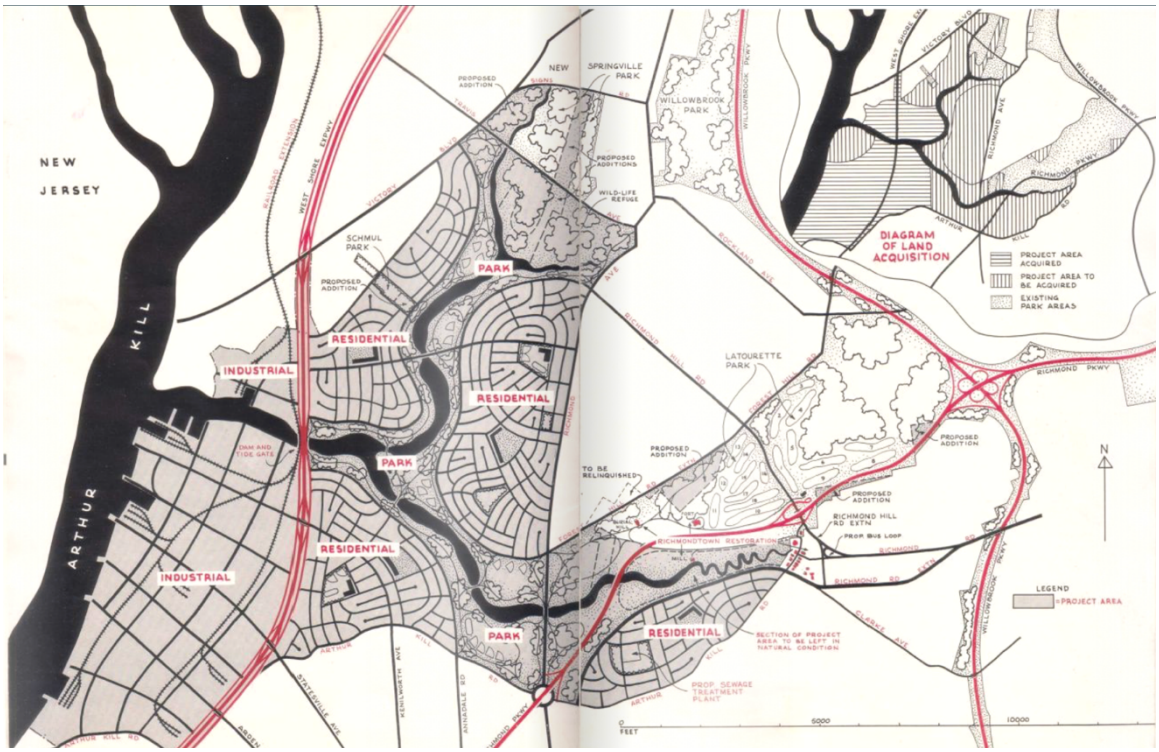

Figure 3. Original plan for Fresh Kills in 1951. Source: Freshkills Park Alliance, from https://freshkillspark.org/blog/robert-moses-on-fresh-kills.

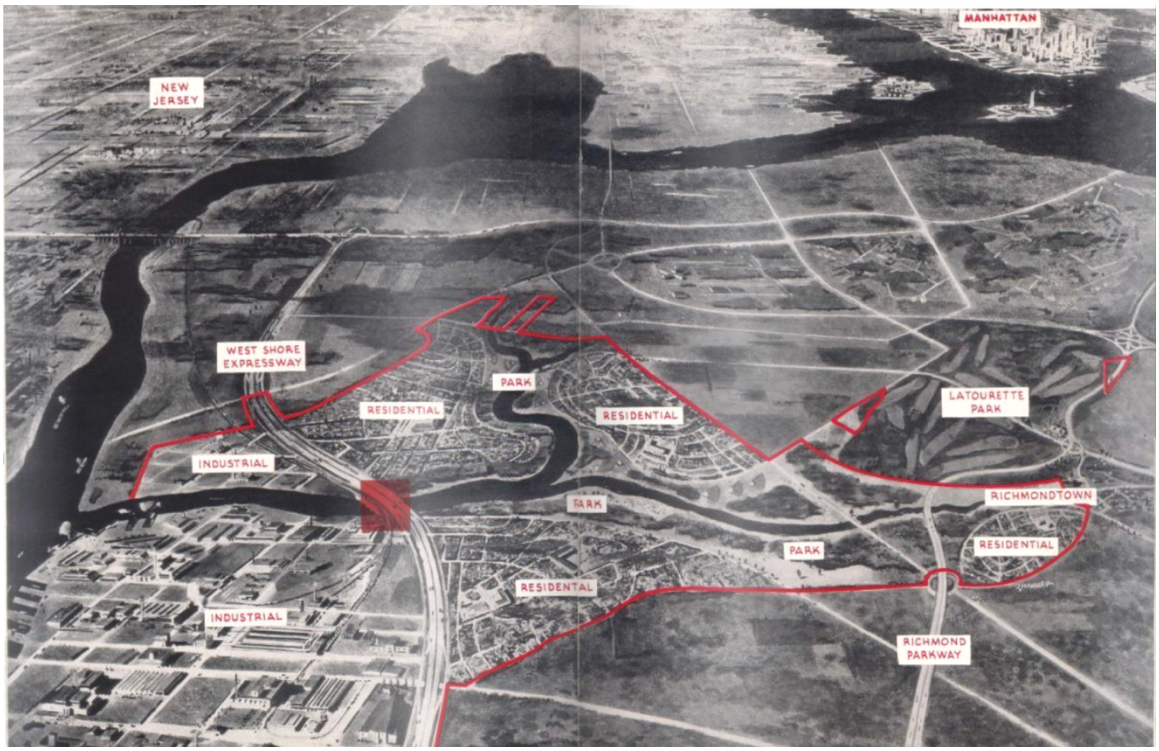

Figure 4. Original plan for Fresh Kills in 1951. Source: Freshkills Park Alliance, from https://freshkillspark.org/blog/robert-moses-on-fresh-kills.

By 1955, Fresh Kills was the largest landfill worldwide, and at its peak landfill operation was collecting 29,000 tons of trash per day.[14] As the landfill grew larger over time, so did the anger of many Staten Island residents, with an on-going battle to fight for the Fresh Kills landfill's closure as their home became the dumping ground for all of New York City's trash. Many nearby residents could not open up their houses' windows because of the strong odors that would come from the landfill.

Figure 5. Image of Fresh Kills landfill during operation in the 1990s. Image by Stephen Ferry, from https://nymag.com/news/features/52452/

A documentary titled, "*The Fresh Kills Story: From World's Largest Garbage Dump to a World-Class Park*" was created in 2012 by Andy Levison from the Staten Island Borough President's Office, showing the effects Fresh Kills landfill had on Staten Island. Although the Fresh Kills landfill is a thing in the past now for Staten Island residents, the memories remain. The documentary showcases many interviews with the

[14] The City of New York, "Freshkills Park : NYC Parks," Freshkills Park : NYC Parks, accessed February 15, 2021, https://www.nycgovparks.org/park-features/freshkills-park/about-the-site.

local community and politicians who fought for the Fresh Kills landfill closure. In the documentary, the Staten Island Borough President (1990-2001) Guy Molinari says,

> My dad was one of those that fought against the establishment of the dump and I recall my father vigorously fight against it. At that time, they talked about having the dump open only for 2-3 years. My father [S. Robert Molinari, New York State Assembly from 1943-1944] said they are not going to do that. Once they start dumping garbage there, they are going to continue and continue and continue.
> -Guy Molinari, Staten Island Borough President (1990-2001)[15]
> Timestamp: 9:35

The dumping did not end after a few years. It took many decades, and the dumping grew every year as more landfills in New York City were closing down, leaving just the Fresh Kills landfill as the only option for New York City's trash. Susan Molinari was a New York congresswoman and an advocate for the closure of the Fresh Kills landfill. She describes in the documentary that when Staten Islanders referred to the Fresh Kills landfill as a dump, that was precisely correct. Fresh Kills landfill, by definition, was never really a landfill but a dump.

> Fresh Kills was never considered actually a landfill because it was never in compliance of one would need to be a landfill. So not only did [Staten Islanders] have the insult of taking all [New York] city's garbage but was still functioning under the qualification of a dump which was just mass garbage being dumped. No leachate control systems, no methane control, no constant monitoring.[16]
> -Susan Molinari, Congresswoman 1990-1997
> Timestamp 10:00

With the expansion of bridges into Staten Island (specifically the Verrazzano-Narrows Bridge), Staten Island became more desirable as it is the only suburban borough in New York City. With the expansion of development and the expansion of the Fresh Kills landfill, more issues arose with the landfill being so close to neighborhoods.

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[15] *The Fresh Kills Story: From World's Largest Garbage Dump to a World-Class Park*, *Youtube* (Staten Island Borough President's Office, 2012), https://www.youtube.com/watch?v=3hMhWOaX_0o.
[16] Ibid.

> …and in 1948 when the position was taken by the state and city that perhaps we should dump garbage on Staten Island and Fresh Kills, there were no surrounding neighbors. There really wasn't anyone to bother by putting garbage in those low tidal wetlands. There was no one to complain. But after Staten Island became built up, neighborhoods started to approach the dump and built right outside the boundaries of the dump and then it became an environmental hazard for those people.[17]
> -Daniel L. Master, Counsel to S.I. Borough President Guy Molinari
> Timestamp 10:37

March 22nd, 2001 was a significant milestone for Staten Island, where the Fresh Kills landfill received its last barge of municipal solid waste.[18] Later in that same year, on September 11th, 2001, was the horrific terrorist attack on the Twin Towers in Manhattan. Fresh Kills landfill was re-opened until June of 2002 to bury all of the rubble, debris, and human remains from the Twin Towers. This then started to change the conversation about Fresh Kills – a 50-year dumping ground for municipal waste is now also referred to as a cemetery and resting place for the lives lost on the September 11th attacks.[19]

Figure 6. Image of the last barge of municipal solid waste to Fresh Kills landfill on March 22nd, 2001. Image by DSNY, from https://freshkillspark.org/blog/last-barge-to-fresh-kills-landfill.

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[17] *The Fresh Kills Story: From World's Largest Garbage Dump to a World-Class Park*, *Youtube* (Staten Island Borough President's Office, 2012), https://www.youtube.com/watch?v=3hMhWOaX_0o.
[18] The City of New York, "Freshkills Park : NYC Parks," Freshkills Park : NYC Parks, accessed February 15, 2021, https://www.nycgovparks.org/park-features/freshkills-park/about-the-site.
[19] Martin V. Melosi, "Fresh Kills: The Making and Unmaking of a Wastescape," *RCC Perspectives* 1 (January 1, 2016): pp. 59-66, https://www.jstor.org/stable/26241345, 63.

Chapter 2: Freshkills Park

A 2-stage international design competition titled "*Fresh Kills: Landfill to Landscape*" was hosted by the Department of City Planning immediately after the closure of Fresh Kills landfill in 2001 to revitalize Fresh Kills.[20] Part one of the competition was about forming the design teams, and part two was the development of the six finalists' conceptual designs and planning approach. The six finalists for this competition included: Field Operations, Hargreaves Associates, JMP Landscape and John McAslan + Partners, Sasaki Associates, Inc., Mathur/da Cunha + Tom Leader Studio, and RIOS Associates Inc.[21] On December 18th, 2001, the Department of City Planning announced the top three finalists of the competition: Field Operations as the winner, JMP Landscape and John McAslan + Partners in second place, and in third place RIOS Associates, Inc.[22] This design competition had four park design goals[23]:

- Transform Fresh Kills into a unique asset
- Create a world class park through public engagement, creative design, and environmental innovation
- Improve quality of life and active recreation opportunities on Staten Island and in the region
- Build an ecologically-sound road system that provides a framework for the park and reduces local traffic congestion

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[20] "Fresh Kills: Landfill to Landscape," City of New York, accessed December 17, 2020, https://www1.nyc.gov/assets/planning/download/pdf/plans/fkl/about_competition.pdf, 1.
[21] "Fresh Kills Park Project," City of New York, accessed December 15, 2020, https://www1.nyc.gov/assets/planning/download/pdf/plans/fkl/fkl.pdf, 8.
[22] "Fresh Kills: Landfill to Landscape," City of New York, accessed December 17, 2020, https://www1.nyc.gov/assets/planning/download/pdf/plans/fkl/about_competition.pdf, 1.
[23] Candace Damon, "New York's New Parkland Fresh Kills Fact Sheet," City of New York, 2003, https://www1.nyc.gov/assets/planning/download/pdf/plans/fkl/factsheet1.pdf, 2.

Figure 7. Original competition entry by Field Operations in 2001. Source: Field Operations, from https://www.nycgovparks.org/park-features/freshkills-park/about-the-site.

After winning the international design competition, Field Operations began designing the Freshkills Park master plan between 2003-2005.[24] James Corner Field Operations is a landscape architecture firm located in New York City specializing in public and urban design.[25] The design team hosted multiple public and community events throughout the design process, which included design charettes with the community. The Freshkills Park draft master plan was completed in March of 2006.

[24] James Corner, "Lifescape–Fresh Kills Parkland" (Revista Topos: International Review of Landscape, 2005), https://d3pcsg2wjq9izr.cloudfront.net/files/19643/articles/5873/aatopos51.pdf, 19.
[25] "James Corner Field Operations," New York Architects, accessed February 3, 2021, https://www.newyork-architects.com/james-corner-field-operations-new-york.

Draft Master Plan

In an article titled "*Lifescape – Fresh Kills Parkland*," James Corner describes the design process when creating the master plan. He writes:

> …rather than erasing the past (landfill), on the one hand, or recreating a long-lost environment (nature), on the other hand, Lifescape instead proposes a growth emergence from past and present conditions toward a new and unique future. The result will be a synthetic, integrative nature, simultaneously wild and cultivated, emergent and engineered. In this way, the plan seeks to change how we experience reclaimed landscapes in the city and demonstrate new potentials for closed landfills and other post-industrial sites around the world.[26]

This park development would not have been possible without New York City Mayor Michael R. Bloomberg, who has supported and funded the project. In the draft master plan, the mayor writes,

> As we embark on the development of this site, we would like to offer Staten Islanders and all New Yorkers a glimpse of the many ways we can re-imagine this extraordinary open space. Fresh Kills Park will be a significant addition to New York City's portfolio of parks, providing waterfront access and innovative recreational uses.[27]

Former Staten Island Borough President James P. Molinaro writes,

> First and foremost, this master plan embodies a most important ending for us: that Fresh Kills will never reopen as New York City's garbage disposal facility. Staten Islanders can finally exhale and vacate from within all those remaining pent-up fears—large and small, real and imagined, from the personal to the community-based—that for two generations both defined and stigmatized Staten Island to the nation and the world as someplace you did not want to be in or even near.[28]
> - James P. Molinaro, Staten Island Borough President (2002-2013)

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[26] James Corner, "Lifescape–Fresh Kills Parkland" (Revista Topos: International Review of Landscape, 2005), https://d3pcsg2wjq9izr.cloudfront.net/files/19643/articles/5873/aatopos51.pdf, 21.
[27] Field Operations, "Fresh Kills Park: Lifescape Draft Master Plan," Freshkills Park, 2004, https://freshkillspark.org/wp-content/uploads/2013/07/Fresh-Kills-Park-Draft-Master-Plan.pdf, 2.
[28] Ibid.

To rebrand Fresh Kills, the spacing between Fresh Kills was removed and is now spelled Freshkills Park. When referring to past landfill operations or referring to the waterways, it is spelled as Fresh Kills. This decision was not made until after the development of the draft master plan, and many documents will show the spelling both ways.

The draft master plan comprises three coordinated systems to organize this large landscape: program, habitat, and circulation. The program includes social, cultural, and physical activities such as sports facilities, biking, canoeing, cycling, birding, nature trails, education, community events, and public art. The habitat system includes wildlife habitat, bird and plant communities, and natural recreational settings such as marshes, prairies, forests, woodland, and barrens.[29]

In terms of circulation, the design includes driving paths, walking paths, bikeways, running trails, and boating.[30] Of the 2,200 acres, only 45% of the original Fresh Kills is landfill, while 55% is made up of the waterways, meadows and woodland.[31] Interestingly the draft master plan explains that although the landfill caused much of disturbance for Staten Island for many years, the landfill has preserved much of the land from development sprawl and fragmentation, which now allows a park to develop in such a large area.[32]

The park will be opening up in phases over the next 30 years, with an anticipated opening of the entire park in 2036.[33] The Freshkills Park draft master plan has the park

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[29] "Fresh Kills Park Project," City of New York, accessed December 15, 2020, https://www1.nyc.gov/assets/planning/download/pdf/plans/fkl/fkl.pdf, 23.
[30] Ibid.
[31] Field Operations, "Fresh Kills Park: Lifescape Draft Master Plan," Freshkills Park, 2004, https://freshkillspark.org/wp-content/uploads/2013/07/Fresh-Kills-Park-Draft-Master-Plan.pdf, 8.
[32] Ibid.
[33] Ibid, 51.

divided into five major areas (figure 8): North Park, South Park, West Park, East Park, and the Confluence. Each of the parks represents the four former landfill mounds. The confluence is located in the center of the site, meeting at the intersection of the four parks and waterways.

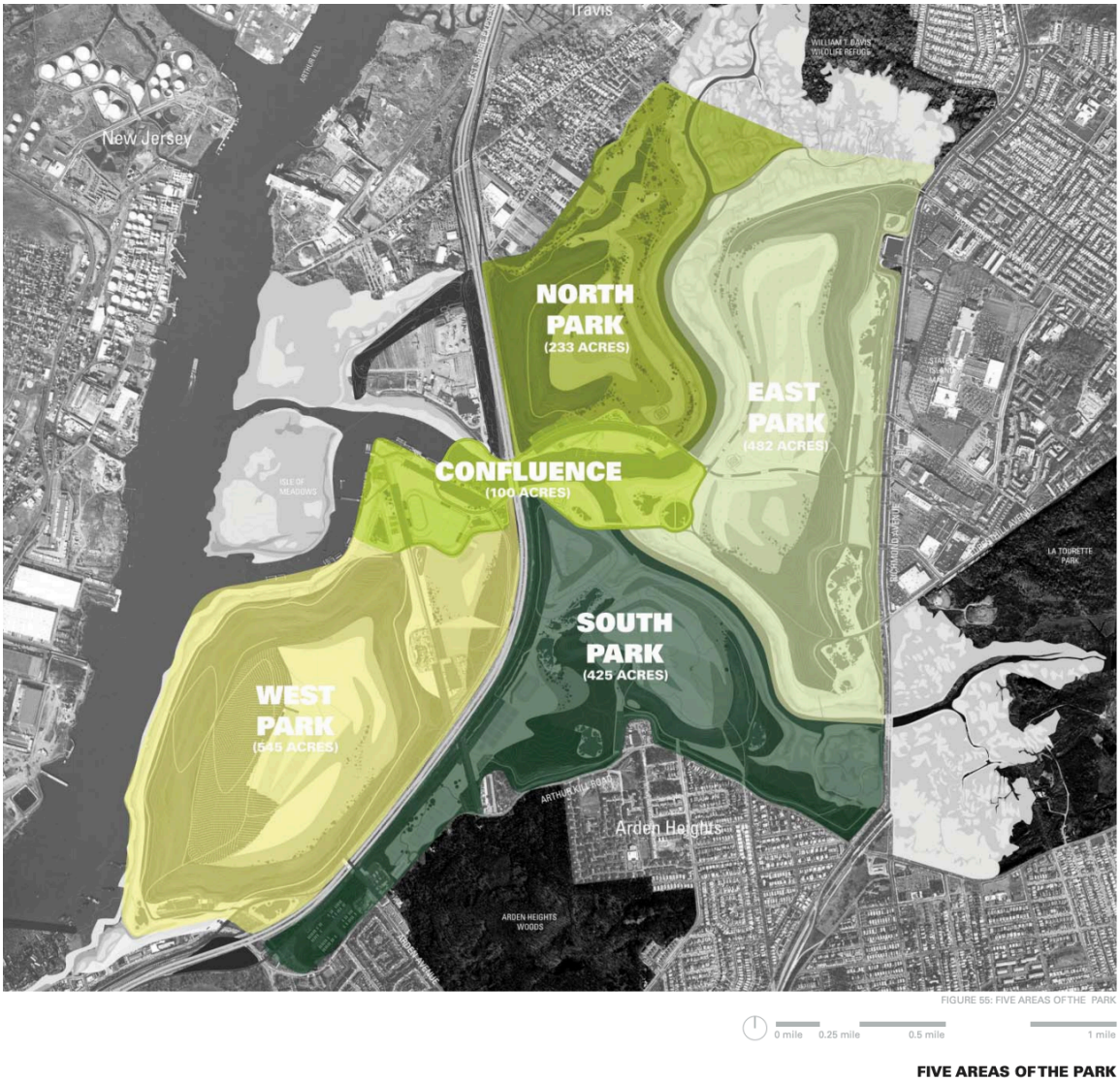

Figure 8. The 5 major areas of Freshkills Park. Source: Field Operations, from https://freshkillspark.org/wp-content/uploads/2013/07/Fresh-Kills-Park-Draft-Master-Plan.pdf.

North Park is located just near the Travis neighborhood. Much of North Park's design is mainly natural settings, including overlooking towers to the William T. Davis

Wildlife Refuge, picnicking fishing, and walking and biking paths. North Park incorporates a neighborhood anchor park in the Travis area called Schmul Park. North Park is measured at 233-acres and incorporates educational wetlands and an eco-educational center.[34] As part of this master's thesis, the design proposal described in chapter 5 is located on just North Park.

South Park is measured at 425-acres and is designed as a more active space, including athletic fields like soccer fields and mountain biking.[35] Part of South Park is a neighborhood anchor park in Arden Heights called the Owl Hollow Soccer Fields, and is currently open to the public. East Park is located along Richmond Avenue, and measures at 482-acres. East Park is comprised of specialized programming and natural areas.[36] East Park includes Freshwater marshes, a golf course, trails, berm overlooks, boat docks, and public art installations.[37] Along Richmond avenue is another anchor park currently open to the public called the New Springville Greenway.

West Park is the largest park, measuring at 545-acres. West Park has lightly programmed natural areas and trails. Part of West Park is an earthwork monument as a memorial for the lives lost in the September 11th, 2001 attack on the World Trade Center.[38] This earthwork monument will be located on West Park, right above where the debris and remains were brought from the September 11th attack. The earthwork

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[34] Field Operations, "Fresh Kills Park: Lifescape Draft Master Plan," Freshkills Park, 2004, https://freshkillspark.org/wp-content/uploads/2013/07/Fresh-Kills-Park-Draft-Master-Plan.pdf, 9.
[35] Ibid.
[36] Ibid.
[37] Ibid.
[38] Ibid.

monument is a direct replication of the twin towers, measuring at the buildings' exact height and width, laying horizontally on the ground as a landform (figure 10).[39]

The Confluence measures at 100-acres and is that central area where all the parks and waterways meet. The confluence is the programmatic core and the waterfront recreation hub, including a creek landing, a terrace, marshes, and sunken forests.[40]

Figure 9. The 5 areas of the park illustrated on the draft master plan. Source: Field Operations, from https://freshkillspark.org/wp-content/uploads/2013/07/Fresh-Kills-Park-Draft-Master-Plan.pdf.

Figure 10. The September 11th earthwork monument as part of the draft master plan. Source: Field Operations, from https://freshkillspark.org/wp-content/uploads/2013/07/Fresh-Kills-Park-Draft-Master-Plan.pdf.

[39] James Corner, "Lifescape–Fresh Kills Parkland" (Revista Topos: International Review of Landscape, 2005), https://d3pcsg2wjq9izr.cloudfront.net/files/19643/articles/5873/aatopos51.pdf, 20.
[40] Field Operations, "Fresh Kills Park: Lifescape Draft Master Plan," Freshkills Park, 2004, https://freshkillspark.org/wp-content/uploads/2013/07/Fresh-Kills-Park-Draft-Master-Plan.pdf, 9.

Anchor Parks

Freshkills Park is opening from the outside-in, and the anchor parks, which are located in neighborhoods of the nearby communities, took precedent for opening.[41] The Freshkills anchor parks include: Schmul Park, Owl Hollow Soccer Fields, and the New Springville Greenway (figure 11). All of the anchor parks are not on former landfill mounds, but rather adjacent to Freshkills Park, and are all open to the public.

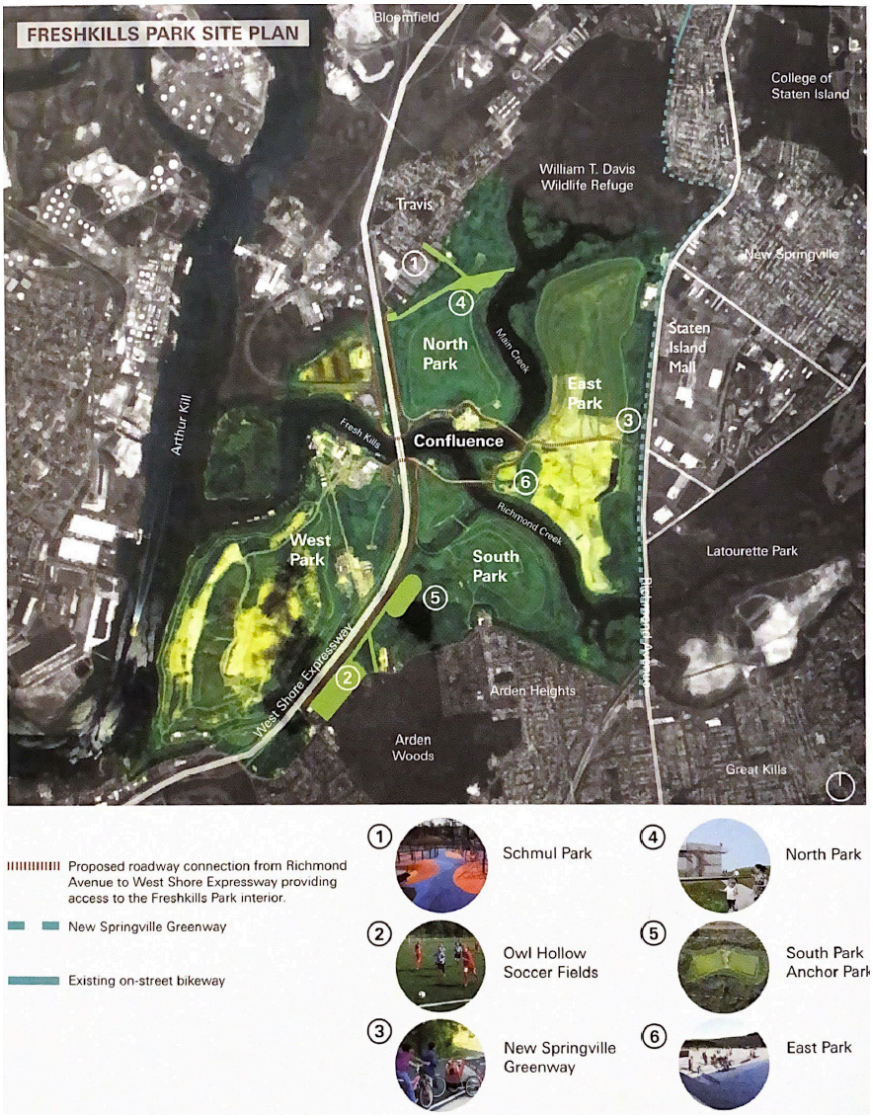

Figure 11. Freshkills Park along with the nearby anchor parks. Source: Freshkills Park Alliance from site tour guide pamphlet.

[41] "The Park Plan," Freshkills Park, May 18, 2020, https://freshkillspark.org/the-park/the-park-plan.

Schmul Park

Schmul Park is located in the Travis neighborhood, connecting to the northern part of North Park on Wild Avenue, Pearson Street, and Melvin Avenue. Schmul Park is right near the location of the proposed design described in chapter 5. Schmul Park was redesigned in 2012 by James Corner Field Operations. Schmul Park measures at 8.5 acres, and the renovations include colorful rubber-clad play mounds, porous surfacing, playground features and many planting beds (figure 12). Also part of Schmul Park are athletic fields like basketball courts, handball courts, and a baseball field. Since Schmul Park is connected to North Park, this will eventually become the main entrance to Freshkills North Park.[42]

Figure 12. Freshkills anchor park Schmul Park in the Travis neighborhood. Image by author, March 2021.

[42] "Schmul Park - Completed 2012," Freshkills Park, December 6, 2018, https://freshkillspark.org/design-construction/schmul-park.

Figure 13. Map showing Schmul Park and Freshkills North Park. Source: City of New York, OpenStreetMap.

Owl Hollow Soccer Fields

The Owl Hollow Soccer Fields is located in Arden Heights, nearby the Arden Heights Woods. The Owl Hollow Soccer Fields are located on the East side of the West Shore Expressway and it located closest to the Freshkills South Park. The Owl Hollow Soccer Fields opened in the spring of 2013 and includes four turf soccer fields and a pedestrian walkway that wraps around the soccer fields' perimeter.[43] Owl Hollow Fields also include stormwater detention basins and berms on the edges of the site.

[43] "Owl Hollow Fields - Completed 2013," Freshkills Park, October 17, 2018, https://freshkillspark.org/design-construction/owl-hollow-fields.


Figure 14. (Left) The soccer fields at Owl Hollow Fields. Image by author, March 2021.
Figure 15. (Right) View of west mound from the Owl Hollow Fields parking lot. Image by author, March 2021.

New Springville Greenway

The most recent anchor park to open is the New Springville Greenway in the summer of 2015. The New Springville Greenway is a 3.2 mile that runs from north to south on the eastern-most part of Freshkills East Park, parallel to Richmond Avenue and across from the Staten Island Mall and shopping districts.[44] The greenway includes improvements to the stormwater management systems and sustainable drainage systems.[45] The greenway includes biking and walking paths and overlook areas to the William T. Davis Wildlife Refuge. Much of the wildlife refuge is made up of marshes and woodland areas where many different types of wildlife nest and forage.

[44] "New Springville Greenway - Completed 2015," Freshkills Park, October 17, 2018, https://freshkillspark.org/design-construction/new-springville-greenway.
[45] Ibid.

Figure 16. Two images of the New Springville Greenway. Images by author, March 2021.

Figure 17. Locations of Schmul Park, Freshkills North Park, and William T. Davis Wildlife Refuge. Source: NYC Department of Parks & Recreation, from http://www.nycgovparks.org/sub_your_park/fresh_kills_park/pdf/North_Park_PublicPresentation041708.pdf.

The next construction of Freshkills is North Park phase 1. This is the first former landfill site opening at Freshkills Park. Originally this phase was supposed to open in the spring of 2020, but due to the COVID-19 pandemic, it has been postponed to the summer of 2021. North Park phase 1 measures at about 21-acres, and includes pathways, picnic lawns, a seed farm, a comfort station, and a bird tower and overlook deck with views of

the William T. Davis Wildlife Refuge and the Fresh Kills main creek.[46] The entrance to this part of Freshkills Park will be connecting to the existing anchor park Schmul Park, shown in figure 20. Based on the NYC Parks Capital Project Tracker, North Park phase 1 is 55% complete in the construction phase as of March 15th, 2021.[47]

Figure 18. Renderings showing North Park phase 1 proposal. Source: Field Operations, from https://freshkillspark.org/design-construction/north-park-phase-1.

[46] "North Park - In Construction," Freshkills Park, March 18, 2021, https://freshkillspark.org/design-construction/north-park-phase-1.
[47] "Freshkills North Park Pathway and Comfort Station Construction," Freshkills North Park Pathway and Comfort Station Construction : NYC Parks, accessed March 15, 2021, https://www.nycgovparks.org/planning-and-building/capital-project-tracker/project/4435.

Figure 19. Plan view showing North Park phase 1. Source: Field Operations, from https://freshkillspark.org/design-construction/north-park-phase-1

Figure 20. Entrance to Freshkills North Park from Schmul Park, anticipated opening in the summer 2021. Image by author, March 2021.

Freshkills Park Alliance

The Freshkills Park Alliance is a not-for-profit organization working with the City of New York to develop Freshkills Park.[48] The mission of the alliance is to "ensure the Park's evolution and continuing operation by raising necessary financial resources, promoting environmental research and ecological restoration, engaging advocates and volunteers, and sponsoring a broad range of recreational, cultural, and educational programs for the public."[49] The Freshkills Park Alliance hosts tours, events and art installations at the park. Since the park that is on former landfill is currently closed during construction, the alliance provides the opportunity to visit the park on scheduled program events to see the park develop overtime. Some of the typical events the alliance hosts in the year include kayak tours, family nature walks, photography events, discovery days, and volunteer cleaning/weeding events.

For the past year, I signed up for many of these events, including the nature walk, multiple photography events and a kayak tour. Due to the COVID-19 pandemic, many of these events were limited in participants to account for social distancing during the park tours. Many events have also adapted to online, such as the discovery days and opportunities to attend virtual field trips and presentations. For example, discovery day has changed to "Freshkills Park Virtual Discovery Week @ Home" which includes different events throughout the discovery week: Landfill-to-Park Monday, Arts & Culture Tuesday, Wildlife & Research Wednesday, STEAM Education Thursday, and Fitness &

[48] "The Alliance," Freshkills Park, May 18, 2020, https://freshkillspark.org/mission.
[49] Ibid.

Recreation Friday.[50] The family nature walks, photography events and kayak tours are still available in person.

Observational Studies

On September 17th, 2020, I attended the family nature walk event hosted by the Freshkills Park Alliance. This was my first time attending an event at Freshkills Park. I have read about Freshkills Park's development, but nothing compares to visiting and seeing it with my own eyes. I was moved to see the great work happening on such a large scale. The alliance supplied the visitors attending the event with binoculars, so I learned about various bird species migrating and nesting on the site. The tour focused on just North Park, and what was really fascinating was walking up north mound and seeing the breathtaking views from above. There are views of New Jersey, along with the rest of Staten Island, and even Manhattan (figure 21).

[50] "Freshkills Park Virtual Discovery Week @ Home," Freshkills Park, July 28, 2020, https://freshkillspark.org/discoveryweek.

Figure 21. View of the Manhattan skyline on North Park. Image by author, November 2020.

Figure 22. View of the Fresh Kills main creek from Freshkills North Park. Image by author, September 2020.

I attended two different photography events during the fall of 2020. The first tour was on September 23rd, 2020, and the second was on November 7th, 2020. Interestingly, many of the participants knew each other because they are all photographers who have been attended the events for many years. All participants brought their own photography equipment, and it was like a community of photographers who share a common interest and passion for Freshkills Park and photography. I spoke to a few participants, and some mentioned that they commute from Manhattan just to attend these photography events. At every stopping point throughout the park, we were free to explore the site and capture photographs on our own to fit with each person's interest at Freshkills Park. Some participants traveled up a mound, some traveled down to the waterway, and some participants captured photographs of the meadows. Each event had three stopping points, and ranged from North Park, South Park, and East Park. West Park was off access to the public due to the ongoing capping process at that mound. What I enjoyed the most about the "*Capturing Change Photography Tours*" was the flexibility to explore on your own during a designated time frame, which allowed me to visit different parts of the park that I wouldn't have been able to see on a nature walk event.

Figure 23. View of Freshkills South Park from East Park. Image by author, September 2020.

Figure 24. View at the top of Freshkills East Park. Image by author, September 2020.

On October 11th, 2020 the Freshkills Park alliance hosted a two-mile kayak tour at Fresh Kills main creek. The event was free and included all the needed equipment such as a kayak, paddle and life jacket. The alliance guided us from start to finish and made it so easy and fun. The employees taught us a lot about the park's ongoing development and general information about Freshkills.

We saw up close parts of the engineered landscape, tidal wetlands, and various birds soaring throughout the park. For a moment, I forgot that I was in Staten Island; there was a sense of peace paddling in the calm waters of Fresh Kills. Paddling through the kill surrounded by the mounds on all sides created a buffer for the surrounding neighborhoods and roadways, and all we were able to see and hear was nature. I brought my go-pro camera to record this extraordinary event. Overall, I enjoyed the event and enjoyed meeting other people who are just as excited as I am about Freshkills Park.

Figure 25. Kayak tour event hosted by the Freshkills Park Alliance. Image by author, October 2020.

Figure 26. Collage of various images at Freshkills Park. Images by author, 2020.

Chapter 3: Case Studies

The three case studies chosen were Gas Works Park, Brookfield Park, and Liberty State Park. Gas Works Park was chosen because this park was the first movement in America of a post-industrial site becoming a community asset and a public space. Brookfield Park was chosen because of its closeness to Freshkills Park and was also a former landfill just like Freshkills Park. Brookfield Park is located less than one mile from Freshkills Park and is currently open to the public. This landfill closed many years prior to Fresh Kills landfill closure, so investigating this site is important to understand the existing plant palette on the capped landfill. Liberty State Park is another post-industrial site located in Jersey City, New Jersey, and looking into this site is important because of its large untouched 250-acre site. Many species have re-colonized this contaminated area and are creating novel ecosystems. Liberty State Park and Brookfield Park are used to influence my thesis identifying plant species that can survive in these post-industrial sites to investigate at Freshkills Park. Gas Works Park helps with understanding the public's perception of the site and how people currently use this park.

Gas Works Park

Gas Works Park was the first to become a movement in America about embracing the historical past and industrial relics, and the first opportunity for a post-industrial landscape to be transformed into a public park in the United States.[51] Gas Works was a gasification plant called Seattle Gas Light Company until 1956, serving gas to the entire

[51] Thaisa Way, "University of Washington Press Blog," *University of Washington Press Blog* (blog), April 15, 2015, https://uwpressblog.com/2015/04/15/gas-works-park-a-brief-history-of-a-seattle-landmark/.

city for many years. Richard Haag, a landscape architect, was born in Seattle and became known for the reclamation of Gas Works Park.[52]

Upon the closing of Gas Works, the site became a toxic wasteland. Due to the proximity of Lake Union and residential neighborhoods, Richard Haag knew the site would be a perfect location for creating a park for the community.[53] Between 1956 and 1975, there was much work to be done to open Gas Works Park to ensure the safety of visitors to this post-industrial landscape.[54] Measuring at 19-acres, the park officially opened in 1975 (figure 27).

Figure 27. Gas Works Park today. Image by Friends of Gas Works Park, from https://fogwp.org.

This project sets an example for other sites throughout the United States that have the potential to become public spaces while also preserving the historical relics of an industrial site and his embrace of the unique historic attributes it as part of the vernacular

[52] Thaisa Way, "University of Washington Press Blog," *University of Washington Press Blog* (blog), April 15, 2015, https://uwpressblog.com/2015/04/15/gas-works-park-a-brief-history-of-a-seattle-landmark/.
[53] Ibid.
[54] Ibid.

landscape. Instead of covering up or removing the site's history, he made it the central focus of the park, preserving the past landscape and incorporating it into the present. Thaisa Way, an urban landscape historian at the University of Washington states, "We can cover things up and pretend we never made mistakes before, or we can take our mistakes and try to address them and also acknowledge them in the landscape."[55]

Gas Works Park is currently used for various activities. Accessibility to the industrial structure is limited due to safety issues. One of the popular attractions is the Kite Hill, which was created to provide the space to dump and bury contaminants and then capped so people could use and sit on the hill (figure 28).[56] Thinking about Kite Hill at Gas Works Park, and the mounds at Freshkills Park, these hills provide incredible views of the surrounding city and different experiences walking around the park.

Gas Works Park is widely used by the community and has economically driven this area of Seattle. Richard Heymann writes, "It was on the grounds of the Gas Works that Seattle made its social and spatial turn to a 'postindustrial city.' Gas Works Park was both produced by and helped to produce the economic, social, and spatial restructuring of Seattle in the 1970s."[57]

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[55] Hallie Golden, "Gas Works Park Is a Beautiful Way to Remember a Toxic Past," Curbed Seattle (Curbed Seattle, April 12, 2019), https://seattle.curbed.com/2019/4/12/18306264/gas-works-park-environmental-history.
[56] Ibid.
[57] Michael Bennett, David W. Teague, and Richard Heymann, "Postindustrial Park or Bourgeois Playground? Preservation and Urban Restructuring at Seattle's Gas Works Park.," in *The Nature of Cities: Ecocriticism and Urban Environments* (Tucson, AZ: University of Arizona Press, 1999), pp. 111-134, 114.

Figure 28. Gas Works Park today. Image by Richard Haag, from https://tclf.org/landscapes/gas-works-park.

The paradigm shift of having the industrial relics as part of Gas Works Park creates a vernacular landscape for the Seattle community. The use of a capped mound at the park relates to Freshkills Park closely. Although both sites have different industrial pasts, both sites make use of the capped mound as an industrial relic. The capped mounds are vernacular landscapes and an industrial relic, both by creating social spaces on the mounds and by embracing its industrial past in the future. A once neglected landscape became utilized and an embraced space by the public and set the groundwork for other post-industrial sites like Freshkills Park. Industry is never considered vernacular, which makes projects like Gas Works Park a true paradigm shift, and a shift in the public's perception of post-industrial landscapes.

Brookfield Park

Brookfield Park is a former landfill located in Staten Island that is now a 260-acre park in the Great Kills area.[58] Although much smaller, Brookfield Park is less than 1 mile away from Freshkills Park (figure 29). Designer John McLaughlin from the Department of Environmental Protection's Bureau of Environmental Planning & Analysis states,

> It's not about planting individual species. It's about putting those communities and ecosystems back and putting as much of the scaffolding as you can. You can't put the entire system back as it once was, but you can put back the fundamental beams that support the community.[59]
> -John McLaughlin, Managing Director
> DEP's Bureau of Environmental Planning & Analysis

Brookfield Park is located along Arthur Kill Road, at the intersection of Brookfield Avenue and Arthur Kill Road. Brookfield landfill was in operation from 1966 to 1980, and accepted household waste like Fresh Kills landfill.[60] Brookfield Park officially opened in 2017 to the public after many years of land remediation by the New York City Department of Environmental Protection.[61] The design incorporates many native plantings and more than 17,000 trees and 76,000 plants were planted at the site.[62] The park consists of 4 different paths and hiking trails with views of the wetlands, marshes, meadows, ponds and rivers.[63]

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[58] "Brookfield Park," Brookfield Park : NYC Parks, accessed January 7, 2021, https://www.nycgovparks.org/parks/brookfield-park.
[59] Nathan Kensinger, "Exploring Staten Island's Newest Park, a Toxic Dump Turned Wetlands Habitat," Curbed NY (Curbed NY, December 21, 2017), https://ny.curbed.com/2017/12/21/16804472/staten-island-brookfield-park-landfill-photo-essay.
[60] "From Brookfield Landfill to Brookfield Park," Freshkills Park, November 5, 2018, https://freshkillspark.org/blog/from-brookfield-landfill-to-brookfield-park.
[61] Ibid.
[62] "Brookfield Park," Brookfield Park : NYC Parks, accessed January 7, 2021, https://www.nycgovparks.org/parks/brookfield-park.
[63] Ibid.

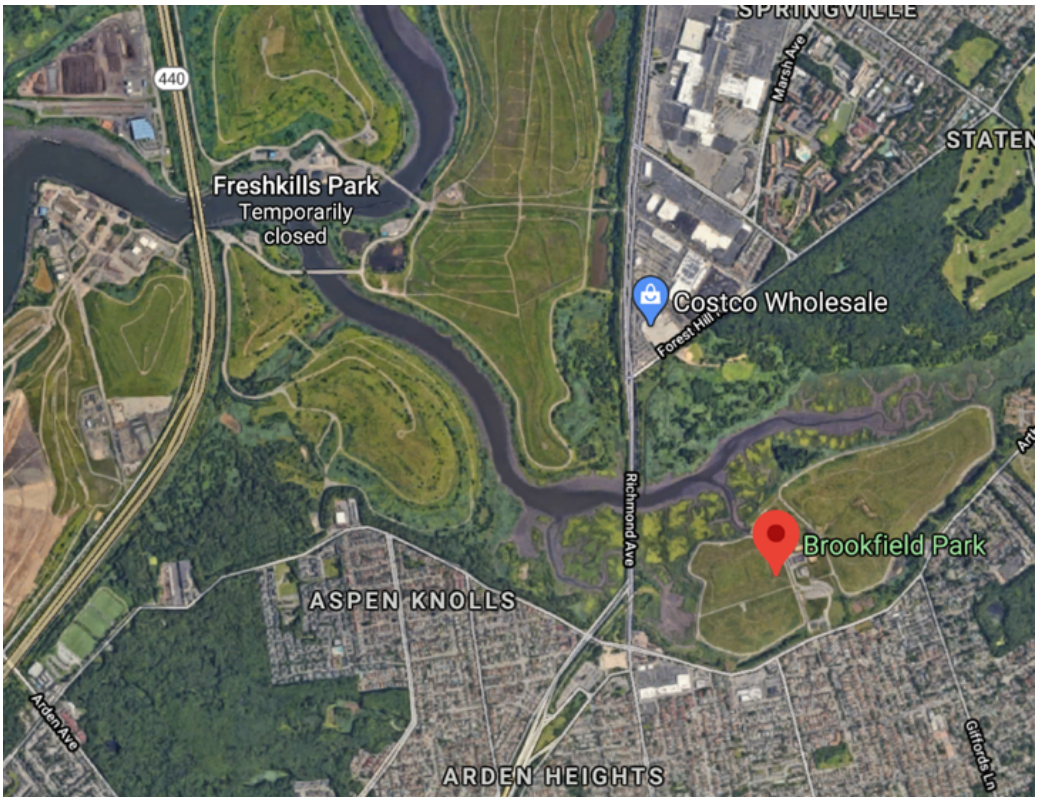

Figure 29. Brookfield Park and Freshkills Park in Staten Island, New York. Aerial source: Google Maps, 2020.

In 1985, shortly after the landfill closure, a study was conducted at Brookfield Park to see if woody plant roots penetrate a clay-lined landfill cap.[64] Regulatory agencies are hesitant to permit trees on capped landfills with the worry of breaking the capped liner, so this study investigated that theory.[65] Within the first few years after the closure, woody plant species were identified on the site as natural colonization from a nearby native woodland, even though the above-capping soil was very shallow.[66] In 1992, the study excavated 13 different species, equating to 30 individual trees and shrubs to investigate the below ground root system.

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[64] George R. Robinson and Steven N. Handel, "Woody Plant Roots Fail to Penetrate a Clay-Lined Landfill: Managment Implications," *Environmental Management* 19, no. 1 (1995): pp. 57-64, https://doi.org/10.1007/bf02472003, 57.
[65] Ibid.
[66] Ibid, 58.

The six tree species excavated at the site include Grey Birch (*Betula populifolia*), Sweet Gum (*Liquidambar styraciflua*), Mulberry (*Morus sp*.), Black Cherry (*Prunus serotina*), Pin Oak (*Quercus palustris*), and Black Locust (*Robinia pseudoacacia*). The six shrub species excavated include Groundsel Bush (*Baccharis halimifolia*), Buttonbush (*Cephalanthus occidentalis*), Bayberry (*Myrica pensylvanica*), Smooth Sumac (*Rhus glabra*), Elderberry (*Sambucus canadensis*), and Arrowwood (*Viburnum dentatum*). All 30 excavated trees and shrubs had extremely shallow root plates indicating that these trees adapted their root structure to the capped environment.[67] This finding suggests that these species can adapt to growing on a capped landfill without penetrating or damaging the cap. These species shown to survive at Brookfield Park, which is nearby Freshkills Park and has a similar industrial background opens up a research opportunity to explore these species and see the survival rate at Freshkills.

[67] George R. Robinson and Steven N. Handel, "Woody Plant Roots Fail to Penetrate a Clay-Lined Landfill: Managment Implications," *Environmental Management* 19, no. 1 (1995): pp. 57-64, https://doi.org/10.1007/bf02472003, 59.

Figure 30. Brookfield Park in Staten Island, New York. Image by author, March 2021.

Figure 31. Brookfield Park in Staten Island, New York. Image by author, March 2021.

Liberty State Park

Liberty State Park is located in Jersey City, New Jersey and is known for its breathtaking views of the Manhattan skyline, the Statue of Liberty and Ellis Island, bringing over four million guests a year to this park.[68] Prior to becoming a park, Liberty State Park was made up of mud flats and salt marshes.[69] The marshes were then filled, just like Freshkills Park, to create a railroad yard. In 1967, the rail yard was discontinued and abandoned, until the State of New Jersey bought the land and started to develop into what we know of today as Liberty State Park.[70] The New Jersey Division of Park and Forestry now manage the site.[71]

Much of this 1,200-acre park is restricted from the public due to contamination and other harmful chemicals in the soil. The part that is accessible to the public and is developed is toward the waterfront for the views and access to the ferry terminals. Currently at the site are walkways and paths, the Liberty Science Center, Interpretive Center, Caven Point Pier, Liberty Landing Marina, the historical Central Railroad of New Jersey Terminal building and ferry terminals.[72]

Since the opening of Liberty State Park in 1976, much of the park was not restored which leaves a huge untouched landscape of about 250-acres for over 50 years. This untouched contaminated landscape has been re-colonized by many unique plant

[68] "Liberty State Park," Visit NJ (Department of State, Division of Travel and Tourism, September 25, 2020), https://www.visitnj.org/article/liberty-state-park.
[69] U.S. Army Corps of Engineers New York District, "Liberty State Park Environmental Resources Inventory," *Hudson-Raritan Estuary Environmental Restoration Study* (2004), 2.
[70] Ibid, 3.
[71] Ibid.
[72] Ibid.

communities creating novel ecosystems.[73] Researchers like Dr. Frank Gallagher have been documenting these novel 4th nature ecosystems at Liberty State Park. He states, "Our research has documented the relationship between soil metal load and plant species distribution, primary productivity, diversity, and assemblage trajectory."[74]

Within the undisturbed site, a minimum of 184 plant species were identified and the dominant terrestrial successional hardwood communities include Quaking Aspen (*Populus tremuloidies*), Eastern Cottonwood (*Populus deltoides*), Grey Birch (*Betula populifolia*), Winged Sumac (*Rhus copallina*), Steeplebush (*Spiraea tomentosa*).[75] The dominant species within the successional shrubland include Cut-Leaved Blackberry (*Rubus laciniata*), Smooth Sumac (*Rhua glabra*), Northern Bayberry (*Myrica pensylvanica*), Canada Goldenrod (*Solidago canadensis*), Common Reed (*Phragmites australis*), and Japanese Knotweed (*Polygonum cuspidatum*).[76] These are voluntary species at Liberty State Park within the undisturbed landscape and can help with identifying potential species to experiment with at Freshkills Park during its beginning stages of park development, which can then help inform the future plant palette for all of Freshkills Park.

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[73] Frank Gallagher, "Liberty State Park: A Study on Contamination and Redevelopment," *Landscape Architect and Specifier News*, January 2019, pp. 66-69, https://lsc-pagepro.mydigitalpublication.com/publication/?m=61306&i=612082&p=67, 68.
[74] Ibid.
[75] U.S. Army Corps of Engineers New York District, "Liberty State Park Environmental Resources Inventory," *Hudson-Raritan Estuary Environmental Restoration Study* (2004), 12.
[76] Ibid.

Figure 32. Liberty State Park ecological restoration site. Image by author, October 2019.

Figure 33. No trespassing sign in the restoration site at Liberty State Park. Image by author, October 2019.

Chapter 4: Greenhouse Bench Study

This study was conducted as part of the Center for Resilient Landscapes fellowship. Grey Birch (*Betula populifolia*) often colonizes urban green areas and old fields and is found to be the dominant tree species at Liberty State Park, New Jersey at 35% cover.[77] One of the research questions in this thesis asked if locally sourced and brownfield-adapted plant material survive at Freshkills Park. While prevalent in abandoned rail sites, this explored its ability to survive and germinate in the Freshkills soil. This greenhouse bench study is modeled after earlier work entitled, "Morphological Variation in the Seed of Grey Birch (*Betula populifolia*): The Effects of Soil-Metal Contamination."[78]

Procedure

In the Fall of 2019, about 5 gallons of soil was collected from Freshkills Park, Liberty State Park Site 14, Liberty State Park Site 48, and Lambert LM-HP professional growing media greenhouse soil. The Freshkills Park soil was collected from three random locations within the five-acre "legacy dump" existing afforestation research site on North Park near Schmul Park. The Liberty State Park soil was collected from two different areas – site 14 and site 48. Liberty State Park site 14 is a higher-than-normal metal concentration site within the soil.[79] Within each of the two sites at Liberty State Park,

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[77] Frank Gallagher et al., "Morphological Variation in the Seed of Gray Birch (Betula Populifolia): The Effects of Soil-Metal Contamination" 6 (n.d.), http://www.urbanhabitats.org/v06n01/graybirch_full.html#cite9.
[78] Ibid.
[79] Frank J. Gallagher et al., "Soil Metal Concentrations and Vegetative Assemblage Structure in an Urban Brownfield," *Environmental Pollution* 153, no. 2 (2008): pp. 351-361, https://doi.org/10.1016/j.envpol.2007.08.011, 354.

three random locations were also chosen to collect the soil. The Lambert LM-HP Professional Growing Media – High Porosity soil was collected from the New Jersey Agricultural Experiment Station (NJAES) greenhouse and used as a control in this experiment.

The soil was sifted manually to remove twigs and other objects, and then dried for one week (figure 34, number 1). The soil from the 3 random sample plots from each site and the professional growing media was then mixed thoroughly for homogeneity. The soil was then sent to the Rutgers Soil Testing Laboratory through the New Jersey Agricultural Experiment Station to find out the macronutrients, micronutrients, and pH within the different soils (figure 34, number 2).

In January 2020, Grey Birch (*Betula populifolia*) catkins were collected from Liberty State Park site 14 & 48. The seeds were stripped from multiple catkins and the seeds were separated from the bracts (figure 34, parts 3 and 4). Eight-hundred seeds were selected of small, medium and large seeds, and mixed. The seeds were then stored in a refrigerator (cold stratified) for about 20 weeks.

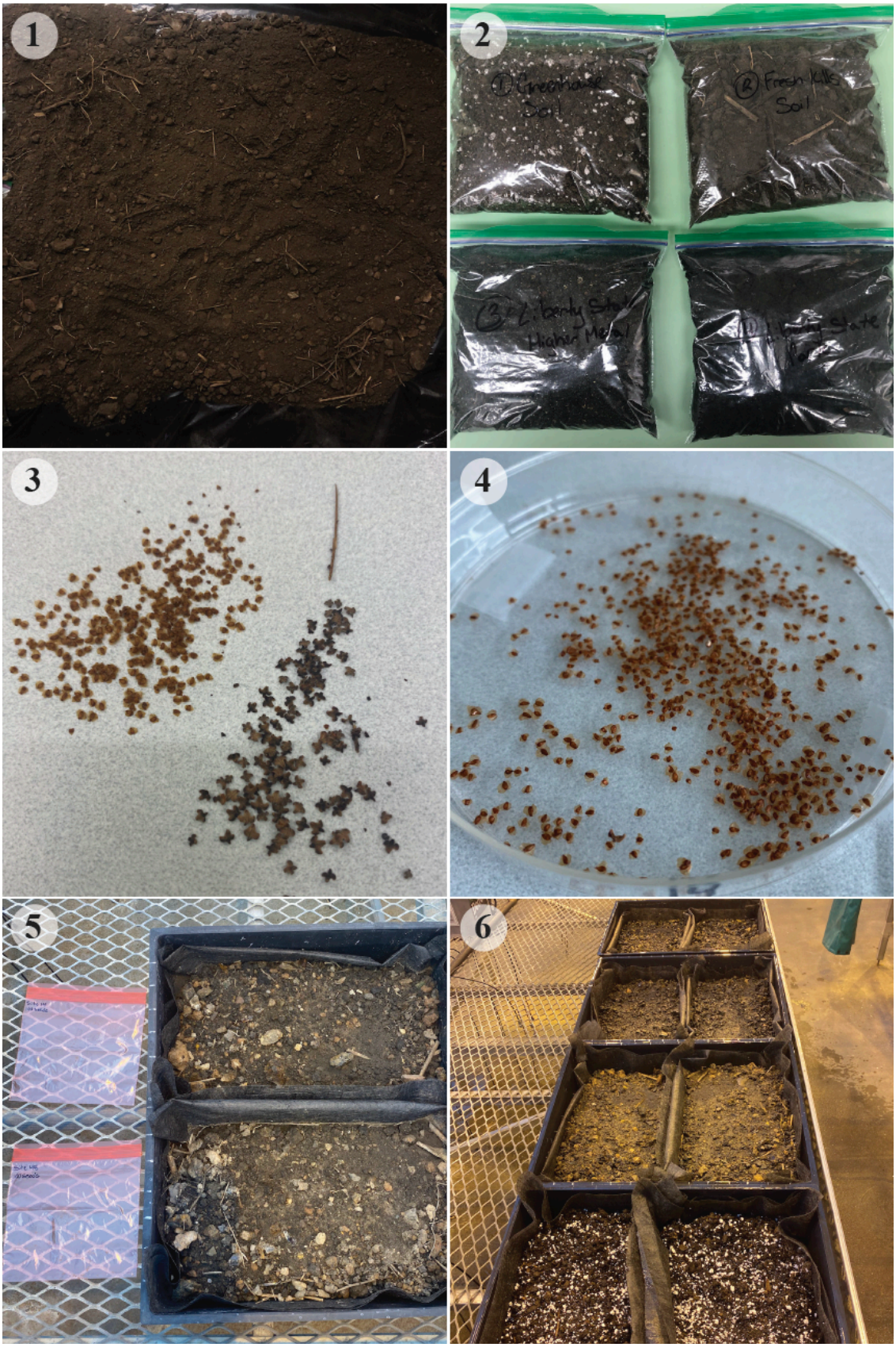

Figure 34. Different components of the bench study. Images by author, summer 2020.

Soil Testing Laboratory Results

The following charts compare the pH, macronutrients, and micronutrients based on the Rutgers Soil Testing Laboratory results. The pH of the Freshkills Park soil and both of the Liberty State Park soils are characterized as "strongly acidic and is suitable for acid-loving ornamentals but too acidic for most other plants" on the soil report. The full soil testing lab report is available in the appendix.

pH	Lambert LM-HP Professional Growing Media	Freshkills Park Soil "Legacy Dump" Site	Liberty State Park (LSP) Site 48 Soil	Liberty State Park Site 14 Soil
pH	6.12	5.58	5.14	5.31

Table 1. pH of the various soil types.

Macronutrients	Lambert LM-HP Professional Growing Media	Freshkills Park Soil "Legacy Dump" Site	Liberty State Park (LSP) Site 48 Soil	Liberty State Park Site 14 Soil
Phosphorus(P)	Opt.	Opt.	Below opt.	Below opt.
Potassium(K)	Below opt.	Opt.	Below opt.	Below opt.
Magnesium(Mg)	Below opt.	Above opt.	Opt.	Opt.
Calcium(Ca)	Below opt.	Above opt.	Below opt.	Below opt.

Table 2. Macronutrients of the various soil types.

Micronutrients	Lambert LM-HP Professional Growing Media	Freshkills Park Soil "Legacy Dump" Site	Liberty State Park (LSP) Site 48 Soil	Liberty State Park Site 14 Soil
Zinc(Zn)	Adequate	High	Adequate	Adequate
Copper(Cu)	Adequate	High	Adequate	Adequate
Manganese(Mn)	Adequate	Adequate	Adequate	Adequate
Boron(B)	Adequate	Adequate	Low	Adequate
Iron(Fe)	Adequate	High	High	High

Table 3. Micronutrients of the various soil types.

Bench Study

The bench study was conducted from June 5th, 2020 to July 30th, 2020, at the NJAES Research Greenhouse to monitor the germination rates of the Grey Birch (*Betula populifolia*). One hundred catkin seeds were selected per soil plot equating to 8 plots, and 800 seeds. There are 4 soil types: Freshkills Park, Liberty State Park site 14, Liberty State Park site 48, and Lambert LM-HP professional growing media greenhouse soil and two different seed sites for each soil type: Liberty State Park site 14 and site 48 (figure 35). The temperature of the NJAES greenhouse was between 72°F - 80°F during the day, and 70°F - 73°F at night, with an average day length of 16 hours per day. The plots were watered twice a week to make sure the soil was moist.

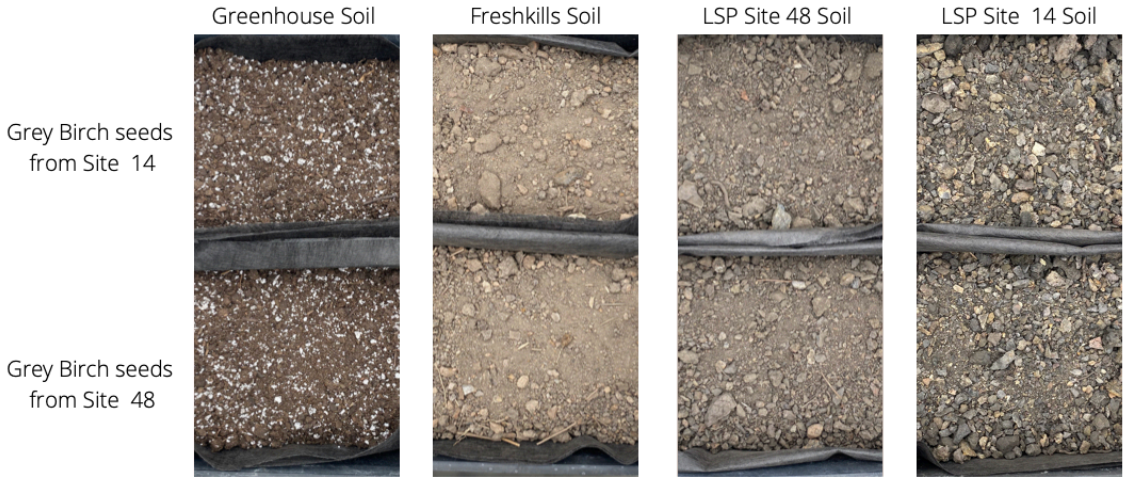

Figure 35. Beginning of the study. Image by author, June 5th, 2020.

Throughout the study, many other species grew due to seeds in the soil. Using my plant knowledge and assistance with the "PictureThis" plant identification application, table 4 and figure 36 shows the species found growing in the soil plots.

Lambert LM-HP Growing Media	Freshkills Park Soil "Legacy Dump" Site	Liberty State Park (LSP) Site 48 Soil	Liberty State Park Site 14 Soil
	Common Mugwort *Artemisia vulgaris*	Viviparous Spikerush *Eleocharis vivipara*	Viviparous Spikerush *Eleocharis vivipara*
	Hairy Bittercress *Cardamine hirsuta*	Neckweed *Veronica peregrina*	Neckweed *Veronica peregrina*
	Creeping Woodsorrel *Oxalis corniculata*	Peppervine *Nekemias arborea*	Peppervine *Nekemias arborea*
	Virginia Springbeauty *Claytonia virginica*	Common Foxglove *Digitalis purpurea*	Common Foxglove *Digitalis purpurea*
	Tree of Heaven *Ailanthus altissima*	Brome Grasses *Bromus sp.*	Brome Grasses *Bromus sp.*
		Carpetweed *Mollugo verticillata*	Tree of Heaven *Ailanthus altissima*
		Fragrant Sumac *Rhus aromatica*	Lamb's Quarters *Chenopodium album*

Table 4. Various species found growing in the soils during the study.

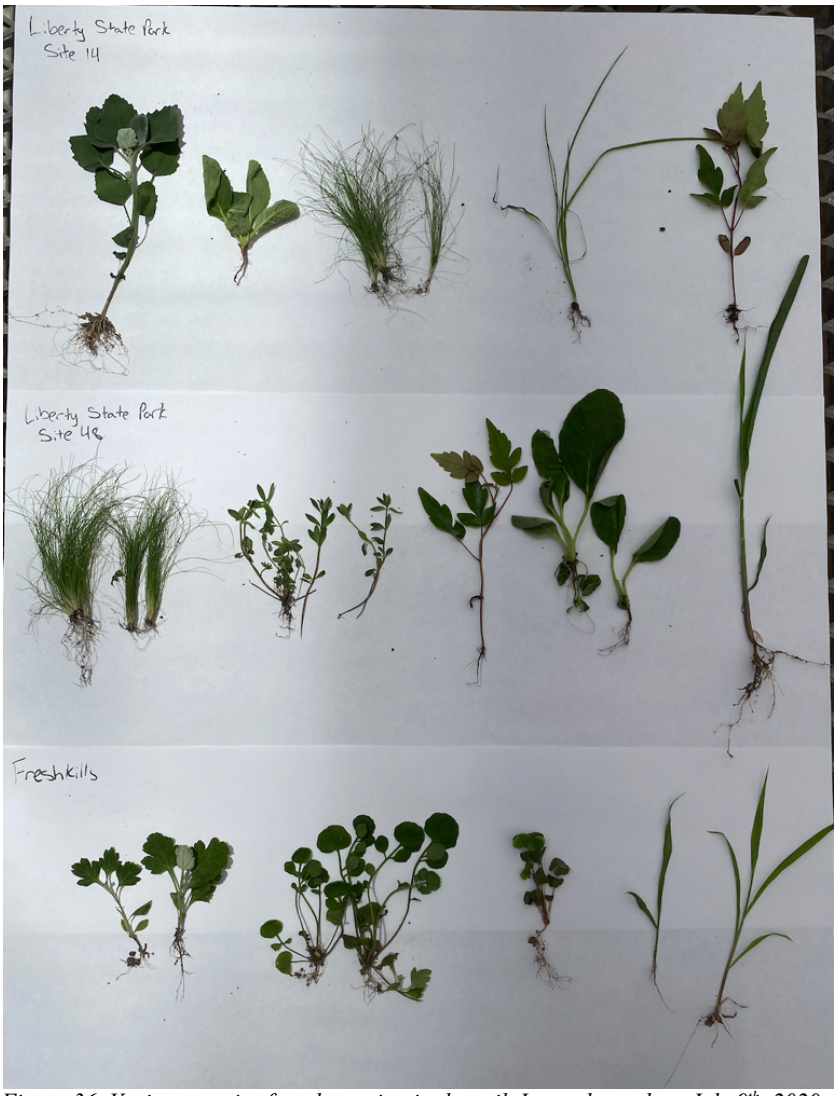

Figure 36. Various species found growing in the soil. Image by author, July 9th, 2020.

All of the species listed in table 4 and shown in figure 36 were pulled out of the plots midway through the study to avoid competition and interfere with the growth of the Grey Birch (*Betula populifolia*).

Results

Table 5 shows the final results of how many Grey Birch (*Betula populifolia*) seedlings (dead and alive) were identified in the soil plots.

	Lambert LM-HP Professional Growing Media	Freshkills Park Soil "Legacy Dump" Site	Liberty State Park (LSP) Site 48 Soil	Liberty State Park Site 14 Soil
Seeds from LSP Site 14	None found	None found	**Seedlings: 3** Largest: 2" Smallest: $^{3}/_{4}$"	None found
Seeds from LSP Site 48	**Seedlings: 28** Largest: 11.5" Smallest: 1.2"	None found	**Seedlings: 1** Measurement: 1"	**Seedlings: 3** Largest: $^{3}/_{4}$" Smallest: $^{5}/_{16}$"

Table 5. Final results of the bench study showing how many Grey Birch seedlings grew in the various soils.

Figure 37. Final results of the bench study. Image by author, July 30th, 2020.


Figure 38. (Left) Grey Birch seedlings in the professional growing media. Image by author, July 30th, 2020.
Figure 39. (Right) All seedlings found at the end of the study. Image by author, July 30th, 2020.

Conclusion

- The results of the study showed that very little Grey Birch survived in the Liberty State Park soil (between a 1-3% germination rate). Within the Freshkills Park soil, there were some observations of seedlings, but died rather quickly (between 0-1% germination), while the Lambert LM-HP Professional Growing Media had a 28-30% germination rate in the seeds from Liberty State Park site 48.
- The pH of the Freshkills and Liberty State Park soils are very acidic and have shown not to support the Grey Birch seeds in this study. The pH of the professional growing media is 6.12 while the Freshkills Park soil at 5.58, leading to an assumption that a higher pH can help the success rate of Grey Birch.
- Although the macronutrients and micronutrients were optimum or above optimum in the Freshkills soil, the organic matter was lacking and shows that soil amendment is necessary to increase the chances of germination in the Freshkills soil.
- Another observation is that many other species were found growing in the Freshkills soil such as Common Mugwort (*Artemisia vulgaris*) and the existing soil is supporting many non-native species at Freshkills Park.

Chapter 5: The Experiment

Draft Master Plan – North Park

As part of my investigation, I looked at the existing plans from the draft master plan around the design proposal site on North Park (figure 40). The draft master plan is comprised of both natural areas and more active and programmed areas. James Corner characterizes the North Park by simple, vast natural settings, meadows, wetlands, and creeks.[80] Some of the significant elements that are part of the north park master plan include: restored streams and trails, a mixed woodland, an expanded park lawn and picnic area, a pond and educational wetland, an eco-educational center, successional grasslands and meadows, a bird observation deck, an overlook deck, and a canoe dock.[81] Part of the North Park master plan are renovations of a softball field and playground as part of the anchor park Schmul Park, high and low saltwater marshes, a fishing dock, a creek landing, a flare station exhibit, and a Staten Island waste transfer facility.

[80] Field Operations, "Fresh Kills Park: Lifescape Draft Master Plan," Freshkills Park, 2004, https://freshkillspark.org/wp-content/uploads/2013/07/Fresh-Kills-Park-Draft-Master-Plan.pdf, 42.
[81] Ibid, 43.

Figure 40. Draft master plan for part of North Park near the design proposal and existing research site. Image by author, adapted from the draft master plan.

The existing research at the site titled "Forest Creation in the City: Testing an anthropogenic forest succession strategy" became a compelling part of this intervention and an opportunity to build public interest in the park. The research is led by United States Department of Agriculture (USDA) Forest Service researchers Richard Hallett, Ron Zalesny, John Brissette, Nancy Falxa Sonti and Mark Kubiske, along with the New York City (NYC) Parks Natural Resources Group Katerli Bounds and Kristy King, the Natural Areas Conservancy researcher Clara Pregitzer, and Yale School of Forestry and Environmental Science researchers Mark Bradford and Alex Felson.[82] The research question of this study is as follows: "Can we use pioneer species such as willow and

[82] "Afforestation Strategies," Freshkills Park, September 17, 2018, https://freshkillspark.org/scientific-research/afforestation-strategies.

poplar as part of an anthropogenic forest succession program to achieve more rapid canopy closure on urban afforestation sites thereby reducing maintenance costs and allowing for a faster creation of a forest in the city?"[83] Early successional species like poplar and willow have been shown to adapt to highly disturbed landscapes in other locations of Staten Island, such as Mariner's Marsh and Ocean Breeze Park. This study started in a greenhouse (see figure 41), and the best performing genotypes were then planted at Freshkills North Park in 2015.[84] Much of the issues the afforestation strategies are currently facing are invasive species coming into the site before the trees can establish a canopy and shade out the invasive species.

Figure 41. Existing afforestation strategies at North Park. Image by Ron Zalesny, from https://freshkillspark.org/scientific-research/afforestation-strategies.

Part of the afforestation initiative is influenced by Freshkills Park being part of the Million Trees program, which is becoming popular in many major cities. MillionTreesNYC launched in 2007 as an initiative to increase its urban forest in New

[83] "Afforestation Strategies," Freshkills Park, September 17, 2018, https://freshkillspark.org/scientific-research/afforestation-strategies.
[84] Ibid.

York City by 20%, made up of park trees, street trees, and overall trees on public and private land.[85] The million trees were divided up by the following percentages: 22% street trees, 48% trees in parks and other agencies, and 30% trees with private partners, equating to one million trees.[86] With the collaboration between NYC Parks and the non-profit organization New York Restoration Project, New York City became the first city in the world to successfully plant one million trees, some of which are at Freshkills Park.[87]

Experimental Design: Living Laboratory

Based on personal experiences at the project site, I have observed a lack of tree species and an increase in invasive species colonizing North Park. Thinking about the master plan and the proposal of a woodland at Freshkills Park, this thesis explores experimental tree plots to help identify species that can colonize at Freshkills Park and create a woodland on part of North Park. As a result, this can help identify the tree species that can be planted on the rest of the park and enhance the current research around plant species that can survive on post-industrial landscapes and help reduce the invasive species issues they are currently facing.

Many of the elements listed earlier from the draft master plan are part of the design proposal. The modifications include an updated pathway system to connect more with the proposed design and remove the park lawn and picnic area to expand the proposed woodland planting plan. The proposed immersive nature trail is a path that goes

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[85] "About MillionTrees NYC," MillionTrees NYC, accessed February 18, 2021, https://www.milliontreesnyc.org/html/about/about.shtml.
[86] Ibid.
[87] "NYC Just Planted 1 Million Trees. Here's How We Did It.," NYRP, accessed February 19, 2021, https://www.nyrp.org/blog/nyc-just-planted-1-million-trees-heres-how-we-did-it.

through the woodland with the incorporation of living laboratories and experimental research plots (figure 42). The design incorporates homogeneous groves so that it is an experience walking through the landscape on an elevated walkway, only elevated about 1 foot high above the ground plane. The elevated walkway is used to keep the experimental plots protected. The elevated walkway serves to have people visit the site, see the on-going research, and engage with it. Surrounding the groves is a successional meadow, which continues the overall design existing at Freshkills Park.

This area is chosen for the design proposal because of its current research plots through the United States Department of Agriculture (USDA) Forest Service mentioned earlier. There are existing research plots at this site, and based on the draft master plan, this area is also where there is a woodland proposal.

Figure 42. Design proposal plan for part of North Park. Image by author, 2021.

Living Laboratory: Interaction through Citizen Science and Stewardship

As defined by National Geographic, "Citizen science is the practice of public participation and collaboration in scientific research to increase scientific knowledge. Through citizen science, people share and contribute to data monitoring and collection programs."[88] Citizen science allows for a collaboration between the existing researchers at Freshkills Park and the nearby community. This also poses an opportunity for community ownership and can monitor and maintain the research plots. Already existing through the Freshkills Park Alliance are volunteer cleaning and weeding events, which get committed volunteers to help maintain the anchor parks like Schmul Park. Using this same model here can help with maintaining the research plots. Other ways of engaging people are having students measure plant growth, measuring the plants diameter at breast height (DBH), and identifying plant and animal species during the restoration efforts. Since the proposal is an on-going experiment, data collection is essential especially keeping track of growth rates in the homogeneous groves and the competition zones. Participants can work with the lead researchers to monitor the growth rates, success rates, and overall health of the species.

Potential collaborators include the nearby public/private schools and universities. This is also a great way to bring people to the site as field trips and educates the community on the on-going research at Freshkills Park. There is already existing collaboration between the College of Staten Island and other programs like the Greenbelt School Programs through the Greenbelt Conservancy, so the proposals in this thesis would expand those programs to connect the community more to Freshkills Park.

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[88] Christy Ullrich, "Citizen Science," National Geographic Society, October 9, 2012, https://www.nationalgeographic.org/encyclopedia/citizen-science/.

Circulation

The proposed paths are categorized by primary pathways, secondary pathways, and tertiary pathways (figure 43). The primary paths labeled in green are used to connect the entrances and exits and serves as the main way to travel through the research site. The primary paths are measuring at 6-foot widths. The primary paths connect with the Travis-Chelsea neighborhood at two of the three entrances on the northernmost points. The primary paths also connect to the main paths proposed on the draft master plan, shown in gray on figure 43. The secondary paths, labeled in blue are used as discovery paths, measuring at 3-foot widths. The secondary paths branch off the primary paths and immerse the visitor through the center of specific groves.

In contrast, other secondary paths walk around the groves, placing the visitor in an interesting interstitial space between two groves. The tertiary paths, labeled in red on the map, are used as the stewardship pathways. These paths measure at 1-foot width since these paths will not be used as often as the other paths and are mainly used as the monitoring and maintenance paths. The tertiary paths are perpendicular to the primary/secondary path and go across the groves exactly where the amended soil and non-amended soil are divided.

Figure 43. Circulation diagram of the design proposal for North Park. Image by author, 2021.

Planting Plan

Based on my research from other local post-industrial sites, like Liberty State Park in New Jersey, Brookfield Park in Staten Island, and Freshkills Park itself, this proposed planting plan incorporates plant species colonizing these three sites. The planting plan (figure 44) is organized by early successional species and late successional species. The early successional groves are nearby a late-successional grove, which allows for competition and what becomes interesting are the overlapping areas between the early successional and late-successional species. The groves are homogeneous zones so that it is an experience walking through the landscape on the elevated walkway. Visitors can see the groves and how different each species are acclimatizing to a former landfill site.

Figure 44. Planting design proposal. Image by author, 2021.

The early successional groves are Gray Birch (*Betula populifolia*), Eastern Cottonwood (*Populus deltoides*), Willow Sp. (*Salix sp.*), and Eastern Red Cedar (*Juniperus virginiana*). These fast-growing early colonial species are located toward the entrances and edges to create a border for the experimental area. The late successional species are Pin Oak (*Quercus palustris*), Sweetgum (*Liquidambar styraciflua*), Black Locust (*Robinia pseudoacacia*), Common Mulberry (*Morus alba*), Common Hackberry (*Celtis occidentalis*), Northern Bayberry (*Myrica pensylvanica*), and Maple Sp. (*Acer sp.)*. The late successional species are placed throughout the design and are commonly placed near an early successional species to allow for competition zones.

The conceptual planting plan for the individual groves (figure 45) is organized in a radial geometry to continue with the circular groves' design. The spacing varies on the outskirts of the groves from as large as 20 feet in distance on-center of the tree trunks to all the way in the center of the groves, which can be as closely planted as 5 feet on-center. These variations allow for different experiences walking through the grove, more research opportunities, and competitive planting zones.

A second conceptual planting plan proposal (figure 46) is similar to the first planting plan, but the spacing varies slightly in the groves for variation. Some are off-center, some have a cluster of trees in the center, and some do not have a center point within the groves. These variations allow for other different experiences and further research opportunities.

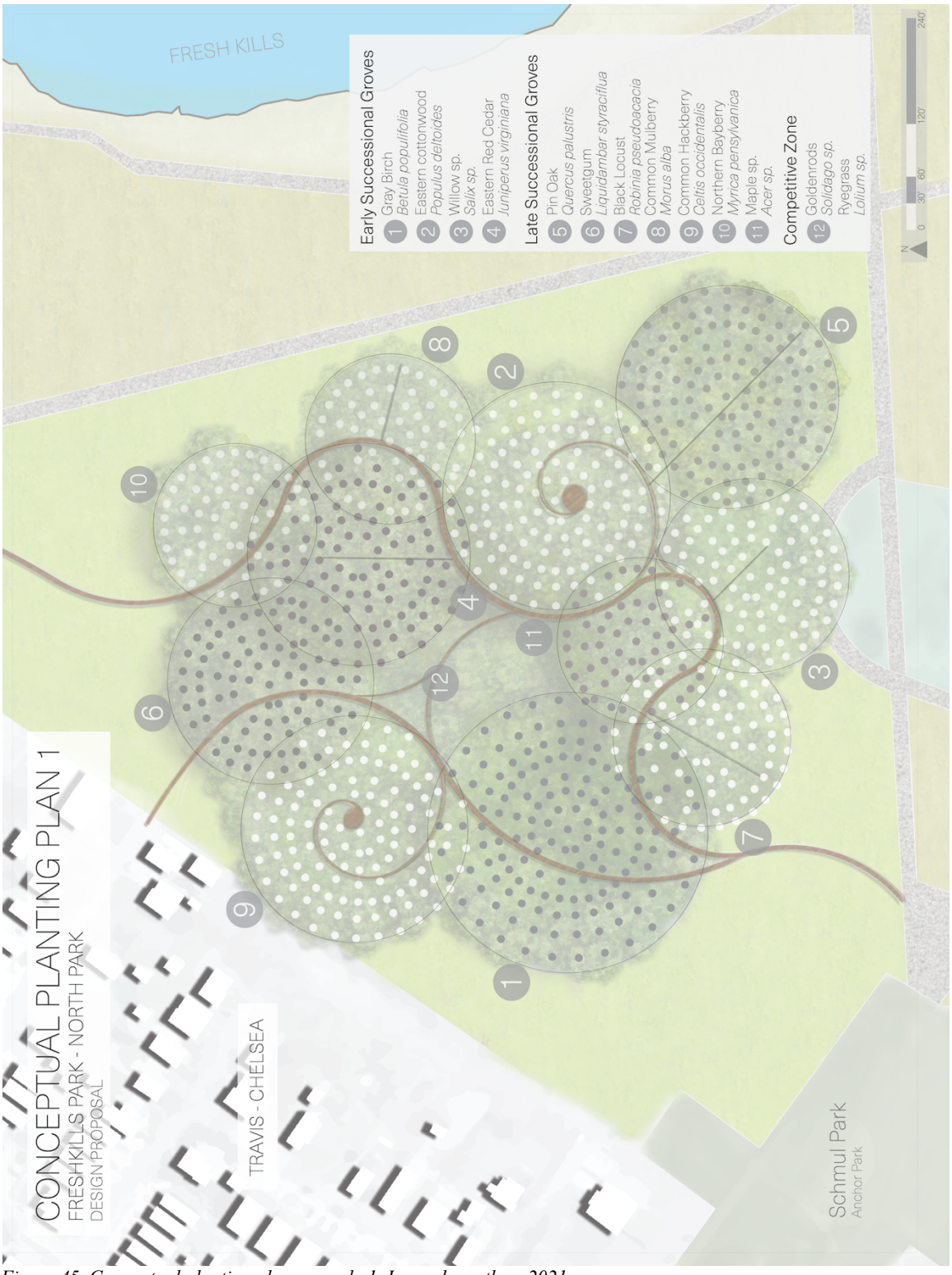

Figure 45. Conceptual planting plan example 1. Image by author, 2021.

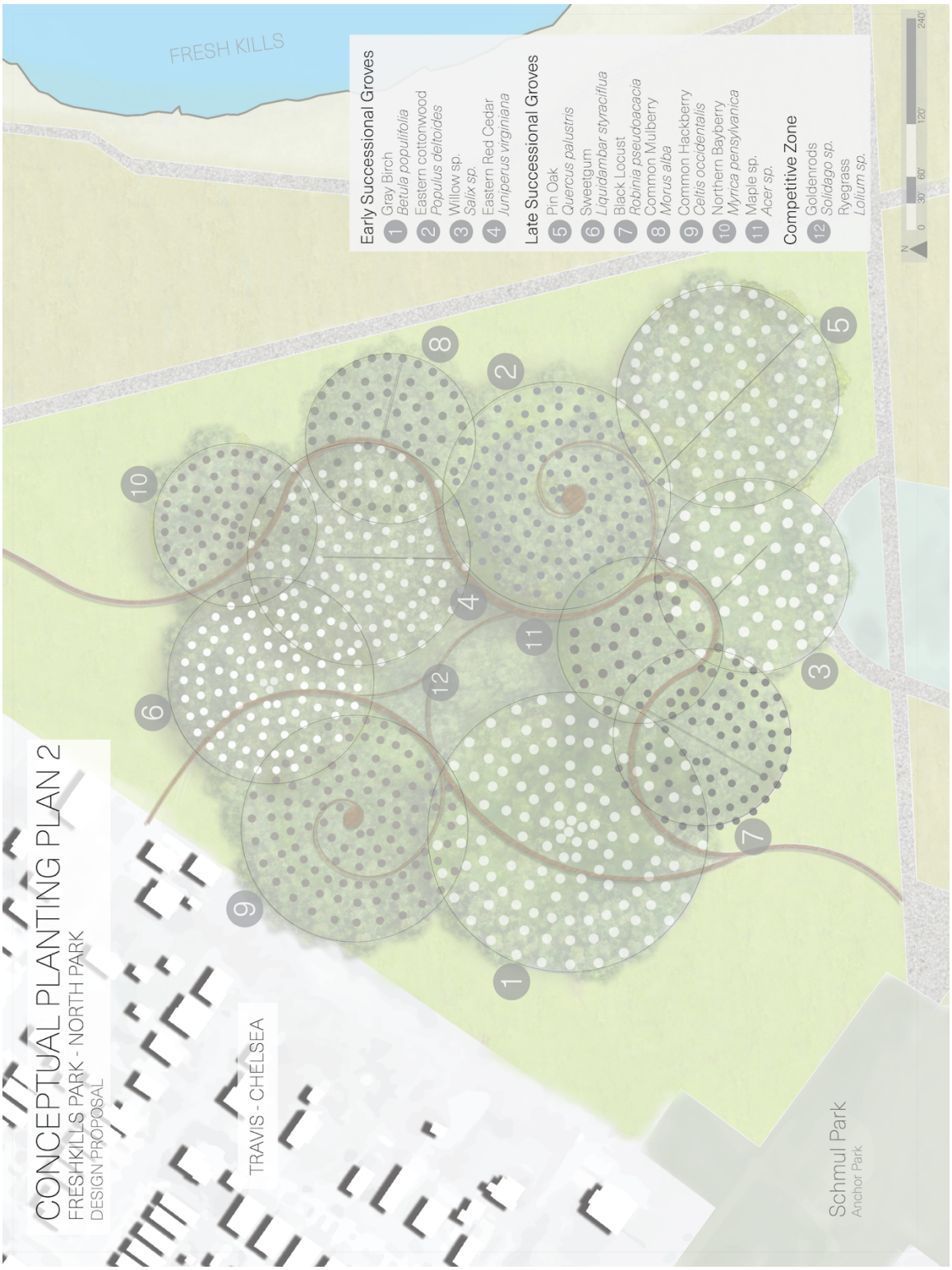

Figure 46. Conceptual planting plan example 2. Image by author, 2021.

Soil Treatment Plan

Relating the design proposal to the greenhouse study, Grey Birch (*Betula populifolia*) did not succeed in the existing soil at Freshkills, and soil amendment is necessary. Using that same idea in this field study proposal, all groves are split directly in half. Half of the grove is the existing soil, and half of the grove is amended soil. This opens an opportunity for all the 11 different species to see what soil the species do best in – amended or non-amended soil. All species prefer different conditions, and this design element will help define where the species do the best in. The amended soil treatment plan is a proposal of increased organic matter mixed into the site on the half groves shown in figure 47. The greenhouse study showed that the greenhouse planting soil did significantly better than the existing soil at Freshkills. The greenhouse soil characteristics are rich in organic matter, which leads to a hypothesis that other species may succeed better in the amended soil in this field study. The greenhouse bench study results also showed that the pH may be too high at Freshkills Park to support these species. As a result, part of the soil plots design is to amend the pH of the treated soils.

Figure 47. Soil treatment plan. Image by author, 2021.

Research Opportunities

Since this is an experiment, we do not know the final result of the research plots. This allows for an ever-changing landscape with endless research opportunities. Some research opportunities with either of the two conceptual planting plans include the following questions:

- Can the species survive at Freshkills Park? What species colonize the areas?
- Do particular species prefer the amended soil or the natural soil at Freshkills Park?
- How do the plant species in the individual groves compete with each other?
- Does the competition change with the variation of spacing of trees in the groves?
- How do the groves compete with each other in the overlapping zones?
- What species colonize in the 4th nature center zone?

Gathering Spaces

Much of this design is a walk-through, but a few gathering spaces are present where people can socialize, relax and use the space as an outdoor classroom for education. There are four locations shown in figure 48. The numbers labeled 1 and 4 represent areas immersed in the center of the groves, while 2 and 3 represent areas where the paths meet in a triangular shape. Shown in figure 52 is what one of the two triangular gathering spaces looks like showing seating around the triangle, along with interactive signage to have visitors look around and explore nature. This perspective rendering image shows an example that says: “Nature Reclaiming Freshkills Park: what species can you identify around you?” and you see an individual sifting through the plants in the

triangular center area trying to identify the species with a Freshkills Park naturalist research notebook. Using methods like this interactive signage can have visitors engaging with the site without having a formal tour around the area.

Figure 48. Proposed gathering spaces within the design proposal. Image by author, 2021.

Figure 49. Three perspectives showing potential results from the design. Image by author, 2021.

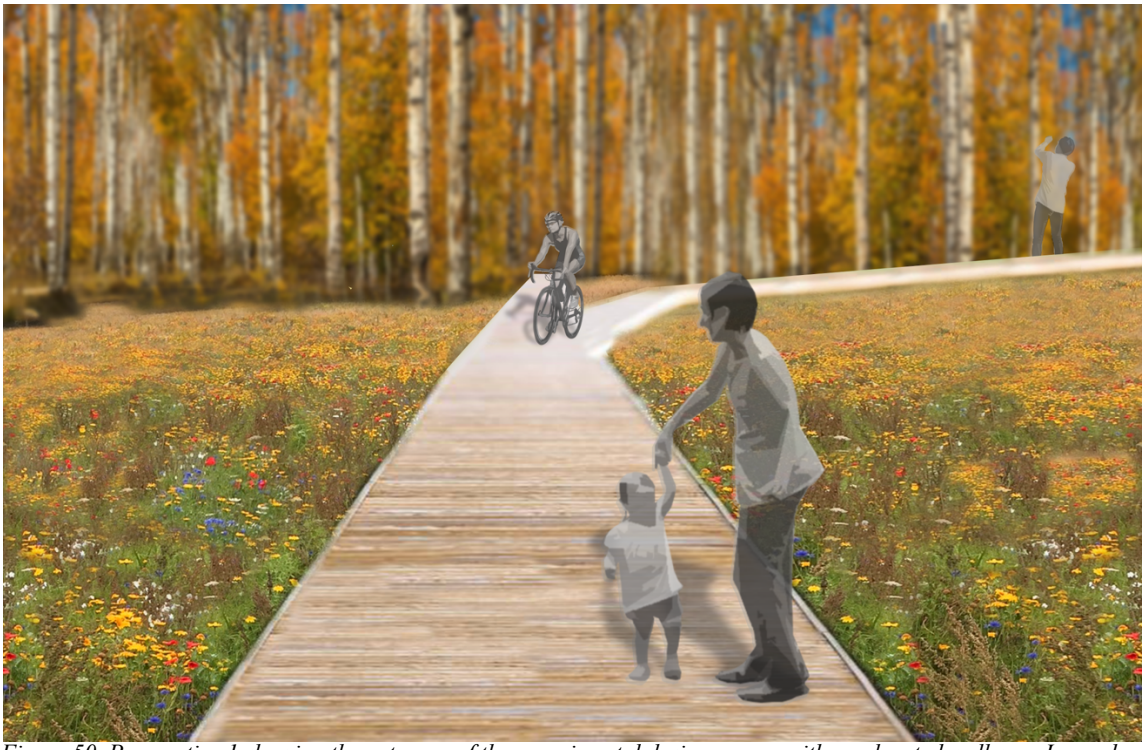

Figure 50. Perspective 1 showing the entrance of the experimental design groves with an elevated walkway. Image by author, 2021.

Figure 51. Perspective 2 showing the walkway within the Grey Birch grove. Image by author, 2021.

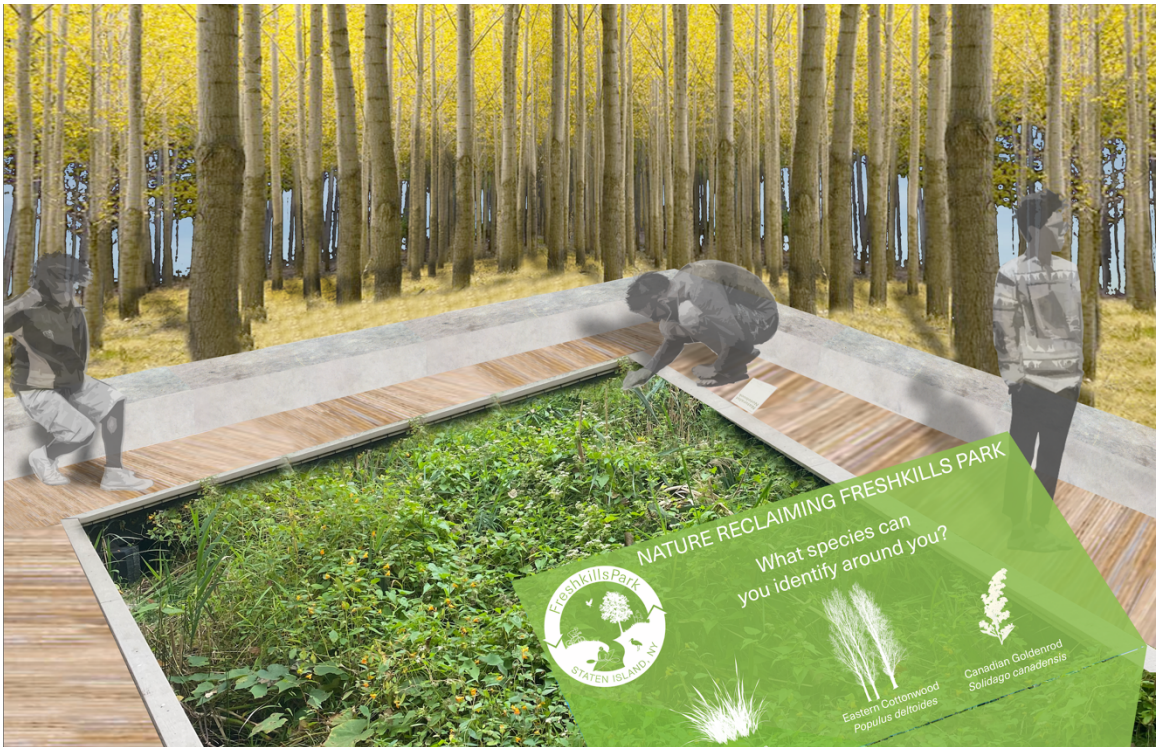

Figure 52. Perspective 3 showing a gathering space with seating and interactive signage around the Eastern Cottonwood grove. Image by author, 2021.

Conclusion

This thesis poses an opportunity for experimentation, enhancing, and expanding the existing NYC Parks plant palette while engaging visitors through citizen science and living laboratories. The design allows for an ever-changing landscape with discoveries and experiences over time for many decades. It also creates a more biodiverse landscape, incorporating native vegetation and woodland habitat and improving the soil quality with the amended soil plots. This design opens up many research opportunities and can help inform other landfill-to-park transformations like Fresh Kills while engaging the community with citizen science to enhance the existing educational programming and research.

Appendix

RUTGERS
New Jersey Agricultural Experiment Station

Soil Testing Laboratory
Rutgers, The State University
ASB II
57 US Highway 1 South
New Brunswick, NJ 08901-8554

Soilless Growth Medium Test Report
Lab #: 2019- 80986

Rutgers - Gallagher
Frank Gallagher
SEBS Landscape Architecture
93 Lipman Drive, Room 113
New Brunswick, NJ 08901

fgallagh@sebs.rutgers.edu
(848)932-5167

Date Received: 2019-12-06
Date Reported: 2019-12-12

Sample ID: 1 - Greenhouse Soil

Results and Interpretations

pH: 6.12 Somewhat high for peat-based potting media.

Available Nutrients (mg/L)

	P	K	Mg	Ca	Cu	Mn	B	Zn	Fe
	6.8	69.6	15.4	26.1	0.05	0.06	0.07	0.44	1.12
	Opt	M	L	L	Opt	Opt	Opt	Opt	Opt
Optimum:	6-10	150-249	70+	200+	0.005-0.5	0.02-3	0.05-0.5	0.3-3	0.3-3

P=phosphorus, K=potassium, Mg=magnesium, Ca=calcium, Cu=copper, Mn=manganese, B=boron, Zn-zinc, Fe=iron

L=low, M=medium, Opt=optimum, H=high, VH=very high

Special Tests Results

Soluble Salts- Electrical conductivity= 0.82 mmho/cm
(Very Low; may indicate lack of available minerals.)

Inorganic Nitrogen- Nitrate-N: 1 ppm (Low) Ammonium-N: 2 ppm (Low)

Comments:

Find Rutgers Cooperative Extension Fact Sheets at www.njaes.rutgers.edu/pubs

Soil Test Report for Lab # 2019- 80986 Page 1/2 RULIMS-ST V6.1.1

Figure 53. Soil test report for the Lambert LM-HP professional growing media. Report provided by the Soil Testing Laboratory, 2019.

RUTGERS
New Jersey Agricultural Experiment Station

Soil Testing Laboratory
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New Brunswick, NJ 08901-8554

Soil Test Report
Lab #: 2019-80987

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Date Received: 2019-12-06
Date Reported: 2019-12-12

Sample ID: 2 - Fresh Kills Soil

Results and Interpretations

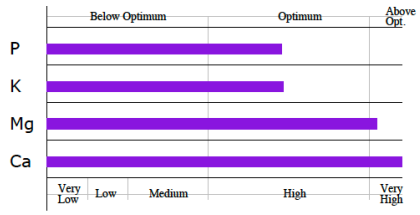
pH: 5.58 Strongly acidic, suitable for the growth of blueberry or potato crops and acid-loving ornamentals such as rhododendron, holly, and spruce, but too acidic for most other plants.

Lime Requirement Index: 7.38

The Lime Requirement Index (LRI) is a measure of the buffering capacity of the soil, its resistance to pH change, and is used to determine the appropriate amount of limestone, when necessary. LRI value near 8.0 indicates low buffering capacity of soil and a lower rate of limestone amendment compared to soil with high buffering capacity (LRI near 7.0).

Macronutrients (pounds per acre)

		by Mehlich 3 extraction
Phosphorus:	101	(Optimum)
Potassium:	207	(Optimum)
Magnesium:	302	(Above Optimum)
Calcium:	3087	(Above Optimum)



Micronutrients (parts per million)

Zinc(Zn)	Copper(Cu)	Manganese(Mn)	Boron(B)	Iron(Fe)
111.70 (High)	90.70 (High)	17.17 (Adequate)	0.96 (Adequate)	197.60 (High)

Special Tests Results

No special test data available

Figure 54. Soil test report for the Freshkills Park soil "legacy dump" site. Report provided by the Soil Testing Laboratory, 2019.

RUTGERS
New Jersey Agricultural Experiment Station

Soil Testing Laboratory
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Soil Test Report
Lab #: 2019-80988

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(848)932-5167

Date Received: 2019-12-06
Date Reported: 2019-12-12

Sample ID: 3 - Liberty State Park Higher Metal

Results and Interpretations

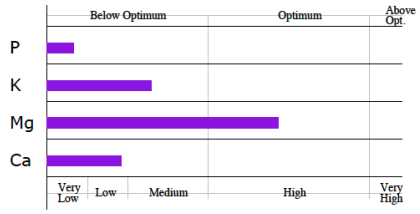
pH: 5.31 Strongly acidic, suitable for the growth of blueberry or potato crops and acid-loving ornamentals such as rhododendron, holly, and spruce, but too acidic for most other plants.

Lime Requirement Index: 7.52

The Lime Requirement Index (LRI) is a measure of the buffering capacity of the soil, its resistance to pH change, and is used to determine the appropriate amount of limestone, when necessary. LRI value near 8.0 indicates low buffering capacity of soil and a lower rate of limestone amendment compared to soil with high buffering capacity (LRI near 7.0).

Macronutrients (pounds per acre)

		by Mehlich 3 extraction
Phosphorus:	15	(Below Optimum)
Potassium:	99	(Below Optimum)
Magnesium:	210	(Optimum)
Calcium:	967	(Below Optimum)



Micronutrients (parts per million)

Zinc(Zn)	Copper(Cu)	Manganese(Mn)	Boron(B)	Iron(Fe)
14.78 (Adequate)	7.92 (Adequate)	8.57 (Adequate)	0.90 (Adequate)	365.70 (High)

Special Tests Results

No special test data available

Figure 55. Soil test report for the Liberty State Park site 14 soil. Report provided by the Soil Testing Laboratory, 2019.

RUTGERS
New Jersey Agricultural Experiment Station

Soil Testing Laboratory
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ASB II
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Soil Test Report
Lab #: 2019-80989

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Date Received: 2019-12-06
Date Reported: 2019-12-12

Sample ID: 4 - Liberty State Park

Results and Interpretations

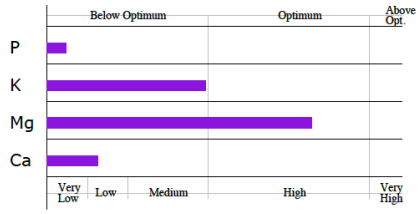
pH: 5.14 Strongly acidic, suitable for the growth of blueberry or potato crops and acid-loving ornamentals such as rhododendron, holly, and spruce, but too acidic for most other plants.

Lime Requirement Index: 7.47

The Lime Requirement Index (LRI) is a measure of the buffering capacity of the soil, its resistance to pH change, and is used to determine the appropriate amount of limestone, when necessary. LRI value near 8.0 indicates low buffering capacity of soil and a lower rate of limestone amendment compared to soil with high buffering capacity (LRI near 7.0).

Macronutrients (pounds per acre)

		by Mehlich 3 extraction
Phosphorus:	11	(Below Optimum)
Potassium:	143	(Below Optimum)
Magnesium:	242	(Optimum)
Calcium:	724	(Below Optimum)



Micronutrients (parts per million)

Zinc(Zn)	Copper(Cu)	Manganese(Mn)	Boron(B)	Iron(Fe)
9.74 (Adequate)	10.52 (Adequate)	9.76 (Adequate)	0.73 (Low)	454.90 (High)

Special Tests Results

No special test data available

Figure 56. Soil test report for the Liberty State Park site 48 soil. Report provided by the Soil Testing Laboratory, 2019.

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