3rdi Technologies

December 7, 2022

Joseph A. Pilewski
Acting Deputy Commissioner
GENERAL SUPPORT SERVICES (GSS)
375 Pearl Street, 24th Floor
New York, NY 10038

Ref: Final Report
Land Use and Capacity Analysis at Hart Island [Contract ID: CT1-069-20218802022]

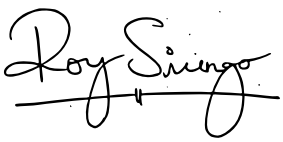
Dear Mr. Pilewski,

Please find attached the Final report for **Land Use and Capacity Analysis at Hart Island.**

The report has been amended, based on our conversation on Sep. 21, 2022, and subsequent discussions. These changes include redesignating the Central Field and Southern Section as 'future opportunity' based on the likely, significant investment required to realize that capacity; and, changing the recommended, operational enhancement for trench separation distance from 6 feet to 8 feet.

On behalf of the entire team, we want to express our gratitude for the opportunity to work on this project.

Sincerely,



Roy Sirengo

Executive Summary

Located in the Long Island Sound, Hart Island holds a special place of reverence for many residents of New York City ("NYC", "City") and has actively served as the City's public cemetery for over a century. Though it is best known as the City Cemetery, Hart Island has served various institutional functions over its life, representing more than a century of municipal history within NYC.

With the transition of Hart Island management, including burial activities, to the New York City Department of Social Services ("DSS") and NYC Department of Parks & Recreation ("Parks"), a series of assessments are being undertaken to address the future of the site. The lack of suitable response to NYC Human Resources Administration ("HRA") Request for Information ("RFI") for alternative burial spaces, led to a need for this study. This report has been prepared for DSS in relation to "Land Use and Capacity Analysis at Hart Island" under Contract ID: CT1-069-20218802022 to assess future burial capacity at Hart Island and find viable strategies to increase that capacity.

A multifaceted methodology was deployed during the course of this study to better demarcate previously uninterred areas, reduce uncertainty around missing historical records and thereby infer future available capacity for continued interments. Our investigative tools included extensive pedestrian surveys of the Island, documentary research, assessment of historic maps and aerials, drone imaging, soil studies, subsurface investigations with ground penetrating radar, and interviews to help determine the suitability for future use of each section of Hart Island.

Our analysis revealed ten areas that are not currently used for burial and have been deemed highly suitable for burials on Hart Island. Highly suitable areas are sections of the island that consist of soil and environmental conditions that support the continuation of current burial practices. There is currently work underway to demolish buildings on Hart Island, and our analysis contemplated useful life remaining under both scenarios; if the buildings remain and if they are torn down.

Under the current operational paradigm including the buildings remaining across Hart Island, the lower bound of the capacity results would be a minimum **capacity of 8 years**. Additionally, adopting simple operational recommendations such as moving the trenches closer together as well as adding a fourth level of caskets in each trench would increase capacity to just under **12 years**. This represents slightly over **7,000 burial spaces** under current protocols and increasing to nearly **10,000 burial spaces** if the enhanced operations were adopted. Capacity calculations have been included in **Appendix A,** while results of this work have been visualized and included in **Appendix B.** Reports related to other findings can be found in **Appendices C through H.**

Based on our analysis, the lower limit of available capacity on the Island if all buildings are demolished is just over **35,000 burial spaces** resulting in a **useful life of 42 years**. Much of the useful capacity has been reclaimed from the footprints of existing buildings. The enhanced operations (closer trenches and a fourth level of caskets) would increase capacity by 64%, thereby

increasing the useful life of Hart Island to 69 years. This approach supports continuing the current operational paradigm without making sweeping changes such as grave recycling and cremation that would face legislative, public, and legal obstacles.

There is significant undeveloped acreage in the Central Field Section. This section is more than 450,000 square feet and represents a minimum capacity of 43 years. The Central Field Section along with the Southern Section are designated as Future Opportunity since additional study is required of the soil conditions and water table. Based on our preliminary site and geotechnical analysis, forms of remediation would be required to fully utilize these sections; including raising the elevation by several feet and exploring techniques to mitigate rising sea levels, such as a sea wall. In total, the sections with Future Opportunity represent an additional 45 years of useful life should alternative burial strategies be implemented in conjunction with significant investments in the aforementioned remediation techniques.

We considered the best location for a visitor center that would welcome visitors and convey the important history the Island holds for New York City, without greatly impacting available burial space. We envision a central location in immediate proximity to the ferry docks and recommend repurposing the area that originally held the caretaker's cottage for this important site.

We also explored the feasibility of developing a crematory onsite and deemed the island an unsuitable location for this facility based on the associated costs and potential environmental impacts. If cremation were to be utilized in the future, the City can explore other options to cremate, and transport cremated remains ("cremains") to the Island. Parks is preparing a Transportation Study for access to Hart Island at the same time as production of this report. Recommendations in this report for the siting of support facilities on the island should be further refined based on the outcomes of the Transportation Study.

TABLES

FIGURES

Introduction

Located in the Long Island Sound, off City Island in the Bronx, Hart Island has served as a public cemetery since 1869 and serves as the final resting place for generations of NYC residents including Civil War veterans, citizens deceased from AIDS-related illness and, more recently, citizens claimed by the COVID-19 pandemic. Hart Island was managed by the NYC Department of Corrections ("NYCDOC", "DOC") until transferred to Parks and DSS in 2021.

This report has been prepared for DSS for the "Land Use and Capacity Analysis at Hart Island" in relation to "Land Use and Capacity Analysis at Hart Island" under Contract ID: CT1-069-20218802022.

The project team was comprised of five firms and two consultants:

- **3RDI Technologies** provided project management.
- **Easton Architects** led the siting study and code analysis for public access.
- **Demerara Engineering** led structural engineering efforts.
- **Brinkerhoff Environmental** (now **VHB**[1]) led soil geology studies.
- **Chrysalis Archaeological Consultants, Inc.** led archeological studies.

The consultants who offered domain expertise in the burial industry were led by **L.F. Sloane Consulting Group** and supported by **Jack Goodnoe**.

Other partners who contributed to this project include:

- **S.Y. Kim Land Surveyor, P.C.** ("SYK") led survey and mapping efforts.
- **artCONIC**, provided graphic design and illustration services.
- **Reform Architecture** assisted with GIS modeling.

All work was conducted under the guidance of an Advisory Committee comprised of stakeholders from various City agencies led by DSS and Parks. Our team met with this Advisory Committee on a monthly basis to provide updates and receive approval for planned work, schedules, and scope changes. The project deliverables outlined in the Project Draft Report, submitted on August 3, 2021, included:

- Existing Conditions: a review of existing data and information gathered from field investigation efforts.
- Soil Suitability Study and Methodology: recommendations for ideal use based on a review of soil characteristics on the Island.
- Climate Change Impact: qualitative discussion on the potential impacts of climate change on burial capacity and current operations.
- Capacity Land Assessment: burial assessment and mathematical approach assessing ground conditions and suitability for various cemetery operations.
- Increasing Capacity Strategies & Costing: cost to mitigate factors that prevent utilization of any portion of the land for ideal burial purpose identified above.

[1] Brinkerhoff Environmental was acquired by Vanasse Hanglin and Brustlin after bid award and retained on the team.

- Capacity Projections: capacity projections for various burial scenarios (including various burial paradigms, cremation, natural burial, grave recycling) aimed at increasing future capacity.
- Siting study to identify the best onsite location for a combined crematorium, cold storage facility and visitor's center.

Per our monthly discussions with the Advisory Committee, some items in the scope of work were modified for various reasons; including schedule impacts from limited ferry access, weather, the need to minimize impacts to ongoing burial operations onsite and other factors.

The single largest change in scope resulted from the NYC Department of Buildings ("DOB") emergency declaration to expedite the demolition of extant structures onsite. This step created an opportunity to reclaim unused space within the footprints of the buildings, as well as reimagine the future of Hart Island which has been nurtured by the tireless service of many City Workers and private citizens over the decades.

Project kickoff occurred on May 3rd, 2021, and was anticipated to end on April 30, 2022. A request for a 30-day extension was approved and granted for the submission of Final Report. A list of deliverables along with planned and modified dates of completion are included in **Table 1**.

Table 1: Schedule of Deliverables

Sl.	Task Names	Planned	Completed
1	Kick Off	5/3/2021	5/3/2021
2	Project Plan	7/09/2021	8/13/2021
3	Report and Presentation[2]	12/28/2021	1/27/2022
4	Final Report	4/30/2022	5/30/2022

Means and Methods

The aim of our field investigation work was directed at gaining more certainty and documenting the known burial areas on the Island. Means and methods employed are included in each consultant report and summarized in this section. Our field activities included:

- Soil investigation to better understand geology and hydrogeology,
- Subsurface mapping via Ground Penetrating Radar.
- Pedestrian surveys to demarcate interred and un-interred areas onsite.
- Geophysical investigations to assess structural properties of the Central Field Section.

The environmental site investigation activities were conducted in general accordance with the New York State Department of Environmental Conservation (NYSDEC) DER-10, Technical Guidance for Site Investigation and Remediation Issued on May 3, 2010.

[2] Existing Conditions Report

Siting studies followed the National Historic Preservation Act (NHPA) and the Advisory Council on Historic Preservation (ACHP), 'Section 106 Regulations', which stipulates for cultural resources and structures, federal agencies (and other governmental agencies using federal funds), must consider the effects of their actions on any properties listed, or determined eligible for listing, on the National Register for Historic Places (NR). Likewise, the State Historic Preservation Act (SHPA) and the NYC Environmental Quality Review Act (CEQRA) guided efforts to consider eligibility of structures for listing, on the State and City Register for Historic Places.

Surveys adhered to the 2018 City of New York, Landmarks Preservation Commission's (NYC LPC) Guidelines for Archaeological Work in New York City and followed all federal and state regulations as they pertain to archaeological and cultural resources. The work was conducted in accordance with the National Historic Preservation Act of 1966, as amended, the Advisory Council on Historic Preservation's "Protection of Historic and Cultural Properties" (36 CFR 800), the New York State Office of Parks, Recreation and Historic Preservation (NY SHPO) and the New York Archaeological Council (NYAC) guidelines for such projects (NYAC 1994; 2000; 2002) as well as the NYC LPC Archaeological guidelines (NYC LPC 2018). The archaeologists performing the work met or exceeded the qualifications specified in National Park Service's 36 CFR 61, Appendix A.

Topography mapping and aerial survey efforts utilized the NYSDOT C.O.R.S. network to establish horizontal & vertical control using NAD 83 and NAVD 88 respectively. Drone photogrammetry was performed with in-fill using GPS[3] to display all visible surface features such as roads, buildings, water, fences, vegetation, bridges, railroads, and a vegetation survey. A 3D surface model of the island was generated from AutoCAD Civil 3D[4] 2020 and a signed survey map has been generated.

Ground Penetrating Radar

A geophysical investigation was performed utilizing ground-penetrating radar (GPR) and Electromagnetic Anomaly Detection (EM) technology.

Documentary and cartography review

Chrysalis undertook a limited documentary review, inclusive of historic maps and aerial imagery, and updated existing information regarding burial and structural locations on the Island. All data was incorporated into the project base map. An accompanying narrative of Chrysalis' findings along with recommendations are included in **Appendix C**.

Soil Sampling

In order to broadly evaluate soil quality, approximately 37 test pits were excavated to the water table. Details are included in VHB's Site Investigation Report in **Appendix D.**

[3] Global Positioning System

[4] 3-Dimensional

Burial Practices

Current Practices

Adult Burial Practices

Since its opening the operational practices at Hart Island, like many cemeteries, have evolved. Up until the COVID-19 Pandemic in early 2020, burials were conducted under the supervision of DOC. During this period burials were performed by incarcerated individuals under the supervision of site-specific DOC personnel. Today, HRA, which is a department under DSS, engages a contractor who has adopted past practices with some minor changes. As the City (Parks and HRA) continues to evaluate the property, certain changes to burial practices have been made in the last several months. These are incorporated in the description below.

As depicted in **Figure 1**, current adult burial practices involve digging a trench that is sixty feet (60') in length by fourteen feet (14') wide, covering an area of eight hundred and forty square feet (840 ft^2). In this space, caskets are placed in two (2) columns, each made up of three (3) caskets stacked on top of each other. Twenty-five (25) rows can fit in each trench, allowing for a total of one hundred and fifty (150) full-sized interments per trench. Each column is separated by approximately eight inches (8") of space, while each row is separated by between two and three inches of space (2"-3"). The caskets are placed directly on top of each other.

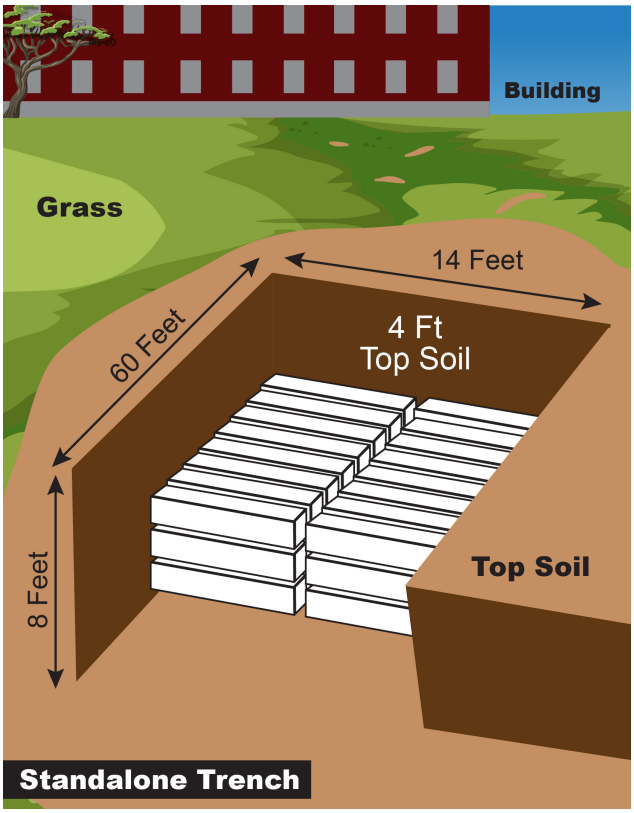


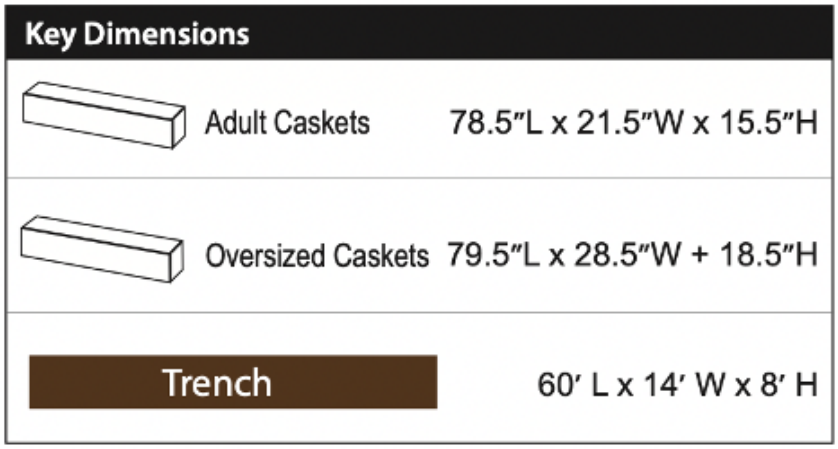
Figure 1: Rendering of Burial Trench

Given the area of the trench and that there are fifty units (a unit is defined as a column of 3 stacked caskets) per trench we can calculate that the area per trench unit is sixteen and eight tenths square feet (16.8 ft^2). Approximately twelve hundred (1,200) interments are conducted annually at Hart Island of which we estimate eight hundred and forty (840) are adult burials (Thompson, 2022). This is a baseline estimate of annual activity prior to the COVID-19 pandemic and is based on available data sets as well as interviews with personnel responsible for the burials. If these burials were distributed evenly throughout the year, then each trench would take on average between two (2) and three (3) months to be filled, and six (6) trenches would need to be excavated annually.

As depicted in **Figure 2**, a standard adult casket used for burials at Hart Island measures seventy-eight and one-half inches (78.5") long by

twenty-one and one-half inches (21.5”) wide and fifteen and one-half inches (15.5”) deep. The area of the casket is eleven and eight tenths square feet (11.8 ft^2). The City also provides oversized caskets to accommodate larger individuals, those caskets typically measure seventy-nine and one-half inches (79.5”) long by twenty-eight and one-half inches (28.5”) wide and eighteen and one-half inches (18.5”) deep. The area of the oversized casket is fifteen and eight tenths square feet (15.8 ft^2)

Figure 2: Casket and Trench Dimensions



It should be noted that each trench is dug between eight (8) and ten (10) feet deep. The three standard adult caskets stacked on top of each other would represent a height of just under three and nine-tenths feet (3.9’), leaving four feet (4’) of fill on top of caskets. The current operating practice is to set any oversized casket received on the floor of the trench and then place standard adult caskets on top. This configuration of caskets would yield a height of just under four and two-tenths feet (4.2’). The two trenches observed during site visits were dug in excess of eight feet (8’), both being closer to ten feet (10’) deep, subsequently the observed amount of topsoil above the caskets was greater than five feet (5’). **This is significantly more topsoil than is present above burials in typical cemetery operations** and will be addressed in the enhancements section.

Historically, burial trenches were dug quite close together, some appearing to be as close as four feet (4’) apart. Under guidance received in 2021, when a new trench is started, it now must be a minimum of fourteen feet (14’) from the last trench. As shown in **Figure 3**, this is equidistant to the width of each trench, significantly increasing the footprint and reducing future burial capacity. To prepare the trench, the contractor employs an excavator and backhoe, along with a front loader to dig the trench and move the soil. When the morgue truck arrives, it is parked near the trench and caskets for burial are moved to the back loading platform of the truck. They then use a single line, hooked to the bucket of the excavator to move each casket which is secured with two straps from the loading platform of the morgue truck and inter the casket in the next available space in the trench (see **Figure 4**). As the team places each casket, they start with the two bottom spaces in the row, caskets are then placed on top of those as depicted in **Figure 5**.

Figure 3: Rendering of Current Trench Burial Practices

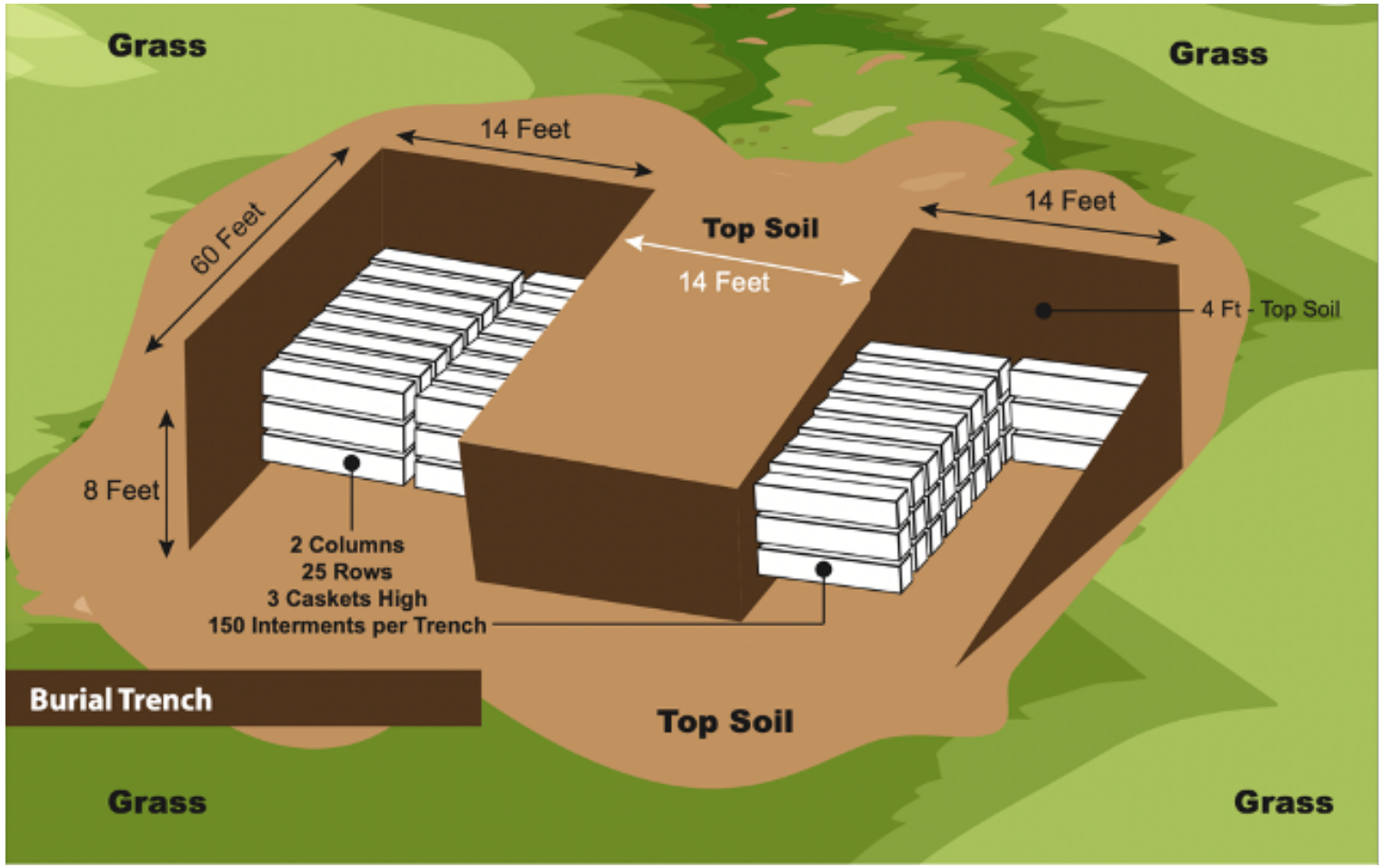


Figure 4: Casket being transferred from morgue truck to burial trench

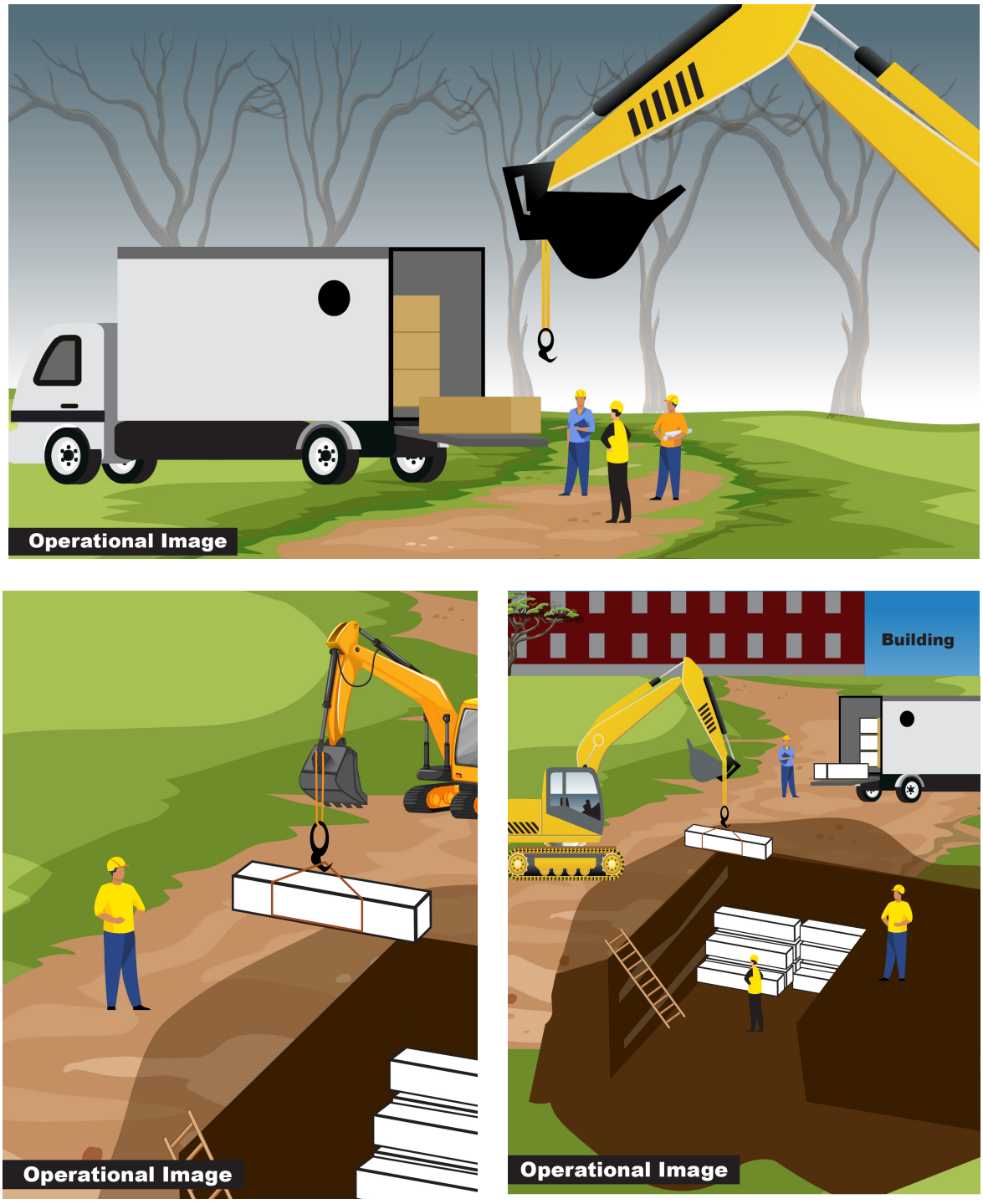
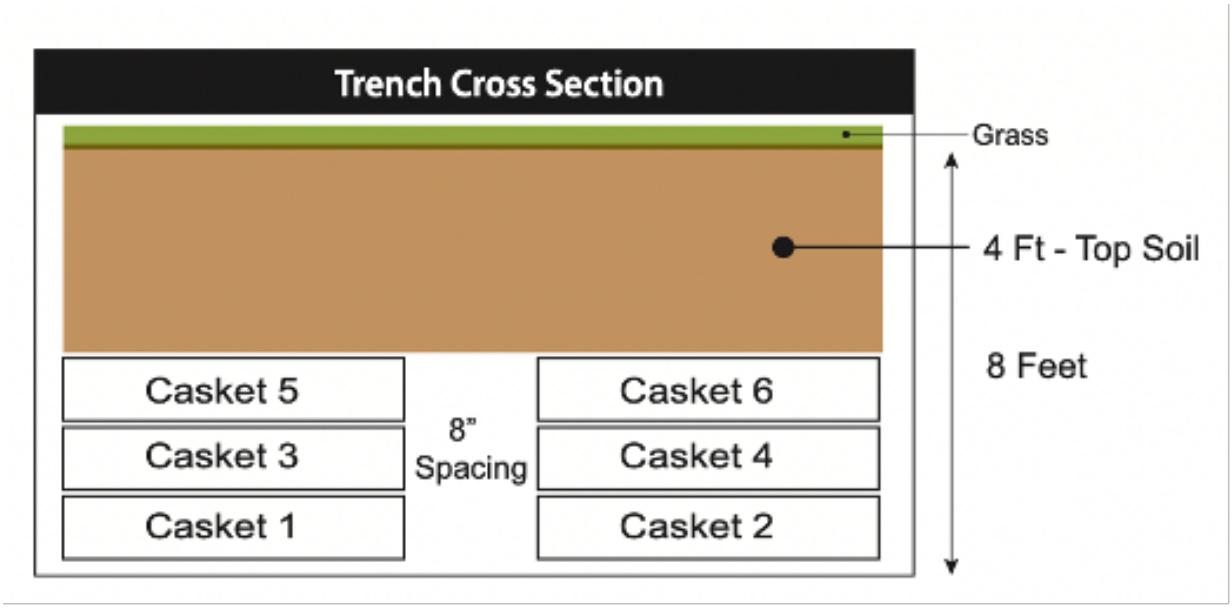
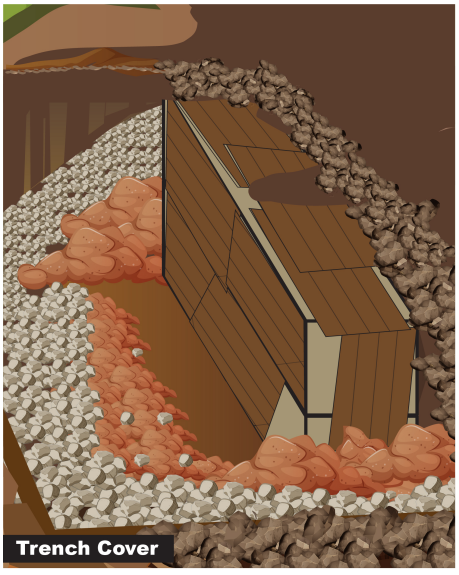


Figure 5: Cross Section of Trench



The operations team can receive a wide range of interments and do not know how many burials they will receive prior to the arrival of the morgue truck on Hart Island. Prior to the pandemic period this would average between fifteen (15) and twenty (20) burials per week (Thompson, 2022). When the team completes the burials for the day, they backfill over all but the last two rows which are protected with pieces of plywood (**Figure 6**) which are removed prior to the next round of burials.

Figure 6: Plywood covering the last two rows following a day of burials



Many variations of burial practices have been employed during the Island's recent history. This includes shortening the length of trenches to accommodate shorter sections and placing trenches closer or farther apart based on ground conditions. Additionally, there have been different rules of guidance for burial practices given the surrounding operations of the island. For example, in the current burial section, the contractor has been instructed to keep trenches one hundred feet from the shell of existing buildings to facilitate the demolition process, whereas previous burials have occurred very close to the buildings. Additionally, trenches are not to encroach on the roots of trees to facilitate tree health, trenches may not lie within the drip line of existing trees.

Infant Burial Practices

In addition to adult burials, Hart Island also takes into its care deceased infants (this includes both infants and fetuses). Current practice for these burials is to utilize a similarly sized trench as for adult burials (60' x 14'). A typical infant casket is twenty inches (20") long by seven inches (7")

wide and six inches (6") deep. One thousand (1,000) infant cases can fit in each trench. We estimate that in a typical year Hart Island receives three hundred and sixty (360) infant cases (Thompson, 2022). This estimate is intended to represent a baseline annual activity level before the pandemic and is based on interviews with personnel as well as available data sets. On average an infant trench takes nearly three years to fill. Given the length of time the trench is open, the operations team has adopted a more robust cover that consists of plywood covered in roofing shingles to provide added protection for the infant caskets that have not been covered with backfill.

Operational Enhancements

Summary

It is our opinion that there are two core operational enhancements that could immediately be implemented on Hart Island to expand capacity: moving the trenches closer together (with appropriate safety steps taken) and adding an additional level of caskets to each new trench. In the long term, we would recommend further exploring the use of cremation. Additionally, we believe the infant burial process can be improved to provide a more dignified and reverential interment. These concepts are discussed in this section. The overall impact on capacity for each recommendation is detailed below. Detailed calculations for each section can be found in the Capacity Analysis section.

Table 2: Summary of Capacity Analysis (Highly Suitable)

	Buildings Demolished		Buildings Remain	
Operational Paradigm	Capacity (Burials)	Useful Life (Years)	Capacity (Burials)	Useful Life (Years)
Current Operations	35,520	42	7,050	8
Enhanced Operations	57,800	69	9,800	12
Cremation	789,600	940	157,920	188

Trench Placement

We would recommend that as Hart Island opens each new section, the operations team plot and pin where each trench will go within the section. This will ensure that each space is planned to its best use, maximizing capacity while ensuring operational requirements are met. To achieve this, it would be advantageous to adopt a pinning process where the corners of each proposed trench are demarcated with a small, numbered metal disc or metal rebar pin set in concrete. The pins provide a standardized reference for burial location that would help facilitate visitation and disinterment. Additionally, the pins would be flush with the ground to ensure no additional operational functions such as lawn care are impaired (see **Figure 7**).

In addition to physical pins, the City may elect to have a licensed survey of each new trench section and update maps on a monthly basis to create a signed and stamped (As-Built) drawing each quarter.

Figure 7: Sample Metal Disc that Could be Used to Mark the Corners of the Trench

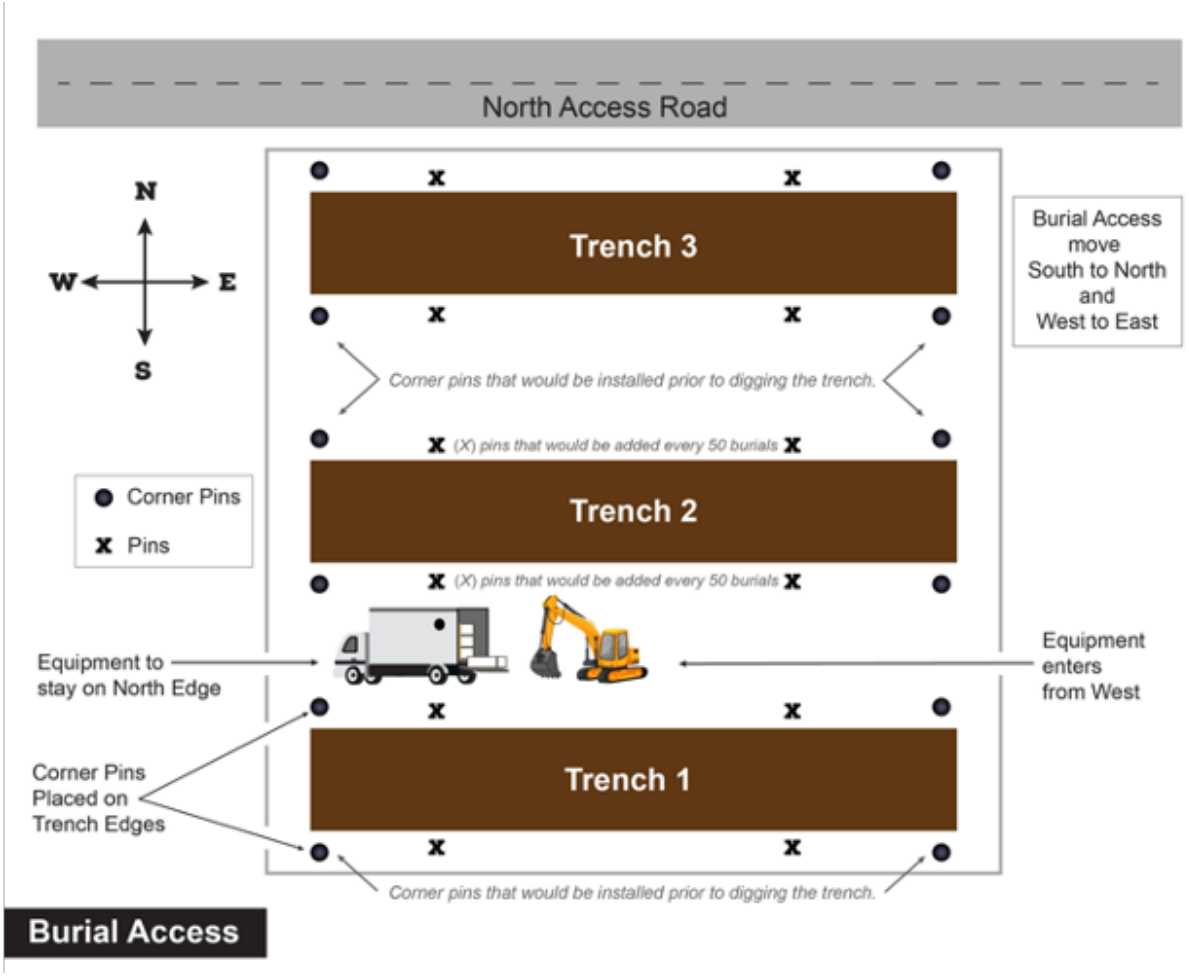
The long-held method of marking each trench was to place numbered granite memorials in the center of the trench. Over time these have shifted position and moved so that one cannot tell the center of the trench or in many cases the accurate start of the trench. More recently, a longer pole (10 feet) with numerical marking has been adopted to limit shifting (see **Figures 8 and 9**). Adding the corner pins, either in addition to or instead of, the center post will provide additional confidence of grave locations for record keeping and historical reference.

Figure 8: Historical granite trench markers

Figure 9: Modern plastic trench markers

As depicted in **Figure 10**, we recommend that the **distance between trenches be reduced from fourteen feet (14') to eight feet (8')**. The main reason for the distance, as we understand it, is to reduce the risk of collapse and provide a more secure surface area for the heavy equipment currently employed for burials. Given that the width of the area between trenches is equidistant to the width of a trench this greatly limits burial capacity. A distance of eight feet (8') would be more than sufficient if the sections are planned in advance. Advanced planning of trench locations will allow the weight of necessary burial equipment to be considered. For example, if the access road is only on the north end of the section, it would be logical to start the first trench at the far south end of the section and work north. This would ensure that the equipment (excavator, morgue truck, etc.) never need be positioned on top of a previously utilized trench where the ground cannot tolerate the heavy weight of vehicles and machinery.

Figure 10: Burial Operations Recommendation

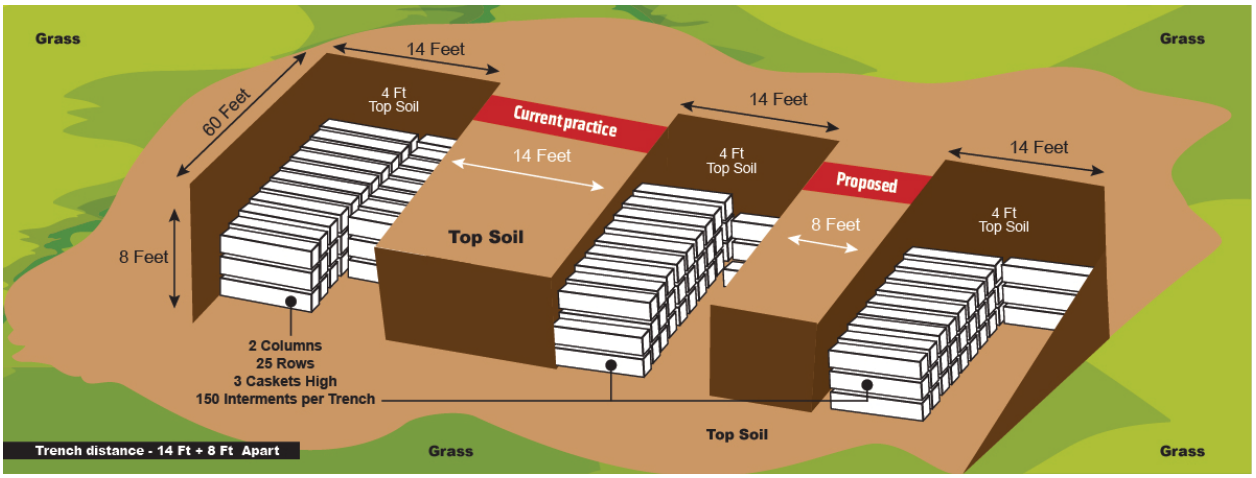


We would also recommend that the agencies responsible for managing Hart Island consider **shifting away from the current excavator burial process.** Instead, we recommend using a forklift (or a backhoe with a fork attachment) to remove multiple caskets from the morgue truck and drive the caskets into the trench. This would reduce the number of individuals who need to enter or spend sustained time in the trench. Additionally, a forklift would be a much smaller and lighter piece of equipment that would be less taxing on the grounds thereby posing less risk to the stability of the trench walls. We also believe this would speed up the process of placing caskets, again limiting the amount of time individuals are required to be in the trench.

Additionally, to increase the safety of the active burial site, we would also recommend utilizing shoring or cribbing. Occupational Safety and Health Administration ("OSHA") guidance provides the best practices for safe operations. Per OSHA standards, "Trenches 5 feet (1.5 meters) deep or greater require a protective system unless the excavation is made entirely in stable rock" (OSHA 2011). Shoring generally consists of posts, wales, struts, and sheeting. Typically, in cemetery operations aluminum hydraulic shoring is utilized, though pneumonic shoring can also be utilized.

Future capacity could be increased by reducing the distance between trenches to eight feet (8') as depicted in **Figure 11**. This could be safely and effectively accomplished through implementing the recommendations above, including, employing a burial process that utilizes lighter equipment, requiring fewer individuals to enter an active burial area, as well as adopting a shoring system. Additionally, by laying out sections in advance, operational planning as well as capacity maximization could be realized. The use of corner pins, in addition to the current center marker, and managing locations on a surveyed As-Built drawing would also ensure space is best utilized and aid in the disinterment process.

Figure 11: Proposed Burial Operation Enhancement

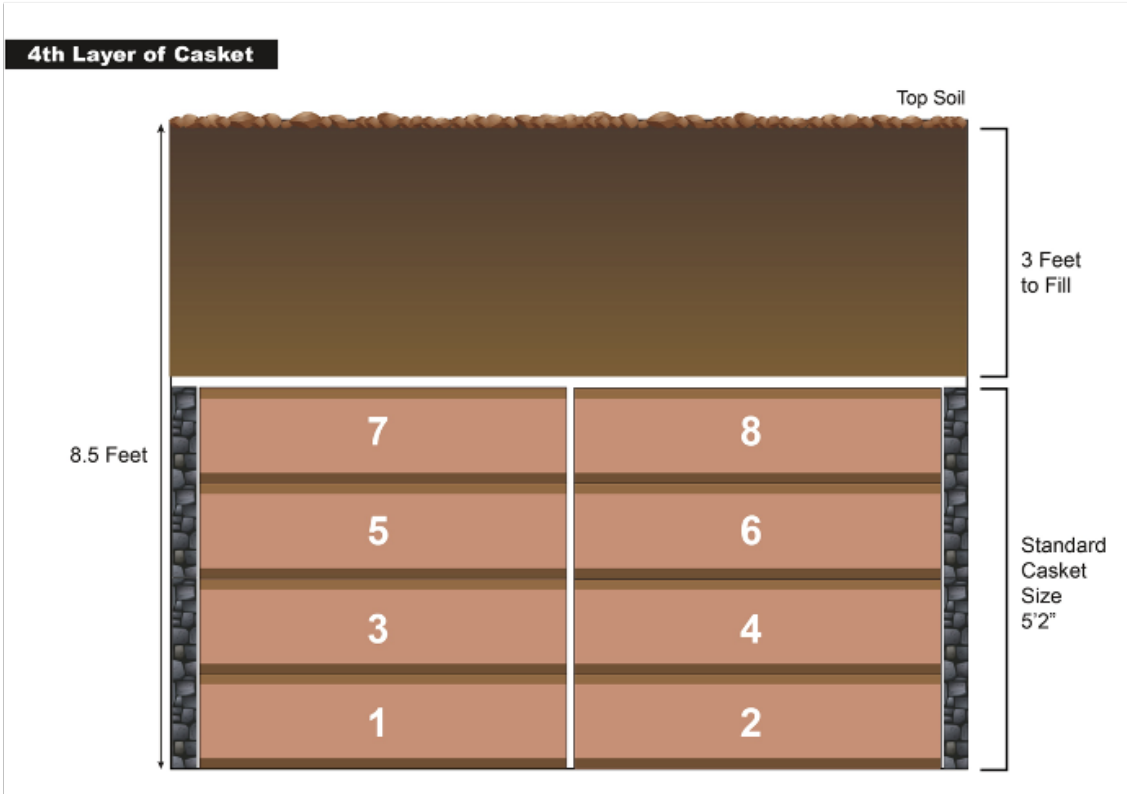


Depth of Graves and Caskets

In observing burials, there was in excess of five feet (5') of fill being placed on the top layer of caskets, which is non-standard industry practice. This is excessive, even with consideration for the fact that the Island has strong crosswinds and is susceptible to erosion. New York State does not have a legal requirement for the depth of graves, leaving this open to the local governments to set a requirement. The City requires that "When human remains are buried in the ground, the top of the coffin or casket shall be at least three feet below the level of the ground, but if the coffin or casket is enclosed in a concrete or metal vault, the top of the vault shall be at least two feet below the level of the ground." (City of New York 2022, §205.25). Based on this requirement, current practice utilizes an additional two feet of fill that is not required. We would recommend adding an additional level of caskets to increase capacity while still maintaining legally required coverage (see **Figure 12**).

Standard caskets stacked four high would stretch sixty-two inches (62") high or just under five feet two inches (5'2"). To ensure compliance with City statutes and allow for a row of oversized caskets at the bottom, the trenches would need to be dug to a minimum of eight feet and five inches (8'5") deep to accommodate this additional row. The trenches observed during this study all exceeded this minimum depth and would easily accommodate a fourth level of caskets. **Adopting this enhancement would add one-third (⅓) more capacity in available burial areas.**

Figure 12: Fourth Level of Caskets



If adding an additional row of caskets is deemed unviable, then we recommend consideration of reducing the depth of the trench. Reducing the depth of the trench by one foot (1") would reduce the volume of dirt that needs to be removed by eight hundred and forty cubic feet (840 ft^3) or across the six trenches opened annually five thousand and forty cubic feet of dirt (5,040 ft^3). Reducing the volume of dirt moved annually will extend the useful life of the equipment and provide commensurate cost savings. Additionally, having a shallower trench will reduce the risk to individuals that need to enter or be near the active burial areas.

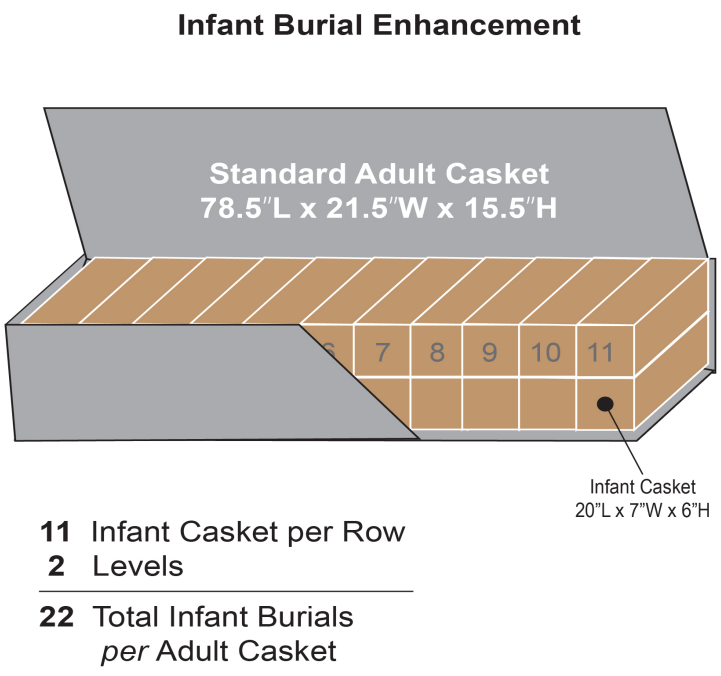
Infant Burial Practices

An infant burial trench can hold one thousand (1,000) infant caskets. Annually approximately three hundred and sixty (360) infant burials occur. As a result, the trench is excavated and not fully closed for over 3 years. While the staff has fashioned a more robust cover for the exposed burials that have not been covered with backfill, the open trench can accumulate water and runoff from inclement weather and the strong winds that prevail across the island. This can require re-excavation and additional operational effort to keep the trench operable and also pose a safety hazard to anyone walking in the area. Another challenge with this process is that densely burying the infant caskets in one area can complicate the disinterment process.

We would recommend that when infant caskets are brought to Hart Island by the morgue truck, they are then placed into a typical full-sized casket and interred in the standard burial trench. With this configuration, twenty-two (22) infant caskets can fit in one full-size casket (see **Figure 13**). It would be most efficient if staff at NYC Office of Chief Medical Examiner ("OCME") placed the infant caskets within the larger burial vessel (standard adult casket) before delivery to Hart Island; however, the placement could feasibly be accomplished on site. OCME has indicated that this would require a one-on-one transfer of custody to ensure the accuracy of recordkeeping[5]. Additionally, we would recommend simplifying the process so that the monthly interment takes place regardless of how full the burial vessel is. In other words, if there were eleven infant cases, half the capacity that fits within the larger vessel, the interment would proceed to allow for timely burial.

Names would be recorded individually and then collectively assigned to that one burial location. This may be achieved by adding an alpha identifier (a-x omitting the letter 'O' to prevent confusion with the number 0) to the placement within the casket. In other words, if the casket would normally be in space 500, the first infant casket to the left of the casket would be 500A.

Figure 13:Enhanced Burial Operation (Infant Burials)



There are a number of options to improve the infant burial process in addition to this method, including shortening trenches. However, from an operational perspective, this change would standardize all the burials on Hart Island, ensuring that the operations team can close all burial trenches efficiently and in a timely fashion.

Shoreline Protection

Hart Island, like many islands, faces severe erosion concerns and rising sea levels that will encroach on the island. The north shore in particular is eroding faster than expected. We explored one concept that would allow the shoreline to be built up while allowing for the space to be used for burials. This concept utilizes standard concrete burial vaults which are commonly used in cemetery operations. These burial vaults would provide structural support for the area as well as reduce the amount of new fill needed to increase the height of the shoreline.

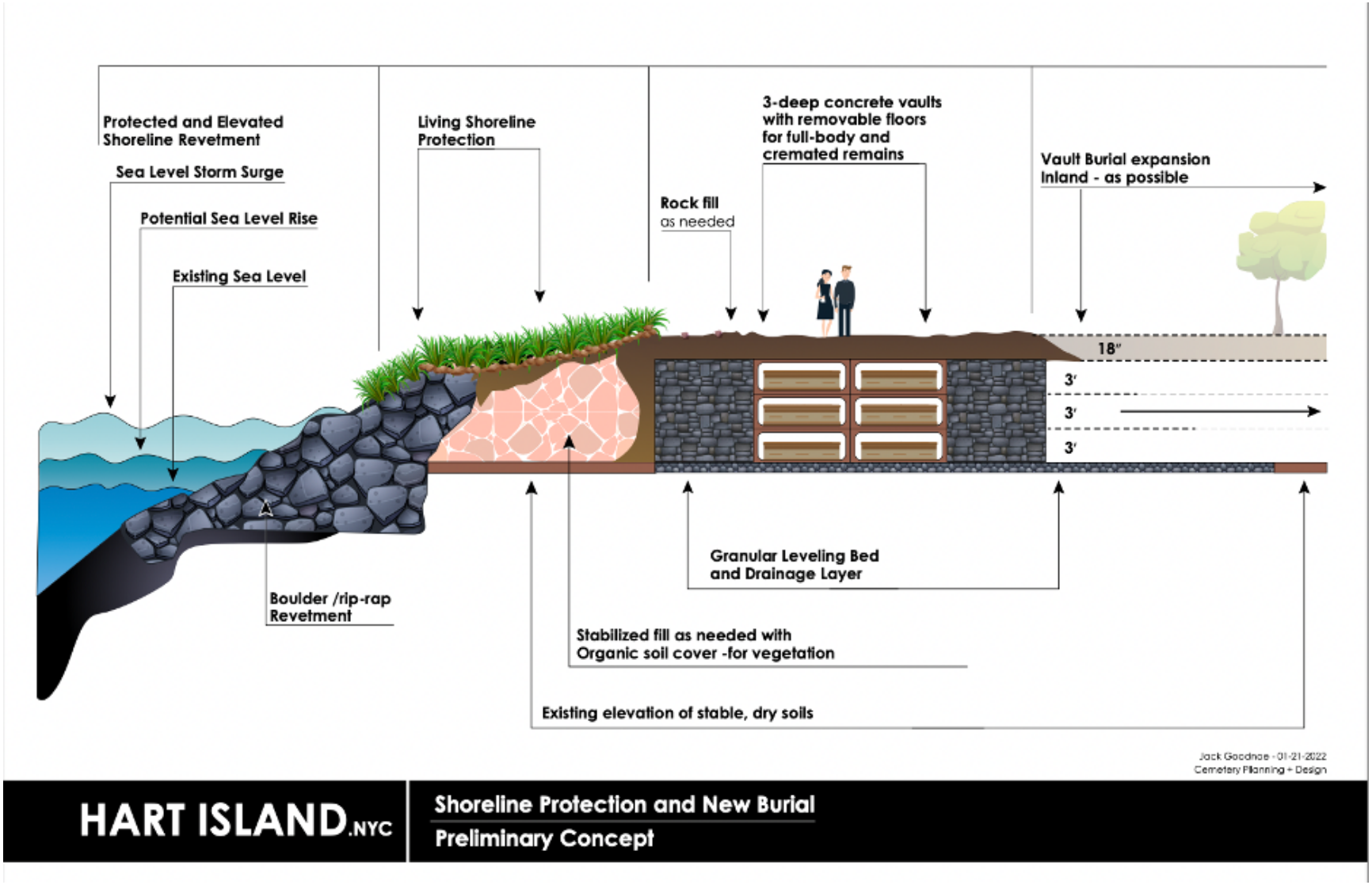
[5] We did not further evaluate coordinating this with various agencies.

To use this method, the site would need to be graded and the vaults would then be placed at the existing elevation. Per the manufacturer, the dimensions of the vault will vary slightly, however, a sample triple-depth vault measures 30" W x 86" L x 73" D and weighs 3,300 pounds. Twenty-four inches of soil would need to be placed on top of the vaults to conform with New York City law (City of New York 2022, §205.25).

Incorporating this method would increase the elevation of an area by 8 feet[6] if the vaults are placed at existing ground level. The area surrounding the vaults would be built up with a mix of soils and rock to provide a drainage layer. An organic barrier would be built up closer to the sea level and covered with vegetation to mitigate erosion and provide a living shoreline protection area. From this area a boulder or rip-rap revetment would be built up, further solidifying the shoreline. This scenario provides an alternative to building sea walls that would protect against storm surges as well as rising sea levels while also providing space for future burials. The triple-depth burial vaults could be placed immediately contiguous to each other and scaled as needed. The vaults would have removable floors or tops that would be lifted to allow for burial in each chamber of the vault. Additional vault burials could be continually expanded in adjacent areas, or the existing trench configuration could be adopted beyond the burial berm.

[6] Based on a limited field investigation, **Demerara's** Geotechnical Investigation Report (Appendix G) discusses the feasibility of this approach.

Figure 14: Shoreline Protection and New Burial Concept



The concept of utilizing burial vaults would represent a deviation in burial practice for Hart Island and is only being recommended as an alternative to combat against rising sea levels. There would be significant logistical issues and costs associated with this solution. Each three-level burial vault would need to be procured from a vault manufacturer. Triple depth vaults are estimated to cost between $850 - $1,500, though savings can be realized if procured in bulk. The vaults and additional materials (rocks, dirt, vegetation etc.) would need to be brought to the island by boat. We anticipate that installation and delivery costs will be a significant additional expense that will require further exploration. Additionally, burial practices would need to be modified in this area. However, we observed the necessary equipment on the island to conduct burials in vaults. Ultimately, this approach provides capacity while securing the stability of the shoreline.

Cremation

Cremation has significantly disrupted the funeral and cemetery industry in the United States over the last several decades. In 1970 the cremation rate in the United States was under 5%, while in 2019 a majority of Americans had adopted cremation, with the rate at almost 55%. In New York State the cremation rate in 2019 was 47.3%. From 2014 to 2018 New York State experienced the fifth highest cremation rate increase in the United States. This trend is expected to continue with the Cremation Association of North America ("CANA") estimating that by 2024 a majority (53.3%) of New York State residents will choose cremation as their final disposition (CANA, 2020)

Table 3: Cremation Practice Adoption Rate by State

Top 10 States with the highest Growth in the number of cremations from 2014 to 2018 (CANA 2020)

State	Increase in # of Cremations	Increase in % of Cremations	Rank by % growth
Texas	20,915	5.9%	33
Florida	20,737	3.9%	44
California	19,802	2.0%	49
Ohio	14,038	6.7%	27
New York	13,549	6.1%	32
Pennsylvania	12,762	7.4%	19
Michigan	11,162	8.7%	10
North Carolina	10,612	7.5%	17
Georgia	8,965	6.9%	26
Illinois	8,812	6.2%	30

On a national basis, while cemeteries can still be important for those who choose cremation, the National Funeral Directors Association ("NFDA") estimates that only 37% of people who select cremation elect to utilize a cemetery (NFDA, 2022).

Cremation has begun to be steadily incorporated into social welfare provisions in numerous countries and has seen greater adoption in the United States. Los Angeles County arranges for the cremation of deceased persons who are declared indigent or are unclaimed (City of Los Angeles, 211 LA, 2021). The county coroner's office holds the cremains for three years, at which time, if unclaimed they are buried in a single grave. In 2018 the program served 1,457 unclaimed individuals who were subsequently interred (Schleuss, 2018). Washington D.C. also relies on

cremation for unclaimed remains, placing the remains in burial plots at Congressional Cemetery through its public disposition program (Williams, 2019). Miami-Dade County in Florida provides funding for cremation through local funeral homes, any unclaimed cremated remains are allowed to be disposed of as the County sees fit. There is an Indigent Cremation Service form that Florida families are asked to fill out which states, "We understand that Florida Law authorizes the disposal of unclaimed cremains after 120 days from the date of cremation." (Miami-Dade County (2021). Several other counties including Santa Clara (California), Broward (Florida), and Toledo (Ohio) also utilize cremation for their indigent burial programs.

A sizable portion of the burials being transferred to Hart Island are unclaimed and have no next of kin to authorize or reject services. New York State has shown increasing deference to the dignity of the individual, and not presupposing an individual's wishes. In 2016, a statewide law was passed ending a system that had been in place for 162 years that had allowed unclaimed bodies to be sent to mortuary and medical schools. The law explicitly bans the "use of unclaimed bodies as cadavers without written consent by a spouse or next of kin, or unless the deceased had registered as a body donor" (Bernstein, 2016). Another major point of concern is that cremation could infringe on the deceased's religious values.

Other concerns over cremation focus on the substantial environmental impact. The cremation process requires a substantial amount of energy and produces significant carbon dioxide emissions. One estimate has a single cremation producing 534.6 pounds of carbon dioxide or as another industry expert indicated that an average cremation uses "the same amount of energy and has the same emissions as about two tanks of gas in an average car" (Little, 2019). The current Hart Island burial process is considerably more environmentally friendly as embalming does not occur and simple pine boxes are used for burial.

Cremation has nonetheless garnered greater popularity as a lower cost and convenient option where services can be scheduled at the discretion of family. Additionally, cremated remains utilize significantly less space which has made it an attractive choice in urban areas facing limited land. At Hart Island, a standard 60' long by 14' wide trench holds 150 adult caskets. Comparatively if that space was used for the placement of cremated remains it could hold between 3,360 (4 levels) – 5,040 (6 levels) sets of cremated remains. Also, the feasibility of building vertical columbaria (niche banks) provides tremendous flexibility especially where the water table does not support inground burial. The significant projected future capacity on Hart Island precludes immediate change to current City burial practices. However, with a majority of New Yorkers soon choosing cremation as their final form of disposition it is an option that is worth further exploration.

Capacity Analysis

Mathematical Approach

To determine remaining capacity, we adopted an approach that gives us a lower bound based on how many trenches we could place conservatively in a section and an upper bound based on the available square footage of each section. As noted, the traditional trench at Hart Island is sixty feet (60') in length by fourteen feet (14') wide. In each trench there are 50 units composed of caskets placed three high for a total capacity per trench of 150 burials. Additionally, currently trenches must be separated by fourteen feet (14'). For each section we fit trenches in the available space and tallied how many could fit per section. This gave us our lower bound for available capacity. The space could be more efficiently used by placing non-standard trenches (i.e., 30' x 14' or 60' x 7') in certain portions of the sections.

To determine our upper bound, we calculated the area of each trench including the 14' easement between each trench (60' x 28' = 1,680 ft^2). We then took this width and divided it by the number of units (50) per trench to get our trench equivalent unit of 33.6 ft^2. For the purposes of this exercise, we rounded this to the nearest square foot of 34 ft^2. A standard adult casket used at Hart Island is 11.8 ft^2, the trench equivalent unit is 288% larger to account for operational inefficiencies such as the necessary distance between trenches.

To determine our upper bound of capacity we took the area of each section and divided it by the calculated trench equivalent unit and multiplied by the number of caskets in each unit (3). For all capacity calculations we round down to nearest integer.

Hypothetically, if we had a parcel that was 65 feet long by 65 feet wide with a total area of 4,255 ft^2, we would calculate the capacity as follows:

Lower Bound: 2 trenches x 150 interments = 300 burials
Upper Bound: 4,255 ft^2 / 34 ft^2 * 3 = 372 burials

To determine the useful life of each section we used the calculated capacity and divided this by the assumed level of annual adult burials, 840 per year. Calculations for the hypothetical scenario below were all rounded to the nearest hundredth of a year. Our hypothetical 65' by 65' section would yield the following useful life calculations:

Lower Bound: 300 / 840 = 0.36 years
Upper Bound: 423 / 840 = 0.44 years

Table 4: Hypothetic Scenario - Useful Life Summary

Paradigm	Low	High
Capacity (Burials)	300	372
Useful Life (Years)	0.36	0.44

In addition to calculating capacity based on current operations we also calculated capacity factoring in the operational enhancements discussed in the Burial Practices: Operational

Enhancements Section. The first recommendation is to limit the distance between trenches to 8 feet. This would change the number of trenches we could fit in a section as the width would be 14 feet plus 8 feet or a total of 22 feet. Our enhanced trench calculation would be 60' x 22' representing an area of 1,320 ft^2. This is approximately 20% smaller than the area required currently for a standard trench and this proportion carries through to the area of the trench equivalent unit which would be 27 ft^2.

Returning to our hypothetical 65' x 65' section we could now fit 3 trenches resulting in the following capacity calculations:

Lower Bound: 3 trenches x 150 interments = 450 burials
Upper Bound: 4,255 ft^2 / 27 ft^2 * 3 = 472 burials

This simple improvement would represent a significant increase in capacity:

Table 5: Hypothetic Scenario - Operation Enhancement (Closer Trenches) Burials

Paradigm	Low	High
Standard	300	372
Closer Trenches	450	472
Variance	*50%*	*22%*

The second recommendation is to add a fourth level of caskets which would impact burial practices as follows:

Lower Bound: 2 trenches x 200 interments = 400 burials
Upper Bound: 4,255 ft^2 / 34 ft^2 * 4 = 497 burials

Table 6: Hypothetic Scenario - Operation Enhancement (Fourth Level) Burials

Paradigm	Low	High
Standard	300	372
4th Level Standard Trenches	400	497
Variance	*33%*	*34%*

Finally, these two operational enhancements, closer trenches and a fourth level of caskets can be paired together:

Lower Bound: 3 trenches x 200 interments = 600 burials
Upper Bound: 4,255 ft^2 / 27 ft^2 * 4 = 630 burials

Table 7: Hypothetic Scenario - Operation Enhancement (Both Enhancements) Burials

Paradigm	Low	High
Standard	300	372
4th Level & Closer Trenches	600	630
Variance	*100%*	*69%*

The result of adopting both enhancements significantly increases capacity and useful life in our hypothetical section.

Table 8: Hypothetic Scenario - Capacity Summary (Both Enhancements) Burials

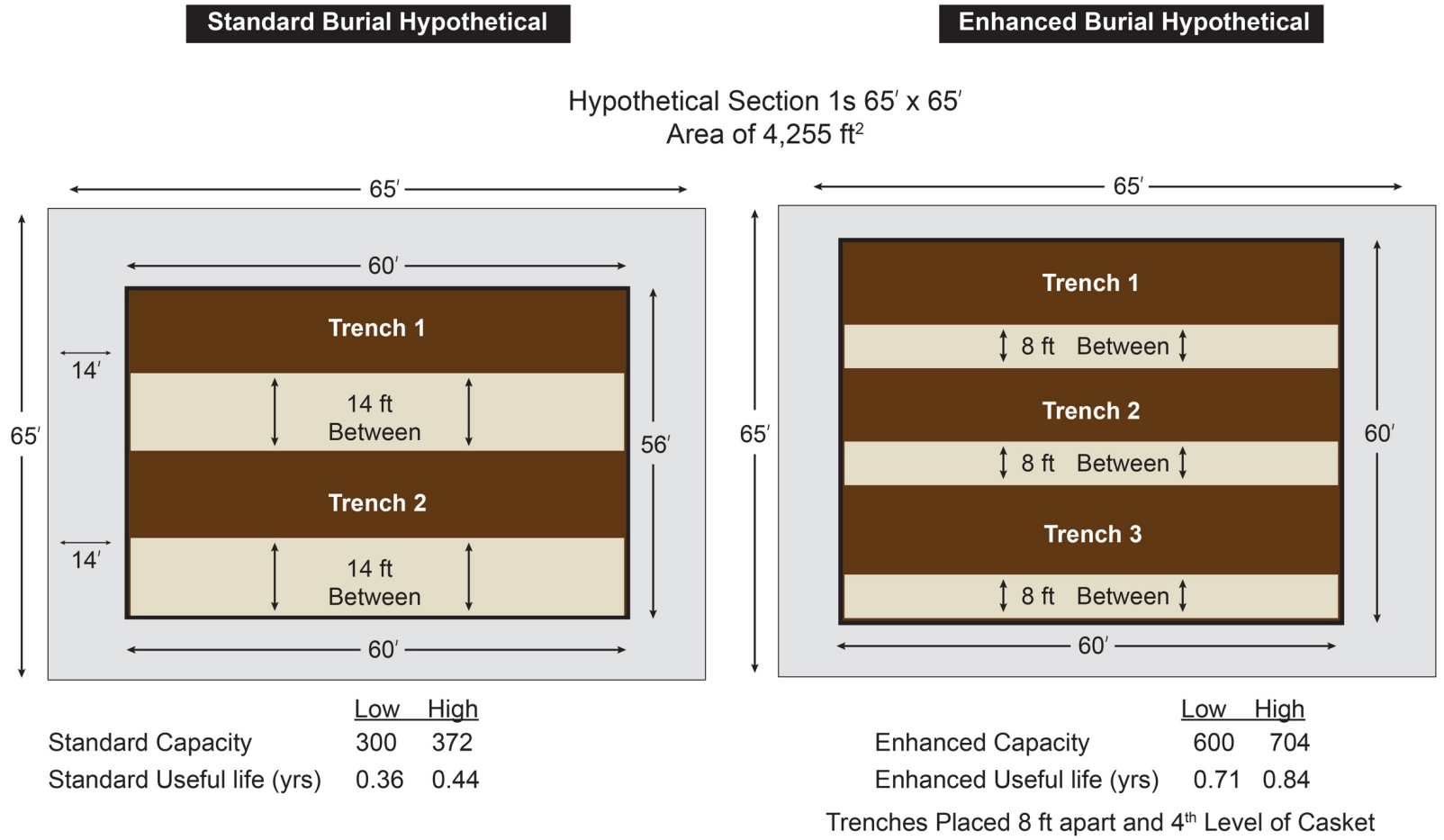
Paradigm	Low	High
Standard Capacity	300	372
Closer Trenches	450	472
Variance Standard Capacity	*50%*	*27%*
4th Level Standard Trenches	400	497
Variance Standard Capacity	*33%*	*34%*
4th Level & Closer Trenches	600	630
Variance Standard Capacity	*100%*	*69%*

Due to rounding the percentage impact is slightly different, however the useful life follows the trends seen in overall capacity:

Table 9: Hypothetic Scenario - Useful Life Summary (Years)

Paradigm	Low	High
Standard Capacity	0.36	0.44
Closer Trenches	0.54	0.56
Variance Standard Capacity	*50%*	*27%*
4th Level Standard Trenches	0.48	0.59
Variance Standard Capacity	*33%*	*34%*
4th Level & Closer Trenches	0.71	0.75
Variance Standard Capacity	*97%*	*69%*

Figure 15: Plan View of Hypothetical Section



Cremation Calculation

Once an individual is cremated the remains are usually placed in an urn. Urns can come in a variety of different sizes and materials. Standard basic urns are typically smaller than 7" w x 7" h x 7" d (**Figure 16**). As such, we assumed each urn would take up one cubic foot for our calculations.

Figure 16: Standard Sheet Bronze Urn

(Batesville, 2020)

Due to the small size, there are a variety of interment options available for the final disposition of cremated remains in a cemetery. In-ground cremation burial is typical and consists of placing the urn in a cremation vault. Additionally, there are a variety of above ground options typically referred to as niches or columbaria. The ability to install above-ground units, more cost effectively will potentially create additional capacity where the water table is high, or the soil is not suitable for in-ground burial.

A standard trench which measures 60' long by 14' feet wide or an area of 840 square feet. If we assume four levels of cremated remains in the trench, there would be 3,360 individual remains that could fit in the trench, this is the lower bound of potential capacity. Our upper limit was established by taking the square footage of the section and multiplying by four, again assuming four levels. If we calculated the potential capacity for our hypothetical 65'x 65' section, we would have between 6,720 and 16,900. This would be between 8.00 and 20.1 years of useful life. Undoubtably, cremation would exponentially increase capacity at Hart Island.

Table 10: Hypothetic Scenario - Cremation Capacity (Burials)

Paradigm	Low	High
Standard Capacity	300	372
Cremation	6,720	16,900
Variance Standard Capacity	2140%	4443%

Table 11: Hypothetic Scenario - Cremation, Future Useful Life (Years)

Paradigm	Low	High
Standard Capacity	0.36	0.44
Cremation	8.00	20.11
Variance Standard Capacity	2122%	4441%

Suitability Rubric

Future capacity was determined based on four factors with the most weight given to reusability of an area for future interments. Details can be found in **Table 16** and **Appendix A**.

Table 12: Suitability Analysis Rubric

Criteria	Explanation
Absence of human remains	The confirmed or inferred absence of prior burials was the single largest factor in our analysis
Ground Conditions	Adequate vadose zone and soil that supports current burial practices
Impacted by 100-Yr Floodplain	Suspected impacts of a 100-year flood event.
Ease of future access	Bounded by at least one road for future operational access.
Unimpacted by visitor center or crematorium siting plan	Potential site of interest for visitor center or crematorium.

The presence of human remains was confirmed based on a multifaceted methodology that included an intensive pedestrian survey of the Island, documentary research, assessment of historic maps and aerials, review of the 2015 Grave Section Location Map, analysis of test pits, ground penetrating radar survey and mapping results along with interviews with various stakeholders. Any areas where remains were known to or determined to exist were discounted in this analysis as not suitable for future capacity.

Ground conditions were assessed for each section to determine its suitability for future burial activities. This preliminary assessment factored in the soil and presence of water determined by test pits, ground penetrating radar results and the proximity to known burial trenches. The presence of an adequate vadose zone for future interments is inferred to be available around the site with the exception of the Landfill Vegetated West Section.

The potential for flooding was also a factor in our analysis, driven by a careful review of the Federal Emergency Management Agency (FEMA) 100 Year Floodplain Map. While much of the island appears to be beyond the scope of a 100-year flood event, given climate change trends, this map should be viewed as the floor for flooding activity. With the exception of the elevated north-eastern portion of the site around the Missile silo, much of the site is potentially prone to flood damage.

The ability and ease of accessing areas throughout the site was also considered to assess the feasibility of conducting future operations and for the potential of greater visitation. The existing roadway system effectively encircles the island providing access to the majority of sections. While the roads are in various states of disrepair, they are effective today and we believe they can even be reduced/removed to allow for better maintenance of the remaining roadways. In either instance, the only areas of the island that were deemed to have accessibility issues were the north missile silo area and the west vegetated area due to elevation changes and significant existing foliage.

The future siting of a visitor center and/or crematorium was also considered. Working closely with the architectural review team, primary and secondary sites were selected for optimal location

of these facilities. To allow for further analysis and consideration, these areas should remain unencumbered by burial until a plan is developed for siting these facilities.

Based on our assessment of these factors we classified sections as Highly Suitable, Future Opportunity or Not Suitable. Highly suitable refers to areas that our site and preliminary geotechnical studies indicated there are no pre-existing burials and current operating practices could be readily employed. The majority of these sections are in the immediate vicinity of current burial areas and are the location of several large structures. This reinforces our study of the section conditions and gives further confidence that these areas have soil conditions that are conducive to continue current burial practices.

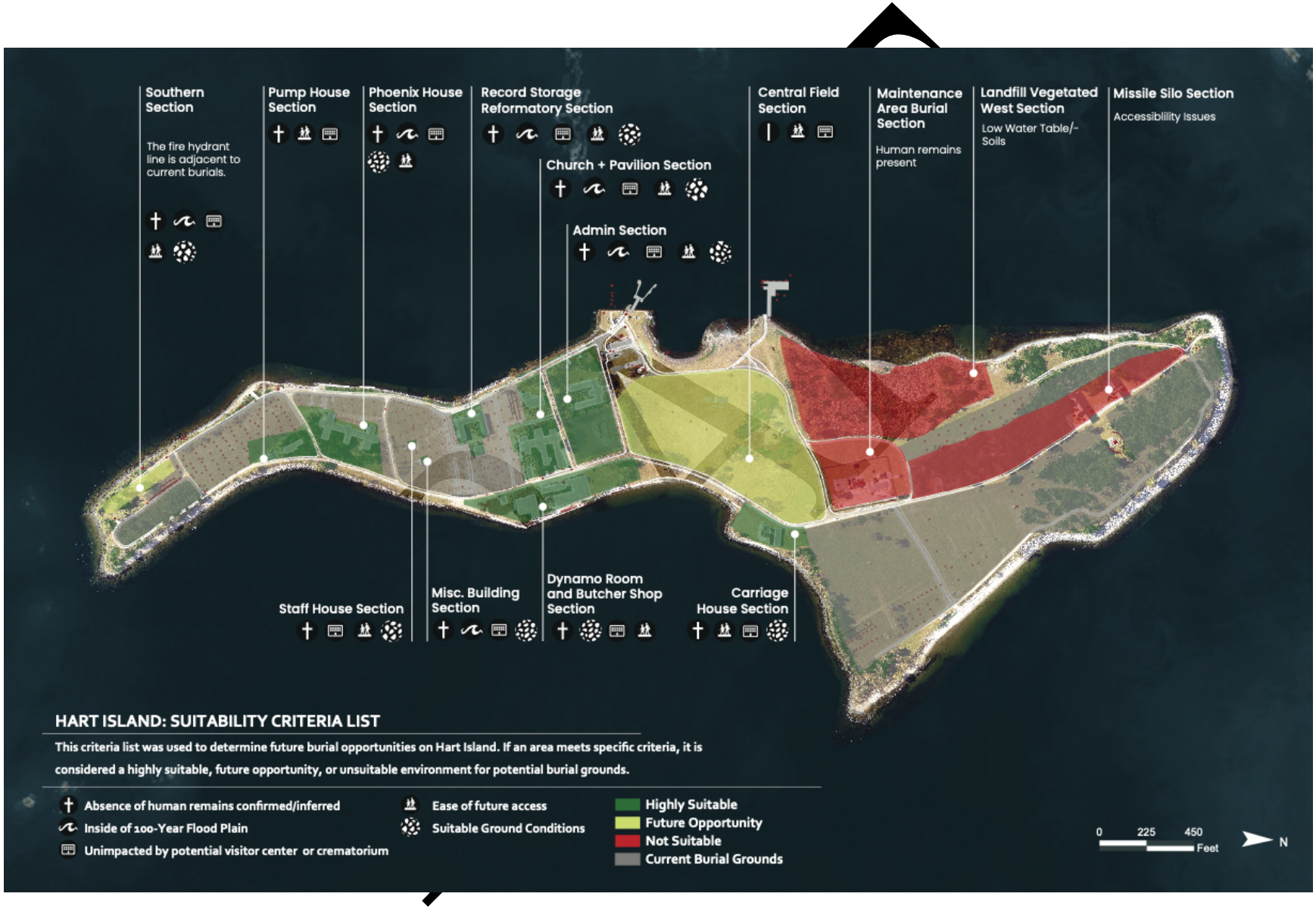
The sections classified as Future Opportunity, are areas where we believe burials are feasible but will take a change in operating practices or investments to ready the sections for burial activities. For example, the Southern section would most likely require substantial investment in a seawall or other forms of remediation to prevent erosion risks and ensure the burial conditions are suitable for burial in perpetuity. Finally, Not Suitable sections have high potential for the presence of human remains or soil conditions that preclude burial options. For example, the Vegetated West Section is primarily fill, that cannot withstand the weight of burials.

Following this methodology, the sections contemplated in our capacity analysis were classified as follows:

Table 13: Suitability Analysis by Section

Name	Location on Island	Designation	Area SqFt. (Round '000s)
Current Burial Section	Central	Highly Suitable	52,000
Administration Section	Central	Highly Suitable	73,000
Dynamo Room and Butcher Shop Section	Central	Highly Suitable	105,000
Carriage House Section	Central	Highly Suitable	44,000
Church and Pavilion Section	Central	Highly Suitable	85,000
Records Storage Reformatory Section	Central	Highly Suitable	28,000
Staff House Section	Central	Highly Suitable	1,000
Miscellaneous Building Section	Central	Highly Suitable	1,000
Phoenix House Section	South	Highly Suitable	72,000
Pump House Section	South	Highly Suitable	25,000
Central Field Section	Central	Future Opportunity	451,000
Southern Section	South	Future Opportunity	25,000
Island Access Section	Central	Not Suitable	136,000
Missile Silo Section	North	Not Suitable	239,000
Vegetated West Section	North	Not Suitable	305,000
Maintenance Area Burial Section	North	Not Suitable	120,000

Figure 17: Suitability by Section



Results

The capacity analysis undertaken analyzed two primary scenarios. For the first scenario, the driving assumption was that all buildings on Hart Island would be demolished, freeing the footprint of those buildings and the surrounding area to be used for burial. Our second scenario calculates remaining capacity if no buildings were torn down (All Buildings Remain). This scenario assumes a perimeter fence around each building that would be a 1:2 ratio to the height of the building. In other words, if the building was 5 feet tall, the perimeter would need to be 10 feet wide around the structure. A buffer of 6 feet from the fence line to where burials would begin is additionally assumed. As such, a 5 feet tall building would require burials to begin 16 feet from the structure (10 feet fence line plus 6 feet buffer).

For both capacity of future burials and the useful life of burial areas we calculated a lower and upper limit. The lower limit is predicated on the placement of trenches throughout the sections while the upper limit is based on the available square footage. The placement of equal sized rectangles is a more inefficient use of space but mirrors current operating practices. The square footage methodology is more efficient and assumes as space is increasingly constrained every effort would be made to maximize available burial space. Results consider capacity in terms of spaces for burials and useful life in years for the Highly Suitable sections.

Table 14: Capacity and Useful Life Lower Limits for Both Scenarios (Highly Suitable)

	Scenario 1: All Buildings Demolished		Scenario 2: All Buildings Remain		Variance	
Paradigm	Capacity (Spaces)	Useful Life (Years)	Capacity (Spaces)	Useful Life (Years)	Capacity (Spaces)	Useful Life (Years)
Current Operations	35,250	42.0	7,050	8.4	(28,200)	(33.6)
Enhanced Operations	57,800	68.8	9,800	11.7	(48,000)	(57.1)
Cremation	789,600	940.0	157,920	188.0	(631,680)	(7,520)

Scenario 1: All Buildings Demolished

Based upon our suitability rubric and methodology it is our opinion that under current operating conditions and utilizing current burial rates, Hart Island has **at least 42.0 years** of useful life remaining in its Highly Suitable Sections. If the proposed operational enhancements were embraced, moving the trenches closer together and adding a fourth level of caskets, this floor would increase to **68.8 years**. Given this significant useful life, immediate changes, like moving towards cremation, are not recommended. However, in the event that cremation was widely adopted the useful life of the island would be **over 900 years**.

Table 15: Scenario 1 - Capacity and Useful Life Lower Limits (Highly Suitable)

Paradigm	Capacity (Spaces)	Useful Life (Years)
Current Operations	35,250	42.0
Enhanced Operations	57,800	68.8
Cremation	789,600	940.0

Due to the changing nature of environmental conditions, personal preferences and burial practices forecasting too far in the future is imprudent. Contemplating a thirty-year horizon; it is recommended that the central portion of the island primarily consisting of the Administration section, Dynamo Room Section and Church & Pavilion Section would be the focus for immediate new burial sections. These three sections are identified as "Phase 1" and provide future burial potential of nearly 20,000 burials or approximately 23 years of useful life. Additionally, these are contiguous to existing burial areas giving enhanced confidence to the viability of burials in the sections as well as the close proximity to maintenance facilities enhancing operational efficiencies.

Table 16: Scenario 1 - Phase 1 Current Operations Capacity and Useful Life

Section Name	Capacity (Spaces) [LOW]	Capacity (Spaces) [HIGH]	Useful Life (Years) [LOW]	Useful Life (Years) [HIGH]
Church and Pavilion Section	6,450	7,500	7.7	8.9
Administration Section	5,100	6,441	6.1	7.7
Dynamo Room and Butcher Shop Section	7,950	9,264	9.5	11.0
Total Phase 1	**19,500**	**23,205**	**23.2**	**27.6**

While it was determined that the Highly Suitable sections represent a minimum of 42 years of useful life, there are an additional 45 years of useful life in sections classified as Future Opportunity. The two Future Opportunity sections are the Central Field Section as well as the Southern Section. It is our recommendation that the Central Field Section be designated for burial in correspondence with the OCME Emergency Burial Protocol (See Emergency Mass Burial Protocol Section for further discussion of this topic).

The following table depicts the capacity and useful life for each section that was categorized as Highly Suitable or Future Opportunity.

Table 17: Total Highly Suitable and Future Opportunity Capacity and Useful Life

Section Name	Designation	Capacity (Spaces) [LOW]	Capacity (Spaces) [HIGH]	Useful Life (Years) [LOW]	Useful Life (Years) [HIGH]
Current Burial Section	Highly Suitable	3,900	4,588	4.6	5.5
Church and Pavilion Section	Highly Suitable	6,450	7,500	7.7	8.9
Administration Section	Highly Suitable	5,100	6,441	6.1	7.7
Dynamo Room and Butcher Shop Section	Highly Suitable	7,950	9,264	9.5	11.0
Pump House Section	Highly Suitable	1,650	2,205	2.0	2.6
Phoenix House Section	Highly Suitable	4,950	6,352	5.9	7.6
Records Storage Reformatory Section	Highly Suitable	2,100	2,470	2.5	2.9
Carriage House Section	Highly Suitable	3,150	3,882	3.8	4.6
Staff House Section	Highly Suitable	0	88	0	0.1
Miscellaneous Building Section	Highly Suitable	0	88	0	0.1
Total Highly Suitable		**35,250**	**42,878**	**42.0**	**51.0**
Southern Section	Future Opportunity	1,800	2,205	2.1	2.6
Central Field Section	Future Opportunity	36,150	39,794	43.0	47.4
Total Future Opportunity		**37,950**	**41,999**	**45.1**	**50.0**
Total Highly Suitable and Future Opportunity		**73,200**	**84,877**	**87.1**	**101.0**

Scenario 2: All Buildings Remain

In our opinion, the second scenario of leaving all the buildings would result in a remaining capacity of **8.4 years**. If the proposed operational enhancements were adopted this would expand to **11.7 years**, while if cremation was adopted there would be a useful life of over **188 years**.

Table 18: Scenario 2 - Capacity and Useful Life Lower Limits (Highly Suitable)

Paradigm	Capacity (Spaces)	Useful Life (Years)
Current Operations	7,050	8.4
Enhanced Operations	9,800	11.7
Cremation	157,920	188.0

Retaining the buildings dramatically reduces the overall square footage available in Highly Suitable sections on Hart Island. This area would be reduced from 486,000 ft^2 to 109,000 ft^2 or reduction in burial area of 377,000 ft^2. The available area in the Future Opportunity sections would be negligibly reduced by the buildings remains as there are no significant structures within the bounds of the Central Field Section.

Table 19: Variance in Available Footage by Section

	Designation	Scenario 1: Buildings Demolished	Scenario 2: Buildings Remain	Variance
Church and Pavilion Section	Highly Suitable	85,000	0	(85,000)
Dynamo Room and Butcher Shop Section	Highly Suitable	105,000	33,000	(72,000)
Phoenix House Section	Highly Suitable	72,000	3,000	(69,000)
Administration Section	Highly Suitable	73,000	5,000	(68,000)
Records Storage Reformatory Section	Highly Suitable	28,000	0	(28,000)
Current Burial Section	Highly Suitable	52,000	31,000	(21,000)
Pump House Section	Highly Suitable	25,000	4,000	(21,000)
Carriage House Section	Highly Suitable	44,000	33,000	(11,000)
Staff House Section	Highly Suitable	1,000	0	(1,000)
Misc. Building Section	Highly Suitable	1,000	0	(1,000)
Highly Suitable		486,000	109,000	(377,000)
Central Field Section	Future Opportunity	451,000	448,000	(3,000)
Southern Section	Future Opportunity	25,000	25,000	0
Future Opportunity		**476,000**	**473,000**	**(3,000)**
Island Access Section	Not Suitable	136,000	113,000	(23,000)
Maintenance Area Burial Section	Not Suitable	120,000	100,000	(20,000)
Missile Silo Section	Not Suitable	239,000	239,000	0
Landfill Vegetated West Section	Not Suitable	305,000	305,000	0
Not Suitable		**800,000**	**757,000**	**(43,000)**
All		**1,762,000**	**1,339,000**	**(423,000)**

The "Phase 1" area comprised of the Administration section, Dynamo Room Section and Church & Pavilion Section would be particularly impacted by not demolishing the buildings. The available useful life of this area would be **between 2.9 and 4.0 years** if the buildings remain whereas if the buildings were to be demolished it would be **23.2 to 27.6 years**.

Table 20: Scenario 2 - Phase 1 Current Operations Capacity and Useful Life

Section Name	Capacity (Spaces) [LOW]	Capacity (Spaces) [HIGH]	Useful Life (Years) [LOW]	Useful Life (Years) [HIGH]
Church and Pavilion Section	0	0	0.0	0.0
Administration Section	150	441	0.2	0.5
Dynamo Room and Butcher Shop Section	2,250	2,911	2.7	3.5
Total Phase 1	**2,400**	**3,352**	**2.9**	**4.0**

Siting Studies: Welcome Center and Crematory

We considered the best location for a visitor center that would welcome visitors and convey the important place Hart Island holds in the history of New York City, without greatly impacting available burial space. The primary location for this facility is envisioned in a central location in immediate proximity to the ferry docks and as such we recommend repurposing the area that originally held the caretaker's cottage for this important site. The Welcome Center structure would be located within the historic stone garden walls, which we propose to preserve and restore. This structure would need to be designed and built in a manor to mitigate future flood risk.

Additionally, we contemplated the ideal siting and the feasibility of developing a crematory onsite. Our analysis deemed the island an unsuitable location for a cremation facility based on the associated costs, logistical hurdles, and potential environmental impacts. If cremation were to be utilized in the future, the City can explore options to transport cremains to the Island. More detailed information regarding the siting of these facilities and impacts of operating a new crematorium on the island can be found in **Appendix E: Land Use Feasibility and Accessibility Study**.

NYC Parks is preparing a Transportation Study for access to Hart Island at the same time as production of this report. Recommendations in this report for the siting of support facilities on the island should be refined based on the outcomes of the Transportation Study.

Figure 18: Proposed Welcome Area and Visitors Center

Feasibility of Grave Re-use

Nearly all cemeteries in the United States employ an "in perpetuity" model whereby a family is purchasing a burial right that confers the rights for a decedent's remains to be interred indefinitely and the cemetery commits to maintaining the decedent's space (grave, crypt, niche, etc.) forever. This is not necessarily the standard throughout the world where different customs and pressures have created varying burial traditions. Cities throughout the world, especially those facing cemetery land scarcity, have begun researching the concept of reusing space. This discussion has created a natural tension, as Dr. Julie Rugg of the University of York's Cemetery Research Group noted, "On the one hand, there is a strong pragmatic justification for re-using graves: the constant need to find new land for interment provides impetus towards the policy; and grave re-use would help to avoid burial fees becoming unaffordable high due to scarcity of space. On the other hand, there are strong ethical misgivings based on wanting the dead to rest in peace, and reluctance to disturb the dead to make way for new burials." (Rugg, J., & Holland, S. 2017, pp. 5).

In much of Central and South America as well as Europe, the majority of cemeteries rely on a lease method where families are allotted a limited time that they are permitted to use the space. After that time, the family has an option to pay a renewal fee to continue using the space. If the fees are not paid, then the remains of the deceased are moved to a communal grave and the space is reused (ABC-CLIO, 2021). Many countries where this practice is more common rely on above ground structures to facilitate easier disinterment of remains and transfer to a communal grave or ossuary.

Another approach to grave reuse is what has been termed the "lift and deepen" method. After a period of time a burial will have decomposed, leaving only bone, casket material and heirlooms. With the "lift and deepen" method, those remains are disinterred and put in a smaller container. The remains in the smaller containers are then re-interred deeper in that same grave. The space above can then be re-used, for new -burials. Once enough time has elapsed, the process can be repeated. It is important that enough time passes to ensure a state of advanced decomposition so that only bone fragments, heirlooms, and casket remnants remain to allow for reducing the footprint of the burial (Rugg, J., & Holland, S. 2017).

The last approach that can be employed is to raise the entire level of a section. This method has been employed in limited locations including Camberwell Old Cemetery in South London, England. At this property they took a section of public graves that were at least one hundred years old and raised the land by roughly eight feet, creating space for new burials while leaving existing interments below (Cohen, 2019).

New York City, as it confronts increasingly limited burial space, passed a state law several years ago that allows cemetery corporations to reacquire unused lots or plots if they were purchased more than seventy-five years prior (The New York State Senate, 2020). Hundreds of graves have been reclaimed using this process. Despite burial constraints no cemetery has embraced grave recycling or reuse in modern times. Evaluating the three methods of reuse mentioned above: lease arrangement, lift and deepen, and the raising of full sections, we believe none of these is a natural

fit for Hart Island. Both the lease arrangement[7] and the lift and deepen method would call for significant archaeological excavation and expertise to be done properly. Given the trench and green burial process (no vault liner and wooden caskets) significant decomposition happens within twenty years of interment. This makes identifying remains difficult and keeping a deceased's remains intact will require manual excavation and professional expertise. We also believe that Hart Island would receive tremendous public outcry if the policy shifted to disturbing remains via a disinterment and reinterment process. Additionally, if either of these methods were to be employed, we would recommend ensuring that State Law be changed to explicitly allow these practices to take place.

From our reading of State Law, the concept of adding additional topsoil to an existing section would be permissible at Hart Island since no rights are conferred upon the decedent and the City retains ownership of the plot. Hart Island experiences difficult weather conditions including shoreline erosion/rising sea levels and extreme winds that will be exacerbated by the demolition of structures and removal of dense overgrowth that previously acted as wind breaks. It is our belief that raising a section by eight or more feet would require significant architectural and design work to make this a reality. Simply getting the amount of topsoil required onto the Island for a small section would be logistically challenging and cost prohibitive. We also believe that even if the cost concerns could be overcome the public perception would be that Hart Island is covering up the history of its existing decedents including people who have passed from the COVID-19 pandemic, AIDS epidemic, and many other significant historic events.

In addition to considering cremation trends as mentioned elsewhere in this report, we would also recommend the exploration of the feasibility of repurposing the Nike Missile Silos. Underground burial chambers or catacombs have been traditional resting places for centuries. While the catacombs of Paris are perhaps most well-known, they may be found in many cities around the world.

Although for much of human history, burial sites have been impermanent, since the early nineteenth century with the growth of cemeteries as we know them today, people in the United States associate a grave as being a permanent resting place. Deviating from this tradition would likely result in great concern from the public. In fact, cities such as Sydney, Australia and London, England faced "resistance and accusations that religious and cultural traditions are being violated" (De Sousa, 2015) when they attempted to adopt grave reuse programs. In the case of Old Camberwell Cemetery in South London, the first week the project was announced, the Southwark Council received more than 660 objections in one week alone (Evans, 2020). As Dr. Rugg noted in her paper on this subject, many individuals have "the intuition that disturbing the dead in order to re-use their graves is repellent and ethically suspect. The reaction to grave re-use rests on the ontological insecurity visited on the living, as they contemplate this threat to the solicitude of their own or their loved one's sentient, vulnerable corpse" (Rugg, J., & Holland, S., 2017).

In the United States, and particularly in New York City, we expect there will be strong cultural presumptions against a new method of caring for our deceased. We further believe Hart Island would face enhanced public scrutiny in being an early adopter of this new method for caring for the deceased. Given the remaining capacity, legal barriers, expected expense and public sentiment

[7] This would likely also present a financial burden to families.

we would not recommend that Hart Island be an early adopter in pursuing a grave reuse program at this time.

Emergency Mass Burial Protocol

The OCME's emergency mass burial protocol calls for the burial of 30,000 individuals in the event of a massive fatality incident or pandemic. Core to this program is the ability for timely and large-scale burial as individuals may need to be immediately placed in a dignified resting place in the immediate aftermath of the event while families are contacted, and disposition choices are made. The burial schema employed must allow for accurate identification of remains as well as the ability to disinter remains. Hart Island represents a natural location for this plan.

Accommodating 30,000 deaths would represent just under 36 years of capacity at the current rate of burial on the Island. However, given the tremendous capacity remaining on the island we would recommend two paths forward. The first would be to identify a large, dedicated area to accommodate the full 30,000 and create a smaller temporary entombment option. The Central Field Section in the center of the island is an ideal location to dedicate to meeting the full requirements of the emergency burial protocol. This section has an area of over 450,000 square feet and based on current operations could accommodate over 36,000 burials. If the operational enhancements recommended in the first half of the report were adopted (trenches are placed closer together and an additional level of caskets added) the area could accommodate over 681,000 burials. The current trench and record keeping system allows for disinterment as well as identification of all individuals placed within the trench. Having a dedicated section will allow the OCME to nimbly respond as required and scale the response to the event by digging the appropriate number of trenches. To accommodate 30,000 individuals there would need to be 200 trenches dug based on current practices or 150 with the enhanced operational practices. We believe both equipment and staffing could be scaled and procured to excavate the required number of trenches as dictated by the OCME.

The second path we would recommend is to create a temporary interment option that would be scaled for smaller emergency events such as the response to the COVID 19 pandemic. To achieve this goal, we would recommend exploring retrofitting the two Nike Missile Silos located on the northern portion of the Island. The Nike Missile Silos date back to the 1950s and the shells, upon visual inspection, appear to be in good structural condition albeit with limited access - currently there is a heavy cement manhole that reveals a 30' ladder. These underground structures contained a room for storing the Nike missiles, an elevator to carry the missiles to the surface for firing. This central room is 60' long by 50' feet wide and approximately 20' feet high. The large elevator platform that was used to raise the missiles occupies the central portion of the silo. There are two silos with similar dimensions located next to each other.

Figure 19: Nike Missile Silo and Elevator

Nike Missile Silo on Hart Island

Nike Missile Silos at Cook County, IL

Images from the Library of Congress of the Barrington, Cook County, IL Nike Missile Silos. These silos were built from standard plans approved by the Army Corps. of Engineers. Left image: NIKE Missile Base C-84, Underground Storage Magazines & Launcher-Loader Assemblies, Easternmost portion of launch area, Barrington, Cook County, IL. Right image: NIKE Missile Base C-84, Underground Storage Magazines & Launcher-Loader Assemblies, Easternmost portion of launch area, Barrington, Cook County, IL (Historic American Engineering Record, C. 1968)

We believe these facilities could be retrofitted to represent tremendous capacity. The central room would need to be retrofitted with a racking system. A conservative estimate of capacity in this space is 2,250 spaces. This assumes the use of standard caskets that are placed on 3 racks that fit two tandem caskets (6 spaces length wise) with 9 feet between each column. If the racks stretch across the full width of the missile silo, then 25 spaces would be available horizontally and could stretch 15 levels high.

A simple hydraulic lift would allow the caskets to be placed on the upper levels (these are currently utilized by cemetery operations to perform burials in mausoleum buildings). If both silos were retrofitted this would provide capacity for 4,500 interments. Additionally, it may prove prudent to retrofit the large elevator for ease of transferring remains in and out of the facility.

Figure 20: Mausoleum Scissor Lift Illustration

The underground nature of this space and thick concrete shell makes the missile silo ideal as it has natural climate control that could be enhanced with a modern HVAC system if needed.

This improvement may require access to a power source which is not present on Hart Island today.

Placement in an indoor location would mitigate the impact of environmental elements that inground burials are subjected to slowing the decomposition of remains and the burial vessel (casket). Additionally, the racking system would allow for easier access to the remains allowing for a simpler and faster disinterment process for families who wish to reinter their loved one in a place of their choosing. If materials are limited the use of the racking system would also allow for body bags to be used for temporary interment. After an appropriate period of time, for families to make an informed disposition choice after the event, the individuals left unclaimed could be transferred to caskets and interred in trenches on Hart Island as a permanent place of burial (disinterment would still be feasible). As such, the City could continually maintain the silos as an option for temporary interment of smaller emergency events or as a staging ground for larger events.

Conclusion

Given the significant undeveloped acreage on Hart Island, we see no reason to make sweeping changes that would involve legislative, public, and legal impacts such as grave reuse and cremation. However, given the limited highly suitable land should the buildings not be removed

it may be prudent to adopt the operational recommendations detailed in this report including moving the trenches closer together as well as adding a fourth level of caskets. Adopting these recommendations significantly increases capacity, in the scenario of the buildings remaining, the capacity would increase from 8 years to 12 years, while if the buildings are demolished the capacity would increase from 42 years to 69 years.

This study was primarily focused on identifying and quantifying future capacity and does not contemplate best uses for the property or delve into future questions of public access beyond siting and programming for a potential visitor's center. Having surplus inventory means that site utilization can be intentional to meet the requirements desired by stakeholders of the island. We recommend continuing to focus current burial activities in the central portion of the island to provide future flexibility while also ensuring efficient operations.

Additionally, we would encourage the City to further study soils and ground conditions in the Central Field Section and an engineering study of the Missile Silos to ensure these are suitable locations to meet the OCME's Emergency Mass Burial Protocol requirements. We also recommend the City evaluate and incorporate the operational enhancements suggested in this report. Finally, with the effects of climate change, and heavy erosion of the North Shore, it is prudent to plan for and scope remediation efforts that protect the shoreline of Hart Island.

As a place of eternal repose, Hart Island is a sacred place with over 100 years of municipal history. A place of stillness and contemplation that has retained these characteristics for decades through the tireless efforts of many citizens and City workers. The demolition of building structures creates new opportunities to re-imagine this unique place so it can continue to provide a vital service for decades to come. We're grateful for the opportunity to have contributed to that effort.

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Appendix A: Capacity Calculations

Scenario 1: Building Footprints Reclaimed | Current Ops							
				Capacity (Spaces)		Useful Life (Years)	
Name	Rating	Area (SqFt. '000s)	Trenches	Low	High	Low	High
Current Burial Section	Highly Suitable	52,000	26	3,900	4,588	4.6	5.5
Administration Section	Highly Suitable	73,000	34	5,100	6,441	6.1	7.7
Dynamo Room and Butcher Shop Section	Highly Suitable	105,000	53	7,950	9,264	9.5	11.0
Phoenix House Section	Highly Suitable	72,000	33	4,950	6,352	5.9	7.6
Pump House Section	Highly Suitable	25,000	11	1,650	2,205	2.0	2.6
Carriage House Section	Highly Suitable	44,000	21	3,150	3,882	3.8	4.6
Church and Pavilion Section	Highly Suitable	85,000	43	6,450	7,500	7.7	8.9
Records Storage Reformatory Section	Highly Suitable	28,000	14	2,100	2,470	2.5	2.9
Staff House Section	Highly Suitable	1,000	0	0	88	0	0.1
Misc. Building Section	Highly Suitable	1,000	0	0	88	0	0.1
Subtotal Highly Suitable		**486,000**	**235**	**35,250**	**42,878**	**42.0**	**51.0**
Central Field Section	Future Opportunity	451,000	241	36,150	39,794	43.0	47.4
Southern Section	Future Opportunity	25,000	12	1,800	2,205	2.1	2.6
Missile Silo Section	Not Suitable	239,000	0	0	21,088	0	25.1
Landfill Vegetated West Section	Not Suitable	305,000	0	0	26,911	0	32.0
Maintenance Area Burial Section	Not Suitable	120,000	0	0	10,588	0	12.6
Island Access Section	Not Suitable	136,000	0	0	12,000	0	14.3
All		**1,762,000**	**488**	**73,200**	**155,464**	**87.1**	**185.1**

Scenario 1: Building Footprints Reclaimed | Enhanced Operations							
				Capacity (Spaces)		Useful Life (Years)	
Name	Rating	Area (SqFt. '000s)	Trenches	Low	High	Low	High
Current Burial Section	Highly Suitable	52,000	32	6,400	7,703	7.6	9.2
Administration Section	Highly Suitable	73,000	45	9,000	10,814	10.7	12.9
Dynamo Room and Butcher Shop Section	Highly Suitable	105,000	64	12,800	15,555	15.2	18.5
Phoenix House Section	Highly Suitable	72,000	39	7,800	10,666	9.3	12.7
Pump House Section	Highly Suitable	25,000	13	2,600	3,703	3.1	4.4
Carriage House Section	Highly Suitable	44,000	25	5,000	6,518	6.0	7.8
Church and Pavilion Section	Highly Suitable	85,000	54	10,800	12,592	12.9	15.0
Records Storage Reformatory Section	Highly Suitable	28,000	17	3,400	4,148	4.0	4.9
Staff House Section	Highly Suitable	1,000	0	0	148	0	0.2
Misc. Building Section	Highly Suitable	1,000	0	0	148	0	0.2
Subtotal Highly Suitable		**486,000**	**289**	**57,800**	**71,995**	**68.8**	**85.8**
Central Field Section	Future Opportunity	451,000	308	61,600	66,814	73.3	79.5
Southern Section	Future Opportunity	25,000	12	2,400	3,703	2.9	4.4
Missile Silo Section	Not Suitable	239,000	0	0	35,407	0	42.2
Landfill Vegetated West Section	Not Suitable	305,000	0	0	45,185	0	53.8
Maintenance Area Burial Section	Not Suitable	120,000	0	0	17,777	0	21.2
Island Access Section	Not Suitable	136,000	0	0	20,148	0	24.0
All		**1,762,000**	**609**	**121,800**	**261,029**	**145.0**	**310.9**

Scenario 1: Building Footprints Reclaimed | Cremation						
			Capacity (Spaces)		Useful Life (Years)	
Name	**Rating**	**Area (SqFt. '000s)**	**Low**	**High**	**Low**	**High**
Current Burial Section	Highly Suitable	52,000	87,360	208,000	104.0	247.6
Administration Section	Highly Suitable	73,000	114,240	292,000	136.0	347.6
Dynamo Room and Butcher Shop Section	Highly Suitable	105,000	178,080	420,000	212.0	500.0
Phoenix House Section	Highly Suitable	72,000	110,880	288,000	132.0	342.9
Pump House Section	Highly Suitable	25,000	36,960	100,000	44.0	119.0
Carriage House Section	Highly Suitable	44,000	70,560	176,000	84.0	209.5
Church and Pavilion Section	Highly Suitable	85,000	144,480	340,000	172.0	404.8
Records Storage Reformatory Section	Highly Suitable	28,000	47,040	112,000	56.0	133.3
Staff House Section	Highly Suitable	1,000	0	4,000	0	4.8
Misc. Building Section	Highly Suitable	1,000	0	4,000	0	4.8
Subtotal Highly Suitable		**486,000**	**789,600**	**1,944,000**	**940.0**	**2,314.3**
Central Field Section	Future Opportunity	451,000	809,760	1,804,000	964.0	2,147.6
Southern Section	Future Opportunity	25,000	40,320	100,000	48.0	119.0
Missile Silo Section	Not Suitable	239,000	0	956,000	0	1,138.1
Landfill Vegetated West Section	Not Suitable	305,000	0	1,220,000	0	1,452.4
Maintenance Area Burial Section	Not Suitable	120,000	0	480,000	0	571.4
Island Access Section	Not Suitable	136,000	0	544,000	0	647.6
All		**1,762,000**	**1,639,680**	**7,048,000**	**1,952.0**	**8,390.5**

Scenario 2: All Buildings Remain | Current Ops							
				Capacity (Spaces)		Useful Life (Years)	
Name		Area (SqFt. '000s)	Trenches	Low	High	Low	High
Current Burial Section	Highly Suitable	31,000	15	2,250	2,735	2.7	3.3
Administration Section	Highly Suitable	5,000	1	150	441	0.2	0.5
Dynamo Room and Butcher Shop Section	Highly Suitable	33,000	15	2,250	2,911	2.7	3.5
Phoenix House Section	Highly Suitable	3,000	0	0	264	0	0.3
Pump House Section	Highly Suitable	4,000	1	150	352	0.2	0.4
Carriage House Section	Highly Suitable	33,000	15	2,250	2,911	2.7	3.5
Church and Pavilion Section	Highly Suitable	0	0	0	0	0	0
Records Storage Reformatory Section	Highly Suitable	0	0	0	0	0	0
Staff House Section	Highly Suitable	0	0	0	0	0	0
Misc. Building Section	Highly Suitable	0	0	0	0	0	0
Subtotal Highly Suitable		**109,000**	**47**	**7,050**	**9,614**	**8.4**	**11.4**
Central Field Section	Future Opportunity	448,000	238	35,700	39,529	42.5	47.1
Southern Section	Future Opportunity	25,000	12	1,800	2,205	2.1	2.6
Missile Silo Section	Not Suitable	239,000	0	0	21,088	0	25.1
Landfill Vegetated West Section	Not Suitable	305,000	0	0	26,911	0	32.0
Maintenance Area Burial Section	Not Suitable	100,000	0	0	8,823	0	10.5
Island Access Section	Not Suitable	113,000	0	0	9,970	0	11.9
All		**1,339,000**	**297**	**44,550**	**118,140**	**53.0**	**140.6**

Scenario 2: All Buildings Remain | Enhanced Operations							
				Capacity (Spaces)		Useful Life (Years)	
		Area (SqFt. '000s)	Trenches	Low	High	Low	High
Current Burial Section	Highly Suitable	31,000	14	2,800	4,592	3.3	5.5
Administration Section	Highly Suitable	5,000	0	0	740	0	0.9
Dynamo Room and Butcher Shop Section	Highly Suitable	33,000	17	3,400	4,888	4.0	5.8
Phoenix House Section	Highly Suitable	3,000	0	0	444	0	0.5
Pump House Section	Highly Suitable	4,000	0	0	592	0	0.7
Carriage House Section	Highly Suitable	33,000	18	3,600	4,888	4.3	5.8
Church and Pavilion Section	Highly Suitable	0	0	0	0	0	0
Records Storage Reformatory Section	Highly Suitable	0	0	0	0	0	0
Staff House Section	Highly Suitable	0	0	0	0	0	0
Misc. Building Section	Highly Suitable	0	0	0	0	0	0
Subtotal Highly Suitable		109,000	49	9,800	16,144	11.7	192
Central Field Section	Future Opportunity	448,000	303	60,600	66,370	72.1	79.0
Southern Section	Future Opportunity	25,000	12	2,400	3,703	2.9	4.4
Missile Silo Section	Not Suitable	239,000	0	0	35,407	0	42.2
Landfill Vegetated West Section	Not Suitable	305,000	0	0	45,185	0	63.8
Maintenance Area Burial Section	Not Suitable	100,000	0	0	14,814	0	17.6
Island Access Section	Not Suitable	113,000	0	0	16,740	0	19.9
All		**1,339,000**	**364**	**72,800**	**198,363**	**86.7**	**236.1**

Scenario 2: All Buildings Remain | Cremation						
			Capacity (Spaces)		Useful Life (Years)	
		Area (SqFt. '000s)	Low	High	Low	High
Current Burial Section	Highly Suitable	31,000	50,400	124,000	60.0	147.6
Administration Section	Highly Suitable	5,000	3,360	20,000	4.0	23.8
Dynamo Room and Butcher Shop Section	Highly Suitable	33,000	50,400	132,000	60.0	157.1
Phoenix House Section	Highly Suitable	3,000	0	12,000	0	14.3
Pump House Section	Highly Suitable	4,000	3,360	16,000	4.0	19.0
Carriage House Section	Highly Suitable	33,000	50,400	132,000	60.0	157.1
Church and Pavilion Section	Highly Suitable	0	0	0	0	0
Records Storage Reformatory Section	Highly Suitable	0	0	0	0	0
Staff House Section	Highly Suitable	0	0	0	0	0
Misc. Building Section	Highly Suitable	0	0	0	0	0
Subtotal Highly Suitable		**109,000**	**157,920**	**436,000**	**188.0**	**519.0**
Central Field Section	Future Opportunity	448,000	799,680	1,792,000	952.0	2,133.3
Southern Section	Future Opportunity	25,000	40,320	100,000	48.0	119.0
Missile Silo Section	Not Suitable	239,000	0	956,000	0	1,138.1
Landfill Vegetated West Section	Not Suitable	305,000	0	1,220,000	0	1,452.4
Maintenance Area Burial Section	Not Suitable	100,000	0	400,000	0	476.2
Island Access Section	Not Suitable	113,000	0	452,000	0	538.1
All		**1,339,000**	**997,920**	**5,356,000**	**1,188.0**	**6,376.2**

Appendix B:
Illustrations of Work Completed

Appendix C:
Chrysalis Archaeology - Historical Assessment

Appendix D:
VHB - Environmental Site Assessment Report

Appendix E:
Easton Architects - Land Use Feasibility and Accessibility Study

Appendix F:
AccuScan - GPR Report

Appendix G:
Demerara – Geotechnical Investigation Report

Appendix H:
SYK – Survey and Mapping Reports