

PLANNING FOR THE DECEASED IN JAMAICA



DRAFT REPORT

Prepared by
Planning Monitoring Evaluation and Research Branch and
Supervised by the Spatial Planning Division
National Environment and Planning Agency
January 2020

Report on the Planning for the deceased in Jamaica.

Prepared by the National Environment and Planning Agency (NEPA)

10&11 Caledonia Avenue

Kingston 5

Jamaica W.I.

Telephone: (876) 754-7540

Fax: (876) 754-7596

Email: pubed@nepa.gov.jm

Website: www.nepa.gov.jm

All rights reserved. This publication may not be produced in whole or part for education or non-profit purposes without special permission from the copyright holder. Acknowledgement of the source must be made and the National Environment & Planning Agency would appreciate receiving a copy of any such publication.

Copyright © 2020 by the National Environment and Planning Agency

EXECUTIVE SUMMARY

This study explored the shortage of burial space for cemetery land use and investigated the potential sources of environmental pollution from the activities of funeral homes. The goal of the study, was to identify and assess the processes associated with the disposal of the deceased in Jamaica.

A combination of Geographic Information Systems (GIS), descriptive and inferential statistics was used to analyze and understand the data. The mixed methodological approach was used to answer the main research question which improved our understanding of the processes associated with the disposal of the deceased in Jamaica. The study was divided into several stages:

1. Analysis of population distribution and changes,
2. Survey of funeral homes including the identification of potential sources of pollution from the activities of funeral homes,
3. Identification of location of existing burial sites,
4. Estimation of existing and projected burial space,
5. Direct Field observation of the conditions of existing cemeteries,
6. Comparison of environmental impact of cremation vs burial using meta-analytical approach,
7. Identification of sustainable burial options.

For the cemetery mapping a sample of 115 burial sites were randomly selected from the target of 427 identified burial sites. Eight (8) cemeteries were investigated per parish (4 urban and 4 rural) for the funeral homes a sample of 35 funeral homes were selected from using a ballot system. Results show that:

- The data from the funeral homes revealed that about 92% of the deceased are buried in the grave while only 8% are cremated.
- The majority (60%) of citizens prefers to bury their loved ones in private cemeteries while the minority (40%) favour public cemeteries.
- Most of (68%) of the cemeteries in the Island have reached their full capacity.
- Most of the funeral homes have been operating for several generations as revealed by the survey but to date there is no national policy regulating their operations.
- There is no uniformity in the way funeral homes handle, store, sort, transport and dispose-of hazardous waste generated from their operations.
- Majority of the funeral homes does not have a waste management plan
- Majority of the cemeteries have no management plan and staffing
- Population growth as a result of rural-to-urban migration, coupled with rapid urbanisation have resulted in intense competition for cemetery land. The lack of space in cemeteries can

be attributed to the prevalence of the practice of ground burials, the reluctance of much of the population to adopt alternative methods and the increase in burial rates due to changing population.

- Most cemeteries have broken graves
- No waste bins are provided at cemeteries
- Funeral services, as currently practiced, are unsustainable.
- There are issues of safety and security in most of the cemeteries due to lack of proper management. Theft is common in cemeteries as criminals take advantage of the lack of maintenance of the area. Vandalism is also increasingly becoming a problem.
- No proper records are kept for the cemeteries. Record-keeping is a very important function in managing cemeteries. Electronic record-keeping is ideal, yet not widely used.
- There is inadequate/insufficient funding to properly manage the cemeteries. The revenues collected for funeral services do not cover the operational costs of cemeteries. Budgets in all municipalities are not sufficient for cemetery management to meet the requirements of managing and maintaining cemeteries.
- Cemetery management is facing several challenges: funding, staffing, lack of modern equipment, basic infrastructure, services and lack of new ideas.

RECOMMENDATIONS

- The study recommends that sustainable alternative disposal options should be encouraged to help address the land use challenges.
- There should be a national policy to govern funeral home operations which should include a waste management plan
- There should be a land use classification for funeral homes and a distinction made between funeral homes and funeral parlours
- Cremations should be incentivised so as to make them more appealing than ground burial.
- It is highly recommended that regional centres should provide a cemetery addressing the need of the DSA of the Regional centres.
- Sub-Regional Centres will need to provide cemetery areas addressing the need of the SRSA.
- Areas not covered by Sub-regional Centre SRSAs, District Centres will need to provide cemeteries at District Service Level.
- Cemeteries and Crematoria should be located on the outskirts of growth centres, on land other than productive agricultural land Class I-III.
- Landscape planning solutions should be included in the design of cemeteries and crematoria

not simply to screen the site but to create pleasant and serene parks for quiet contemplation around burial grounds

- Improve safety and security in cemeteries. In order to prevent the theft and vandalism of tombstones, security should be increased at cemeteries. This is particularly the case in passive cemeteries where burial activity has ceased and traffic is reduced on weekends. The number of security officers and patrols should be increased.
- When budget permits, outsource functions in cemeteries, thus providing a better service to citizens. Create jobs through collaborating with adjacent communities. Low-skilled labour in cemeteries can be provided by communities adjacent to cemeteries. Funeral procedures should be standardized. Having a comprehensive set of municipal by-laws that addresses all aspects of a funeral, from the booking of the grave to the type of burial chosen and the management of a cemetery, increases efficiency.
- All new cemeteries should offer environmentally sustainable burial methods. Wherever possible, space should be allocated in cemeteries that are designed and landscaped to include alternatives to the traditional headstone or tombstone burial, such as a berm section, a garden section and a memorial wall. From the outset, new cemeteries should be conceived for multiple uses, and integrated into urban areas as green space for parks and recreational activities as well as burials.
- Frequently engage all stakeholders in cemeteries to identify problems in providing funeral services and find solutions. Undertakers, religious bodies, and the police service all play some part in the burial process. Their input can be useful to cemetery management.
- Encourage the development of private cemeteries. Private cemeteries in Jamaica are financially sustainable and offer an appealing alternative to municipal cemeteries.
- Solutions to increase the sustainability of cemeteries should be prioritized. Municipalities should establish an agreed-upon set of steps to ensure that representative community input to cemetery planning and the choice of interment methods are canvassed. These stakeholders should include members of the general public, elected representatives at the local level on ward committees, traditional leaders, and staff in the relevant line function departments.
- Community consultation processes must be robust and credible, ensuring that everyone in the community is represented and heard. The aim of the consultations is to help municipalities understand the opinions of the community as it relates to alternative burial methods. This is a first step towards devising ways of addressing the issues raised as well as to make alternative burial methods more appealing.

- Communities should be empowered to make informed choices about burial methods. Municipalities should use all communication means at their disposal – electronic (television and radio) and print media, as well as community meetings and outreach through music and drama in schools – to educate the community about alternative burial methods. The case should be made that alternative methods is a choice that has to be made in order to protect the interests of the living. The issue of land shortage should be stressed and that alternative methods are cheaper in terms of freeing up land for other uses, e.g. housing, and have less impact on the environment. The Ministry of Local Government needs to address the budgetary constraints faced by municipalities in managing cemeteries. At present revenue collection does not cover the operational costs of cemeteries. The cost structure is based on burials but does not take into account the costs associated with the long-term upkeep and maintenance of cemeteries. Subventions from national government should make up the shortfall. This will enable municipalities to invest in the infrastructure and facilities that improve the management of cemeteries and the services provided to the community, from rolling out electronic record-keeping and capturing old paper records to providing proper security and the maintenance and upkeep of the grounds and facilities.

TABLE OF CONTENTS

EXECUTIVE SUMMARY.....	3
TABLE OF CONTENTS.....	7
LIST OF FIGURES	11
ACKNOWLEDGEMENT	13
CHAPTER ONE: PREAMBLE AND BACKGROUND OF THE STUDY	14
1.0 PREAMBLE.....	14
1.1 VISION	14
1.2 MISSION.....	15
1.3 MANDATE	15
1.4 DEFINITION OF TERMS	15
1.5.0 BACKGROUND OF THE STUDY	18
1.5.1 DEFINING BURIAL SITES	19
1.5.2 TYPES OF CEMETERIES/BURIAL SITES IN JAMAICA	20
1.5.3 PROBLEM STATEMENT.....	20
1.5.4 MAJOR ISSUES	21
1.5.5 RESEARCH GOAL AND OBJECTIVES	22
1.5.6 RESEARCH QUESTIONS.....	22
1.5.7 SCOPE OF THE STUDY	23
1.5.8 INSTITUTIONAL/LEGISLATIVE FRAMEWORK.....	23
1.5.9 REGULATORY FRAMEWORK.....	24
1.6.0 ENVIRONMENTAL PERMIT AND LICENSE SYSTEM	24
1.6.1 INTERNATIONAL STANDARDS AND GUIDELINES.....	25
1.7.0 ENVIRONMENTAL CONSERVATION	26
1.7.1 WATER RESOURCES.....	26
1.7.2 PUBLIC HEALTH.....	26
1.7.3 SOLID WASTE	27
1.7.4 AIR QUALITY	27
1.7.5 NOISE.....	27
1.8.0 DEVELOPMENT CONTROL.....	27
1.8.1 PHYSICAL PLANNING AND LAND USE CONTROLS	28

1.8.2	NATIONAL SETTLEMENT STRATEGY (NSS)	28
1.8.3	PLANNING THEORY: CHRISTALLERS CENTRAL PLACE	29
1.8.4	ROLE OF PLANNING STANDARDS AND GUIDELINES	29
1.8.5	GUIDING PRINCIPLES FOR BURIAL PROVISIONS	30
1.8.6	LIMITATION OF THE STUDY	30
1.9.0	HISTORY OF DISPOSAL OF THE DECEASED IN JAMAICA	31
1.9.1	PRE-COLOMBIAN JAMAICA	31
1.9.2	THE SLAVE BURIAL	31
1.9.3	PLANNING FOR THE DECEASED IN THE POST SLAVERY ERA	32
1.9.4	EARLIEST CEMETERIES IN JAMAICA	32
1.9.5	NEWS REPORTS ON CEMETERIES IN CONTEMPORARY JAMAICA	33
1.9.6	NATIONAL PHYSICAL PLAN 1978 TO 1998 JAMAICA	34
CHAPTER TWO: METHODOLOGY		36
2.0	INTRODUCTION	36
2.1	OUTLINE OF THE STUDY	38
2.2	THE PROCEDURE FOR CEMETERY SELECTION	41
2.3	DATA COLLECTION	42
2.3.1	PRIMARY DATA COLLECTION	42
2.3.2	SECONDARY DATA COLLECTION	42
2.4	MATERIALS	43
2.4.1	HARDWARE AND SOFTWARE	43
2.5	RESEARCH DESIGN	43
2.6	SAMPLE DOMAINS	43
2.7	TARGETED CEMETERIES	43
2.8	SAMPLE DESIGN	44
2.9	STRATIFICATION	44
2.10	SAMPLE FRAME	44
2.11	QUESTIONNAIRE ADMINISTRATION	45
2.12	DATA ANALYSIS	45
CHAPTER THREE: FINDINGS DESCRIPTION, ANALYSIS AND SYNTHESIS		46
3.0	POPULATION DISTRIBUTION AND CHANGES IN JAMAICA	46
3.1	POPULATION OUTLIERS	47
3.2	PRELIMINARY STAGE	51
3.2.1	IDENTIFYING POTENTIAL SOURCES OF POLLUTION FROM THE ACTIVITIES	

OF FUNERAL HOMES/DIRECTORS	51
3.3 PRESENTATION OF SURVEY/INTERVIEW DATA FROM FUNERAL HOMES	51
3.4 INSTITUTIONS OF THE DEATH CARE INDUSTRY	52
3.4.1 LIFE CYCLE ASSESSMENT OF DISPOSAL OF DECEASED HUMANS	60
3.5 POTENTIAL SOURCES OF POLLUTION FROM THE FUNERAL PROCESS	61
3.5.1 COFFINS/CASKETS.....	61
3.5.2 EMBALMING PROCESS	62
3.5.3 THE CORPSE	62
3.5.4 SHARPS.....	62
3.5.5 PHARMACEUTICAL AND CHEMOTHERAPY WASTE	63
3.5.5.1 BIO HAZARDOUS WASTE	63
3.6 FINAL STAGE.....	63
3.6.1 LOCATION OF CEMETERIES IN JAMAICA.....	63
3.6.2 LOCATION OF CREMATORIIUMS IN JAMAICA.	67
3.7 DETAILS OF THE CREMATION PROCESS	68
3.7.1 COMPARISON BETWEEN BURIALS VS CREMATION.....	68
3.8 ACREAGES OF LAND NEEDED BY EXISTING POPULATION USING THE NATIONAL SETTLEMENT STRATEGY	74
3.9 GLOBAL OUTLOOK: LAND ALLOCATION	80
3.9.1 HYPOTHETICAL SCENARIO.....	80
3.10 PHYSICAL CONDITION OF CEMETERIES	81
3.10.1 SAMPLE PROCEDURE.....	81
3.10.2 DESCRIPTIVE ANALYSIS	82
3.10.3 EMPIRICAL RESULTS	85
3.10.4 INTERPRETATION OF RESULTS	86
3.10.5 RESULTS FOR THE FACE TO FACE INTERVIEW	89
3.10.5.1 OPERATIONAL DATA	89
3.10.5.2 SHORTCOMINGS IN MANAGEMENT POLICIES AND OPERATIONS	90
3.11 SUSTAINABLE DISPOSAL OPTIONS	90
3.11.1 IMPROVING CEMETERIES	91
3.11.1.1A TIER BURIALS	91
3.11.1.1B ECO- CEMETERY	91
3.11.1.1c NATURAL BURIAL	92
3.11.1.1d MULTI-USE CEMETERY.....	92
3.11.1.1e MULTI-TIER VERTICAL BURIAL SYSTEM	94

3.11.1.1F DIGITAL MEMORIAL CEMETERY	94
3.11.1.1G BIODEGRADABLE BURIAL POD	94
3.11.1.1H GARMENTS FOR THE GRAVE	96
3.11.1.2 IMPROVING CREMATION	96
3.11.1.2.1 GREENING CREMATION	96
3.11.1.2.2 CHRISTIAN VIEWS ON CREMATION	97
3.11.1.2.3 ALKALINE HYDROLYSIS OR RESOMATION	98
3.11.1.2.4 CRYOMATION	98
3.11.1.2.5 BURIAL AT SEA	98
CHAPTER FOUR: CONCLUSION, RECOMMENDATION, POLICY STATEMENTS AND STRATEGIES.....	99
4.0 DISCUSSION OF FINDINGS	100
4.1 RECOMMENDATION.....	102
4.2 CONCLUSION	105
4.3 SUGGESTIONS FOR FURTHER RESEARCH	105
4.4 IMPLICATIONS FOR SOCIETY.....	106
5.0 REFERENCES	107
6.0 APPENDIX I	110
PLANNING CONDITIONS - FUNERAL HOME	110
6.1 APPENDIX II.....	113
6.2 APPENDIX III	114
6.3 APPENDIX IV	115
6.4 APPENDIX V	116

LIST OF FIGURES

Figure 1 Community Facilities 1978-98 National Physical Plan.....	35
Figure 2 Chart of the Research Process	36
Figure 3 Population Hotspot	47
Figure 4 Population Density 1980 - 2019	48
Figure 5 Mortality Rate 2002 – 2018.....	49
Figure 6 Total Deaths per Parish 2006- 2015	50
Figure 7 Years in Funeral Home Business.....	53
Figure 8 Location of the Funeral Homes	54
Figure 9 Ownership of Branches in other Parishes	54
Figure 10 Vital Chemicals used for Embalmmment	55
Figure 11 Chemical Waste Disposal Method.....	56
Figure 12 Colour Coding of Waste	56
Figure 13 Cremation vs Burial.....	57
Figure 14 Most preferred burial sites by clients.....	58
Figure 15 Knowledge of NEPA's Role in Regulating Funeral Homes	59
Figure 16 Cradle to the Grave Assessment of the funeral Process	60
Figure 17 Coffins/Caskets.....	61
Figure 18 Burial Sites in Jamaica.....	65
Figure 19 Number of Identified Burial sites by Parish	66
Figure 20 Location of Crematorium.....	67
Figure 21 Estimated Cost for Cremation vs Ground Burial for a single individual.....	69
Figure 22 Existing Cemetery Space Need.....	74
Figure 23 Population Hotspot and Cemetery Utilization.....	76
Figure 24 Projected and Planned Acreage	77
Figure 25 Existing and Projected Acreage of Land Needed for Cemetery Use 2019 - 2030	78
Figure 26 Capsula Mundi.....	95

LIST OF TABLES

Table 1 Jamaican Water Quality Standards (Key Parameters)	26
Table 2 Cemetery News Report	33
Table 3 Research Methodology.....	39
Table 4 Population Distribution and Change	46
Table 5 Comparison of environmental impact of cremation vs ground burial using meta-analytical approach	69
Table 6 Impact of cemetery and cremation on the Environment	73
Table 7 Differential Ratio in the provisions of lands for cemetery land.....	75
Table 8 Variables Measured.....	82
Table 9 Summary of Descriptive Analysis	85
Table 10 Cemeteries in Urban vs Rural Areas	87
Table 11 Variable who's alpha levels was greater than 0.5.....	89
Table 12 Examples of Multi-Use Cemeteries	93

ACKNOWLEDGEMENT

The Analytical Study of the Planning for the Deceased was prepared by a multidisciplinary team at the National Environment and Planning Agency with support from the Ministry of Local Government and Municipalities.

Mr Ainsworth Carroll	Director, PPMERD
Mrs Marvette Brown	Manager, Planning Monitoring Evaluation Research (PMER) Branch
Mr Leonard Francis	Director, Spatial Planning Division
Mr Dwight Williams	Manager, Local Area Planning Branch
Mr Jason Gregory	Physical Planner, Local Area Planning Branch
Ms Vivienne Johnson	Administrative Secretary
Ms Renee Walcott	Corporate Planner
Mrs Shani Parchment Hado	Research Officer
Mr Eromonsele Akhidenor	Research Officer
Ms Kellie Gough	Environmental Economist
Ms. Cordene Segree	Monitoring and Evaluation Officer

CHAPTER ONE: PREAMBLE AND BACKGROUND OF THE STUDY

1.0 PREAMBLE

The National Environment and Planning Agency (hereinafter NEPA) is an Executive Agency of the Ministry of Economic Growth and Job Creation. The Agency became operational on April 1, 2001. The Agency operates under a number of Acts which provide the legal framework for its work. The legislations outlined below guide the Management of the environment and the processing of development application:

- Executive Agencies Act (2002)
- Natural Resources Conservation Authority Act (1991)
- Town and Country Planning Act (1957)
- Land Development and Utilization Act (1966)
- Beach Control Act (1956)
- Watersheds Protection Act (1963)
- Wildlife Protection Act (1945)
- Endangered Species (Protection, Conservation and Regulation of Trade) Act (2000)
- Others

The work of NEPA is guided by Policies, Plans and Orders designed to achieve the mission and mandate of the Agency. These are detailed below:

- National Physical Plan 1978 – 1998
- Policy for Jamaica’s System of Protected Areas (Draft) – 2016
- The National Strategy and Action Plan on Biological Diversity of Jamaica
- Watershed Management Policy (Draft) 2015
- Beach Access and Management Policy (Draft) 2017
- Environmental Management Systems Policy and Strategy (Draft)
- The National Environmental Education Action Plan for Sustainable Development (NEEAPSD)
- Protected Areas System Master Plan: Jamaica 2013-2017
- Wildlife Trade Policy (Draft) 2017
- Biosafety Policy (Draft) 2017
- Provisional and Confirmed Development Orders

In keeping with the overarching vision of the sustainable development of Jamaica, the Agency has outlined its vision and mission to guide the policy and programmatic activities.

1.1 VISION

“Jamaica’s Natural resources are used in a sustainable way and there is broad based understanding of environment, planning and development issues, with extensive participation amongst citizens and a high level of compliance with relevant legislation.”

1.2 MISSION

“To promote sustainable development by ensuring protection of the environment and orderly development in Jamaica through highly motivated staff performing at the highest standard.”

1.3 MANDATE

“To manage the natural and built environment to achieve sustainable development”

In addition, the programmes and policies of the Agency are aligned to the following three national outcomes under Goal #4 of the Jamaica National Development Plan - Vision 2030:

- National Outcome # 13: Sustainable Use and Management of Natural Resources;
- National Outcome # 14: Hazard Reduction and Climate Change Adaptation;
- National Outcome # 15: Sustainable Urban and Rural Development.

The sustainable development agenda for the country is closely aligned to its international commitments under the United Nations Sustainable Development Goals (SDGs). The goals for the Agency are specifically contained within six (6) SDGs. These are SDGs 6,9, 11, 12, 13, 14 and 15 they cover issues in respect of water resources, life on land, life under water, climate change and climate variability, spatial planning and green or sustainable cities, sustainable production and consumption among others.

1.4 DEFINITION OF TERMS

This aspect of the study will outline some basic terminologies related to the topic under review:

Acres, gross - total ground burial acres in the cemetery, including incidental usage.

Acres, net - area of the land used for gravesites.

At-need sale - purchase of burial plot, crypt, or niche at time of death.

Burial - the placement of human remains in a grave.

Burial Park - a tract of land for the burial of human remains in the ground, used or intended to be used, and dedicated for cemetery purposes.

Burial registers- Usually there is a legal requirement to maintain records regarding the burials (or interment of ashes) within a cemetery. These burial registers usually contain (at a minimum) the name of the person buried, the date of burial and the location of the burial within the cemetery

Cement vault or concrete vault - a reinforced concrete box to receive the casket prior to interment. The top is sealed to prevent moisture from entering.

Cemetery - a place used, or intended to be used, and dedicated for cemetery purposes. A place where six or more human bodies are buried

Cemetery authority - cemetery association, corporation sole or other person owning or controlling cemetery lands or property.

Cemetery, public - a cemetery owned and operated by a city, county, city and county, or public cemetery district.

Cinerarium - any place prepared for inurnment of cremated human remains.

Columbarium - a structure, room, or other space in a building or structure containing niches for inurnment of cremated human remains in a place used, or intended to be used, and dedicated for cemetery purposes.

Cremated remains - human remains after incineration in a crematory

Cremation - the reduction of the body of a deceased person to cremated remains in a crematory.

Crematory - a building or structure containing one or more furnaces for the reduction of bodies of deceased persons to cremated remains.

Single plots: Single plot are the most common type of plot in a cemetery. Single plots contain the remains of one person in a casket.

Companion plots: Companion plots are two plots that are sold together for a couple, usually a married couple. Companion plots can be two plots side-by-side, or a single plot in which the caskets are buried on top of each other (often referred to as “double depth”). Double depth plots can be more affordable than side-by-side companion plots, as only one large outer burial container is usually required, rather than two.

Family plots: In some cemeteries, a family may purchase a small area of the cemetery to be dedicated to the family. With family plots, there is usually a single large headstone engraved with the family name marking the area, and then each individual family member who is buried in the family area will have his or her own smaller headstone marking the individual grave. In some cases, a family plot may simply be a row of single plots purchased as a package by a single family.

Plots for cremated remains: Cremated remains may be buried in a cemetery plot alongside buried caskets. Because cremated remains take up less space, many cemeteries allow multiple urns to be buried in a single plot.

Crypt - a space in a mausoleum of sufficient size, used or intended to be used to entomb uncremated human remains.

Crypt, companion - two or more crypts entered through a single crypt opening.

Disinterment - removal of human remains from an original site.

Entombment - the placement of human remains in a crypt or vault.

Exhumation - disinterment.

Family cemeteries- Family (or private) cemeteries small plot of land, often in wooded areas bordering their fields families would arrange to bury their dead together.

Grave - a space of ground in a burial park used, or intended to be used, for burial.

Human remains - the body of a deceased person, including the body in any stage of decomposition and cremated remains

Inter - the generic term covering all dispositions of human remains but generally indicating buried in the earth.

Interment - the disposition of human remains by inurnment, entombment, or burial.

Inurnment - placing cremated remains in an urn and placing the urn in a niche.

Inurnment garden - a lawn property set aside for cremated remains.

Lawn crypts - gravity-flow drained and ventilated companion crypts of reinforced concrete construction, built 18" to 20" beneath the surface.

Lawn cemetery- The lawn beam cemetery, a recent development, seeks to solve the problems of the lawn cemetery while retaining many of its benefits. Low (10–15 cm) raised concrete slabs (beams) are placed across the cemetery. Commemorative plaques (usually standardized in terms of size and materials similar to lawn cemeteries) stand on these beams adjacent to each grave. As in a lawn cemetery, grass grows over the graves themselves.

Lot - space in a cemetery, used, or intended to be used, for the interment of human remains

Mausoleum - any building or structure used, or intended to be used, for the entombment of Un-cremated human remains.

Memorial park - cemetery.

Memorial service - funeral

Monumental cemetery- A monumental cemetery is the traditional style of cemetery where headstones or other monuments made of marble, granite or similar materials rise vertically above the ground (typically around 50 cm but some can be over 2 meters high).

Morgue - cold room set aside for the displaying of unidentified human remains.

Mortuary - a place where dead bodies are kept for a time before burial.

Natural cemeteries- A natural cemetery or eco-cemetery or green cemetery is a new style of cemetery and is an area set aside for natural burials (with or without coffins). Natural burials are motivated by a desire to be environmentally conscious with the body rapidly decomposing and becoming part of the natural environment without incurring the environmental cost of traditional

Niche - a space in a columbarium used, or intended to be used, for inurnment of cremated human remains.

Plot - see lot.

Remains - dead body.

Sepulcher - a tomb or vault.

Urn - container for deposit of cremated remains.

Public cemetery: A public cemetery is one used by the general community, a neighborhood, or a church while a private cemetery is one used only by a family or a small portion of the community.

1.5.0 BACKGROUND OF THE STUDY

In 2015, the National Environment and Planning Agency began a study that will provide empirical information to address the long-term challenges with the provision and maintenance of burial space. The study was completed in March 2020. The study was conducted based on the broad outcry from society, funeral sector, government and businesses about the non-availability of burial space in the nation's designated cemeteries particularly those in major urban areas. There were huge concerns over the sustainability of in ground burial which is observed as the most dominant disposal practices in Jamaica. Various research has shown that as world population increases, so also will the disposal of the deceased become a challenge as a result of more demand for land space, consumption of resources, waste of materials, and issues of pollution (Olson 2018; Davies and Rumble 2012). In Jamaica, the law permits that whenever death occurs, the deceased can be laid to rest in one of these two ways—burial (a term used in Jamaica law to include three forms: ground burial, entombment in a mausoleum, or vault) and cremation (involving the scattering of urns, burial of urn in a container and keeping the urn in a columbarium or designated location).

Several studies that have been conducted and peer reviewed concerning the disposal of the deceased either by burial or cremation. A common feature of these studies is that they fail to explore in detail the root of the problem confronting humanity from the Death Care Industry. Meaning that the studies are fragmented and isolated as they do not address the topic under review in a comprehensive manner (Basmajian and Coutts 2010). Some examples of the studies available are those concerning GHG emissions from crematoria (Elzenga 1996; Santarsiero et al. 2005), the potential groundwater pollution of cemeteries (van Haaren, 1951; Brinkmann et al. 1987; Dent 2002; Spongberg and Becks, 2000a and 2000b; Trick et al. 2005) and the decomposition stages in the soil (Iserson 1994; Dent et al. 2004).

In addition, there are quite a few other studies debating what defines a cemetery (Curl, 1999; Rugg, 2000) and those exploring the history of cemetery and monument design (Jackson & Vergara, 1996; Sloane, 1991), and examining the rise of cremation (Prothero, 2001). Lastly, some other studies have also explored the cultural-historical dimensions of deaths and burials in Western Europe and the United States (Aries, 1981; Bloch & Parry, 1983; Laderman, 1999; Sanders, 2008). On the other hand, only a few studies can be found in the Caribbean on the topic of disposal of human remains.

Example of such studies are those on cemetery vulnerability (Mueller and Meidl 2017), house yard burials of enslaved Africans in Jamaica (Watters 1994; Armstrong and Fleischman 2003) and socio-cultural and historical perspectives of burials in the Caribbean (Arroyo 2018; Blouet 2013; Sutherland 2008).

Despite the recognized importance of death and burial as socio-cultural and environmental phenomena. Studies available do not focus on the environmental and planning aspect of disposal of the deceased combined. The empirical analysis of the complete process (cradle to the grave) linked with the disposal of the deceased has been vastly understudied (Capels & Senville, 1994; Francaviglia, 1971; Pattison, 1955; Rugg, 2006). Majority of the available peer reviewed literature are from developed countries, tied to “specific localities or subnational regions which are not related to the Jamaican context (Zelinsky (1994, p. 30). It is important to note that the disposal of deceased human is guided by cultural, religious or legal procedures developed to protect human health and the local ecosystem¹. It is therefore necessary to have studies specific to the local situation. The goal of this study, was to identify and assess the processes associated with the disposal of the deceased in Jamaica.

This study provided information to support identified knowledge gaps, namely(1) it shed light on population distribution and changes across the major population hotspots in the country (2) identified waste streams associated with the activities of funeral homes (3) provided information on the physical condition of cemeteries in Jamaica(4) quantified the acreage needed for cemetery land use (4) evaluated the processes and impacts on a general bases associated with the most common disposal techniques, i.e. burial and cremation; and (5) made recommendations on sustainable disposal options that might be suitable for Jamaica.

1.5.1 DEFINING BURIAL SITES

The purpose for this definition is to establish a common language for international, comparative and multidisciplinary study. Burial sites can be defined as a tract of land used for burials² and on the other hand, “cemetery” is used to describe the resting place of the deceased. It is defined by the Webster’s Dictionary (3rd int ed.) as an area for burial entombment. Meaning any burial ground,

¹ <http://jamaica-gleaner.com/article/flair/20190617/laws-eve-whos-responsible-disposing-dead-body>

² <https://www.shabdkosh.com/dictionary/english-hindi/burial+site/burial+site-meaning-in-hindi>

typically a large one or graveyard. For the purpose of this study, the term cemetery refers to a planned site for burial of several to many bodies (Rug 2000).

In modern times, cemetery definition has come to encompass more than earth burials. For example, the cemetery regulation act of Michigan state in the United States of America, states that: “cemetery means one or a combination of more than one of the following: “(i) a burial ground for earth interments (ii) a mausoleum for crypt entombments (iii) a crematory for the cremation of human remains (iv) a columbarium for the inurnment of cremated remains”. Therefore, the term burial site or cemetery will be used interchangeably in this study (Rugg 2000).

1.5.2 TYPES OF CEMETERIES/BURIAL SITES IN JAMAICA

There are two broad categories of cemeteries in Jamaica. a) Public and b) private. These two categories of cemeteries can be classified into six sub-types of cemeteries/burial sites: (i) religious cemeteries usually associated with churches;(ii) public cemeteries owned by government and open to the public; (iii) private cemeteries owned by organizations such as, the military; (iv) ethnic cemeteries owned and operated to support certain ethnic groups and family plots owned by families (v) mass graves, often for victims of disaster and (vi) commercial for profit, non-denominational cemeteries examples are Dovecot and Meadowrest.

1.5.3 PROBLEM STATEMENT

There is dearth of research focusing on the complete processes associated with laying the deceased to rest in Jamaica. The pollution potential associated with the deceased and the permanence of cemetery as a land use makes decisions concerning it very important. Finding burial spaces in existing cemeteries has become difficult and several communities are hard pressed to find cemetery space within their borders. There is competition between cemeteries and other land uses. The pollution potentials of the processes when these choices are made and the permanence of cemeteries as a land use make decisions concerning it very important.

Most communities across rural Jamaica are involved in backyard burials which further add to the problem. The dominant practice of ground burial has resulted in the scarcity of burial spaces in existing cemeteries. Of greatest concern is that empirical information relating to the magnitude of the problem is not readily available. For example, there are widespread speculations that only cemeteries in urban centers are reaching full capacity.

Furthermore, the non-availability of empirical information to guide planning decisions contributes to the current challenges. Overall, there exists almost no standardized information available to guide planners and environmentalists in understanding the dimensions of the problems. While models exist for projecting a variety of dimensions of community development, no recent source provides clear information about how mortality and its complete process impact land use, or how to project demands for burial space in a country like Jamaica (American Society of Planning Officials, 1950; Nelson, 2004).

1.5.4 MAJOR ISSUES

The sustainable disposal of the dead is a civic duty, just as is the maintenance of a hygienic environment. As mentioned in the previous chapter, there is a problem finding burial spaces in existing cemeteries and several communities are hard pressed to find cemetery space within their borders (GOJ Development and Investment Manual). In addition, most persons do not want cemeteries located near them based on myths and threats of environmental problems that are often linked to burials such as soil and groundwater pollution and long-term occupation of land. On the other hand, cremation as well costs energy and causes emissions of combustion gases, heavy metals like mercury and persistent organic pollutants (Mari & Domingo, 2010).

The major issues identified in Jamaica are institutional, environmental and social perspectives. They include inter alia:

1. Limited number of cemeteries/crematoria to meet the growing demand of the country;
2. Poor development and maintenance of cemetery facilities;
3. No national policy regulating the activities of funeral homes;
4. Lack of funds to support the management of cemetery facilities;
5. Review of principles and rules on cemetery management such as the rotation or tenure systems for cemeteries in Jamaica;
6. No updated policies on carrying capacities and limits of acceptable change for cemeteries including absence of a well formatted procedure for decommissioning;
7. Cemeteries are not suitably sited and the use may not be optimal for the specific plot of land;
8. Competition between cemetery and other land uses;
9. Poor road access / road infrastructure serving cemetery facilities/sites

10. Lack of stability, safety and maintenance of gravesites;
11. No defined standards regarding the type of materials that should be used for the construction of coffins, morgues, mausoleum and combustion chambers etc.;
12. Pollution from inhumation: pollution to the water bearing stratum, air pollution and infectious diseases amongst others;
13. Lack of a standardized decommissioning protocol;
14. The impact of tradition, customs and perceptions of the public regarding cemeteries;
15. Problem of staffing, poor record keeping and record management for most public cemeteries.

1.5.5 RESEARCH GOAL AND OBJECTIVES

Research Goal: To improve our understanding of the impact of current disposal practices in Jamaica and to explore all the processes associated with the disposal of the deceased from cradle to grave (Life cycle assessment approach).

The specific objectives are to:

1. Explore population distribution and changes in Jamaica
2. Outline and explore the key sources of pollution from the activities or operations of the Death Care Industry.
3. Identify cemetery locations in relation to the National Settlement Strategy including gross deficiency in the provision of cemetery space based on existing and projected population
4. Explore physical condition of existing cemeteries
5. Assess the processes (life cycle assessment) and impact of cremation versus burial (meta-analysis);
6. Explore alternative management option for burial vs cremation suitable for Jamaica (Literature Review).

1.5.6 RESEARCH QUESTIONS

Main Research question:

1. What are the environmental and planning implications of current disposal practices, considering the steps from death to final disposal?

Sub Questions

- I. How has population changed over time and where are the population hotspots that

are likely to impact cemetery land use?

- II. What are the waste streams linked with the operational activities of funeral homes?
- III. What are the different processes involved in the disposal of the deceased from cradle to grave?
- IV. Where are burial sites located in Jamaica and what acreage of land is needed for cemetery land use based on the existing and projected population?
- V. What other disposal options are available that can help alleviate the problem of non-availability of burial spaces?

1.5.7 SCOPE OF THE STUDY

The scope of this study will be restricted solely to the following:

- Study of population distribution and changes,
- Identification of potential sources of pollution from the operational activities of funeral homes,
- Processes associated with funerals,
- Location and physical condition of cemeteries/crematoria in Jamaica.

1.5.8 INSTITUTIONAL/LEGISLATIVE FRAMEWORK

The management of cemeteries in Jamaica is the responsibility of the Municipal Corporation (Parish Council) and is supported by the following authorities/regulations:

- Vision 2030 Jamaica National Development Plan
- BPOA 1994(Barbados Plan of Action)
- National Physical Plan 1978-1998
- TCPA/NRCA/LDUC
- Development Orders
- Jamaica National Heritage Trust Act
- Burial Within Towns' Limits Act
- Parishes (Abandoned Cemeteries) Act
- The Public Cemetery Management and Regulation Act
- Kingston and St. Andrew (Cemeteries) Act
- Public Health Act
- Transport Act
- Cremation Act

- Jamaica constabulary Force
- Registrar Generals Office
- Development and investment manual
- WHO (World Health Organization)³
- Churches

1.5.9 REGULATORY FRAMEWORK

Development of cemeteries must proceed in compliance with the governing legislations and policies on environmental conservation, safety and health, physical planning criteria, and building codes. This section will present some of the available legislation that guides the establishment and operations of the Death Care Industry.

1.6.0 ENVIRONMENTAL PERMIT AND LICENSE SYSTEM

The environmental Permit and License System (P&L), introduced in 1997, is a regulatory mechanism to ensure that all developments in Jamaica meet required standards in order to attenuate negative environmental impacts. The P&L System is administered by the **Natural Resources Conservation Authority (NRCA)**, through the Permit and License Secretariat. The NRCA was created and established under the Natural Resources Conservation Act (1991). This Act is the overriding legislation governing environmental management and sustainable development through the protection and responsible management of Jamaica’s natural resources and the control of pollution. The NRCA Act and the Natural Resources Conservation (Permits and Licenses) Regulations established a system of permits for certain prescribed activities as mandated by the Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order, 1996. The Order provides that the entire island of Jamaica is a prescribed area and lists specified categories of enterprise, construction and development that require a permit. Cemeteries and crematoriums require permits under this Order. The operation of a sewage treatment plant also requires a NRCA license.

The **National and Environment Planning Agency (NEPA)** has overall responsibility for controlling development of land and natural resources conservation. **NEPA** represents a merger between the National Resources Conservation Authority (NRCA), the Town Planning Department (TPD), and the Land Development and Utilization Commission (LDUC). **NEPA** has the NRCA Act as its core legislative mandate and now administers the Town and Country Planning Act. All development projects must have planning and building permissions (which considers planning constraints such as zonation, parking, availability of municipal services) from the Local Planning

³

[https://apps.who.int/iris/bitstream/handle/10665/108132/EUR_ICP_EHNA_01_04_01\(A\).pdf;jsessionid=62BF54173B33D3CA5DD71DF400137785?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/108132/EUR_ICP_EHNA_01_04_01(A).pdf;jsessionid=62BF54173B33D3CA5DD71DF400137785?sequence=1)

Authority and NEPA. The NRCA Act makes provision in Sections 9 and 10 for Environmental Impact Assessments (EIAs) to be conducted for projects falling within a schedule of prescribed activities (such as cemetery/crematoria development projects), as a means of providing documentation to support an application for an environmental permit.

The **Local Planning Authority/The Parish Council** is responsible for the general management, regulation, and control of cemeteries in Jamaica through the Cemetery Management and Regulation Act 1894. The Local Authority must issue the rights for burial and to build vaults. Provisions are made for the Local Government Minister/Parish Council to regulate operations within the cemetery and ensure the continued protection of public health. Permission to build is administered by the Local Planning Authority under the Parish Councils' Building Act, upon a review of the building plans for the developed site. The development not only includes vault construction for burial, but also a banquet hall and a non-denominational chapel. The Burial within Town Limits Act defines town limits in relation to burial and also provides a basis for the discontinuation of burial grounds in Jamaica. The Parish Council administers this Act.

1.6.1 INTERNATIONAL STANDARDS AND GUIDELINES

The World Health Organization (Ucisik and Rushbrook, 1998) has established a briefing document with some guidelines for siting of cemeteries. These include:

1. Human or animal remains must not be buried within 250 m of any well, borehole or spring from which a potable water supply is drawn. This distance may be greater if the site has a steep hydrogeological gradient or the velocity of groundwater flow within an aquifer is rapid
2. The place of interment should be at least 30 m away from any other spring or watercourse and at least 10 m from any field or drain.

All burial pits on the site must maintain a minimum of one metre of subsoil below the bottom of the burial pit (i.e. the base of the burial must be at least one metre above solid rock).

4. The base of all burial pits on the site must maintain a minimum of one metre clearance above the highest natural water table. (Any variability in the water table should be considered.)
5. Burial excavations should be backfilled as soon as the remains are interred, providing a minimum of one metre soil cover at the surface

1.7.0 ENVIRONMENTAL CONSERVATION

1.7.1 WATER RESOURCES

The **Water Resources Authority (WRA)** administers the Water Resources Act 1995, which regulates the allocation and preservation of water resources in Jamaica. WRA manages the water resources of Jamaica by issuing 5-year licenses for the abstraction of ground and surface waters. WRA also implements the Water Sector Policy Strategy/Action Plan (Ministry of Water, 1999), which addresses water resource management, urban water and sewerage, rural water and sanitation, urban drainage and irrigation. The WRA are normally asked to review cemetery development proposals and advise the NRCA accordingly.

Aside from stipulating that topsoil should be stored to prevent its dispersal, the permit also established that the burial vaults should be concrete sealed to prevent grave leachate from entering the soil, and eventually the groundwater system. In addition, NRCA water quality standards (Table 1) may be used to monitor the environmental performance of permitted developments.

Table 1 Jamaican Water Quality Standards (Key Parameters)

Parameter	Freshwater	Sewage Effluent	Trade Effluent
Nitrates mg/L	0.10 - 7.5	10 (Nitrogen)	10
Phosphates mg/L	0.01 - 0.8	4	5
Biological Oxygen Demand mg/L	0.8 - 1.7	20	<30
Total Suspended Solids mg/L	-	20	<150
Faecal Coliform - MPN/100 ml	-	1000	100

1.7.2 PUBLIC HEALTH

The **Public Health Act (1985)** makes provision for the establishment of the **Central Health Committee (appointed by the Minister chaired by the Chief Medical Officer)**. The Public Health Act under Section 7 makes provision for the local health boards (Parish Council) to regulate *inter alia* such areas as public sanitary conveniences, lodging houses and camps, swimming pools, restaurants, public nuisances, garbage and waste. This is done in conjunction with the Central Health Committee. The **Environmental Health Unit (EHU)** of the Ministry of Health has responsibility for administering the act, including the review of designs for sewage treatment, and are normally asked to review the development proposals for cemeteries. A condition in the NRCA permit usually recommends that the design of sewage treatment system is subject to final approval from the EHU before implementation.

1.7.3 SOLID WASTE

The **National Solid Waste Management Authority** (NSWMA) is the public authority responsible for solid waste management in Jamaica, under the National Solid Waste Management Act, 2001. This includes provision for environmentally sound waste collection, transportation, re-use and recycling, and the establishment of a licensing system for operators of solid waste management facilities and collection systems.

1.7.4 AIR QUALITY

The Clean Air Act (1964) is administered by the Central Health Committee and regulates air emissions of any noxious or offensive gases and dust from a premise.

1.7.5 NOISE

The main legislation for the control of noise in Jamaica is the **Noise Abatement Act (1997)**. Section 3 of this Act prohibits persons in private or public places from operating amplification devices in such a way that could cause a nuisance to persons in the vicinity. Under the Act, a person who wishes to operate sound equipment in a public area where there is a potential for disturbing residents of the area, is required to make a written application to the Superintendent of Police in charge of the division for permission to do so, no later than ten clear days before the date on which it is proposed to hold such activity.

1.8.0 DEVELOPMENT CONTROL

The National Works Agency (NWA) is responsible for reviewing the development proposal and approving any proposed road or drainage works, particularly as they tie in with pre-existing municipal roads and drainage systems. Legislative amendments to the Water Resources Act of 1995 have resulted in the repeal of the Flood Water Control Act 1958, which was regulated by the NWA. With the legislative amendments under way, the Water Resources Authority (WRA) will now have the mandate to regulate and manage flood water control. The NWA, however, maintains responsibility for approving and regulating drainage designs in terms of surveys, civil works and clearance.

The **National Water Commission (NWC)** has the responsibility for municipal water supply and sewage services.

1.8.1 PHYSICAL PLANNING AND LAND USE CONTROLS

The Water Resources Development Master Plan as required under the Water Resources Authority Act (1995) has been developed to allow the proper management of water resources. It evaluates and recommends how Jamaica should use its water resources. A licensing system is in place to govern the allocation of such resources. The Water Resources Authority Act was promulgated to regulate and manage the abstraction and allocation of water resources and preserve water quality through the establishment of the Water Resources Authority.

The National Physical Plan was developed to foster orderly development in the country. It focuses on physical planning, settlement, conservation, income generators (i.e. forestry and fisheries, agriculture, mineral industries, tourism and manufacturing) and public utilities using Development Orders.

1.8.2 NATIONAL SETTLEMENT STRATEGY (NSS)

The National settlement strategy applies the time-distance relationship and was seen to be a vehicle through which the rationalization of land uses could be achieved along with a better balance of social, economic and physical development across the Island.

The NSS proposed that areas of enough scale and critical mass would be targeted for investment through a hierarchy of settlements. Thus, developing efficient and sustainable cities, towns and rural places to bring a better spread of opportunities, better quality of life and better places to live in. Therefore, the main objectives of the National Settlement Strategy in the NPP 1978 – 1998 were to:

- rationalize the rural to urban ratio by providing strategies to minimize rural migration to large urban centres,
- improve rural centres by decentralizing development across a hierarchy of settlements island wide
- control urban sprawl

There are three types of growth centers identified in the proposed National Settlement Strategy¹, District Centres, Sub-Regional Centres and Regional Centres. The growth centers are associated with three related types of Service Areas:

1. District Service Area (DSA), stretches to approximately 6 km from the growth centre, estimated as 10 minutes driving time.
2. Sub-Regional Service Area (SRSA), extending to approximately 15 km from the growth centre, estimated as 25 minutes driving time;

3. Regional Service Area (RSA), approximately 27 km from the growth centre, estimated as 45 minutes driving time

Distance at 36 km/h (please note that speed differences on different roads and gradients are not factored into the calculation). Driving distance does not refer specifically to private vehicles, but also to public service means of transportation.

1.8.3 PLANNING THEORY: CHRISTALLERS CENTRAL PLACE

This study adopts the Christaller's Central Place Theory and makes the below assumptions:

- That Service Areas of each tier (DSAs, SRSAs and RSAs) should stretch across the length and breadth of the country.
- The Service Areas of one tier should be fully included within one or more Service Area of the higher tiers

Differentiation of the respective roles of centres and the spatial range / extent of their catchment or service areas in this way is based on application of Central Place Theory, originally developed by Walter Christaller. All three types of centres have a DSA around them serving a population 6 km or 10 minutes away from the Growth Centre. Sub-Regional and Regional Centres also have a SRSA, serving a population 15 km or 25 minutes driving time away, and finally Regional Centres have a RSA, covering a population 27 km or 45 minutes away.

1.8.4 ROLE OF PLANNING STANDARDS AND GUIDELINES

The siting of cemeteries and their related facilities involves the use of standards, access guidelines and threshold norms which are an essential element of strategic forward planning used to allocate and reserve land for cemetery uses. A cemetery is a community-type facility even though they are often not exclusively owned and managed by the government. Cemeteries are often provided by the public sector and private developers. In respect to planning over the long term, access standards, threshold guidelines and site sizes are increasingly important in ensuring that enough land has been reserved for burial purposes in specific designated areas. It is important to allocate land for the disposal of the deceased now and for the future to prevent the illegal use of underdeveloped land. Besides aiding planners, standards – by providing predefined spatial norms – ideally facilitate a more equitable provision of services and facilities to diverse communities. However, standards and guidelines should always be adapted to the local contextual conditions of each city, district, suburb and neighborhood.

1.8.5 GUIDING PRINCIPLES FOR BURIAL PROVISIONS

Cultural, humanitarian, economic, social and environmental values govern people's attitude towards the disposal of the dead and help to frame the context for a strategic response to the shortages of available space for the burial of the deceased. The strategic principles are as follows:

- Choice
- Cost
- Proximity
- Open space
- Archaeology

Choice-: It should be a person's basic right to choose how their body is disposed of and strategic planning must work to help sustain that choice by maintaining the supply of burial space consistent with forecast demand. It must reflect the emergence of new sects, new types of disposal methods such as woodland burial and opportunities for commemorating ash remains. Only when all avenues have been explored and no acceptable solution found should consideration be given to overriding the basic right of choice.

Cost -: Disposal of the deceased by whatever means should be affordable so that every person can receive a decent ceremony and commemoration. Scarcer burial space will have the effect of raising the cost of burial to the bereaved.

Proximity -: the bereaved particularly the aged should be able to visit graves or places of memorials without having to travel unduly long distances.

Open Space -: Cemeteries play an important role in open space provisions.

Archaeology-: cemeteries contain archaeological evidence of considerable importance both on and under the land surface.

1.8.6 LIMITATION OF THE STUDY

2. The low response rate from the funeral homes makes it impossible to generalize the result obtained it is anticipated that relevant questions will be asked during the consultation exercise.
3. Four hundred and twenty-seven (427) burial sites were identified and mapped and estimated as the existing cemetery acreage. This number may not account for all the sites that has been used for burial. The lack of data such as the acreage, exact boundaries and

actual names of the burial sites was a huge limitation. It is anticipated that as more data becomes available the acreage will be updated.

4. Lack of appropriate life cycle assessment software like Simapro and Ecoinvent database to conduct environmental impact of cremation vs burial.
5. Estimates are based on observation which is subject to bias. However, the study provides insight on the overall issue of the disposal of the deceased.
6. Some of the data used in this study was secondary data and the author may have no control over the gaps that exist in the data.

In areas where data was not available data from other jurisdiction was used to gain an insight into possible environmental problems that might occur. Cost and time constraints were also limiting factors.

1.9.0 HISTORY OF DISPOSAL OF THE DECEASED IN JAMAICA

1.9.1 PRE-COLOMBIAN JAMAICA

Prior to the arrival of Columbus in 1494, Jamaica was inhabited by the Arawaks/Taino Indians. Historically there are several evidences that the Tainos buried their dead in caves and preserved their bones. (Irving 1992).

1.9.2 THE SLAVE BURIAL

There are seven major archaeological sites in Jamaica which provide an insight into burial practices during the slavery and post slavery era. These sites are the Old Naval Dockyard in Port Royal; St. Peter's Church in Port Royal; Spanish Town, Thetford, Juan de Bollas, Drax Hall and Seville Plantation (Hauser, 2008). Each of these sites offers a different perspective of life in slavery and post-slavery colonial period in Jamaica. On the Seville Plantation site of St. Ann's Parish, Jamaica, researchers excavated four unique burials in the early 1990's. These burials represent a pattern that is distinct from all others in the Caribbean, as they are the only examples of African slaves buried in the house-yard context (Armstrong and Fleischman, 2003).

The disposal of the deceased during the slavery era was mainly through ground burial by placing the deceased in a coffin. During the said period there was no evidence of the use of embalment fluids. Embalment fluids have been identified by scholars as a principal threat to the environment (Bedino 2002; Verma et al 2013). The African burial customs seen in the 18th century included the wrapping of the deceased in a shroud for burial a predominant practice from West African region. The custom is to lay objects such as mats, rugs, cloth, or stones upon the graves as a token (Medford 2004).

1.9.3 PLANNING FOR THE DECEASED IN THE POST SLAVERY ERA

Jamaica is a multi-ethnic country with traits of Tainos, Jews, European, Chinese, Indian and African cultures among others. Africans, Jews, Syrians/Lebanese, Europeans and the Chinese diaspora brought their culture of inhumation with ritual practices to Jamaica (Olive 2003). The East Indians usually cremated the body of the deceased and the ashes immersed in a river or sea.” (Laxmi and Ajai Mansingh. 1999 Home away from home: 150 years of Indian Presence in Jamaica 1845-1995. Kingston: Ian Randle Publishers, Print).

1.9.4 EARLIEST CEMETERIES IN JAMAICA

Cemeteries are important because they provide information on the customs, tastes and traditions of earlier times. The earliest cemeteries in Jamaica include special cemeteries such as the Jewish, Chinese and Naval Cemetery. Some remarkable burial grounds declared as National Heritage sites are also listed here⁴:

- Bedward's Tomb - The Bedward’s Tomb is located in Bedward Cemetery, August Town
- Jewish Cemetery - The old Jewish Cemetery at #1 Hunt's Bay in St. Andrew, is an important landmark
- Lacovia Tombstones - A tale is told that a party was in progress at a nearby tavern when a disagreement occurred.
- Carmel Moravian Cemetery - The earliest Moravian Mission began its work in Jamaica in

⁴ <http://www.jnht.com/cemeteries.php>

1754.

- Port Royal Naval Cemetery

1.9.5 NEWS REPORTS ON CEMETERIES IN CONTEMPORARY JAMAICA

The disposal of the deceased took center stage in contemporary Jamaica. This research compiled several news reports concerning cemetery management in Jamaica.

Table 2 Cemetery News Report

Source	Concerns/Title of Report	Date
Gleaner	God's Acre/Establishment of May Pen Cemetery Kingston	July 2 1880
The Jamaica Gazette Government Notice	Closure of Cemetery in Kingston	March 22 1949
The Gleaner	Tivoli Students Join ongoing protest at the Maypen Cemetery	November 2 1999
The Gleaner	Kingston and St Andrew to buy old cemetery for park	October 14 1950
The Gleaner	£5,000 Pounds Sterling Cemetery Improvement by the Chinese Benevolent Society	June 21 1956
The Gleaner: Report by Ray Fremmer	Old Catholic Cemetery on Duke Street being used to build the Government printing Press Office	Date Unknown
The Daily Observer	Public Cemetery Ordered Closed. The St Catherine Public Health Department ordered the immediate closure of the Number 5 Public Cemetery in Spanish Town.	April 16 1998

The Gleaner	Burials Resume at Maypen Cemetery	December 18 2002
Sunday Gleaner	Flooded Graves in the Charles Town Maroon Cemetery	February 15 2009
The Gleaner	Cemetery Restoration Fund launched	June 13 1987
The Gleaner	Rotting bodies thrown on Maypen Cemeteries	October 23 1999
The Gleaner	Site of 75,000 Crematorium being Prepared	March 4 1968 p.8
The Gleaner	Bill on disposal of abandoned Cemeteries	October 5 1957

Table 2 shows some of the reports in the news concerning the disposal of the deceased in Jamaica.

1.9.6 NATIONAL PHYSICAL PLAN 1978 TO 1998 JAMAICA

The National Physical plan recognized that Population growth, coupled with urban and commercial expansion has resulted in intense competition for land. It highlighted the fixed and scarce nature of Jamaica's land resource, it stated that 50 percent of the island is over 307.7m (1,000 ft.) above sea level and that there was huge competition for scarce flat land.

The Plan proposes that community facilities must be established in accordance with the settlement strategy for development. The plan examined facilities for which major physical structures and /or land area is required but failed to include cemetery as one of those facilities required by communities (see Fig. 1).

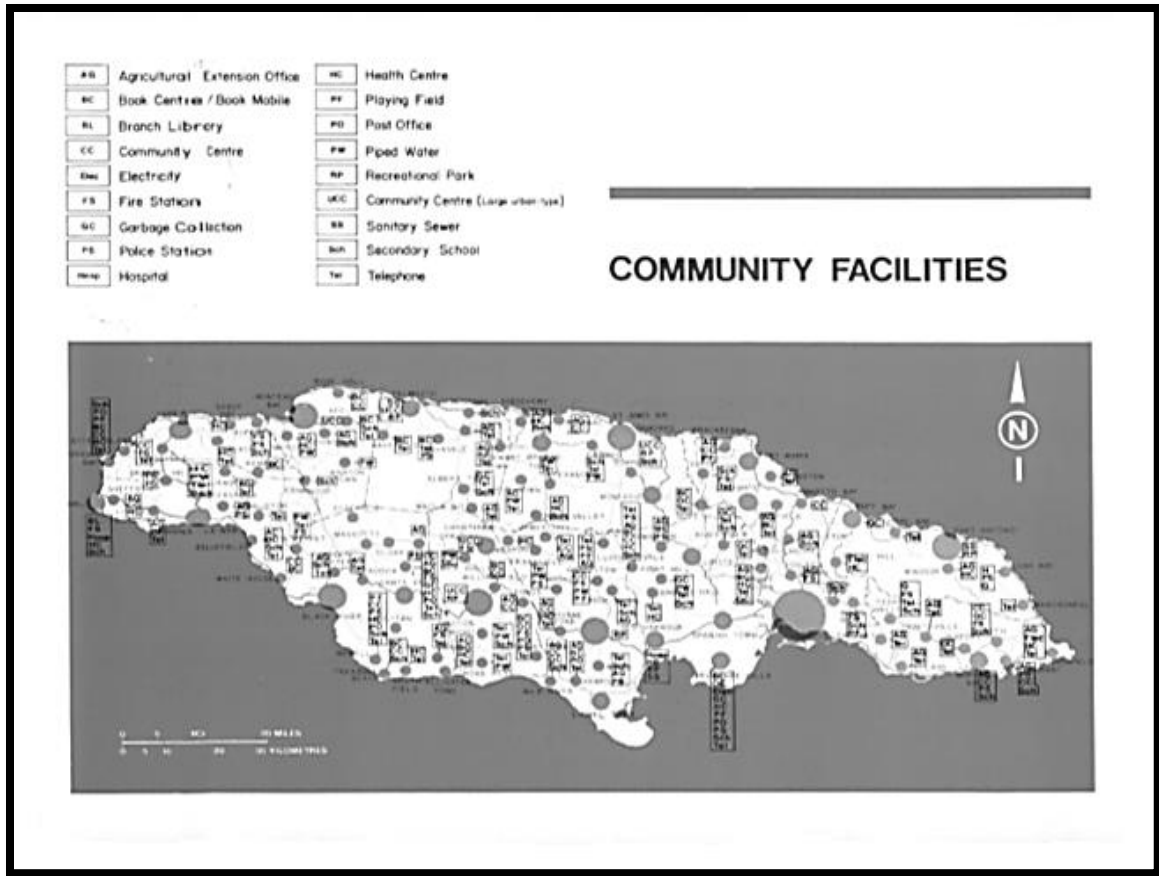


Figure 1 Community Facilities 1978-98 National Physical Plan

CHAPTER TWO: METHODOLOGY

2.0 INTRODUCTION

Flow Chart of the research process:

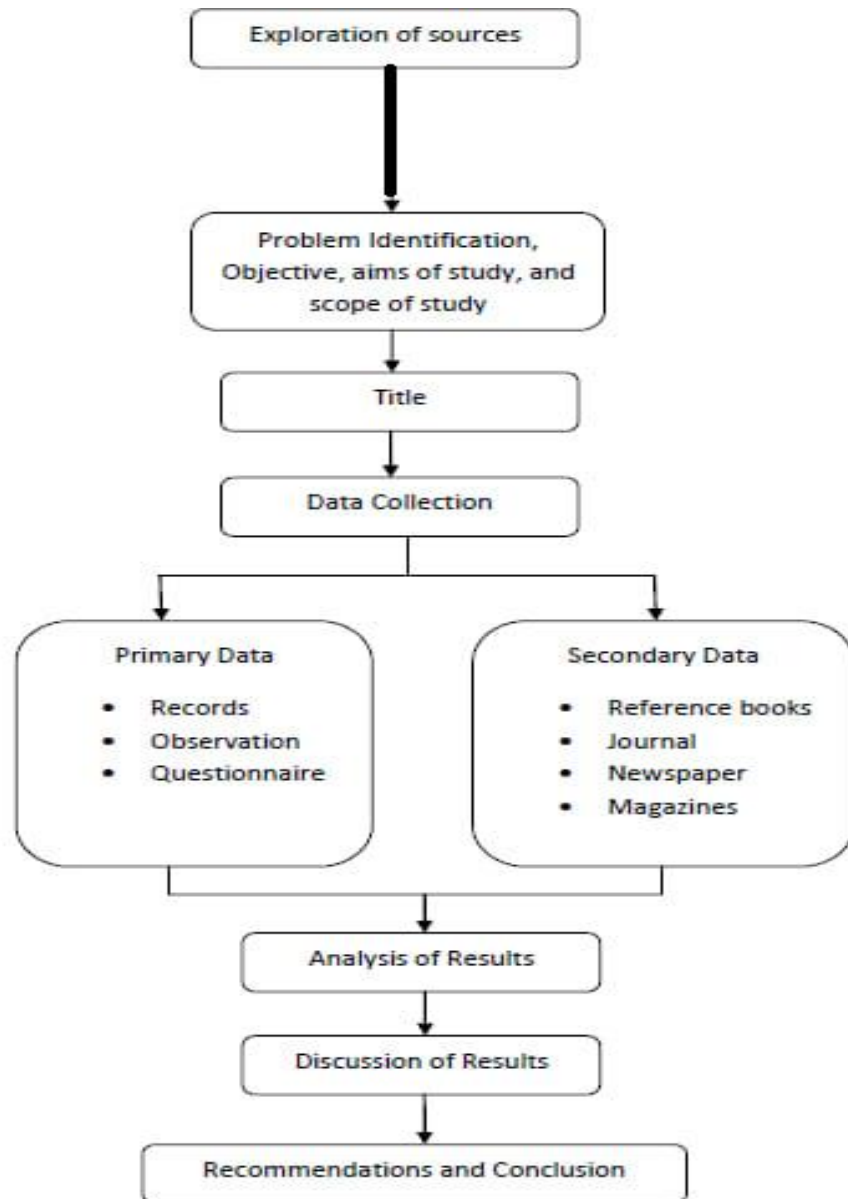


Figure 2 Chart of the Research Process

This chapter highlights the research design, target population and sample selection procedures, conceptualization, instrumentation, data collection procedures, data analysis, and ethical issues including how validity and reliability were maintained. The chapter also presented the procedures used to carry out the field study and data analysis and further described the methodology used to collect and analyze the data. The funeral cycle was split into two stages viz: - a preliminary stage and a final stage. Both stages were investigated separately based on their environmental and physical planning consequences (Keijzer 2011). It was necessary to begin the analysis with population distribution and change since it gave an idea of the potential areas of concern due to population density and rates of urbanization.

In the preliminary stage, the activities of funeral homes were investigated using a combination of face to face interview and an online questionnaire created on ESRI ArcGIS Platform (Survey 123). The main process or step in the preliminary stage that was of concern is the embalment of the deceased with chemicals and the discharge of medical waste generated as a result of the operations of funeral homes⁵. The transportation of the body and that of the family of the deceased was not considered in the analysis. Considering the final stage, Jamaica's law admits two main types of body disposal: burial and cremation, although a third option can be considered which is donation of the body for scientific purposes (Wet op de lijkbezorging, 2010). The latter occur quite rarely (Monuta, 2010a). The condition of the final resting place of the deceased (cemetery) was investigated using a field observation tool created on Collector for ArcGIS to collect cemetery data in urban and rural Jamaica.

⁵ <https://mic.com/articles/139645/traditional-burial-is-polluting-the-planet-so-where-will-we-all-go-when-we-die#.Z9RZLZ4Lz>

The aim of this study was to improve our understanding of the impact of current disposal practices and its associated processes. The methodology was designed to answer the main research question tagged “what are the environmental and planning implications of current disposal practices, considering the steps from death to final disposal?”

Sub Questions

- I. How has the population changed overtime and where are the population hotspots that are likely to impact cemetery land use?
- II. What are the waste streams linked with the operational activities of funeral homes?
- III. What are the different processes involved in the disposal of the deceased from cradle to grave?
- IV. Where are burial sites located in Jamaica and what acreage of land is needed for cemetery land use based on the existing and projected population?
- V. What other disposal options are available that can help alleviate the problem of non-availability of burial spaces?

2.1 OUTLINE OF THE STUDY

The study was divided into the following stages:

- Analysis of population distribution and changes,
- Survey of funeral homes,
- Identification of location of existing burial sites,
- Estimation of existing and projected burial space,
- Direct Field observation of the conditions of existing cemeteries,
- Comparison of environmental impact of cremation vs ground burial using meta-analytical approach (*see Table*),
- Sustainable burial options.

Table 3 Research Methodology

1. Analysis of population Data	Secondary /STATIN	Spatial Statistic(Mapping Clusters: Moran's 1)
2. Activities of Funeral Homes	Primary data/Field Work	Questionnaire/IBM SPSS
3. Identification of Cemetery location	Secondary & primary data. Sources: SPD, Parish Council and Field work	Remote Sensing Google Earth/Digitization/ArcGIS Collector
4. Assessment of the Physical Condition of Cemeteries and Calculation of cemetery space.	Secondary/Primary/ Parish Council and Field work	ArcGIS /IBM SPSS Integration of Microsoft Visual Basics into ArcMap/ Proximity Analysis
5. Identification of the funeral process and impact of cremation vs burial	Secondary/Literature Review	Meta-Analysis/Life Cycle Approach
6. Explore Alternative option to ground burial vs Cremation	Secondary /literature Review	Meta-Analysis

1. Analysis of population distribution and changes

Population data was obtained from the Statistical Institute of Jamaica and an analysis of the spatial distribution and changes in population was carried out using both descriptive and geospatial techniques.

2. Survey of Funeral Homes

The study gathered information from over 200 funeral homes and a sample of 20 funeral homes were drawn through a ballot system. The procedure involved writing the names of the funeral homes in cards and placing them in a box. Twenty (20) funeral homes were drawn from the pool. Questionnaires were then administered online to the identified funeral homes and a visit was paid to some selected funeral homes. In addition, the cost and environmental impact of burials vs cremation was carried out using a meta-analytical approach.

3. Identification of Location of existing burials sites

Secondary and primary information was collected from churches and Municipal Authorities and a digitization of existing cemetery was carried out on Arcmap and mapping was done using Collector for ArcGIS.

4. Estimation of existing and projected burial space

Satellite Imagery from Bing, Google Earth and IKONOS high resolution imagery was used as base map to digitize the location of existing burial sites/cemeteries and the information used to estimate the existing and projected need for cemetery land use. This was done in two steps: 1. Calculation of existing need for cemetery land and 2. Calculation of projected need for cemetery land.

- **Calculation of Existing Need for Cemetery Land**

The Statistical Institute of Jamaica publishes retrospective fertility and mortality information and the data can be used for the planning of service and infrastructure delivery to the community. Projections also provide the basis for assessing future requirements for residential and commercial land, housing, public utilities, and the provision of a wide variety of services. The data for this section of the analysis was obtained through several processes. The first stage was to obtain a listing of all cemeteries across Jamaica from the Ministry of local government, churches, private entities, NLA and the parish councils. The second stage was to verify the information using satellite imagery and the third stage was to make site visits.

Jamaica's Development and Investment Manual stipulates that public cemetery provisions shall be at the rate of Forty (40) hectares to every 100,000 population. The calculation of existing need for cemetery land was done using this standard.

$98.8/100,000 * \text{Existing population} = \text{Cemetery Need}$

$\text{Existing Acreage for cemetery per district} = \text{Cemetery needs} - \text{Existing Acreage} = \text{Deficit}$

Assumptions:

It is assumed that if the existing need is greater than existing provisions, we will have a deficit and

in areas where the existing provision is greater than the need, we would have a surplus. (See Map for output of calculation in ArcGIS)

- **Calculation of projected cemetery need**

$98.8/100,000 * 2030 \text{ population} = \text{Projected Cemetery Need}$

5. Direct Field Observation of the Conditions of Existing Cemeteries

This study used a sample size of 115 burial sites/cemeteries which are geographically distributed across Electoral Constituencies. The sample was randomly selected from the target population of 427 identified burial sites. Eight (8) cemeteries were investigated per parish (4 urban and 4 rural) using collector for ArcGIS.

6. Comparison of environmental impact of cremation vs ground burial using meta-analytical approach (See Table 2)

The impact of cremation vs ground burial was carried out using a Meta analytical approach. This method for systematically combine different qualitative and quantitative study data from several selected studies to develop a single conclusion.

7. Sustainable disposal options

A selection of sustainable disposal option suitable for Jamaica was carried out.

2.2 THE PROCEDURE FOR CEMETERY SELECTION

The selection of cemeteries to be surveyed was done by using the Electoral Constituency map of Jamaica which was divided into rectangular grids and cemetery point features were overlaid on it. A sample was then selected from each grid. The measured grid was a 4 x 4 rectangular grid of 1000 x 800 meters with an interval distance of 1000 meters (1 km) apart (Haining 2003). Each rectangular grid cell was allocated a 5 co-ordinate transect and a middle point to ensure adequate representation.

Statistical Test

The Independent Sample t Test was used to test the result of the data obtained (see Appendix I for Independent t test formula).

Model Specification

The Independent Samples t Test is the most frequently and universally adopted model to compare the means of two independent groups in order to determine whether there is statistical evidence that the associated population means are significantly different. This model will enable us to understand the geographic patterns, status and conditions of cemeteries across Jamaica. The questions to be answered here: (1). Are cemeteries in rural areas in better conditions than those in the urban areas? (2) Are there more cemeteries in rural areas with spaces for burials than in urban centers? (3) Is the issue of space only affecting urban areas?

In order to have an understanding of Cemeteries Island wide the variables in table 1 was used as a matrix to map at least 8 cemeteries in each parish (Observations were made in 4 cemeteries in rural areas and 4 cemeteries in urban areas).

The result of the investigation provided new insight into the condition, pattern, and geographic distribution of cemeteries.

2.3 DATA COLLECTION

The data collected for this study included primary and secondary data. The study applied a mixed methodology approach comprising both quantitative and qualitative aspects.

2.3.1 PRIMARY DATA COLLECTION

The primary data collection focused on several activities:

- Use of satellite derived imagery and digitization in ArcGIS to create data
- Collection of data through direct field observation
- Questionnaire survey
- Face to face interviews

2.3.2 SECONDARY DATA COLLECTION

Qualitative and quantitative information were collected as follows:

- Review of existing literatures e.g. STATIN Census data, Parish Council Reports, Development Orders and Plans etc.
- Consultations with Stakeholders – Morticians, Undertakers, PC personnel, Private facility owner etc.

2.4 MATERIALS

Geo-referenced digital map of Jamaica was used as the base map on the ArcGIS/Arc Map platform. Other materials included: direct field observation sheets which was used for the collection of information in the field; slope and soil data obtained for the purposes of analysis, rainfall and wind models, Digital Elevation Model, geological data which includes earthquake fault line data; Land use and vegetative cover data (past and present) and information on surface and ground water.

2.4.1 HARDWARE AND SOFTWARE

ARCGIS 10.5.1 was used for the creation and analysis of maps. GPS unit was used to collect GPS co-ordinates and Collector for ArcGIS was used to collect field data. IBM SPSS was used to code and analyse cemetery data. NLA Digital Lot Parcel Data, Jamaica DEM, Google Earth, Landsat 8 and Ikonos Satellite Imagery were used to inform the study where necessary.

2.5 RESEARCH DESIGN

The quantitative aspect of the study used a pre-constructed online-administered questionnaire, field observation of existing cemeteries. An online questionnaire survey administered to undertakers and funeral home operators in the different parts of Jamaica: Cornwall, Middlesex and Surrey – which are subdivided into 14 parishes: Kingston, St. Andrew, St. Catherine, Clarendon, Manchester, St. Elizabeth, Westmoreland, Hanover, St. James, Trelawney, St. Ann, St. Mary, Portland and St. Thomas.

2.6 SAMPLE DOMAINS

The sample domains are defined as the analytical subgroups for which equally reliable estimates are required. The agreed sampling domains for the study are.

1. Kingston Metropolitan Area (KMA)
2. Other Towns (OT)
3. Rural Areas (RA)

2.7 TARGETED CEMETERIES

The targeted cemeteries are the six types of cemeteries in Jamaica located within Urban Areas, Other Towns and Rural Area which are geographically spread across Electoral Constituencies.

2.8 SAMPLE DESIGN

The design for this survey uses a multi-stage cluster probability sampling with three stages of selection. The sample was selected in three stages to maximize its efficiency. The stratification of the sample ensures an adequate spread of the sample within the sampling domain and across the fourteen parishes of Jamaica. The clustering of elements in this sample design allows for a reduction in administrative, travel and other data collection costs. The three stages of the sample design were:

1. Stage 1: selection of the sampling domain
2. Stage 2: Selection of cemeteries in Electoral Constituency
3. Stage 3: Selection of ED's where the cemeteries are located.

2.9 STRATIFICATION

Strata are independent and mutually exclusive subsets of the target population. Within each stratum, sample elements are selected independently, as each ED in Jamaica is wholly contained in one and only one of the strata identified for this study. The sample is explicitly stratified by the three domains specified earlier, namely the Kingston Metropolitan Area (KMA), Other Towns (OT) and Rural Areas (RA). The KMA consists of the parish of Kingston (all urban) and the urban areas of St. Andrew. Other Towns consists of the parish capitals and other urban areas not in the KMA, and Rural Areas consists of all the remaining areas not in KMA or OTs. Within each domain, the sample is implicitly stratified by parish.

2.10 SAMPLE FRAME

The sampling frame is based on the data and cartographic materials from the 2011 Population and Housing Census conducted by the Statistical Institute of Jamaica (STATIN). The National Lands Agency's digital lot parcel data was used to ascertain the appropriate acreage of each of the cemeteries located in the sampling frame.

The sample frame is organized based on the list of Enumeration Districts (EDs) canvassed by STATIN for the *2011 Population & Housing Census*. EDs are geographically defined collections of dwelling units used by STATIN specifically for survey purposes. An ED is either urban or rural, with average size of 150 dwellings for urban and 100 dwellings for rural. EDs are defined in such a way to ensure that each ED:

1. Is wholly contained within one of Jamaica's fourteen parishes
2. Is entirely urban or rural
3. Contains approximately the same number of dwellings

2.11 QUESTIONNAIRE ADMINISTRATION

The pre-constructed questionnaires were administered to funeral homes via the survey 123 online platform.

2.12 DATA ANALYSIS

Data from the completed survey and field mapping (cemetery assessment) was analysed using IBM SPSS and ArcGIS. The data for description, analysis and synthesis includes primary and secondary data; such as; remotely sensed data; field mapping data, socio-economic data as well as other secondary data obtained from selected Government of Jamaica Agencies⁶.

6

CHAPTER THREE: FINDINGS DESCRIPTION, ANALYSIS AND SYNTHESIS

3.0 POPULATION DISTRIBUTION AND CHANGES IN JAMAICA

Population distribution and settlement patterns helps to explain the demand that maybe placed on land. Given projected population increases through to 2030 and associated increases in deaths per annum, additional facilities and cemetery capacity will be required to provide the services required by the Jamaican community.

Table 4 Population Distribution and Change

	2011		2001		1960	
	Total		Total		Total	
	No.	No.	No.	%	No.	%
JAMAICA	2,697,983	100.00	2,607,632	100.00	1,609,814	100.00
Kingston	89,057	3.30	96,052	3.68	123,403	7.67
St. Andrew	573,369	21.25	555,828	21.32	296,013	18.39
St. Thomas	93,902	3.48	91,604	3.51	68,725	4.27
Portland	81,744	3.03	80,205	3.08	64,510	4.01
St. Mary	113,615	4.21	111,466	4.27	94,233	5.85
St. Ann	172,362	6.39	166,762	6.40	114,360	7.10
Trelawny	75,164	2.79	73,066	2.80	56,080	3.48
St. James	183,811	6.81	175,127	6.72	83,003	5.16
Hanover	69,533	2.58	67,037	2.57	53,902	3.35
Westmoreland	144,103	5.34	138,948	5.33	109,606	6.81
St. Elizabeth	150,205	5.57	146,404	5.61	116,706	7.25
Manchester	189,797	7.03	185,801	7.13	111,788	6.94
Clarendon	245,103	9.08	237,024	9.09	163,950	10.18
St. Catherine	516,218	19.13	482,308	18.50	153,535	9.54

Table 4 shows the distribution and changes observed in Jamaica over the period 1960 - 2011. Looking at the rate of increase within the ten (10) years census period in terms of absolute numbers St Catherine had the largest increase, (33,910) and was followed by St Andrew (17,541), St James (8,684), Clarendon (8,079), St. Ann (5,600) and Westmoreland (5,155). These six parishes gained over 5,000 people during the period. They accounted for more than three quarters (87 per cent) of the overall increase for the country. The assumption here is that the areas of high demand for cemetery space is likely to be closely related to these areas of high population density.

3.1 POPULATION OUTLIERS

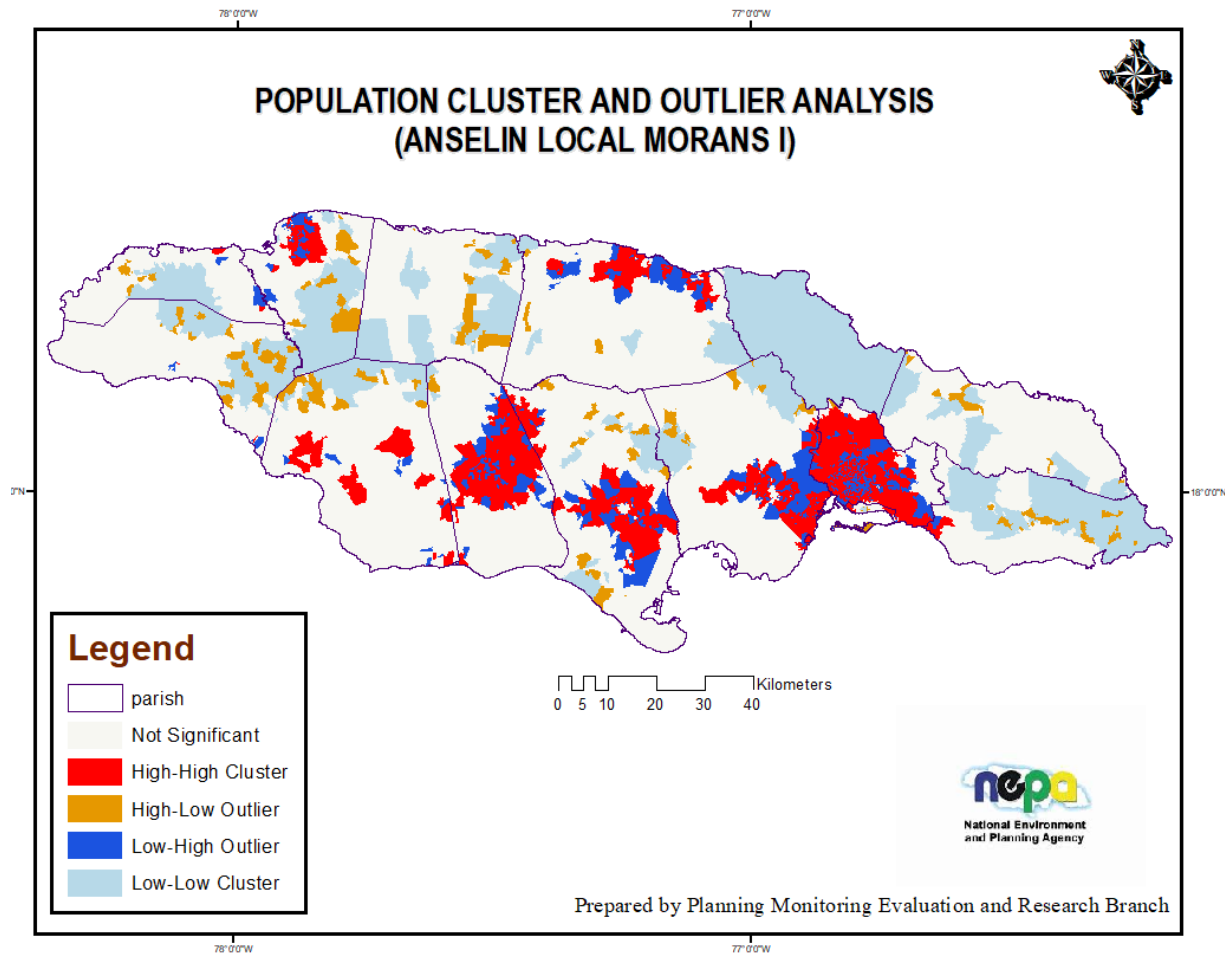


Figure 3 Population Hotspot

Source: Compiled from data obtained from STATIN Census Data

The map shows the distribution of Jamaica's population using the local Anselin Morans I (cluster and outlier analysis). The output displays areas of significant clustering of population as well as outliers. The output field, cluster/outlier type (COType), distinguishes between a statistically significant (0.05 level) cluster of high values (HH), cluster of low values (LL), outlier in which a high value is surrounded by primarily low values (HL), and outlier in which a low value is surrounded primarily by high values (LH).

Map Interpretation

The areas in white shows areas that were not statistically significant meaning that they were not part of the significant areas whether high or low. The red colored areas represent areas with a high population clustered next to other areas with high population. Brown areas represent census tracks

where you have high population next to areas of low population while the Blue represents census tracks with low population surrounded by other census tracks with high population. The light blue areas are areas with low population surrounded by low populated areas. The general assumption is that two extremes are common throughout Jamaica; the densely (high) populated areas and sparsely (low) populated areas⁷. Population Density in Jamaica 2002 - 2018

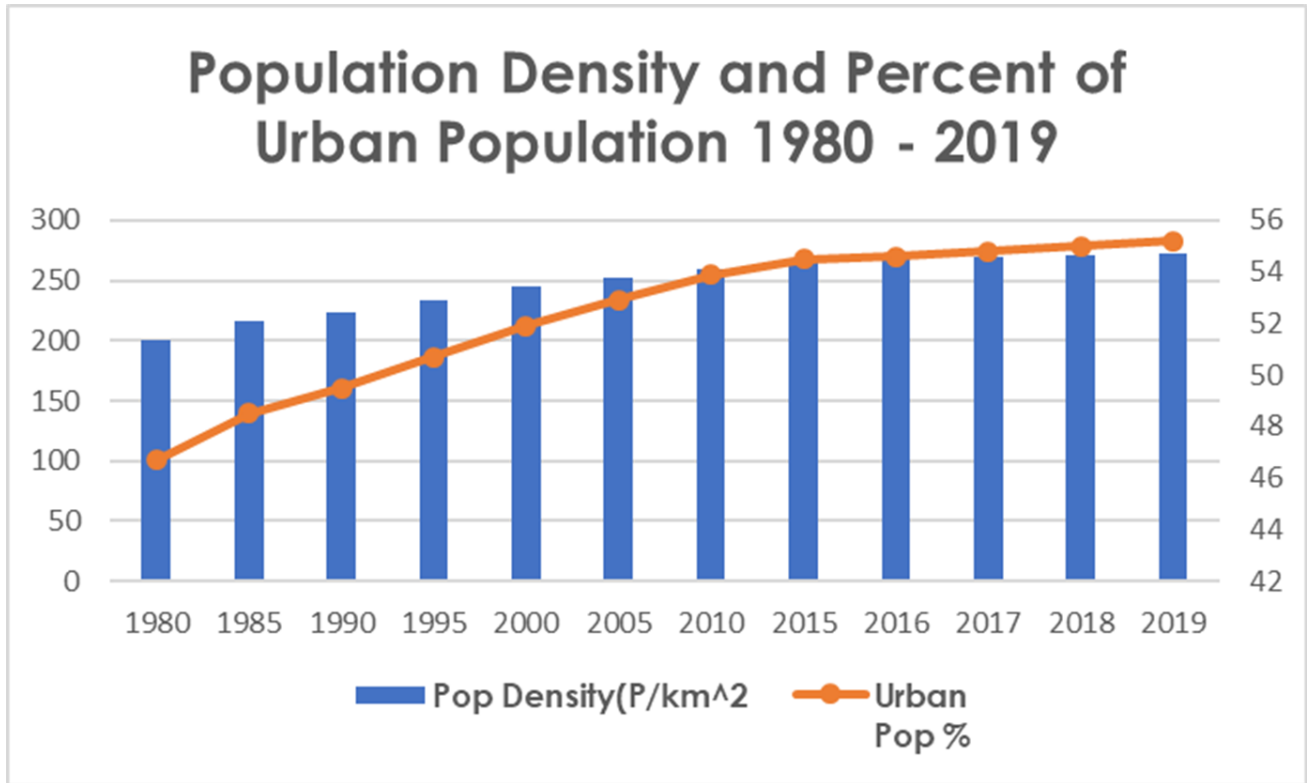


Figure 4 Population Density 1980 - 2019

Data Source: United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects: The 2019 Revision.

The map shows the trend in population density in Jamaica. There has been gradual increase in population density from the 1980s. Currently, the 2019 population density in Jamaica is 272 people per Km² (705 people per mi²), calculated on a total land area of 10,830 Km² (4,181 sq. miles)

⁷ <http://www.princeton.edu/~alaink/Orf467F08/The%20Gravity%20Model>

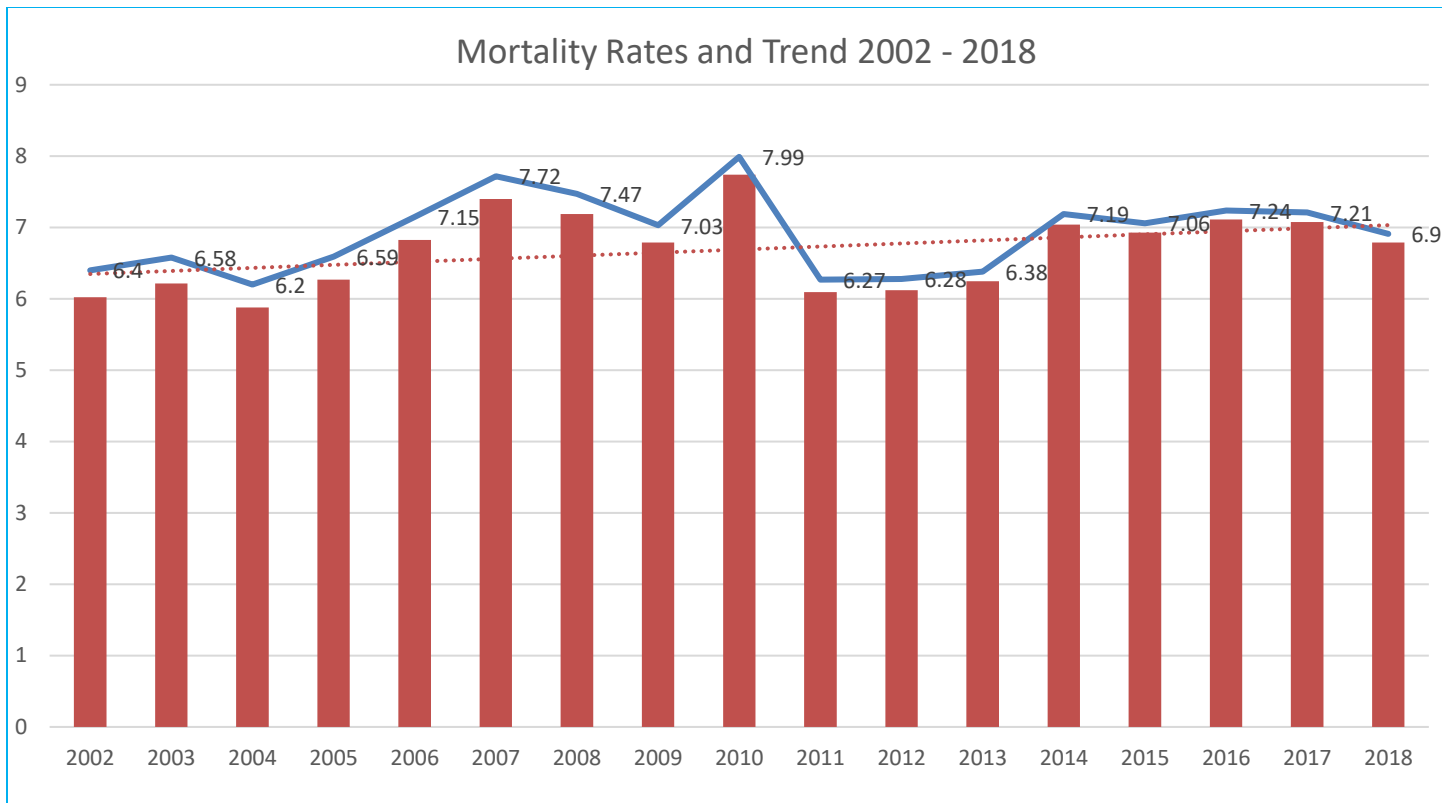


Figure 5 Mortality Rate 2002 – 2018

Death rate: 6.91 deaths/1,000 population (2018)

Figure 4 (combo chart) shows the trend and rates of death for one year per 1,000 population known as crude death rate from 2002- 2018. The death rate in Jamaica rose from 6.4 in 2002 to 6.58 in 2003 and declined to 6.2 in 2004. There was an increase from 6.59 in 2005 to 7.72 in 2007. In 2008 the death rate decreased to 7.47 and in 2009 there was a further decline to 7.03. The rate peaked in 2010 to an all-time high of 7.99 then gradually declined in 2011 to 6.27. The death rate has been fluctuating but below the 2010 rate which remains the highest on record.

<https://knoema.com/atlas/Jamaica/Population-density>

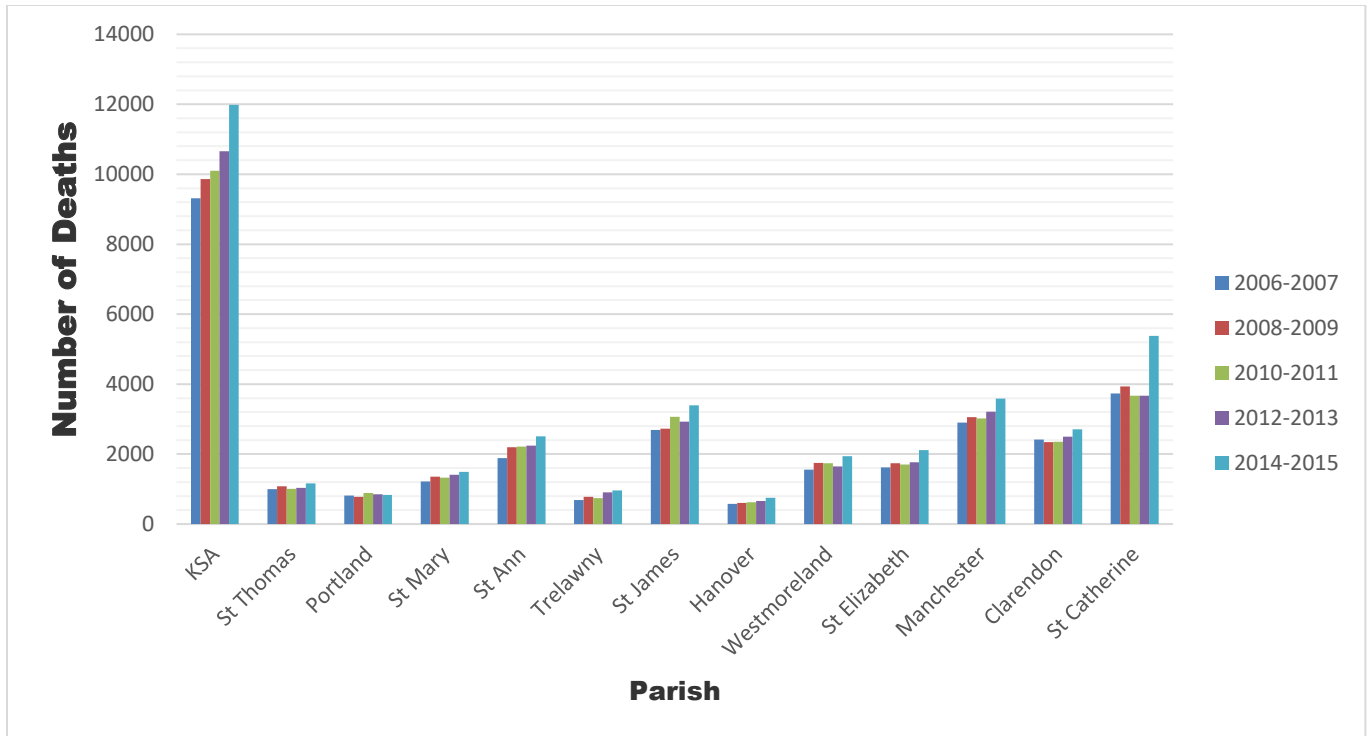


Figure 6 Total Deaths per Parish 2006- 2015

Data Source: STATIN

Figure 5 shows the number of deaths per parish from 2006 -2015. The data shows that Kingston and St Andrew parishes have the highest number of deaths in all the years measured and this is followed by St Catherine. A close look at the distribution of death shows that the rates are associated with population meaning that areas with high population is likely to have more deaths and more pressure on land for cemetery

3.2 PRELIMINARY STAGE

When someone dies there are many steps taken before burial or cremation of the deceased. This stage is referred to as the preliminary stage. The steps of arranging for disposal — from making the first calls when someone dies to the funeral home to taking care of the matters that have to be handled until the deceased is laid to rest. This forms the base of planning for the deceased.

3.2.1 IDENTIFYING POTENTIAL SOURCES OF POLLUTION FROM THE ACTIVITIES OF FUNERAL HOMES/DIRECTORS

A funeral home or funeral parlour, is a business that provides interment and funeral services for the dead and their families. These services may include a prepared wake and funeral, and the provision of a chapel for the funeral. Several funeral homes in Jamaica offers professional embalming, funeral, cemetery and crematorium services. Funeral home or funeral parlours provides interment and funeral services. The services they provide may include a prepared wake and funeral, or the provision of a chapel for the funeral. The funeral parlour falls under Class I – shops-in the use classes order in the Development Order. Currently, there is no outlined distinction to what is a “funeral parlour” and “funeral home”. (Please see Appendix I for Planning Conditions for Funeral Homes)

3.3 PRESENTATION OF SURVEY/INTERVIEW DATA FROM FUNERAL HOMES

When a loved one passes there are rituals performed for disposing of their bodies. It is pertinent to note that bodies cannot be described as "waste" – There are lots of emotional connotations associated with them among the living to be called waste. However, biological waste is generated during the processing of the body around death. Every step of corpse management generates waste. The most common forms of disposition in Jamaica are burial (interment) and cremation. Cremation is not exactly the same as incineration, but the processes are related but before the bodies are finally laid to rest the process begins from the services of the Funeral Home or Funeral Parlour.

3.4 INSTITUTIONS OF THE DEATH CARE INDUSTRY

The institutions of the death care industry comprise morgues, mortuaries, funeral homes, cemeteries/crematoria. Morgues keep dead bodies until they can be identified or undergo an autopsy. Hospitals usually have morgues for the bodies of patients who have died until they can be taken away to a funeral home. The morgue keeps the body refrigerated to prevent biological decay. If a medical examiner needs to look at the body (as often happens in criminal cases), this happens at a morgue.

This section of the study explored the activities of funeral home operators. The survey examined matters such as years of operation, location, types of waste streams and disposal of hazardous chemicals and medical waste, knowledge of global standard practice relating to hazardous waste handling, separation, storage, and transportation. In addition, the study also investigated the Funeral Home's experience with clients on the preferred disposal option whether it is predominantly cremation or ground burial. On a final note the questions were concluded by finding out if the funeral home were aware of the role of NEPA in the permitting and licensing of Funeral home facilities. A face to face discussion was held with selected funeral homes and an online questionnaire was administered to some selected others via survey 123 on ArcGIS platform. Thirty-five survey instruments were administered, and 15 responses were received but only thirteen of those instruments were usable. The information below is an analysis of the primary data and results of the face to face interviews conducted.

Number of Years in the Funeral Home Business

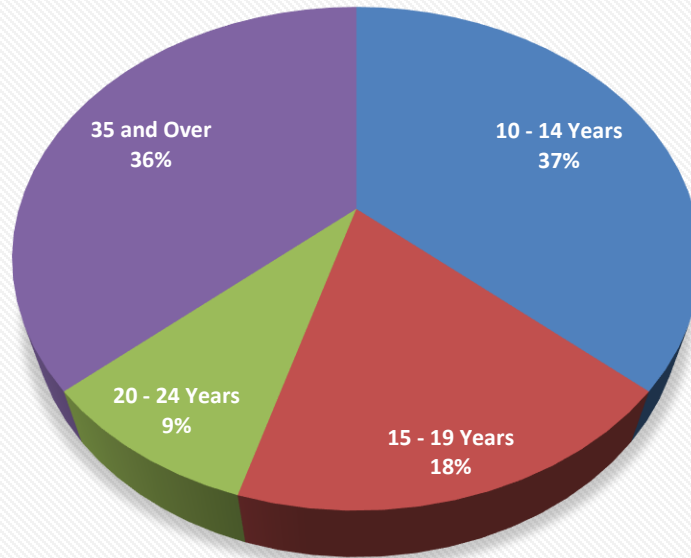


Figure 7 Years in Funeral Home Business

Figure 6 (pie chart) shows that 37 % of the funeral homes sampled have been in funeral home business for over 10-14 years while 36% stated that they have been in business for over 35 years. Also, 18% of the participants stated that they have been operating for about 15-19 years and 9% for 20-24 years.

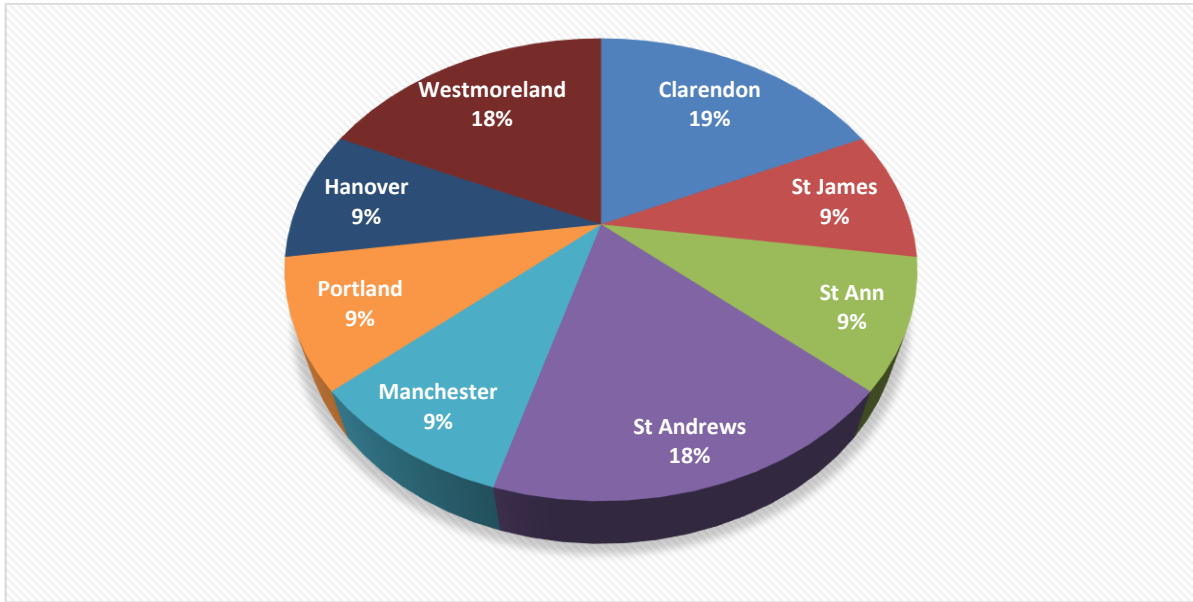


Figure 8 Location of the Funeral Homes

Figure 7 (pie chart) shows that funeral homes located in eight (8) parishes participated in the survey. It is worthy to note that hard and soft copies of the questionnaires were sent to funeral homes located in all the parishes in Jamaica but only those located in the 8 parishes shown here responded to the survey.

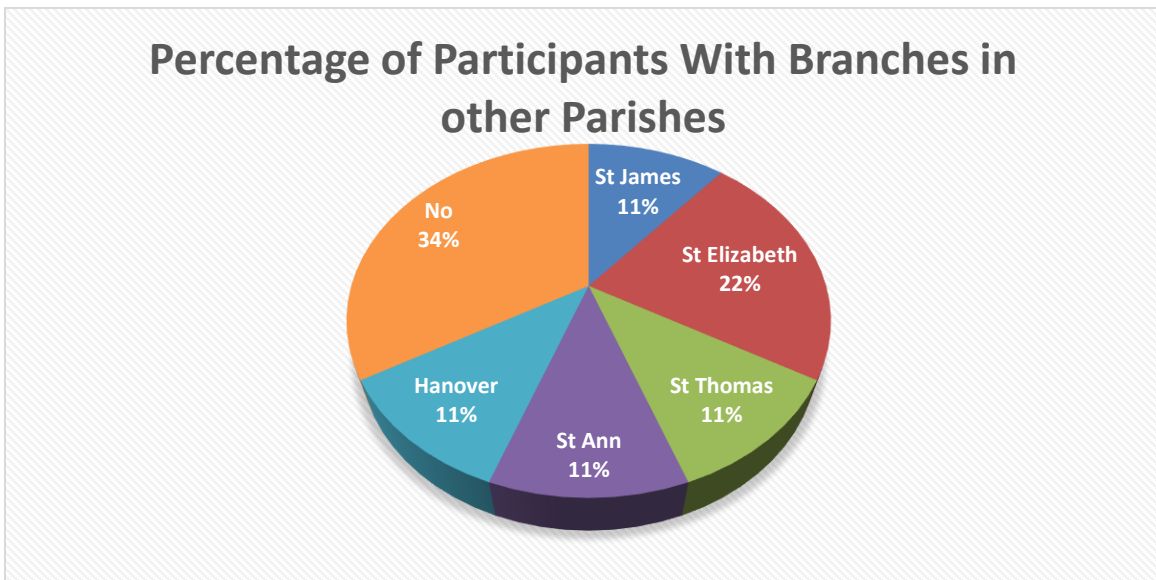


Figure 9 Ownership of Branches in other Parishes

The funeral homes surveyed stated that they have branches in other parishes as shown in the pie chart. Twenty two percent of the respondents stated that they have branches in St Elizabeth while 34% of the survey

respondents stated that they do not have any branches. Eleven percent have branches in St James and another 11% have branches in St Thomas including Hanover and St Ann.

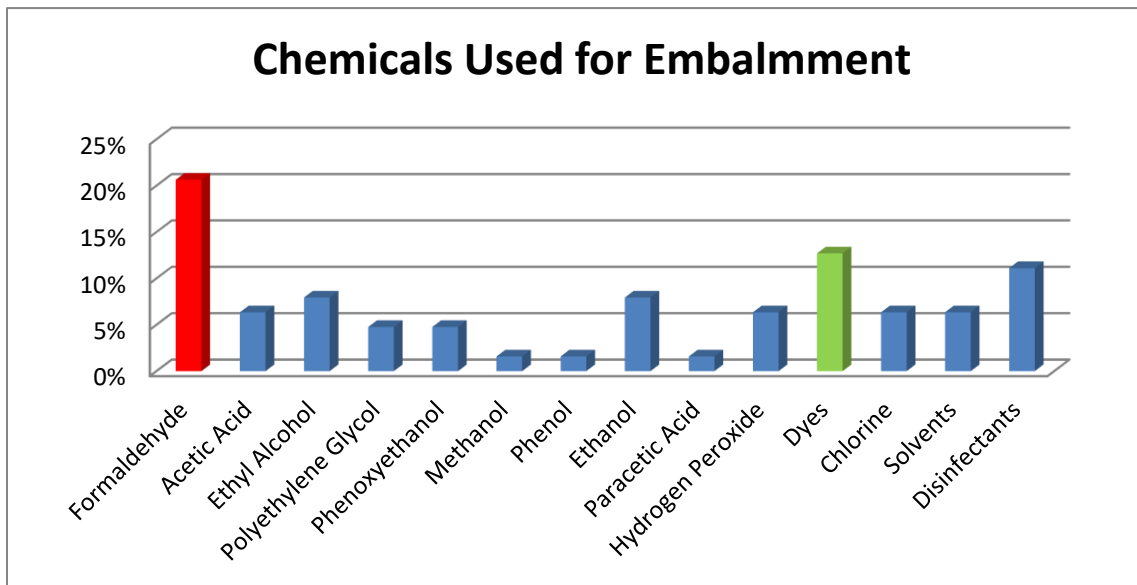


Figure 10 Vital Chemicals used for Embalmmnt

Figure 8 shows the different chemicals used by funeral home operators for embalmmnt. According to the funeral homes surveyed they stated that the most widely used chemical is Formaldehyde.

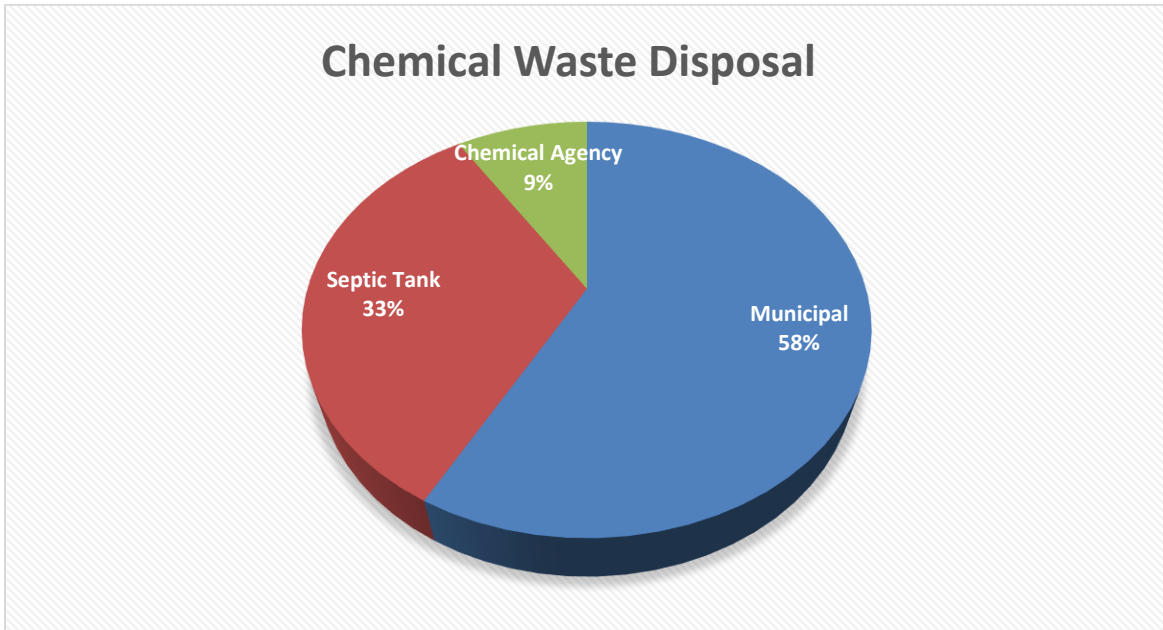


Figure 11 Chemical Waste Disposal Method

Figure 10 shows the results from funeral home operators who were asked how the chemical waste generated from their facilities were discarded. The majority (58 %) of respondents stated that the chemical waste was taken to the municipal dump while 33% stipulated that they have septic tanks within their premises for the disposal of the chemical waste and 9% stated that the waste was taken to the Chemical Agency for treatment and disposal.



Figure 12 Colour Coding of Waste

Figure 11 (pie chart) shows that majority (70%) of the funeral homes stated that they use standard colour coding and labelling of biomedical waste recommended by the world health Organisation while some (20%) funeral homes do not use any standard. Minority (10%) of the respondents stated they do not separate their waste before disposal. Colour coding helps waste disposal companies distinguish different types of wastes, and easily sorts them into different categories. Because proper waste removal is so important, the survey asked whether the waste generated was colour coded for easy identification before disposal.

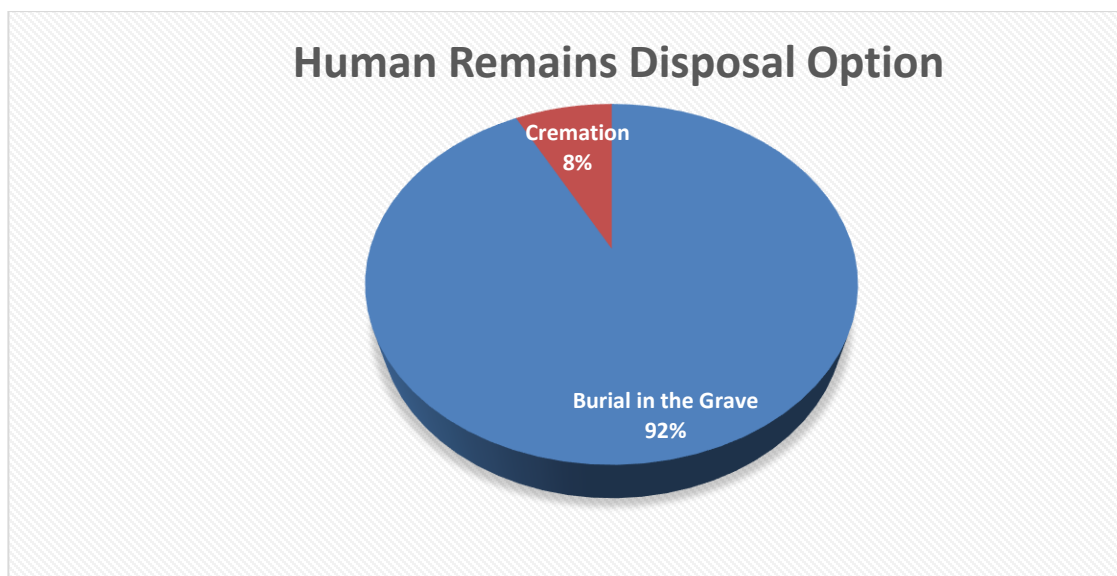


Figure 13 Cremation vs Burial

Figure 12 shows funeral home operators who were asked to indicate the most preferred disposal method chosen by their clients over the past five (5) years. Majority (92%) of the funeral homes stated that most of their clients over the past five (5) years prefer to be buried in the ground while some few others stated that 8% of their clients preferred to be cremated.

Ranked :Lowest - Highest 1 -being most used cemetery and 6 -least used cemetery

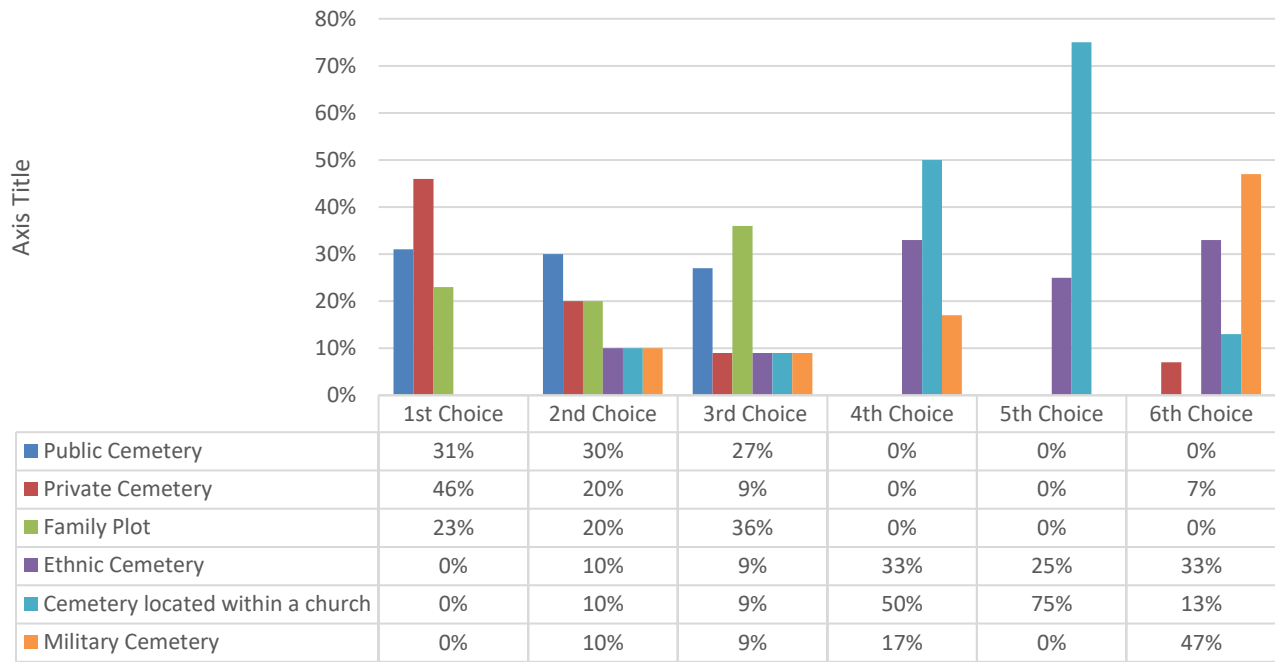


Figure 14 Most preferred burial sites by clients

Figure 13 is an analysis of the ranking of the most preferred burial option by clients using the individual funeral homes services. The most frequently used burial sites over the last five (5) years were ranked by the funeral homes surveyed from the list given below:

- Public cemetery
- Private Cemetery
- Ethnic cemetery
- Family Plot
- Cemetery in church premises
- Military cemetery

The analysis shows that private cemetery ranks as the most used option among the six different types of burial sites/cemetery. The summary of the analysis is given below:

The first (1st) Choice is the Private cemetery (46%) followed by 2. Public Cemetery (31%) 3. Family Plot (23%)
 2nd choice- 1. Public Cemetery (30%) 2. Private Cemetery (20%) 3. Family Plot (20%). 4. Ethnic Cemetery 10%
 5. Cemetery located within a church (10%) 6. Military Cemetery (10%).

3rd choice- 1. Family plot (36%) 2. Public cemetery (27%) 3. Private Cemetery (9%) 4.Ethnic Cemetery (9%)
5.Cemetery located within a church (9%) 6.Military cemetery (9%)

4th choice- 1. Cemetery located with a church (50%) 2. Ethnic cemetery (33%) 3.Military Cemetery (17%)

5th choice- 1. Cemetery located within a church (75%) 2.Ethnic Cemetery (25%)

6th choice- 1. Military Cemetery (47%) 2. Ethnic cemetery (33%) 3. Cemetery located within a church (13%) 4. Private Cemetery (7%).

Figure 13 (bar chart) shows that majority of the clients were buried at Private cemeteries. This option was followed by Public cemetery and the third choice was Family plot. More Jamaicans according to the data prefer to bury their loved ones in a private cemetery.

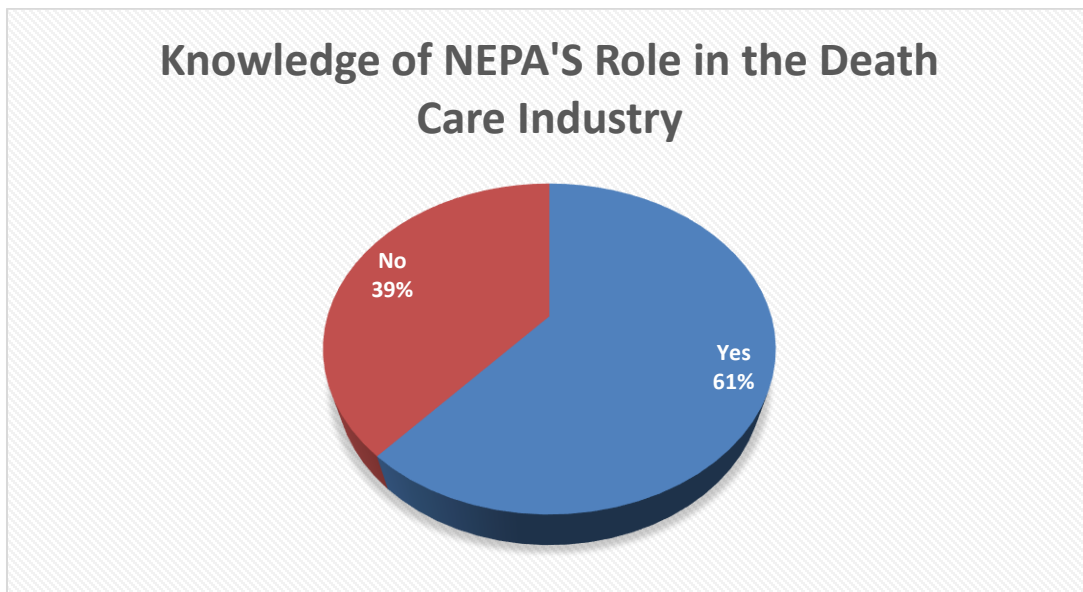


Figure 15 Knowledge of NEPA's Role in Regulating Funeral Homes

Figure 14 (pie chart) shows that majority (61.5%) of the respondents stated that they were aware of the work of NEPA regarding permitting and licensing of funeral homes while minority (38.5%) said they were not aware.

3.4.1 LIFE CYCLE ASSESSMENT OF DISPOSAL OF DECEASED HUMANS

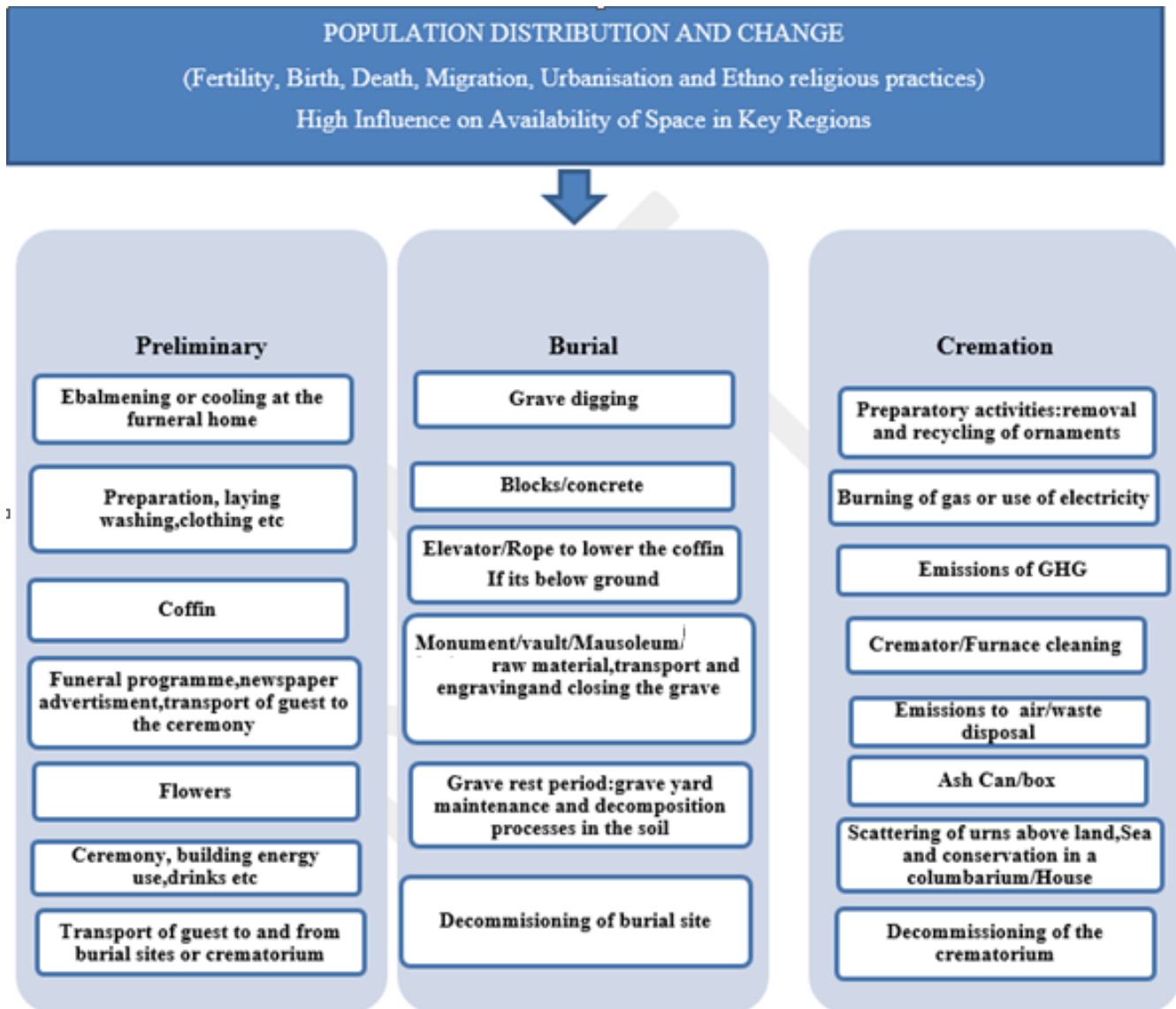


Figure 16 Cradle to the Grave Assessment of the funeral Process

Figure 15 shows the different stages involved in the disposal of the deceased. The different stages generates waste which could impact the environment if not properly managed.

3.5 POTENTIAL SOURCES OF POLLUTION FROM THE FUNERAL PROCESS

3.5.1 COFFINS/CASKETS



Figure 17 Coffins/Caskets

Caskets are often the most expensive item on the funeral expense list. All ground burials conducted in Jamaica involves the use of a casket. The caskets vary widely in style and price and are sold primarily for their visual appeal. Caskets are made of metal, wood, fibreboard, fiberglass or plastic. On average, a casket can cost between \$75,000-\$200,000. Producing caskets requires the utilization of many resources and can be a source of pollution.

Even though no direct studies have been conducted on the impact of casket manufacture on the environment in Jamaica, studies conducted in the United States discovered that burials use 30 million board feet of hardwoods, 2,700 tons of copper and bronze, 104,272 tons of steel, and 1,636,000 tons of reinforced concrete every year. The amount of casket wood alone is equivalent to about 4 million acres of forest and could build about 4.5 million homes (The Berkeley Planning Journal).

In addition, no studies have been done in Jamaica relating to the emissions from the death care industry research in other areas have shown that the whole burial process is a CO₂ emissions nightmare. So much energy is required to manufacture a casket and to transport it. Some other emissions come from:

- Cutting down trees
- Manufacturing the casket
- Digging the grave
- Transporting the wood
- Transporting the casket

- Cement manufacturing

3.5.2 EMBALMING PROCESS

According to the funeral homes interviewed during the face to face sessions, the embalming process involves pumping blood and lymph out of the body and replacing it with embalming fluid. The replacement fluid (about 2 or 3 gallons for an adult male body) is a formaldehyde solution with water and sometimes glutaraldehyde, methanol, ethanol, and phenol. In some cases, dyes are also added. The fluid removed from the body is flushed down the drain which enters the sewage system and is treated by the wastewater treatment system. The blood can be a substantial load to the BOD to the sewage plant.

The main ingredients in embalming fluid are formaldehyde, glutaraldehyde, phenol, humectants, dyes, anti-endemic chemicals, and disinfectants. These chemicals have the potential of sipping into the soil when adequate measures are not taken. In Jamaica, certain measures are taken to ensure that some of this impact are mitigated. For example, permits for the operation of cemeteries usually stipulates that topsoil should be stored to prevent its dispersal, the permit also established that the burial vaults should be concrete sealed to prevent grave leachate from entering the soil, and eventually the groundwater system. There still exist a threat that if graves are not properly monitored and maintained the chemicals could find their way to the natural environment.

In the United States for example, According to the National Funeral Directors Association in the United States “Eight hundred and twenty-seven (827,000) gallons of formaldehyde-based embalming fluid into our waterways and soil every single year, according to the National Funeral Directors Association (NFDA). Not only is embalming fluid toxic, but the chemicals used to process and finish the wood for the caskets are also detrimental to the environment. People tend to act like once you bury something, it has no effect on the environment anymore which is simply untrue. Based on this, adequate care must be put in place to monitor the processes outlined above.

3.5.3 THE CORPSE

Many deaths occur after a sickness, in some cases due to an infectious disease. While it is possible that an infectious disease could pass to a mortuary employee or visitor this is not our direct concern here. The bigger risk is medical equipment or materials in the body which may eventually pollute the environment. People who had been receiving chemotherapy might have ports on their bodies and trace chemotherapy agents could be present.

3.5.4 SHARPS

Sharps, means needles, blades, glass instruments and containers such as syringes, and anything else that can

penetrate the skin. When the sharps are used they often contaminate with bodily fluids or treatment chemicals. The funeral homes use cutting instruments in preparation of bodies for interment and cremation. These sharps are very dangerous to the environment.

3.5.5 PHARMACEUTICAL AND CHEMOTHERAPY WASTE

Chemotherapy medications are used for cancer and sometimes other diseases. Majority of these chemotherapy drugs are cytotoxic: they kill cells. That means waste containing those drugs is hazardous waste and also the materials and tools used to clean up a spill of chemotherapy or chemotherapy-contaminated waste must be treated as hazardous waste⁸.

3.5.5.1 BIO HAZARDOUS WASTE

Mortuaries end up with bio hazardous waste. The quantities are small compared with what is produced at hospitals or doctors' offices. Other materials identified at the funeral homes which might be dangerous are as gauze and bandages on the body, and some materials used in preparation of the body (e.g. disposable gloves, gauze, and tubing). Lack of improper management may result in pollution of the environment.

3.6 FINAL STAGE

The final stage of the cycle comprises of the two disposal methods backed by law in Jamaica. The two methods will be examined in this section.

3.6.1 LOCATION OF CEMETERIES IN JAMAICA

The quality and capacity of facilities, in offering the right range of services to communities and operated by competent staff, together with good maintenance of the facilities, remain critical to the effective delivery of such services. According to the requirements of the GOJ's Development and Investment Manual, 40 hectares of cemetery land should be allocated to every 100,000 of population. Of these, 50-60% should be used for interment. Of the acreage devoted to interment 70 percent shall be used for burial and 30 percent for cremation. (30-40%) of land in cemeteries should be used for roads and gardens. Adequate parking areas, meeting halls, small chapels, places to sell flowers and wreaths etc. should be provided. The Development Bible also addressed monument and interments. It was recommended that multiple interment in monuments must not be more than a height of 3.6 meters (12 feet) corresponding to 1.5 to 2 stories above ground largely dependent on soil type. In addition, it stated that the depth of interment/burial for adults in ordinary tombs should be 2 to 2.4 meters and 1.5 meters for children under 10 years.

⁸ <https://www.malsparo.com/chemotherapy.htm>

The GOJ Development and Investment Manual also emphasizes the need to avoid development of cemeteries on productive Class I-III agricultural areas, and mentions the practice (more common in the rural areas) of laying family members to rest in family plots close to family dwellings. The Manual implies a cultural resistance to living near to cemeteries, and suggests the location of such facilities on the outskirts of urban settlements and at a certain distance from residential areas. However, it is suggested that landscaping solutions may not simply screen the cemetery and making it unobtrusive, but also create green gardens and small parks separate from the areas dedicated to internment that could beautify the cemetery and provide areas for quiet contemplation.

Distribution of Burial Sites & Crematoriums across Jamaica

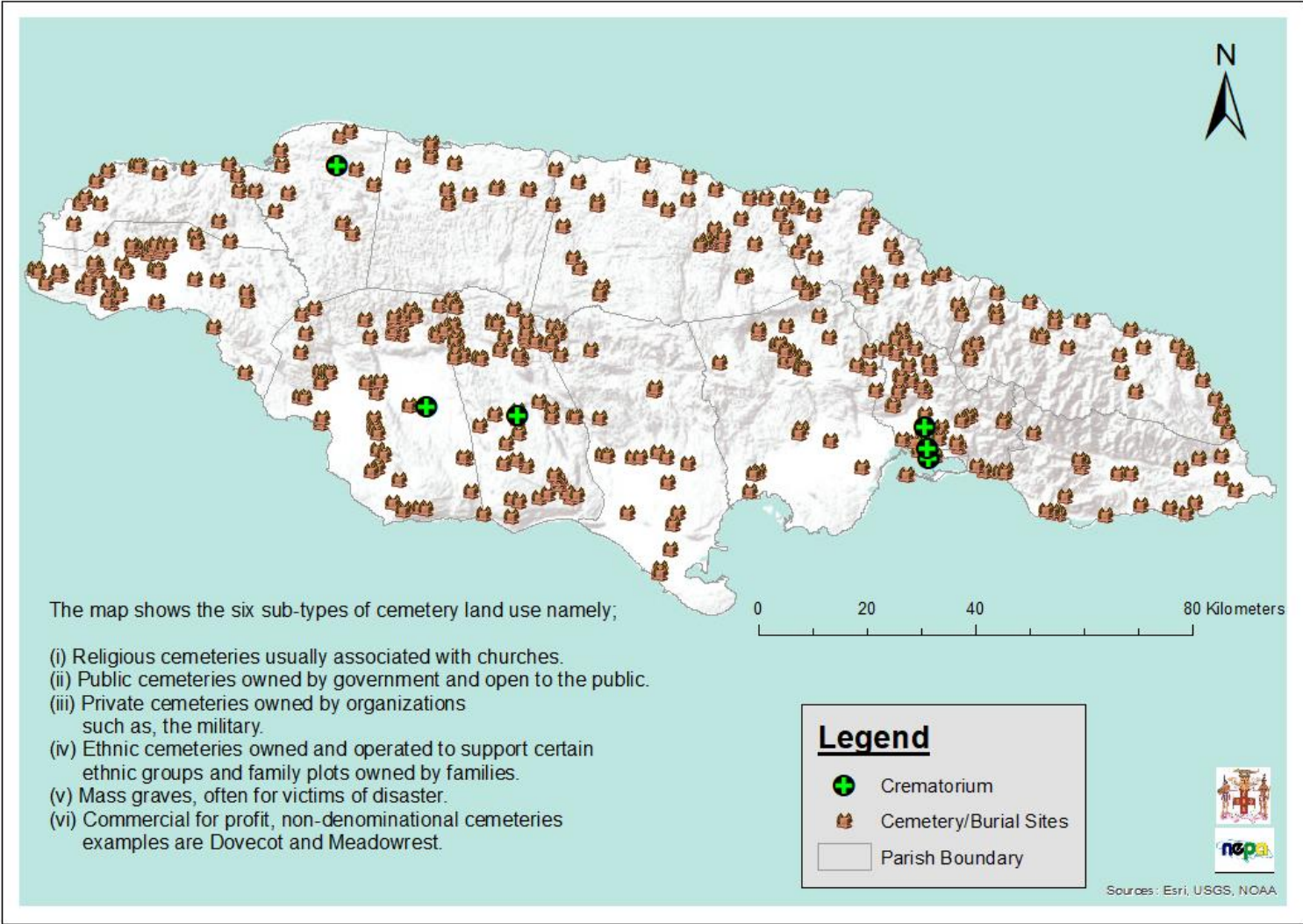


Figure 18 Burial Sites in Jamaica

Data source: Ministry of Local Government and Field work.

Figure 17 shows the six different types of burial sites/cemeteries in Jamaica. The data shows that significant amount of space is already committed towards the burial of the deceased. Currently, there is an estimated 427 burial sites/cemeteries across Jamaica. Most of these sites are privately and publicly owned by ethnic,religious,institutions,families and the government.

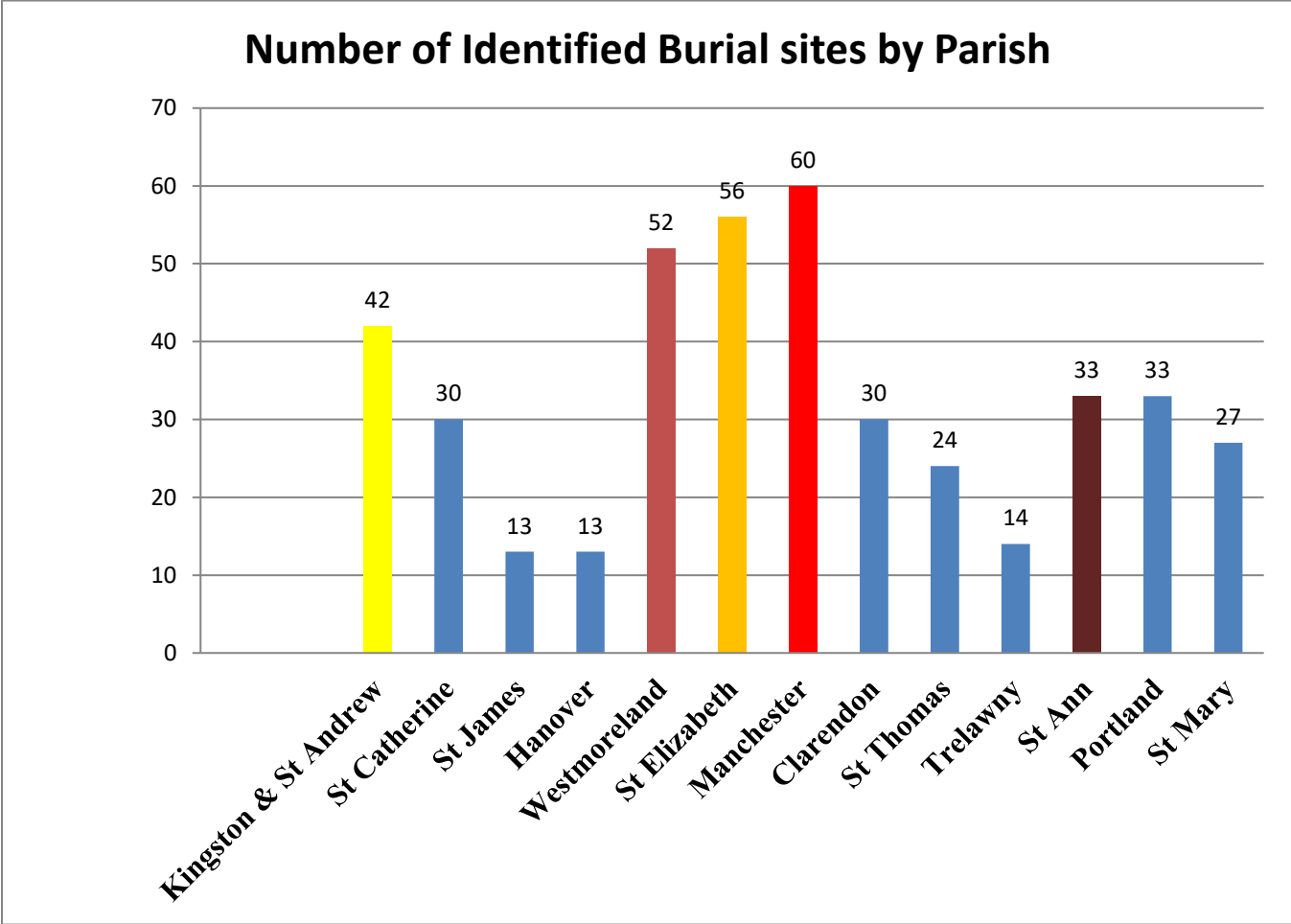


Figure 19 Number of Identified Burial sites by Parish

Figure 18 shows that Manchester have the most burial sites, followed by St Elizabeth. The least areas with burial sites are Hanover and St James. It is pertinent to note that most of the sites in Manchester and Westmoreland are family burial plots.

3.6.2 LOCATION OF CREMATORIUMS IN JAMAICA.

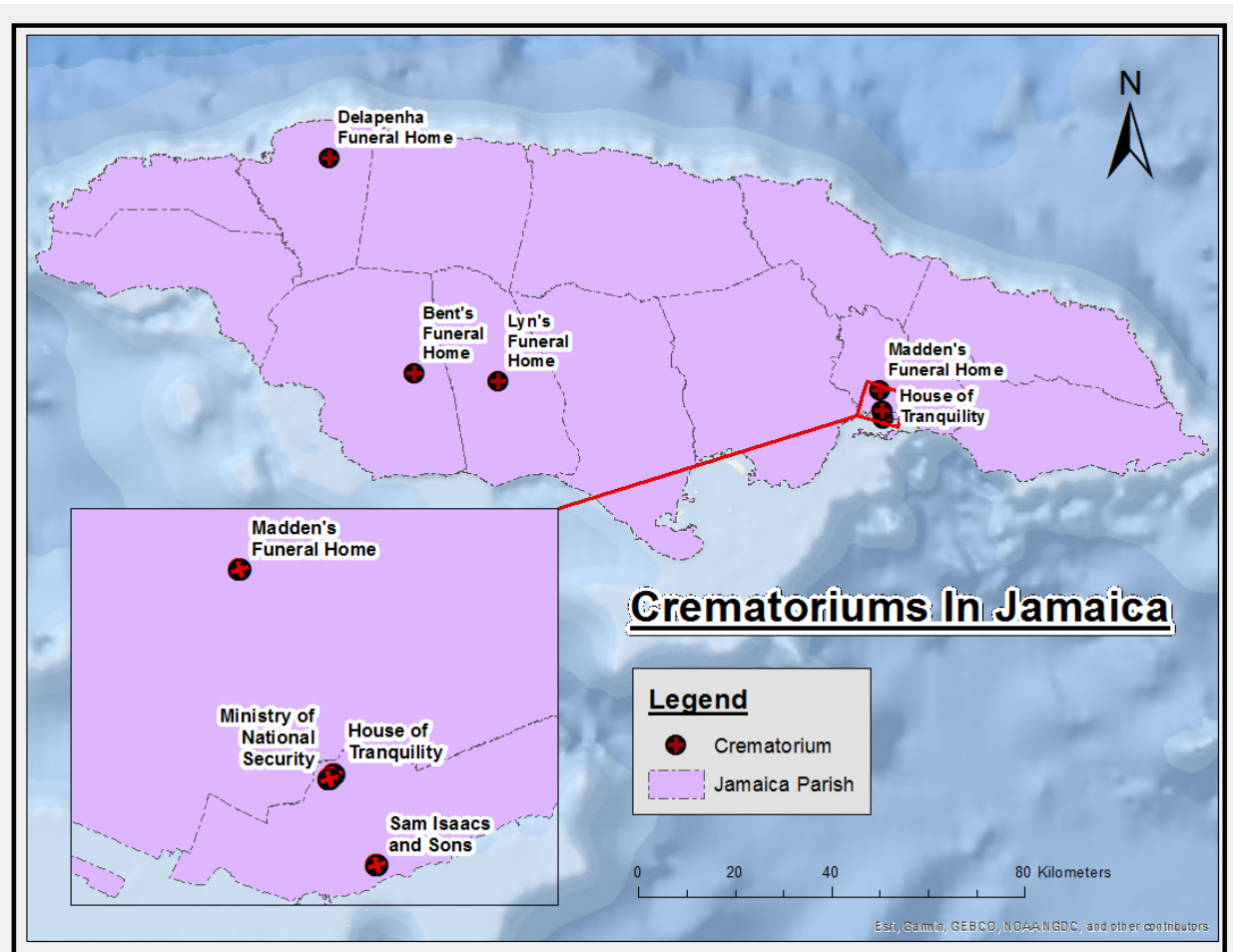


Figure 20 Location of Crematorium

Figure 19 shows the location of crematoriums in Jamaica. According to data available there are seven approved crematoriums in Jamaica and they are:

1. Crematorium owned by Madden's Funeral Home
2. Crematorium owned by ministry of National Security
3. House of Tranquility
4. Sam Isaacs and Sons
5. Lyns Funeral Home
6. Brent's Funeral Home
7. Crematorium owned by Delapehna Funeral Home.

3.7 DETAILS OF THE CREMATION PROCESS

In the cremation process the body - with a garment and perhaps in a container - enters a chamber. Natural gas is used to heat the unit and exhaust goes through a scrubber to ensure smoke does not exit the facility.

In most cases there are precautionary measures taken by mortuaries to ensure that mechanical devices are not put into the chambers. One of the measures is to take x-rays of the body. Mechanical devices and pacemakers are removed from the body as are jewelry and watches. The crematory operator essentially performs surgery on the dead body, cutting it open to take out artificial devices. These operations generate waste.

3.7.1 COMPARISON BETWEEN BURIALS VS CREMATION

Cremation is a popular alternative to burial, but it can also potentially impact the environment negatively. Although cremation is more eco-friendly than burial, cremations burn much gas (a temperature of 750 to 800 degrees must be maintained for 45 to 90 minutes) releasing greenhouse gases and vaporising other chemicals that may be present in the body such as mercury (dental fillings) and dioxins and furans. Emission of vaporised toxic mercury into the air is worrying. It returns to the earth where it can convert to highly toxic methyl mercury and contaminate various foods⁹. It is pertinent to note that emissions will not necessarily include mercury where facilities embrace procedures to ensure removal of toxic implants in deceased humans.

Estimating the Cost of Cremation versus Ground Burial in Jamaica

⁹ <https://www.irishtimes.com/news/science/which-to-choose-burial-or-cremation-1.3355960>

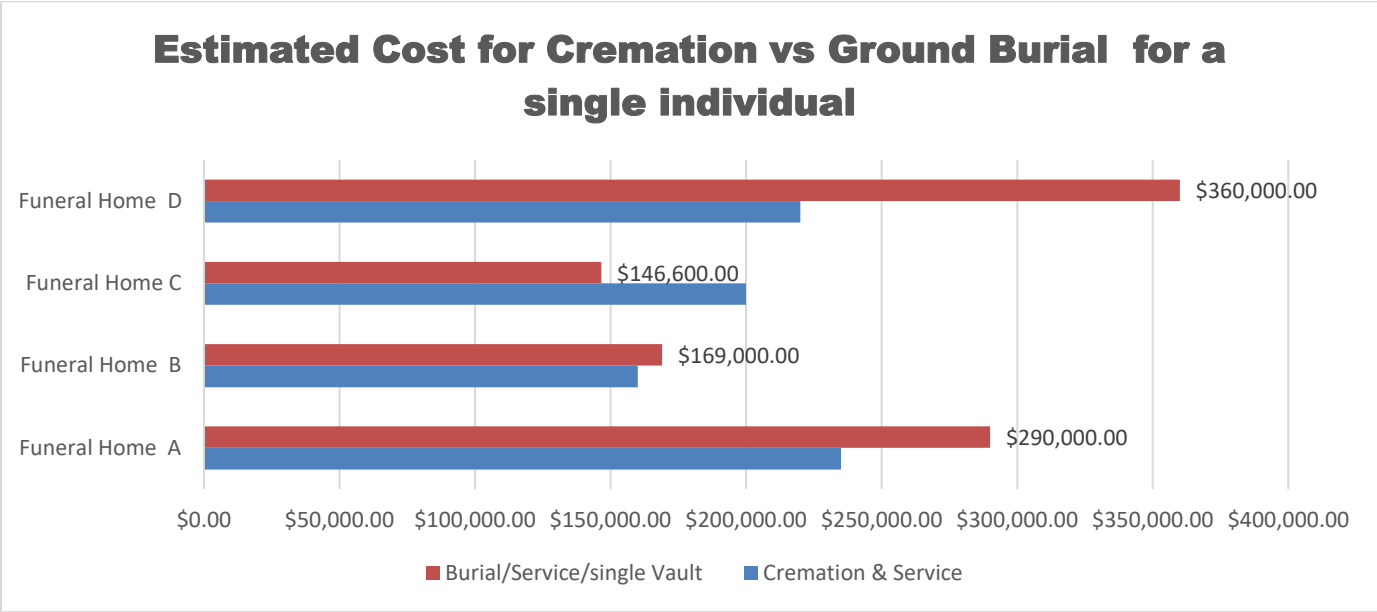


Figure 21 Estimated Cost for Cremation vs Ground Burial for a single individual

Figure 21 shows the estimated cost of burial vs cremation of one individual (cadaver) in Jamaica.

Table 5 Comparison of environmental impact of cremation vs ground burial using meta-analytical approach

Ground Burial (impact)	Author	Cremation (Impact)	Author
Soil contamination: Release of leachate such as ammonia gas and other elements such as sodium, potassium, chloride, bicarbonate nitrate, phosphate ammonium and sulphate ions to surrounding soil	Knight & Dent 1995; Fiedler et al 2012	Loss of Forensic and historical data source	Buschman &Tsokos 2014;
Soil maybe contaminated by inorganic contaminant divided into two groups: internal contaminants (e.g amalgam tooth	Sponberg & Becks 2000; Amuno &Oluwajana 2014)	Ashes contain large amount of nutrients like phosphate which when scattered can result in nutrient enrichment and can affect both aquatic and terrestrial ecosystems.	Guttman et al 2011; Chambers 2001; Smith et al 1999.

fillings) and external contaminant (e.g coffin metal fittings).		Effects maybe eutrophication, nitrate toxicity in drinking water or alteration of soil chemistry.	
Ground water contamination: Dead bodies can contaminate ground water in 2 ways: 1. bacteria and viruses from graves through seepage 2. Increased concentration of naturally occurring organic and inorganic substances. The list of main pollutants from cemeteries includes substances which are known to possess carcinogenic or mutagenic properties; metals and their compounds; arsenic and its compounds; and substances which contribute to eutrophication (in particular, nitrates and phosphates).	WHO 1998; Zychowski 2012; EU Directive 98/83/EC	Crematory emissions could include the emission of trace metals which may be due to extraneous materials in the dead body. The following metals have been associated with crematory emissions- arsenic, cadmium, chromium, Mercury, lead and thallium among others.	Mari & Domingo 2010; Santarsiero 2005; Olson 2016; Nelson et al 2012myers 2015.

<p>Accumulation of materials in graves: extraneous non decomposable items per grave such as orthopaedic materials, plastics, cardiac Pacemaker, coffins, breast implants, artificial heart valves, synthetic materials etc. There is a situation currently plaguing the state of Norway, where “a three-decade-long practice of wrapping their dead in plastic before laying them to rest in wooden caskets, believing the practice was more sanitary” (Jervell, 2013) has rendered the cemeteries full of bodies which cannot seem to decompose without outside intervention.</p>	<p>(Keijzer & Kok, 2011); (Mennen & van Bruggen, 1997) (Durães <i>et al.</i>, 2010). (Zelenovic, 2008).</p>	<p>Cremation of medical devices, prosthetics and radioactive implants could cause explosion in the crematory</p>	<p>Gale & Mulley 2002; Smith et al 2012; Keijzer 2011</p>
--	---	--	---

<p>Permanent Land use: Though individual spaces created by after-death rituals vary widely, together they form broad geographic patterns (Jackson & Vegara, 1996; Rugg, 2000; Sloane, 1991; Walter, 2005). Cemeteries occupy critical community space (Pattison, 1955) They contain sensitive contents and are permanent land uses. Poorly maintained and crowded cemeteries, depress the surrounding neighbourhood.</p>		<p>Risk associated with the body of a cancer patient who has undergone 1-125 therapy.</p>	<p>Jesus 2010; Direcao da Saude 2015</p>
<p>Concretization results in flooding of nearby communities. Run-Off due to Concretization and Pavement: The modernization of Mumbai has entailed an increase in the use of concrete, which is particularly impervious, leading to increased run-off of rainwater.</p>	<p>Liang et al 2019; Prasanna et al 2019</p>		

Table 6 Impact of cemetery and cremation on the Environment

Impact Category of Burial and Cremation	Source
Climate Change	Bruyn et al 2010
Ozone Depletion	Bruyn et al 2010
Human toxicity	<u>Harmelen 2007</u>
Photochemical Oxidant Formation	Bruyn et al 2010
Particulate Matter Formation	Bruyn et al 2010
Ionizing Radiation	Bruyn et al 2010
Terrestrial acidification	Bruyn et al 2010
Freshwater Eutrophication	Bruyn et al 2010
Marine Eutrophication	Bruyn et al 2010
Terrestrial Ecotoxicity	<u>Harmelen 2007</u>
Fresh water Ecotoxicity	<u>Harmelen et al 2007</u>
Marine Ecotoxicity	Life cycle Initiative 2004
Agricultural Land Occupation	<u>Harmelen et al 2012</u>
Urban Land Occupation	<u>Harmelen et al 2012</u>
Natural Land Transformation	<u>Harmelen et al 2012</u>
Contribution to Water scarcity and stress	<u>Harmelen et al 2012</u>

The table is a general analysis of the potential impact of cremation on the environment and does not in any way imply that these problems exist in Jamaica. These cases could occur when these operations are not properly managed.

3.8 ACREAGES OF LAND NEEDED BY EXISTING POPULATION USING THE NATIONAL SETTLEMENT STRATEGY

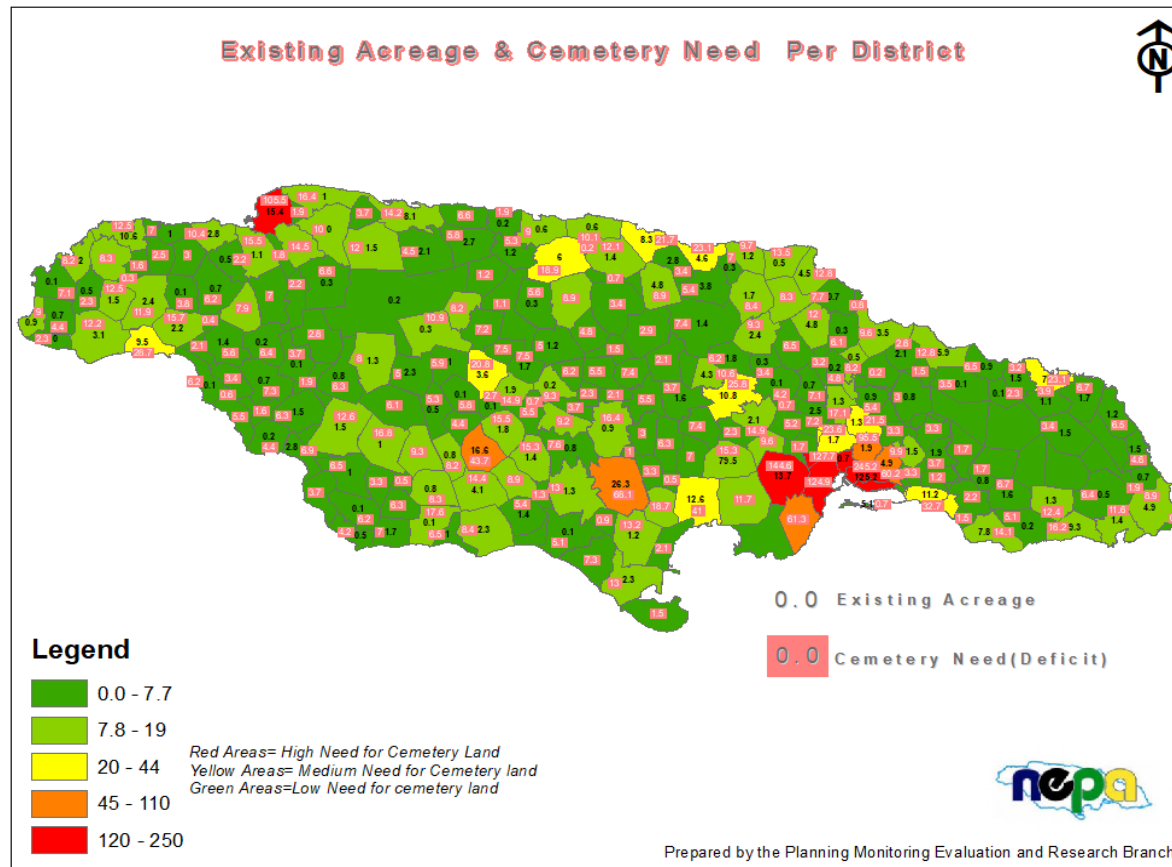


Figure 22 Existing Cemetery Space Need

Data source: Parish Council and Field work

Figure 22 shows the existing acreage and demand for cemetery land by parish. The numerals in black indicate existing acreage presently committed towards cemetery land use while the numerals in pink represents cemetery needs. The country requires a minimum of 2700 acres of land. Based on calculations there is a total of 712.6 acres of lands available for cemeteries. The calculations show that there is a deficit of 1987.4 acres. The map shows that there are some areas where there are no cemeteries.

Table 7 Differential Ratio in the provisions of lands for cemetery land.

Parish	Existing Acreage	Existing Need 2019	Diff. Ratio (%)	Projected Need 2030(Acres)
Kingston & St Andrew	162.3	823.7	19.7	870.2
St Catherine	262.5	982.6	26.7	1070.2
St James	23.1	222.7	10.3	242
Hanover	23.5	131	17.9	134.5
Westmoreland	24.1	188.9	12.7	190.7
St Elizabeth	19.3	205.5	9.3	240.5
Manchester	34.7	172.6	20.1	198.8
Clarendon	36.8	254	14.4	281
St Thomas	28.4	90.8	31.2	94.4
Trelawny	16.2	81.5	19.8	88.7
St Ann	38.1	172.9	22.0	187.7
Portland	23.3	81	28.7	89
St Mary	20.3	121.4	16.7	137.1

The table shows that St Elizabeth, St James, Westmoreland and Clarendon have the worst ratios in terms of differentials between existing land capacity and the acreage needed to contain the dead. St Thomas, Portland and St Catherine have the highest ratios of capacity to bury their dead but are all woefully inadequate.

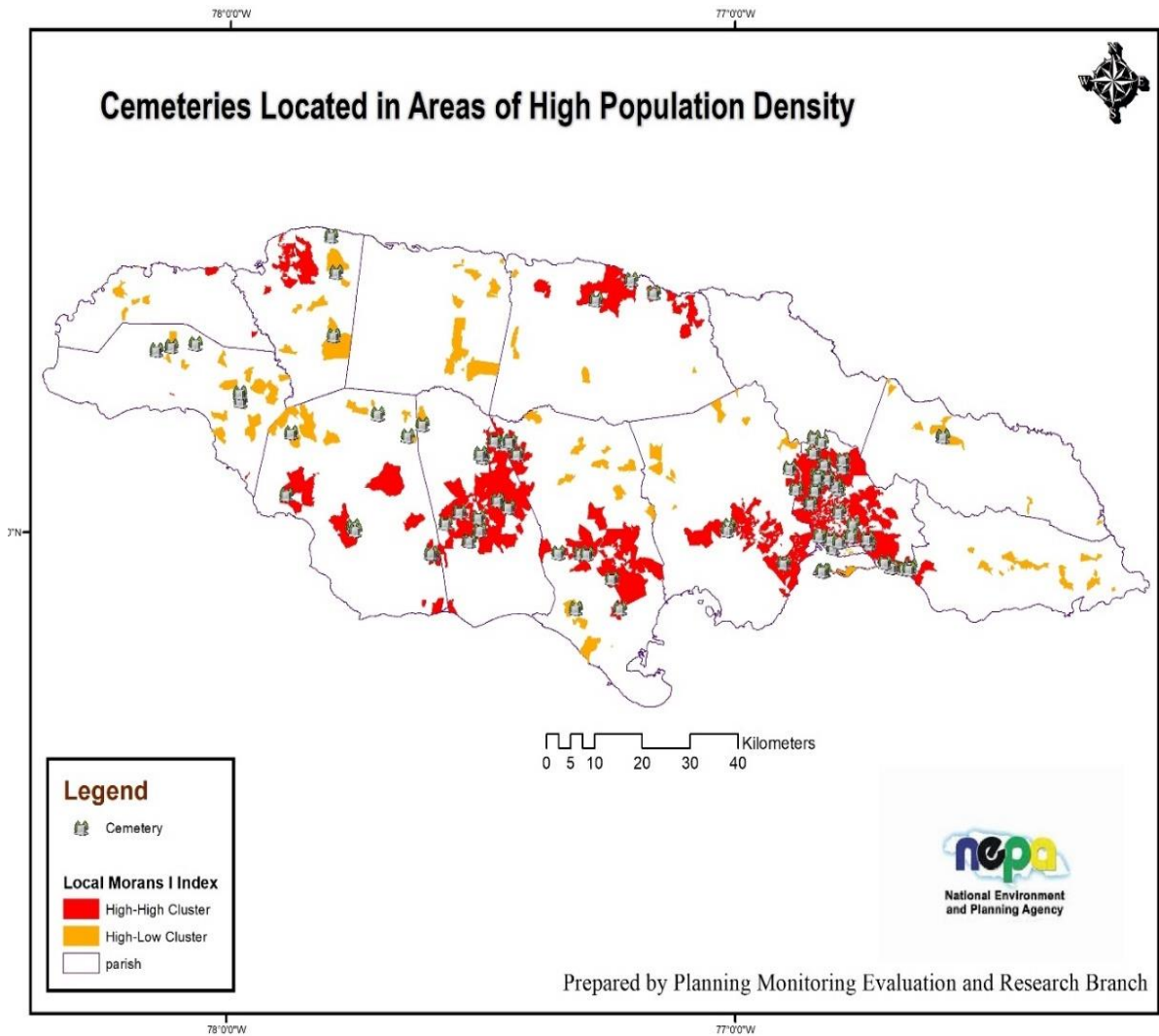


Figure 23 Population Hotspot and Cemetery Utilization

Figure 23 shows that population plays a significant role in the way cemetery is being used. The cemeteries located in highly populated areas where found to have reached their full capacity.

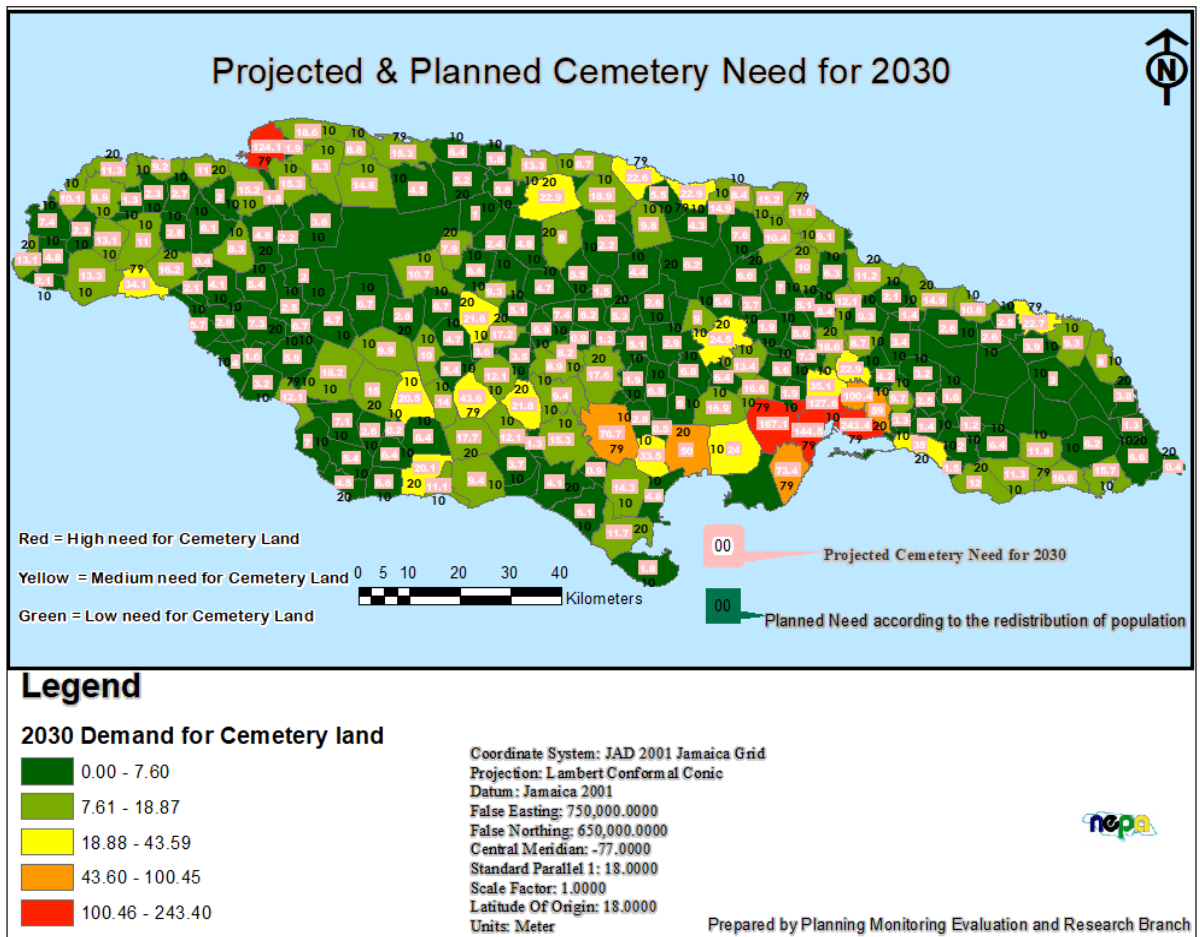


Figure 24 Projected and Planned Acreage

Figure 24 shows the planned and projected acreage for cemetery land by parish. According to the data, with a planned distribution of population across Jamaica by the year 2030, the demand for land for cemetery land use will still be at a deficit. The details of this has been presented in the bar chart presented below.

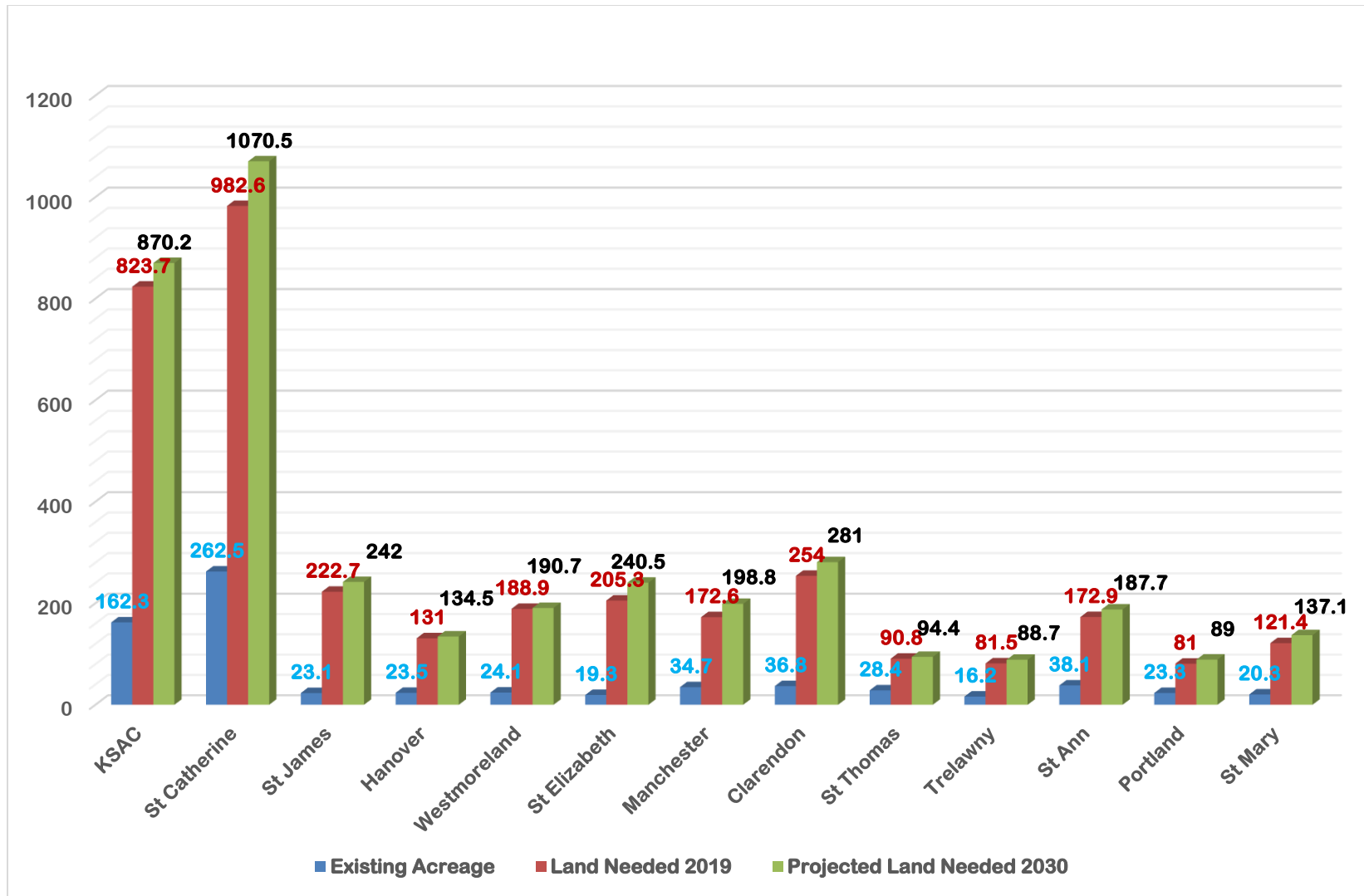


Figure 25 Existing and Projected Acreage of Land Needed for Cemetery Use 2019 - 2030

Figure 25 represents an analysis of the existing and projected land need for cemetery. According to the data, Kingston and St Andrew currently has existing acreage of 162.3 acres of land and 823.7 acres of land is needed for cemetery space. St Catherine has the highest demand for cemetery space the existing acreage currently used for cemetery is 262.5 acres and 9982.6 acres is needed plus 1070.5 acres which will be needed based on projected needs in the year 2030. There is also a high demand for cemetery space in Clarendon followed by St Ann.

3.9 GLOBAL OUTLOOK: LAND ALLOCATION

Land allocation on a global scale strongly illustrates the problem of burials. Every year 55.3 million people die worldwide according to World Health Organization. If every person gets a standard 7 ft by 3 ft grave plot this means that 1,161,300,000 square feet, or 41.66 square miles of habitable/arable land is now solely devoted to graveyards every year! And this number is only growing as our world population continues to grow.

Since people have been choosing burial funerals for centuries. Worldwide, rough estimates of land usage for graveyards would be around 4,300 square miles or 14,357 km².

In China, the disposal of human remains consumes over 10 billion RMB (US\$1.6 Million), 4X10⁶ m³ woods and 6.67x10⁷ lands per annum. It was calculated that area of land needed in China for a period of 10 years if this trend can continue will be about the size of Singapore¹⁰.

3.9.1 HYPOTHETICAL SCENARIO

The average death rate per 1,000 population in the five years preceding 2018 in Jamaica was 6.99ⁱⁱ. Assuming a constant death rate per year, for a population of 10,000 people over the course of the next 30 years, sites able to accommodate the internment of 2,100 deceased will need to be identified. Assuming a gross area per burial plot of 5.33 square metresⁱⁱⁱ, this equates to 1.12 hectares per 10,000 people (assuming the totality of internments are burial, and no reopening/recycling of graves occurs). Population growth, the aging of the existing demographic structure and the declining birth rate suggest an increased life expectancy and a declining death rate, will suggest a less pressing demand for burial grounds in the next 30 years.

¹⁰ Wen,C and H. Zhou (1999). "The Influence of Feng Shui on Chinese Traditional Mortuary Culture and its Policy Orientation in Present Funeral Reformation" *The Ideological Front* 25(2):58 - 64

3.10 PHYSICAL CONDITION OF CEMETERIES

Physical inspections were made of one hundred and fifteen (115) cemeteries using a field observation tool. Notes were taken of the internal and external environments, the physical condition of the fences, gates and the structures.

Comparing Cemeteries in Urban and Rural Areas; their conditions, design, capacity, level of Utilization and Security.

The data for this section of the study was collected through direct field observation in partnership with Parish Council Officials. Data pertaining to the study was gathered with the aid of 115 field observation forms (see Appendix 1). The categorization was done in such a way that 115 cemeteries was surveyed in the identified sample units (KMA, Other Towns and Rural Areas). The direct field observation tool was designed to gather information about the overall status or conditions of cemeteries in Jamaica. The following information were obtained: General information about the cemetery, status of the entrance to the cemetery, grounds, roads and paths, condition of the interment or burial sites, presence of buildings on site, restrooms, presence of drainage, proximity to natural resources and built up areas including cemetery utilization and capacity.

3.10.1 SAMPLE PROCEDURE

This study is based on a multi-level sampling approach. Jamaica was divided into three broad spatial units (KMA, Other Towns and Rural Areas). Other Towns mainly refers to other parish capitals. Public and private cemeteries located within the Electoral Constituency were randomly selected ensuring their geographical distribution. The coordinates of cemeteries selected were located by the aid of GPS Unit. A total of 115 cemeteries in urban and rural areas were randomly selected and relevant information collected at these sites with the aid of field observation instrument. The names and definitions of the variables extracted from the field observation are shown in Appendix II.

3.10.2 DESCRIPTIVE ANALYSIS

The descriptive analysis is the result of the observation made for the 115 cemeteries.

Table 8 Variables Measured

Variables	Observation category	Urban	Rural	Total
		%	%	%
Distinct Entrance to the Cemetery (Access)	Yes	29	24	53
	No	14	33	47
Cemeteries in an open area	Yes	26	46	72
	No	17	11	28
Access Ramps for Handicap	Yes	3	5	8
	No	40	52	92
Signage Rules	Yes	10	4	14
	No	33	53	86
Cemetery Keepers	Yes	13	11	24
	No	30	46	76
Cleanliness	Poorly maintained	9	15	24
	Moderately maintained	21	32	53
	Highly Maintained	13	10	23
Fencing	No Fence	20	43	63
	Low Fence	17	14	31
	High enclosed fence	5	1	6
Lighting	Present	5	3	8
	Absent	37	55	92
Cemetery Layout	No Layout	20	24	44
	Moderate layout	17	31	48
	Perfect layout	5	3	8

Parking	Present	3	5	8
	Absent	40	52	92
General Condition	Clean and well maintained	10	10	20
	Entire site is bushy	28	41	69
	Some part of the site is bushy	4	7	11
Trails	Yes	7	6	13
	No	36	51	87
Condition of Sidewalk	Bad	17	37	54
	Partial	17	14	31
	Perfect	9	6	15
Drainage	No man-made drainage	25	43	68
	Drainage in some part	11	8	19
	drainage in entire site	6	7	13
Tombs for Adult and Children	Yes	23	39	62
	No	20	18	38
Condition of Burial Sites	Broken/sinking graves	12	28	40
	Some broken/sinking	21	21	42
	No evidence of sinking	9	9	18
Good Layout Tombs	Yes	12	13	25
	No	31	44	75
Section for Cremated Urns	Yes	8	4	12
	No	35	53	88
Buildings on Site	Yes	16	9	23
	No	27	50	77
Full Funeral on Site	yes	8	5	13
	No	35	52	87
Rest Rooms on site	Yes	9	2	11
	No	34	55	89
Cemeteries located near Rivers	Yes	7	8	15
	No	35	50	85

Trash Cans on Site	Yes	7	6	13
	No	36	51	87
Availability of Burial Space	Yes	22	17	39
	No	21	40	61
Running out of Burial Space	Yes	36	32	68
	No	7	25	32

Explanation in this section is carried out in relation to the observed variables. The direct field observation survey data shows the status and physical condition of cemeteries in urban and rural Jamaica. Most cemeteries (53%) in both urban and rural area have a distinct entrance meaning that entrances to such sites are clearly marked. The data shows that 72% of these cemeteries are in an open area while 92% of cemeteries are inaccessible to those who are handicapped. There are no signage rules or maps which guide visitors to the site or indications showing how the site should be navigated. Ninety-two of cemeteries have no form of signage on site. In the matter of cemetery keepers or guard it was observed that 76% of sites visited have no form of keepers or guard and in terms of maintenance only 23 % of the observed sites can be said to be well maintained. The other issue which received attention was parking it was observed that 92% of cemeteries in Jamaica have no form of parking. Funeral attendees usually park by the roadside disrupting other road users. For fencing it was found that 63% of cemeteries have no form of perimeter fence and only 8% of these cemeteries have a proper layout. The general conditions of the cemeteries revealed that 80% of the cemeteries were bushy. Trails (87%) have no proper trails, condition of sidewalk was poor as 85% of cemeteries have no well-defined sidewalk and 68% have no proper drainage.

There were no clearly marked tombs indicating graves for children or adult as 62% of cemeteries do not have a clear distinction of this variable. Eighty-two per cent of cemeteries have broken and sinking graves. It was also observed that 75% of the cemeteries had no proper layout of tombs meaning that tombs where not properly laid out to maximise space for cemeteries with sites that host cremated urns only 12% of cemeteries had sections for cremated urns. Variables such as buildings on site, full funeral ceremonies on site and rest rooms were indicated by 23%, 13% and 11% only had such facilities. It was also observed that 85% of the cemeteries are not located 61 feet to a river or water bodies while 87% of cemeteries in Jamaica have no waste collection bins

on site. In addition, it was observed that 61% of cemeteries still have space while 39% have ran out of space and have been closed out of those cemeteries with space 68% of them are running out of space and will soon be closed only 32% showed availability of space in both urban and rural areas.

Table 9 Summary of Descriptive Analysis

Parameter	Condition 1	Condition 2	Condition 3
Cemetery Environment	Majority of the cemeteries are overgrown, with, tombstones barely visible	Majority of the cemeteries are accessed by unpaved, bumpy roads, unkempt surroundings, overgrown	Majority of the cemeteries have thick undergrowth covering tombstones and entire cemetery space
Structures	In most cemeteries with fencing the gates are broken down, broken fences and in some situations no fences at all.	Iron gates and wall fence are all in poor condition	Majority of the cemeteries have no perimeter fence
Facilities	No directional signs, no paved paths /internal roads, No sign of electricity, water supply	No site maps	
Security	No signs of security or cemetery keepers in most of the cemeteries visited		

3.10.3 EMPIRICAL RESULTS

The Independent Samples *t* Test was calculated to ascertain the significant factors that explain the pattern, geographical distribution, conditions and status of cemeteries in both urban and rural areas. There are 26 variables that were entered into the Independent Samples *t* Test on SPSS; the major reason for carrying out this procedure is to empirically extract the most prominent variables that clearly help us understand the status and conditions of cemeteries. See Appendix III for empirical values for all 26 variables measured.

3.10.4 INTERPRETATION OF RESULTS

The test conducted is a two tailed statistical test performed to understand the significant difference between cemeteries in urban and rural areas in Jamaica. The question that the two tailed tests answered was: Are the conditions in rural cemeteries better than those in the urban areas? In the group (dichotomous) variables, forty-nine (49) cemeteries in urban areas were compared to sixty-six (66) cemeteries in rural areas (see Appendix III) using the mean value, standard deviation and standard error mean of all observed parameters. Based on the sampling units selected it is assumed that all urban areas will demonstrate similar characteristics and all rural areas will also show similar characteristics. The sample is a true representation of the target population. Generalisation can be assumed using this result.

Independent Sample Test

The independent-samples t-test is used to determine if a difference exists between the means of two independent groups on a continuous dependent variable. More specifically, it will let you determine whether the difference between these two groups is statistically significant. In the results in table x there are two hypothesis which states:

H₀: That the urban and rural measured variables are not equal

H_A: That the urban and rural measured variables are equal

There are two rows of result in each of the variables that states

1. Equal variance assumed
2. Equal variance not assumed

What this is referring to is that there is an assumption of the independent t Test that there are equal variances in the observed features for all the cemeteries observed. That is the variability is equal for both groups. The Levenes test of equality of variance help us to determine whether to interpret the first row or the bottom row.

Decision Rule for Levene's Test (for $\alpha = .05$)

If $P \leq .05$ the variances are significantly different then we interpret the bottom row of result for t.

If $P \geq .05$ the variances are not significantly different we interpret the top row results for t

If $P \leq .05$ the test is significant (the observed variables differ significantly for cemeteries in urban compared to rural areas.

If $P \geq .05$ the test is not significant (the observed variables do not differ in urban compared to rural areas.

Table 10 Cemeteries in Urban vs Rural Areas

Variable Name	Performance	Interpretation
Distinct Entrance	t(109)=-2.73, p=.007	There was a statistically significant difference in mean engagement score between urban and rural cemeteries for distinct entrances, Cemeteries in urban areas have more distinct entrances compared to those in rural areas
Cemeteries in Open Area	t(88)=2.42, p=.018	There was a statistically significant difference in mean engagement score between urban and rural cemeteries for open areas. There are more cemeteries located in open areas in rural areas compared to the urban areas
Signs in Cemeteries	t(75)=-2.16,p=.033	There was a statistically significant difference in mean engagement score between urban and rural cemeteries for signage in cemeteries. There are more cemeteries with signage rules in urban centres compared to rural areas
Fencing	t(78)=3.38,p=.001	There was a statistically significant difference in mean engagement score

		between urban and rural cemeteries for fencing. More cemeteries are fenced in urban areas than in rural areas
Building on site	t(82)=-2.83, p=.006	There was a statistically significant difference in mean engagement score between urban and rural cemeteries for building on site. There are more cemeteries with buildings on site in urban areas than in rural areas
Rest Rooms Availability	t(66)=-2.49, p=.015	There was a statistically significant difference in mean engagement score between urban and rural cemeteries for rest rooms. There are more cemeteries with restrooms in urban areas than the rural areas
Availability of Burial Spaces in Cemeteries	t(98)=2,25, p=.026	There was a statistically significant difference in mean engagement score between urban and rural cemeteries for availability of space in cemeteries. There are more cemeteries with space in rural areas than in urban centres
Running out of Space	t(112)=-3.39, p=.001	There was a statistically significant difference in mean engagement score between urban and rural cemeteries for cemeteries running out of space. More cemeteries have run out of space in urban areas compared to those in the rural areas.

See the independent test result table for the variables whose alpha levels were greater or equal to .05.

Table 11 Variable who's alpha levels was greater than 0.5

Variable Name	Performance P>.05
Access for Handicap	.242
Cleanliness	.459
Cemetery Well laid out	.069
Parking	.729
General Condition of the Cemetery	.198
Availability of trails	.076
Condition of sidewalk	.397
Cemetery drainage	.207
Condition of burial sites	.186
Layout of Tombs	.166
Garbage Bin observed on site	.076

The table shows variables with p value greater than .05 alpha level. Meaning that these parameters showed no statistically significant difference in mean engagement score between urban and rural cemeteries for the measured variables. What this means is that nationally these variables are lacking in the nation's burial sites in both urban and rural areas. Of interest is cemetery and natural hazards.

3.10.5 RESULTS FOR THE FACE TO FACE INTERVIEW

Data on cemetery management was garnered from interactions with local government officials some of the interview responses are presented in this section.

3.10.5.1 OPERATIONAL DATA

In embarking upon this study, the expectation was that reliable data would be made available on issues pertaining to cemetery management over the preceding ten years. Such important information was expected in relation to annual budgets, maintenance cost, available plots and level of patronage. The contrary was proven to be the case as virtually no data could be accessed from most Municipal Corporations after two years of waiting. Even basic information such as the acreage of each cemetery and their establishment dates were unavailable. Maintenance action

reports has been virtually non-existent save for clearing of bushes in cemeteries following public complaints about their unkempt state.

3.10.5.2 SHORTCOMINGS IN MANAGEMENT POLICIES AND OPERATIONS

The law requires that a permit for burial must be presented for each deceased person. The system offers the option of burial at the cemetery or burial on family plots for which different fees are charged by the parish council. Where burial is to take place on family plot, the parish council official must beforehand inspect and approve the suitability of the venue; and where it is adjudged unsuitable, say due to environmental and social concerns say objections by concerned parties or where the ownership of the burial site is in dispute, permission would be denied.

The 115 cemeteries visited are under the management of the Parish Council and private entities (church and families). Unlike the private cemeteries most of the public cemeteries visited are still being managed by old methods which are labour intensive, technologically backward and wanting in new ideas. The common characteristic of overgrown bushes, broken graves and the absence of basic services, tell the story of neglect. The impression created is that the cemeteries are places where the dead are interred and thereafter forgotten. This may explain why they are not serviced by public utilities (water) and there are no structures on site in most cemeteries which offer shelter of any kind to visitors. The current level of staffing is indicative of the lack of operational capacity (personnel) of the cemeteries and their capability (equipment) for servicing the population and for maintaining the cemeteries. The concretization of graves in order to protect ground water is causing flooding to nearby communities especially in cemeteries like Dovecot and Meadowrest.

3.11 SUSTAINABLE DISPOSAL OPTIONS

In previous sections, we analyzed the most common forms of body disposal (burial and cremation) and explored their likely environmental impact if not properly managed. In this section, we will advance how to properly manage these disposal options and explore alternatives currently in use outside of Jamaica. There are many stories of sustainable disposal practices around the world it is important to capture good practices that are legal, smart and appropriate for Jamaica based on socio economic, religious and environmental factors.

3.11.1 IMPROVING CEMETERIES

The sustainable management practices and alternatives under considerations are:

- Tier Burials
- Eco-Cemetery
- Natural Burial
- Multi Use Cemetery
- Multi-tier Vertical Burial System
- Digital Memorial Cemetery
- Grave re-use after a set period
- Biodegradable burial pod
- Burial at Sea
- Alkali Hydrolysis
- Cryomation

3.11.1.1a TIER BURIALS

This is a situation where more than two or three burials are allowed in a single grave by putting one upon another but this is dependent on the characteristics of the environment as recommended by the GOJ's Development and Investment Manual. E.G this is already being done at Dovecot, Meadowrest and in selected public cemeteries.

3.11.1.1b ECO- CEMETERY

The eco-cemetery represents the idea of rapid return of the corpses to nature and non-polluting burial methods and cemetery planning. It envisages environmental sustainability and recycling in natural ways. It proposes new methods that decrease the amount of wood, steel or other metals used in making coffins, and that prevent pollution of the environment with chemical treatments of the corpse during burial. It also encourages protection of the natural landscape, as well as the fauna and the flora at the time of planning the cemetery and choosing its location. The method often uses grave markers that do not intrude on the landscape. Graves are marked with markers native to the landscape, such as trees, shrubs or flat stones. In some cases, graves are unmarked, and the plots are identified by surveying techniques such as using GIS.

The main purpose of eco-cemeteries is to decrease the negative impacts of the cemeteries on the underground water, natural vegetation and fauna existing in the burial area, using materials that

biodegrade more rapidly and minimise the ecological footprint of the individual. Bodies in eco-cemeteries are usually buried in a casket made of cardboard or wicker, or simply in a shroud.

For example, Italy has been forced to adopt the eco-cemetery concept in response to space and environmental challenges in cemetery planning. The country faces severe limitations in finding new suitable areas for cemeteries. Cemetery planning in Italy considered the decomposition process which occurs in a burial site and situate cemeteries so as to realise the best micro-environment conditions to increase the rate of decomposition prior to the expiry of the burial rights. The Italian legislation addresses the topography of the area and the chemical and physical characteristics of the soil. The law establishes the expiry of burial rights granted based on realised micro-environment characteristics, in order to reuse the sites. This has come about as a result of environmental concerns about in-ground burial.

3.11.1.1c NATURAL BURIAL

Natural burial can be defined, as we have stated, as “the act of returning a body as naturally as possible to the earth” (Natural Burial Association, 2016a), “as directly and simply as possible” (Harris, 2008, p. 2) in a manner that does not inhibit decomposition. Such a concept isn’t necessarily innovative, and indeed, natural burial has been practiced for thousands of years, having been interrupted in the recent past by new methods such as embalming, metal coffins, concrete vaults, and mausoleums that mitigate the decomposition process. The contemporary notion of natural burial, as we will refer to it from here on, can therefore be understood as a Western response to contemporary burial methods, hailing in particular from the UK and the USA, having been adopted to a smaller degree in Canada, Australia, and New Zealand (Marshall & Rounds, 2011; Natural Burial Association, 2016b; Natural Burials New Zealand, 2016).

Various countries have also been pioneers in the application of a concept dubbed “natural burial”, “the act of returning a body as naturally as possible to the earth”, without many of the extraneous materials that characterize current burial practices (Natural Burial Association, 2016a).

3.11.1.1d MULTI-USE CEMETERY

The following table shows some of the functions multiple-use cemeteries have been put to in Countries like Australia, Egypt and the United States which can also be replicated in Jamaica.

Table 12 Examples of Multi-Use Cemeteries

Cemetery	Functioning
Pinnaroo Cemetery Perth, Australia	<p>After-funeral catering:</p> <p>Pinnaroo Cafe- A 70-seat cafe is open seven days a week to all members of the public; Facilities built from local materials including limestone and hardwood.</p>
Cairene cemetery: City of the Dead, Cairo Egypt dates as far back as the 10th century Over 1 mil people live there	<p>Residential areas:</p> <ul style="list-style-type: none"> • Overnight stays by families who visit the deceased; • Apartments for permanent stays by cemetery residents whose Livelihoods are derived from burial activities; shows signs of rich architectural and urban history; the curing of a certain disease or the fulfilment of a particular type of wish.
Spring Grove Cemetery and Arboretum, Ohio U.S. National Historic Landmark	<p>Includes fine arts, architecture, education programs; Attracts Photographers, bird watchers, students always visit cemetery because of its arboretum; Involvement in studies and projects mainly on horticulture; Hosts weddings, fun walks and runs.</p>
Green Wood Cemetery, Brooklyn, USA A National Historic Landmark in 2006	<p>A tourist destination, Visitors' centre and museum/exhibition space, birdwatchers, ticketed tours to picnic, bike, hike and just sit in the peaceful quietness; Whiskey-tasting nights, theatre performances</p>

The multi-use approach to cemetery design can help to ameliorate the problem of land scarcity in presenting a wider range of options for the community.

3.11.1.1e MULTI-TIER VERTICAL BURIAL SYSTEM

Jewish burial law is based in part on a passage in Genesis "For dust you are -- and to dust you shall return." Jewish law stipulates that the dead be buried separately on a layer of dust and earth. So while there is no restriction on multilevel burial, each body must rest on soil. To comply with religious law, the towers of the vertical cemetery structures have pipes filled with dirt inside their columns so that each layer is still technically connected to the ground. "A body is laid on earth, connected to the earth". Vertical cemeteries also exist where populations are dense and land is scarce, such as in China, Japan, Egypt and even New Orleans, where high waters make burial difficult. Furthermore, Brazil is home to the world's tallest vertical cemetery, the Memorial Necropole Ecumenica in Santos, which is 32 stories high.

3.11.1.1f DIGITAL MEMORIAL CEMETERY

It is not an actual cemetery, but it is a perpetuation place to mourn and remember the dead. The family and friends of a person who passed away can gather all the digital data they wish on one small memorial stick. The sticks are gathered into a memorial archive or library; a neutral place to come and remember your beloved person, The scenario of use- By a quick computer search, you find the location of the requested memorial stick. The location is indicated by light, you take the stick to a separate memorialization room, there you can watch and listen to all the pictures, movies, songs or any other data. This way you mourn and remember the dead. It is a way to heal and cope with the loss of the dead. The design of the memory stick and its stand creates the visual link between the traditional cemetery and the new future digital ones, furthermore the place of mourning remains public and neutral.

3.11.1.1g BIODEGRADABLE BURIAL POD

The Italy based Capsula Mundi project, for example, proposes the use of an "egg-shaped pod" instead of a coffin or a cinerary urn. This pod, made of biodegradable materials, would envelop the body (or the ashes) in the grave, and a tree would be planted on top of it, to serve as a memorial to the deceased (Capsula Mundi, 2016).

Traditional burials and cemeteries use a lot of energy, a lot of resources, and take up a lot of natural land. Cremations use a lot of energy as well. The amount of energy used during cremation is the same amount a living person would have used in one month of their life. Cemeteries can take up a

lot of land that require a very large amount of water and maintenance. While the headstones can be beautiful, just imagine a forest of living trees that fills the same area. Each tree would be the gravestone, representing the life of the person buried below it.

Citelli and Pretzel have created a large biodegradable burial pod, called Capsula Mundi that is made from starch plastic. The starch plastic is refined from using seasonal plants such as potatoes and corn. While the person who plans to be buried in the burial pod is alive, they will choose their favorite tree. The tree that they choose will be planted directly above the biodegradable burial pod. The burial pod will be placed into the earth just like a seed. As Capsula Mundi decomposes the nutrients will feed the growth of the tree planted directly above. The roots will engulf the pod and sustain life from its decomposition.

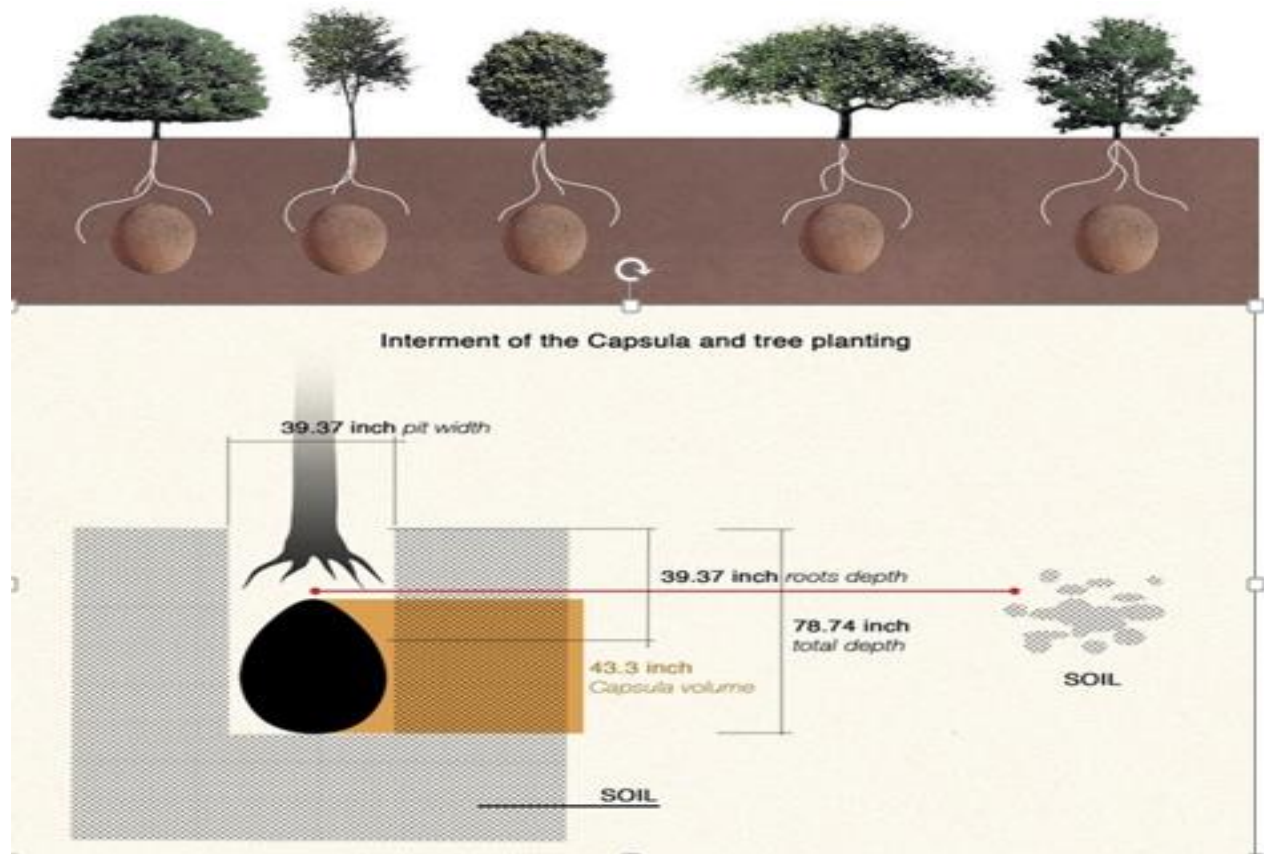


Figure 26 Capsula Mundi

Source: Capsula Mundi, 2016

3.11.1.1h GARMENTS FOR THE GRAVE

Pia Interlandi, a designer from Australia, has developed, through forensic research, Garments for the Grave, “burial garments which have a predictable rate of decomposition” (Interlandi, 2013a, 2013b).

3.11.1.2 IMPROVING CREMATION

Cremation is generally considered to be less damaging to the environment than traditional in-ground burial. Cremation doesn't require the vast acreage of land needed for cemeteries and doesn't leave behind some 800,000 gallons of formaldehyde each year according to what is being reported in the United States. With in-ground burial, there is also the problem of huge amounts of unrecycled metals, concrete, and wood left in the ground. A similar project, the Bios Urn, is “a biodegradable urn, designed to turn the ashes of a person into a tree” (Bios Urn, 2016). Cremation is one of the most common disposal methods. This can be due to personal, ethnic or religious reasons. During cremation, the body is exposed to vigorous heat causing it to burn, leaving the ‘ashes’. After the cremation the ashes are handed over to the family, who can disperse them in a special place or keep them close by, usually in an urn. This is the first alternative that will help to save land resources.

3.11.1.2.1 GREENING CREMATION

- Choose a casket or cremation container made of non-toxic materials such as recycled cardboard.
- Purchase a biodegradable urn or container for the remains.
- Authorize your cremation facility to recycle medical parts and metals.
- Contribute to the carbon fund to offset emissions.
- Select a cremation provider that uses an energy efficient furnace and filtering to minimize pollutants.
- Opt for a direct cremation in order to skip embalming.

3.11.1.2.2 CHRISTIAN VIEWS ON CREMATION

Does the Bible offer instruction? The Bible is clear concerning death and the mortality of the body. Genesis 3:19 says, “By the sweat of your brow you will eat your food until you return to the ground, since from it you were taken; for dust you are and to dust you will return.”

Jesus further illustrated a perspective towards the disposal of the body when he spoke to one who would follow Him: Luke 9:59-60 says, “He said to another man, ‘Follow me.’ But the man replied, ‘Lord, first let me go and bury my father.’ Jesus said to him, ‘Let the dead bury their own dead, but you go and proclaim the kingdom of God.’” At first, this appears to be a harsh and unfeeling response, but Jesus was determined that those who followed Him would give *Him* their full attention; disposing of the body of the dead was obviously of very low priority. If the Bible renders a low priority to this issue then it would seem that the method of disposal may be left to individual taste and, perhaps, other societal and environmental dictates.

Cremation, while still a controversial practice is nonetheless widely performed throughout the world. For those who favour cremation, it offers the following benefits:

- The entire process of cremation, whether or not it includes a service or just the incineration of the corpse, is far cheaper than burial, even though a coffin or container is used.
- For those prone to ponder the lasting appearance, the process of cremation offers a quick, purifying process. This helps people to banish the thought of the body lying for decades in the ground while suffering slow decay.
- The cremains, as the ashes are termed, can be kept at home in a fashionable container or urn, thus offering the family the opportunity to remember the loved-one on a daily basis.

There are also complete innovations: various new technologies (Cryomation, Promessa, and ecoLation) propose a two-stage process, consisting of freezing and consequent fragmentation of the body, to present an end product that is aesthetically similar to cremation ashes (ecoLegacy, 2016; Incinerator Replacement Technology Ltd, 2016; Promessa Organic, 2014). Other Disposal Options

3.11.1.2.3 ALKALINE HYDROLYSIS OR RESOMATION

An alternative or eco-friendly cremation. The body is put inside a stainless-steel cremation chamber and a mix of chemical components (water and alkali solution of potassium hydroxide) is heated to high temperature, pressure is put and the body is hydrolyzed. The result is a greenish liquid and soft white bones.

3.11.1.2.4 CRYOMATION

The process uses liquid nitrogen to freeze the body to 196°C; once the body is brittle, it is fragmented, foreign metal objects removed, and the rest freeze dried under a vacuum to remove the moisture leaving a sterile powder.

3.11.1.2.5 BURIAL AT SEA

Burial at sea is the disposal of human remains in the ocean, normally from a ship or boat. It is regularly performed by navies, and is done by private citizens in many countries.

CHAPTER FOUR: CONCLUSION, RECOMMENDATION, POLICY STATEMENTS AND STRATEGIES.

This chapter outlines the overall findings of this research. The project started with the discovery that the country is running out of space for burial and most public cemeteries are unsightly spaces that are not properly maintained.

- The data from the funeral homes revealed that about (92%) of the deceased are buried in the grave while only 8% are cremated.
- Most of the funeral homes have been operating for several generations as revealed by the survey but to date there is no national policy regulating their operations.
- There is no uniformity in the way funeral home handle, store, sort, transport and dispose-off hazardous waste generated from their operations.
- Majority of the funeral home does not have a waste management plan
- Majority (60%) of citizens prefer to bury their loved ones in private cemetery while (40%) public cemetery.
- Majority of the cemeteries have no management plan and staffing
- Population growth as a result of rural to urban migration, coupled with rapid urbanisation has resulted in intense competition for cemetery land. The lack of space in cemeteries. Can be attributed to the prevalence of the practice of ground burials, the reluctance of much of the population to adopt alternative methods and the increase in burial rates due to changing population.
- Most cemeteries have broken graves
- Majority (68%) of cemeteries in the Island has reached their full capacity.
- There are no waste bins provided at the cemeteries.
- **Funeral services, as currently practiced, are unsustainable.** In-ground burial takes up land that has competing uses for the important human needs of housing and agriculture.
- **There are issues of safety and security in most of the cemeteries due to lack of proper management.** Theft are common in cemeteries as criminals take advantage of the lack of maintenance of the area. Vandalism is also increasingly becoming a problem.
- **Record-keeping requires attention.** Record-keeping is a very important function in managing cemeteries. Electronic record-keeping is ideal, yet not widely used.
- **There is inadequate/insufficient funding to properly manage the cemeteries.** The revenues collected for funeral services do not cover the operational costs of cemeteries. Budgets in all municipalities are not sufficient for cemetery management to meet the requirements of managing and maintaining cemeteries.

- Cemetery management is facing challenges of funding, staffing, modern equipment, basic infrastructure, services and new ideas.

4.0 DISCUSSION OF FINDINGS

The study began with an assessment of Jamaica's population distribution, patterns and changes using the 2011 STATIN's Population Census. The data shows that two extremes are common: the sparsely populated areas and the densely populated areas. The underlying assumption is that areas of high demand for cemetery space would be highly related to areas of dense population. Also, the findings revealed that the activities of funeral homes are worrisome particularly the use of chemicals, disposal of waste and use of natural resources.

The country is in dire need for regulations in the funerary sector. Now, even though, inspections of funeral homes are carried out under the Public Health Act there is no specific regulation in the funeral industry. The implication for this lack of regulation is that anybody can enter the industry without adequate training. There is therefore an obligation on the part of the government to ensure that operators of funeral homes are observing proper public health standards in respect of the different aspects of the business, as this is important in terms of protecting the integrity of the industry and to maintaining public confidence in their operations.

The physical condition of most cemeteries in the country are in a deplorable state. Burial sites ought to be suitably sited and properly maintained. There is an urgent need for improvements in the physical appearance of burial facilities. Management of cemeteries includes many skill sets. These range from the most hands-on tasks on the ground, from grave-digging to landscaping and horticulture, to the more high-level tasks undertaken by managers, including the scheduling and logistics associated with running a cemetery but a look at the cemeteries in Jamaica this is absent.

On a day-to-day and weekly basis the cemetery officer and horticulturalist have to plan for the funerals that have been booked in their cemetery, taking care of everything from the booking of the grave and burial method, to the digging of the grave and making sure each burial goes smoothly. They also have to manage the flow of visitors to the cemetery paying their respects at

the graves of loved ones, and perhaps unveiling tombstones, and ensure their security and the maintenance and upkeep of the cemetery.

Cemetery maintenance covers a lot of different areas. The access road, internal roads and internal walkways either need to be tarred or, if dirt, then graded and kept smooth and passable in all weathers. Fences and gates, and building structures must be maintained, as well as signage and grave numbers. Horticultural issues include mowing of the lawns, weed control, watering, and pruning trees, shrubs and flowers. Finally, water, sewer and storm-water drains must be kept in good working order. The research has shown that more need to be done about the country's cemeteries so much is lacking and these sites need the attention of the government and the private sector if need be.

A key solution to the diminishing availability of land is the introduction of burial alternatives. Many of these have existed for many years around the world but are not actively practised in Jamaica. There is limited knowledge of and exposure among communities to alternative ways of disposal which would reduce these pressures. One example is cremation. Cremation reduces mortal remains as the body is burnt to ash, and it is a sustainable alternative to traditional burial. Cremation is permissible in the Christian, Jewish, Hindu, Parsi and Buddhist faiths. It is however, forbidden, by Islam and Orthodox Judaism. It is not looked upon favourably by most Africans holding traditional beliefs.

Finally, in the context of land scarcity and despite the availability of a range of alternatives, conventional burial is still the most common and preferred. Even though they aren't very eco-friendly, ground burials are the most common and traditional method of being buried. Bodies are placed into a casket, or coffin, and buried typically 6 feet under in a local cemetery. Often, headstones are then placed above ground over the location of the body to state the name and date of birth and death. This gives loved ones a place to visit and pay respects.

A change of mindset regarding funeral and burial practices is required, and the solutions must involve communities. The funeral and burial services offered by municipalities cannot be decontextualized from the religious and cultural beliefs that people hold. With increasing demands for new cemeteries throughout the island, the preparation of a policy/ guideline document seeks to

fill a void created by the lack of a national policy that addresses the establishment of cemeteries and funeral homes and is intended to assist the planning authorities in assessing applications for this use. Though a preliminary draft Cemetery Planning Policy/Guideline was prepared by the Spatial Planning Division. The issues addressed in the preliminary draft included siting and design, landscaping, use as open space, access/egress and parking, size and additional facilities. There are equally no specific standards/codes in Jamaica to regulate construction of burial vaults or monument. Of vital importance is the quest to make cemeteries eco-friendlier and the selection of an appropriate location. Achieving this objective requires addressing ecological concerns in choosing cemetery locations, in planning, design, maintenance and especially in burial practices which do not give rise to environmental problems such as pollution and the contamination of soils and groundwater.

Burial leaves significant footprint on the natural environment. Consider the various steps – embalming the corpse, sturdy coffin, tombstone and manicured grave site. About 800,000 tons of formaldehyde-based embalming fluid is buried annually in US graveyards. Ten acres of cemetery contain enough coffin wood to build 40 houses. Formaldehyde is a probable carcinogen and the adverse effect of its eventual leaching into the ground has never been adequately assessed.

4.1 RECOMMENDATION

- There should be a national policy to govern funeral home operations which should include a waste management plan
- There should be a land use classification for Funeral Homes and a distinction made between a funeral home and funeral parlour
- More data should be collected in the funerary sector for better management
- Cremations should be incentivized to be more appealing than ground burial.
- It is highly recommended that regional centres should provide a cemetery addressing the need of the DSA of the Regional centres.
- Sub-Regional Centres will need to provide cemetery areas addressing the need of the SRSA.
- Areas not covered by Sub-regional Centre SRSAs, District Centres will need to provide cemeteries at District Service Level.
- Cemeteries and Crematoria should be located on the outskirts of growth centres, on land other than productive agricultural land Class I-III.

- Landscape planning solutions should be included in the design of cemeteries and crematoria not simply to screen the site but to create pleasant and serene parks for quiet contemplation around burial grounds.
- **Improve safety and security in cemeteries.** In order to prevent the theft and vandalism of tombstones, security should be increased at cemeteries. This is particularly the case in passive cemeteries where burial activity has ceased and traffic is reduced on weekends. The number of security officers and patrols should be increased.
- **When budget permits, outsource functions in cemeteries.** Thus providing a better service to citizens.
- **Create jobs through collaborating with adjacent communities.** Low-skilled labour in cemeteries can be provided by communities adjacent to cemeteries
- **Funeral procedures should be standardized.** Having a comprehensive set of municipal by-laws that addresses all aspects of a funeral, from the booking of the grave to the type of burial chosen and the management of a cemetery, increases efficiency.
- **All new cemeteries should offer environmentally sustainable burial methods.** Wherever possible, space should be allocated in cemeteries that are designed and landscaped to include alternatives to the traditional headstone or tombstone burial, such as a berm section, a garden section and a memorial wall. From the outset, new cemeteries should be conceived for multiple uses, and integrated into urban areas as green space for parks and recreational activities as well as burials.
- **Frequently engage all stakeholders in cemeteries to identify problems in providing funeral services and find solutions.** Undertakers, religious bodies, and the police service all play some part in the burial process. Their input on problems can be useful to cemetery management.
- **Encourage the development of private cemeteries.** Private cemeteries in Jamaica are financially sustainable and offer an appealing alternative to municipal cemeteries.
- **Solutions to increase the sustainability of cemeteries should be prioritized.** Municipalities should establish an agreed-upon set of steps to ensure that representative community input to cemetery planning and the choice of interment methods are canvassed. These stakeholders should include members of the general public, elected representatives at the local level on ward committees, traditional leaders, and staff in the relevant line function departments.
- **Community consultation processes must be robust and credible,** ensuring that everyone in the community is represented and heard. The aim of the consultations is to help municipalities understand the position of the community on alternative burial methods, and their feelings on the matter. This is a first step towards finding ways to address issues raised and think of ways to make alternative burial methods more appealing.

- **Communities should be empowered to make informed choices about burial methods.** Municipalities should use all communication means at their disposal – electronic (television and radio) and print media, as well as community meetings and outreach through music and drama in schools – to educate the community about alternative burial methods.
- The case should be made that alternative methods are a choice that has to be made in order to protect the interests of the living. The issue of land shortage should be stressed and that alternative methods are cheaper in terms of freeing up land for other uses, e.g. housing, and have less impact on the environment.
- **Ministry of Local government need to address the budgetary constraints faced by municipalities in managing cemeteries.** At present revenue collection does not cover the operational costs of cemeteries. The cost structure is based on burials but does not take into account the costs associated with the long-term upkeep and maintenance of cemeteries. Subventions from national government should make up the shortfall. This will enable municipalities to invest in the infrastructure and facilities that improve the management of cemeteries and the services provided to the community, from rolling out electronic record-keeping and capturing old paper records to providing proper security and the maintenance and upkeep of the grounds and facilities.
- **Technology should be used to manage cemeteries.**

4.2 CONCLUSION

The data shows that the demand for cemetery land has become a national emergency that currently demands an urgent attention. The demand currently far exceeds current acreage. Municipalities face several challenges in cemeteries management at the macro level, with issues such as funding and long-term sustainability, and the micro level, in terms of administration and operations. On a day-to-day basis cemetery managers are required to meet the burial needs of the communities they serve, which they do under trying circumstances. Sustainability for the future is a key issue. However, it seems that those responsible for managing cemeteries in municipalities are left to their own devices in finding solutions to these problems.

Thus far the Municipal Corporations have not acted as a repository of knowledge on cemeteries management, there needs to be a commissioned research into the challenges facing cemeteries. There needs to be a Local Government Summit on Cemeteries Management and a National Strategic Framework for Cemeteries, Crematoria and Undertakers. There is room for the Municipal Corporation to take a more proactive leadership role in driving solutions to the challenges facing cemeteries.

It is necessary to bring together all the stakeholders (consultation) – cemeteries management professionals, funeral parlours and undertakers, political leadership in municipalities (municipal councils) and national government – will be a critical component of good practices in cemeteries management for the future.

4.3 SUGGESTIONS FOR FURTHER RESEARCH

A serious limitation in this research was the lack of data from the municipalities and field measurements for soil and water pollution both close to and further away from cemeteries. A study exploring the level of pollution of cemeteries would be interesting for Jamaica.

Furthermore, even though there are articles about crematorium emissions, there is often a limited number of repeated measurements which show high variations and make it hard to draw solid conclusions. Furthermore, the measurements are highly dependent on the applied type of flue gas cleaning installation, body weight, clothing and attributes in the coffin, and coffin composition, but those factors are often not registered, which again makes it difficult to use the data for reliable conclusions. Considering the new techniques, it is essential to know more about the exact composition of the remains and of the waste streams, like the liquid that is released to sewage.

Both the input side of this research as well as the output side could be improved. The analysis of the relative values of this research gives an indication of the magnitude of the results, but more specific comparisons could be made. Without losing respect for this subject, it might be useful to compare the funeral effects with waste treatment effects, in order to see where and how environmental effects could be reduced. Another point of interest for further interpretation of the results was already indicated at the beginning of this chapter, namely the development of scenarios. Information about environmental impacts in different scenarios could be a useful tool for policy makers. Perception studies of Jamaicans towards alternative period option is urgently needed.

4.4 IMPLICATIONS FOR SOCIETY

This research provides input for the discussion on the pollution potential of funerals, which is particularly a comparison of burial and cremation and a call for “greener” funerals and funeral methods. This study shows that, although there are differences between the environmental impacts of the final parts, the largest environmental impact and the largest reduction potential lays in the preliminary part. As said before, this research tried to analyse this complex and unusual problem from a scientific point of view, leaving out all social aspects whenever possible, without losing respect for the ethical limits. Even though this research presents some interesting conclusions and consequently raises new questions, one could ask whether this topic merits further research

5.0 REFERENCES

- Armstrong, D., & Fleischman, M. (2003). House-Yard Burials of Enslaved Laborers in Eighteenth-Century Jamaica. *International Journal of Historical Archaeology*, 7(1), 33-65. Retrieved from www.jstor.org/stable/20853015
- Blouet, H. (2013). Interpretations of Burial and Commemoration in Moravian and African Diasporas on St. John, Virgin Islands. *International Journal of Historical Archaeology*, 17(4), 731-781. Retrieved from www.jstor.org/stable/24572698
- Brinkmann, F.J.J., Canton, J.H., Derks, H.J.G.M., Hagen-Fast, A.K., Slingerland, P., & Willemsen, W.H. (1987). Drainwater van begraafplaatsen, ontvangend oppervlaktewater en
- Carlton Basmajian & Christopher Coutts (2010) Planning for the Disposal of the Dead, *Journal of the American Planning Association*, 76:3, 305-317, DOI: [10.1080/01944361003791913](https://doi.org/10.1080/01944361003791913)
- Crematoria emissions as they stand with current practice. *Microchemical Journal*, 79, pp199-
- Curl, J.S. (1999). *Oxford dictionary of architecture*. Oxford, UK: Oxford University Press.
- Davies, D., & Rumble, H. (2012). *Natural burial: Traditional-secular spiritualities and funeral innovation*. New York, NY: Continuum
- Dent, B.D., Forbes, S.L., & Stuart, B.H. (2004). Review of human decomposition processes in soil. *Environmental geology*, 45 (4), pp576-585.
- Elzenga, J.G. (1996). *Crematoria*. Bilthoven: RIVM.
- Green, C. A. (2012). *CSIR Guidelines for the provision of social facilities in South African settlements*. CSIR Built Environment.
- Haining, R. P. (2003) *Spatial Data Analysis: Theory and Practice*. Cambridge University Press. West Nyack,

- Iserson, K.V. (1994). *Death to dust. What happens to death bodies.* Tucson: Galen Press Ltd.
- Jackson, K., & Vegara, J. (1996). *Silent cities: The evolution of the American cemetery.* Cambridge, MA: MIT Press.
- Jackson, K., & Vegara, J. (1996). *Silent cities: The evolution of the American cemetery.* Cambridge, MA: MIT Press.
- Jossiana Arroyo (2018) *Cities of the Dead: Performing Life in the Caribbean*, *Journal of Latin American Cultural Studies*, 27:3, 331-356, DOI: [10.1080/13569325.2018.1485559](https://doi.org/10.1080/13569325.2018.1485559)
- Laderman, G. (1999). *The sacred remains: American attitudes toward death, 1799-1883.* New Haven, CT: Yale University Press.
- Laderman, G. (1999). *The sacred remains: American attitudes toward death, 1799-1883.* New Haven, CT: Yale University Press.
- Laxmi and Ajai Mansingh. 1999 *Home away from home: 150 years of Indian Presence in Jamaica 1845-1995.* Kingston: Ian Randle Publishers, Print)
- Marshall, R., & Sutherland, P. (2008). *The Social Relations of Bereavement in the Caribbean.* *OMEGA - Journal of Death and Dying*, 57(1), 21–34. <https://doi.org/10.2190/OM.57.1.b>
- Mundi 2016 Retrieved from <https://www.capsulamundi.it/en/> on 23 March 2020**
- National Spatial Strategy Branch (NSSB) (2017) *Jamaica National Settlement Strategy (Second Draft). Toward the preparation of the National Spatial Plan*
- Philip R. Olson. (2018) *Domesticating Deathcare: The Women of the U.S. Natural Deathcare Movement.* *Journal of Medical Humanities* 39:2, pages 195-215.
- Prothero, S. (2001). *Purified by fire: a history of cremation in America.* Los Angeles: University of California Press.
- Rouse, Irving. *The Tainos Rise and Decline of the People who greeted Columbus.* New Haven: Yale

University Press, 1992. Print

Sanders, G. (2008). Late capital: Negotiating a new American way of death. Unpublished doctoral dissertation, Vanderbilt University, Nashville.

Santarsiero, A., Trevisan, G., Cappiello, G., Formenton, G., & Dell'Andrea, E. (2005). Urban

Senior, Olive. Encyclopaedia of Jamaican Heritage. St. Andrew: Twin Guinep Publishers, 2003. Print

Sloane, D. (1991). The last great necessity: Cemeteries in American history. Baltimore: Johns Hopkins Press.

Spongberg, A. & Becks, P.M., 2000. Inorganic Soil Contamination from Cemetery Leachate, Water, Air and Soil Pollution, 117 (1-4), 313-327

Statistical Institute of Jamaica, Births, Deaths and Marriages. Available at http://statinja.gov.jm/Demo_SocialStats/newbirthdeathmarriage.aspx [Accessed 30/04/2019]

Trick, J., Klinck, B., Coombs, J., Noy, D., & Williams, G. (2005). Burial sites and their impact on groundwater. Proceedings of the 4th International Groundwater Quality Conference: Bringing groundwater quality research to the watershed scale.

Van Haaren, F.W.J., 1951. Cemeteries as sources of groundwater contamination. (emneerlandês). Water 35(16): 167– 172.

waterorganismen. Rapportnummer 840276001. Bilthoven: RIVM.

Watters, D.R. Hist Arch (1994) 28: 56.

6.0 APPENDIX I

PLANNING CONDITIONS - Funeral Home

NEPA has set of planning conditions for the operation of Funeral Home and they are stated as follows:

1. No signs are to be erected unless pursuant to the Town and Country Planning (Control of Advertisements) Regulations, 1978.

Reason: To ensure safe and satisfactory standards of development.

2. The development must begin no later than the expiration of two (2) years beginning with the date on which permission was granted.

Reason: To prevent the accumulation of planning approvals which have not been implemented.

3. Building approval shall be obtained under the Building Act from the Clarendon Municipal Corporation for any future expansion to the building or any other building/s to be constructed on site.

Reason: To ensure safe and satisfactory standards of development

4.
 - i. The storm water drainage plan shall be implemented based on the design approved by the National Works Agency.
 - ii. Surface drainage and storm water runoff shall be effectively intercepted and disposed of, before reaching the roadway.

iii. Silt and debris traps should be utilized in the drainage system.

iv. Roof water shall be collected in gutters along the eaves and channeled to the storm water drainage system.

Reason: To reduce the potential hydrological impact of the storm water run-off from the development on the roadways.

5.
 - i. Car parking spaces shall be marked out in accordance with approved plans by the National Works Agency and shall be kept available for such use at all times unless otherwise agreed to in writing by the Authority.
 - ii. A minimum of _____ (___) car parking spaces shall be constructed using permeable material. Only the driveway shall be paved and the undeveloped areas are to be landscaped.

Reason: To ensure satisfactory development standards and that there is adequate and sufficient parking to serve the development as well as to ensure that the surface drainage is captured on site.

6.
 - i. A minimum of 5% (or ___) of the total parking spaces, along with sanitary and other facilities for example ramps; hearing aids and grip rails are to be provided for the disabled. These facilities shall be clearly identified on the plan and subsequently labeled on site.
 - ii. The doors should be made wide enough and the offices laid out to facilitate the ease of use for the disabled and challenged. Special bathroom facilities should also be installed to accommodate disabled/challenged persons.

Reason: To ensure that satisfactory parking and other facilities are provided for disabled persons.

7.
 - i. Spoils and debris shall be removed and disposed of at a site approved by the Local Planning Authority or the relevant authority.
 - ii. There shall be no burning of waste on the site.

Reason: To ensure satisfactory health and environmental standards.

8. Any solid waste disposal facility to be located on this site shall be properly screened and so designed that it is easily accessible to the garbage disposal vehicles.

Reason: To ensure satisfactory health and environment standards.

9. The storage of hazardous waste shall not occur on-site, however any intention to store hazardous waste will require further planning permission and an environmental permit issued by the National Resources Conservation Authority.

Reason: To ensure safe and satisfactory standards of development

10. The applicant shall ensure that a contractual arrangement is entered into with the _____ or any such approved facility for the disposal of medical/ biohazard waste. A copy of this contractual arrangement shall be submitted to the Manager of the Enforcement Branch of the National Environment and Planning Agency, 10 Caledonia Avenue, Kingston 5 or EnforcementManager@nepa.gov.jm prior to the commencement of operation.

Reason: To ensure safe and satisfactory disposal, health and environmental standards.

11. The disposal of all operational waste from the facility shall be done in a manner approved by Ministry of Health.

Reason: To ensure safe and satisfactory health and environmental standards of development.

12. There shall be no expansion or operational development on the site beyond that which is illustrated on plans date stamped by the National Environment and Planning Agency _____ without planning permission.

Reason: To prevent the intrusion and operations of unapproved non-conforming uses without planning permission.

13. Arrangements for fire security, escape, equipment etc., shall be to the satisfaction of the Jamaica Fire Brigade. Such arrangements shall be put in place within ninety (90) days from the date of this permission

Reason: To ensure that safe and satisfactory standards of development are adhered to.

6.1 APPENDIX II

Planning conditions for cemetery

The NEPA's planning conditions for cemetery development stipulates as follows:

A chapel and cemetery on 100,003.476 square metres (approx. 25 acres) of land. The property is to be divided into fifty-nine (59) sections to be executed in five (5) phases

- Forty (40) sections will be utilized for two (2) tiered burials (approx. 662,746 plots)
- Seventeen (17) sections will be utilized for one (1) tiered burials (approx. 281,520 plots)
- Two (2) sections will be utilized for one (1) tiered burials that will accommodate sepulchers (approx. 33,235 plots)
- Burial Density
 - Approximately 65,609.88 vaults per acre
- The proposal for the reservation of the pauper sections is at 5% of each section.
- Phase 2 onwards is to begin once the preceding phase has achieved 70% completion.
- Internal roads are to be constructed of concrete with a curb to contain drainage.
- The Chapel is to be constructed for the purposes of hosting funeral services. The chapel is to have sewage treatment via a septic tank to tile field system.
- Water supply is proposed to be via National Water Commission, electricity via the Jamaica Public Service & solid waste disposal via National Solid Waste Management Authority.

6.2 APPENDIX III

The general formulation of the test statistic for an Independent Samples t Test is denoted t .

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

with

$$s_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

Where

\bar{x}_1 = Mean of first sample

\bar{x}_2 = Mean of second sample

n_1 = Sample size (i.e., number of observations) of first sample

n_2 = Sample size (i.e., number of observations) of second sample

s_1 = Standard deviation of first sample

s_2 = Standard deviation of second sample

s_p = Pooled standard deviation

The calculated t value is then compared to the critical t value from the t distribution table with degrees of freedom $df = n_1 + n_2 - 2$ and chosen confidence level. If the calculated t value is greater than the critical t value, then we reject the null hypothesis

6.3 APPENDIX IV

Variable names and definitions of variables used in the Independent t Test.

Variable names and definitions of variables

Variables	Description	
1 Location	1= Urban 2= Rural	(Nominal)
2 Distinct Entrance to the Cemetery	1=Yes 2=No	(Nominal)
3 Cemeteries in Open Area	1=Yes 2=No	(Nominal)
4 Access Ramps for Handicap	1=Yes 2=No	(Nominal)
5 Signage Rules	1=Yes 2=No	(Nominal)
6 Cemetery Guards	1=Yes 2=No	(Nominal)
7 Cleanliness	Ordered categories	(Ordinal)
8 Fencing	Ordered categories	(Ordinal)
9 Lighting	Present , Absent	(Nominal)
10 Cemetery Layout	Ordered categories	(Ordinal)
11 Parking	Present , Absent	(Nominal)
12 General Condition	Ordered categories	(Ordinal)
13 Trails	1=Yes 2=No	(Nominal)
14 Condition of Sidewalk	Ordered categories	(Ordinal)
15 Cemetery Drainages	Ordered categories	(Ordinal)
16 Tombs for Adult Children	Present , Absent	(Nominal)
17 Condition Burial Sites	Ordered categories	(Ordinal)
18 Good Layout Tombs	1=Yes 2=No	(Ordinal)
19 Section for Cremated Urns	1=Yes 2=No	(Nominal)
20 Buildings On Site	1=Yes 2=No	(Nominal)
21 Full Funeral on Site	1=Yes 2=No	(Nominal)
22 Rest Rooms on site	1=Yes 2=No	(Nominal)
23 Cemeteries located near Rivers	1=Yes 2=No	(Nominal)
24 Trash Cans on Site	1=Yes 2=No	(Nominal)
25 Availability of Space	1=Yes 2=No	(Nominal)
26 Running out Space	1=Yes 2=No	(Nominal)

6.4 APPENDIX V

Shows the values for all 26 variables.

Group Statistics					
	Location	N	Mean	Std. Deviation	Std. Error Mean
Distinct Entrance	Urban	49	1.3265	.47380	.06769
	Rural	66	1.5758	.49801	.06130
Cemetery in Open Area	Urban	49	1.3878	.49229	.07033
	Rural	66	1.1818	.38865	.04784
Ramps for Handicap	Urban	49	1.9388	.24223	.03460
	Rural	66	1.9091	.28968	.03566
Signage Rules	Urban	49	1.7755	.42157	.06022
	Rural	66	1.9242	.26664	.03282
Cemetery Keepers	Urban	49	1.6939	.46566	.06652
	Rural	66	1.8030	.40076	.04933
Cleanliness	Urban	49	2.1020	.71429	.10204
	Rural	66	1.8939	.65934	.08116
Fencing	Urban	49	1.6735	.71844	.10263
	Rural	66	1.2727	.48184	.05931
Lighting	Urban	49	1.8776	.33120	.04731
	Rural	66	1.9545	.20990	.02584
Cemetery Layout	Urban	49	1.6531	.69375	.09911
	Rural	66	1.6364	.57208	.07042
Parking	Urban	49	1.9184	.27664	.03952
	Rural	66	1.9091	.28968	.03566
General Condition	Urban	49	1.8571	.57735	.08248
	Rural	66	1.9545	.53871	.06631
Trails	Urban	49	1.8367	.37344	.05335
	Rural	66	1.8939	.31027	.03819
Condition of sidewalk	Urban	49	1.7959	.76321	.10903
	Rural	66	1.4545	.68347	.08413
Drainage	Urban	49	1.5510	.73771	.10539

	Rural	66	1.3788	.69648	.08573
Visible tombs for adult and children	Urban	49	1.4694	.50423	.07203
	Rural	66	1.3182	.46934	.05777
Condition of individual burial sites	Urban	49	1.8980	.71429	.10204
	Rural	66	1.6667	.73030	.08989
Tomb layout(arrangement)	Urban	49	1.7143	.45644	.06521
	Rural	66	1.7727	.42228	.05198
Sections reserved for Cremated Urns	Urban	49	1.8163	.39123	.05589
	Rural	66	1.9242	.26664	.03282
Building on site	Urban	49	1.6327	.48708	.06958
	Rural	66	1.8636	.34580	.04257
Full funeral on site	Urban	49	1.8163	.39123	.05589
	Rural	66	1.9091	.28968	.03566
Rest Room on site	Urban	49	1.7959	.40721	.05817
	Rural	66	1.9545	.20990	.02584
Cemetery Near Rivers or wells	Urban	49	1.8367	.37344	.05335
	Rural	66	1.8636	.34580	.04257
Trash cans on site	Urban	49	1.8367	.37344	.05335
	Rural	66	1.8939	.31027	.03819
Availability of burial space	Urban	49	1.5102	.50508	.07215
	Rural	66	1.3030	.46309	.05700
Running out of space	Urban	49	1.1633	.37344	.05335
	Rural	66	1.4394	.50012	.06156

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Distinct Entrance	Equal variances assumed	4.522	.036	-2.709	113	.008	-.24923	.09200	-.43150	-.06696

	Equal variances not assumed			- 2.729	106.24 9	.007	- .2492 3	.09132	- .43027	- .06818
Cemeteries. in Open Area	Equal variances assumed	21.891	.000	2.507	113	.014	.2059 4	.08216	.04316	.36871
	Equal variances not assumed			2.421	88.678	.018	.2059 4	.08506	.03692	.37495
Access for Handicap	Equal variances assumed	1.383	.242	.582	113	.562	.0296 8	.05102	- .07139	.13076
	Equal variances not assumed			.597	111.34 7	.551	.0296 8	.04969	- .06877	.12814
Signage Rules	Equal variances assumed	23.269	.000	- 2.312	113	.023	- .1487 3	.06433	- .27619	- .02128
	Equal variances not assumed			- 2.169	75.808	.033	- .1487 3	.06859	- .28534	- .01212
Cemetery Keepers	Equal variances assumed	6.926	.010	- 1.348	113	.180	- .1091 5	.08100	- .26962	.05132
	Equal variances not assumed			- 1.318	94.257	.191	- .1091 5	.08282	- .27358	.05528
Cleanliness	Equal variances assumed	.552	.459	1.615	113	.109	.2081 0	.12884	- .04715	.46335
	Equal variances not assumed			1.596	98.755	.114	.2081 0	.13038	- .05061	.46681
Fencing	Equal variances assumed	17.358	.000	3.578	113	.001	.4007 4	.11201	.17884	.62265
	Equal variances not assumed			3.381	78.913	.001	.4007 4	.11854	.16479	.63669

Lighting	Equal variances assumed	9.718	.002	-1.522	113	.131	-.07699	.05058	-.17720	.02321
	Equal variances not assumed			-1.428	75.909	.157	-.07699	.05391	-.18437	.03038
Cemetery well laid out	Equal variances assumed	3.365	.069	.141	113	.888	.01670	.11817	-.21742	.25081
	Equal variances not assumed			.137	91.481	.891	.01670	.12158	-.22478	.25818
Parking	Equal variances assumed	.120	.729	.173	113	.863	.00928	.05360	-.09691	.11546
	Equal variances not assumed			.174	106.058	.862	.00928	.05323	-.09625	.11481
General Condition	Equal variances assumed	1.680	.198	-.930	113	.354	-.09740	.10474	-.30492	.11011
	Equal variances not assumed			-.920	99.430	.360	-.09740	.10583	-.30738	.11257
Trails	Equal variances assumed	3.209	.076	-.896	113	.372	-.05720	.06384	-.18369	.06928
	Equal variances not assumed			-.872	91.970	.386	-.05720	.06561	-.18751	.07310
Condition of Sidewalk	Equal variances assumed	.724	.397	2.520	113	.013	.34137	.13547	.07297	.60977
	Equal variances not assumed			2.479	96.827	.015	.34137	.13771	.06804	.61470
Cemetery Drainage	Equal variances assumed	1.608	.207	1.279	113	.204	.17223	.13469	-.09462	.43909

	Equal variances not assumed			1.268	100.158	.208	.17223	.13585	- .09729	.44176
Tombs for Adult and Children	Equal variances assumed	6.763	.011	1.655	113	.101	.15121	.09136	- .02979	.33220
	Equal variances not assumed			1.638	99.277	.105	.15121	.09234	- .03201	.33442
Condition of Burial Sites	Equal variances assumed	1.772	.186	1.695	113	.093	.23129	.13644	- .03902	.50160
	Equal variances not assumed			1.701	104.801	.092	.23129	.13599	- .03836	.50094
Layout of Tombs	Equal variances assumed	1.948	.166	-.709	113	.480	-.05844	.08243	- .22175	.10486
	Equal variances not assumed			-.701	98.897	.485	-.05844	.08339	- .22390	.10702
Section for Cremated Urns	Equal variances assumed	12.953	.000	- 1.758	113	.081	-.10792	.06137	- .22950	.01367
	Equal variances not assumed			- 1.665	79.805	.100	-.10792	.06481	- .23691	.02107
Buildings on Site	Equal variances assumed	34.001	.000	- 2.975	113	.004	-.23098	.07765	- .38482	-.07714
	Equal variances not assumed			- 2.832	82.151	.006	-.23098	.08157	- .39325	-.06872
Full Funeral on Site	Equal variances assumed	8.732	.004	- 1.462	113	.147	-.09276	.06347	- .21851	.03298
	Equal variances not assumed			- 1.399	84.669	.165	-.09276	.06630	- .22459	.03906

Rest Rooms	Equal variances assumed	34.947	.000	- 2.718	113	.008	- .1586 3	.05836	- .27425	- .04301
	Equal variances not assumed			- 2.492	66.882	.015	- .1586 3	.06365	- .28568	- .03157
Cemetery in proximity to surface and underground water	Equal variances assumed	.631	.429	-.399	113	.691	- .0269 0	.06747	- .16058	.10677
	Equal variances not assumed			-.394	98.953	.694	- .0269 0	.06825	- .16232	.10852
Trash Cans located on Site	Equal variances assumed	3.209	.076	-.896	113	.372	- .0572 0	.06384	- .18369	.06928
	Equal variances not assumed			-.872	91.970	.386	- .0572 0	.06561	- .18751	.07310
Availability of burial space	Equal variances assumed	8.776	.004	2.282	113	.024	.2071 7	.09077	.02733	.38701
	Equal variances not assumed			2.253	98.329	.026	.2071 7	.09195	.02470	.38964
Running out space	Equal variances assumed	46.722	.000	- 3.249	113	.002	- .2761 3	.08499	- .44450	- .10776
	Equal variances not assumed			- 3.390	112.99 2	.001	- .2761 3	.08146	- .43752	- .11474

REFERENCES

Being compiled on Desktop | Mendeley

APPENDIX I

PLANNING CONDITIONS - Funeral Home

NEPA has set of planning conditions for the operation of Funeral Home and they are stated as follows:

1. No signs are to be erected unless pursuant to the Town and Country Planning (Control of Advertisements) Regulations, 1978.

Reason: To ensure safe and satisfactory standards of development.

2. The development must begin no later than the expiration of two (2) years beginning with the date on which permission was granted.

Reason: To prevent the accumulation of planning approvals which have not been implemented.

3. Building approval shall be obtained under the Building Act from the Clarendon Municipal Corporation for any future expansion to the building or any other building/s to be constructed on site.

Reason: To ensure safe and satisfactory standards of development

4.
 - i. The storm water drainage plan shall be implemented based on the design approved by the National Works Agency.
 - ii. Surface drainage and storm water runoff shall be effectively intercepted and disposed of, before reaching the roadway.

iii. Silt and debris traps should be utilized in the drainage system.

iv. Roof water shall be collected in gutters along the eaves and channeled to the storm water drainage system.

Reason: To reduce the potential hydrological impact of the storm water run-off from the development on the roadways.

5.
 - i. Car parking spaces shall be marked out in accordance with approved plans by the National Works Agency and shall be kept available for such use at all times unless otherwise agreed to in writing by the Authority.
 - ii. A minimum of _____ (___) car parking spaces shall be constructed using permeable material. Only the driveway shall be paved and the undeveloped areas are to be landscaped.

Reason: To ensure satisfactory development standards and that there is adequate and sufficient parking to serve the development as well as to ensure that the surface drainage is captured on site.

6.
 - i. A minimum of 5% (or ___) of the total parking spaces, along with sanitary and other facilities for example ramps; hearing aids and grip rails are to be provided for the disabled. These facilities shall be clearly identified on the plan and subsequently labeled on site.
 - ii. The doors should be made wide enough and the offices laid out to facilitate the ease of use for the disabled and challenged. Special bathroom facilities should also be installed to accommodate disabled/challenged persons.

Reason: To ensure that satisfactory parking and other facilities are provided for disabled persons.

7.
 - i. Spoils and debris shall be removed and disposed of at a site approved by the Local Planning Authority or the relevant authority.
 - ii. There shall be no burning of waste on the site.

Reason: To ensure satisfactory health and environmental standards.

-
8. Any solid waste disposal facility to be located on this site shall be properly screened and so designed that it is easily accessible to the garbage disposal vehicles.

Reason: To ensure satisfactory health and environment standards.

9. The storage of hazardous waste shall not occur on-site, however any intention to store hazardous waste will require further planning permission and an environmental permit issued by the National Resources Conservation Authority.

Reason: To ensure safe and satisfactory standards of development

10. The applicant shall ensure that a contractual arrangement is entered into with the _____ or any such approved facility for the disposal of medical/ biohazard waste. A copy of this contractual arrangement shall be submitted to the Manager of the Enforcement Branch of the National Environment and Planning Agency, 10 Caledonia Avenue, Kingston 5 or EnforcementManager@nepa.gov.jm prior to the commencement of operation.

Reason: To ensure safe and satisfactory disposal, health and environmental standards.

11. The disposal of all operational waste from the facility shall be done in a manner approved by Ministry of Health.

Reason: To ensure safe and satisfactory health and environmental standards of development.

12. There shall be no expansion or operational development on the site beyond that which is illustrated on plans date stamped by the National Environment and Planning Agency _____ without planning permission.

Reason: To prevent the intrusion and operations of unapproved non-conforming uses without planning permission.

-
13. Arrangements for fire security, escape, equipment etc., shall be to the satisfaction of the Jamaica Fire Brigade. Such arrangements shall be put in place within ninety (90) days from the date of this permission

Reason: To ensure that safe and satisfactory standards of development are adhered to.

APPENDIX II

Planning conditions for cemetery

The NEPA's planning conditions for cemetery development stipulates as follows:

A chapel and cemetery on 100,003.476 square metres (approx. 25 acres) of land. The property is to be divided into fifty nine (59) sections to be executed in five (5) phases

- Forty (40) sections will be utilized for two (2) tiered burials (approx. 662,746 plots)
- Seventeen (17) sections will be utilized for one (1) tiered burials (approx. 281,520 plots)
- Two (2) sections will be utilized for one (1) tiered burials that will accommodate sepulchers (approx. 33,235 plots)
- Burial Density
 - Approximately 65,609.88 vaults per acre
- The proposal for the reservation of the pauper sections is at 5% of each section.
- Phase 2 onwards is to begin once the preceding phase has achieved 70% completion.
- Internal roads are to be constructed of concrete with a curb to contain drainage.
- The Chapel is to be constructed for the purposes of hosting funeral services. The chapel is to have sewage treatment via a septic tank to tile field system.
- Water supply is proposed to be via National Water Commission, electricity via the Jamaica Public Service & solid waste disposal via National Solid Waste Management Authority.

APPENDIX III

The general formulation of the test statistic for an Independent Samples t Test is denoted t .

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

with

$$s_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

Where

\bar{x}_1 = Mean of first sample

\bar{x}_2 = Mean of second sample

n_1 = Sample size (i.e., number of observations) of first sample

n_2 = Sample size (i.e., number of observations) of second sample

s_1 = Standard deviation of first sample

s_2^2 = Standard deviation of second sample

s_{pooled} = Pooled standard deviation

The calculated t value is then compared to the critical t value from the t distribution table with degrees of freedom $df = n_1 + n_2 - 2$ and chosen confidence level. If the calculated t value is greater than the critical t value, then we reject the null hypothesis.

APPENDIX IV

Variable names and definitions of variables used in the Independent t Test.

Variable names and definitions of variables

Variables	Description	
1 Location	1= Urban 2= Rural	(Nominal)
2 Distinct Entrance to the Cemetery	1=Yes 2=No	(Nominal)
3 Cemeteries in Open Area	1=Yes 2=No	(Nominal)
4 Access Ramps for Handicap	1=Yes 2=No	(Nominal)
5 Signage Rules	1=Yes 2=No	(Nominal)
6 Cemetery Guards	1=Yes 2=No	(Nominal)
7 Cleanliness	Ordered categories	(Ordinal)
8 Fencing	Ordered categories	(Ordinal)
9 Lighting	Present , Absent	(Nominal)
10 Cemetery Layout	Ordered categories	(Ordinal)
11 Parking	Present , Absent	(Nominal)
12 General Condition	Ordered categories	(Ordinal)
13 Trails	1=Yes 2=No	(Nominal)

14	Condition of Sidewalk	Ordered categories	(Ordinal)
15	Cemetery Drainages	Ordered categories	(Ordinal)
16	Tombs for Adult Children	Present , Absent	(Nominal)
17	Condition Burial Sites	Ordered categories	(Ordinal)
18	Good Layout Tombs	1=Yes 2=No	(Ordinal)
19	Section for Cremated Urns	1=Yes 2=No	(Nominal)
20	Buildings On Site	1=Yes 2=No	(Nominal)
21	Full Funeral on Site	1=Yes 2=No	(Nominal)
22	Rest Rooms on site	1=Yes 2=No	(Nominal)
23	Cemeteries located near Rivers	1=Yes 2=No	(Nominal)
24	Trash Cans on Site	1=Yes 2=No	(Nominal)
25	Availability of Space	1=Yes 2=No	(Nominal)
26	Running out Space	1=Yes 2=No	(Nominal)

APPENDIX V

Shows the values for all 26 variables.

Group Statistics

	Location	N	Mean	Std. Deviation	Std. Error Mean
Distinct Entrance	Urban	49	1.3265	.47380	.06769
	Rural	66	1.5758	.49801	.06130
Cemetery in Open Area	Urban	49	1.3878	.49229	.07033
	Rural	66	1.1818	.38865	.04784
Ramps for Handicap	Urban	49	1.9388	.24223	.03460
	Rural	66	1.9091	.28968	.03566
Signage Rules	Urban	49	1.7755	.42157	.06022
	Rural	66	1.9242	.26664	.03282
Cemetery Keepers	Urban	49	1.6939	.46566	.06652
	Rural	66	1.8030	.40076	.04933
Cleanliness	Urban	49	2.1020	.71429	.10204
	Rural	66	1.8939	.65934	.08116
Fencing	Urban	49	1.6735	.71844	.10263

	Rural	66	1.2727	.48184	.05931
Lighting	Urban	49	1.8776	.33120	.04731
	Rural	66	1.9545	.20990	.02584
Cemetery Layout	Urban	49	1.6531	.69375	.09911
	Rural	66	1.6364	.57208	.07042
Parking	Urban	49	1.9184	.27664	.03952
	Rural	66	1.9091	.28968	.03566
General Condition	Urban	49	1.8571	.57735	.08248
	Rural	66	1.9545	.53871	.06631
Trails	Urban	49	1.8367	.37344	.05335
	Rural	66	1.8939	.31027	.03819
Condition of sidewalk	Urban	49	1.7959	.76321	.10903
	Rural	66	1.4545	.68347	.08413
Drainage	Urban	49	1.5510	.73771	.10539
	Rural	66	1.3788	.69648	.08573
Visible tombs for adult and children	Urban	49	1.4694	.50423	.07203
	Rural	66	1.3182	.46934	.05777
Condition of individual burial sites	Urban	49	1.8980	.71429	.10204
	Rural	66	1.6667	.73030	.08989
Tomb layout(arrangement)	Urban	49	1.7143	.45644	.06521
	Rural	66	1.7727	.42228	.05198
Sections reserved for Cremated Urns	Urban	49	1.8163	.39123	.05589
	Rural	66	1.9242	.26664	.03282
Building on site	Urban	49	1.6327	.48708	.06958
	Rural	66	1.8636	.34580	.04257
Full funeral on site	Urban	49	1.8163	.39123	.05589
	Rural	66	1.9091	.28968	.03566
Rest Room on site	Urban	49	1.7959	.40721	.05817
	Rural	66	1.9545	.20990	.02584
Cemetery Near Rivers or wells	Urban	49	1.8367	.37344	.05335
	Rural	66	1.8636	.34580	.04257
Trash cans on site	Urban	49	1.8367	.37344	.05335
	Rural	66	1.8939	.31027	.03819
Availability of burial space	Urban	49	1.5102	.50508	.07215
	Rural	66	1.3030	.46309	.05700
Running out of space	Urban	49	1.1633	.37344	.05335

Rural	66	1.4394	.50012	.06156
-------	----	--------	--------	--------

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2- taile d)	Mean Differ ence	Std. Error Differ ence	95% Confidence Interval of the Difference	
									Lower	Upper
Distinct Entrance	Equal variances assumed	4.522	.036	-2.709	113	.008	-.24923	.09200	-.43150	-.06696
	Equal variances not assumed			-2.729	106.249	.007	-.24923	.09132	-.43027	-.06818
Cemeteries. in Open Area	Equal variances assumed	21.891	.000	2.507	113	.014	.20594	.08216	.04316	.36871
	Equal variances not assumed			2.421	88.678	.018	.20594	.08506	.03692	.37495
Access for Handicap	Equal variances assumed	1.383	.242	.582	113	.562	.02968	.05102	-.07139	.13076
	Equal variances not assumed			.597	111.347	.551	.02968	.04969	-.06877	.12814
Signage Rules	Equal variances assumed	23.269	.000	-2.312	113	.023	-.14873	.06433	-.27619	-.02128
	Equal variances not assumed			-2.169	75.808	.033	-.14873	.06859	-.28534	-.01212

Cemetery Keepers	Equal variances assumed	6.926	.010	-1.348	113	.180	-	.08100	-.26962	.05132
	Equal variances not assumed			-1.318	94.257	.191	-	.08282	-.27358	.05528
Cleanliness	Equal variances assumed	.552	.459	1.615	113	.109	.20810	.12884	-.04715	.46335
	Equal variances not assumed			1.596	98.755	.114	.20810	.13038	-.05061	.46681
Fencing	Equal variances assumed	17.358	.000	3.578	113	.001	.40074	.11201	.17884	.62265
	Equal variances not assumed			3.381	78.913	.001	.40074	.11854	.16479	.63669
Lighting	Equal variances assumed	9.718	.002	-1.522	113	.131	-	.05058	-.17720	.02321
	Equal variances not assumed			-1.428	75.909	.157	-	.05391	-.18437	.03038
Cemetery well laid out	Equal variances assumed	3.365	.069	.141	113	.888	.01670	.11817	-.21742	.25081
	Equal variances not assumed			.137	91.481	.891	.01670	.12158	-.22478	.25818
Parking	Equal variances assumed	.120	.729	.173	113	.863	.00928	.05360	-.09691	.11546
	Equal variances not assumed			.174	106.058	.862	.00928	.05323	-.09625	.11481

Layout of Tombs	Equal variances assumed	1.948	.166	-.709	113	.480	-	.08243	-.22175	.10486
	Equal variances not assumed			-.701	98.897	.485	-.05844	.08339	-.22390	.10702
Section for Cremated Urns	Equal variances assumed	12.953	.000	-1.758	113	.081	-.10792	.06137	-.22950	.01367
	Equal variances not assumed			-1.665	79.805	.100	-.10792	.06481	-.23691	.02107
Buildings on Site	Equal variances assumed	34.001	.000	-2.975	113	.004	-.23098	.07765	-.38482	-.07714
	Equal variances not assumed			-2.832	82.151	.006	-.23098	.08157	-.39325	-.06872
Full Funeral on Site	Equal variances assumed	8.732	.004	-1.462	113	.147	-.09276	.06347	-.21851	.03298
	Equal variances not assumed			-1.399	84.669	.165	-.09276	.06630	-.22459	.03906
Rest Rooms	Equal variances assumed	34.947	.000	-2.718	113	.008	-.15863	.05836	-.27425	-.04301
	Equal variances not assumed			-2.492	66.882	.015	-.15863	.06365	-.28568	-.03157
Cemetery in proximity to surface and underground water	Equal variances assumed	.631	.429	-.399	113	.691	-.02690	.06747	-.16058	.10677
	Equal variances not assumed			-.394	98.953	.694	-.02690	.06825	-.16232	.10852

Trash Cans located on Site	Equal variances assumed	3.209	.076	-.896	113	.372	-	.06384	-.18369	.06928
	Equal variances not assumed			-.872	91.970	.386	-.05720	.06561	-.18751	.07310
Availability of burial space	Equal variances assumed	8.776	.004	2.282	113	.024	.20717	.09077	.02733	.38701
	Equal variances not assumed			2.253	98.329	.026	.20717	.09195	.02470	.38964
Running out space	Equal variances assumed	46.722	.000	-3.249	113	.002	-.27613	.08499	-.44450	-.10776
	Equal variances not assumed			-3.390	112.992	.001	-.27613	.08146	-.43752	-.11474

APPENDIX VI INTEGRATING VISUAL BASICS PROGRAMMING INTO ARCMAP

