FORT LAUDERDALE CEMETERY MASTER PLAN

JANUARY 10, 2018 - DRAFT FOR REVIEW AND COMMENT

KEITH

PREPARED FOR

CITY OF FORT LAUDERDALE, FLORIDA
PARKS AND RECREATION DEPARTMENT

PREPARED BY

KEITH
LANDSCAPE ARCHITECTURE, PLANNING, CIVIL ENGINEERING, SURVEY

WITH

GRANT THORNTON
INDEPENDENT AUDIT AND PERPETUAL CARE ADVISORY CONSULTANT

BRIZAGA
ENVIRONMENTAL CONSULTANT

MASUEN CONSULTING
IRRIGATION CONSULTANT

COMPLETED WITH CONTRIBUTIONS FROM THE FOLLOWING INDIVIDUALS & ORGANIZATIONS

OFFICE OF THE MAYOR
MAYOR DEAN J. TRANTALIS

CITY COMMISSION
HEATHER MORAITIS, COMMISSIONER DISTRICT 1
STEVEN GLASSMAN, COMMISSIONER DISTRICT 2
ROBERT MCKINZIE, COMMISSIONER DISTRICT 3
BEN SORENSEN, COMMISSIONER DISTRICT 4, VICE MAYOR

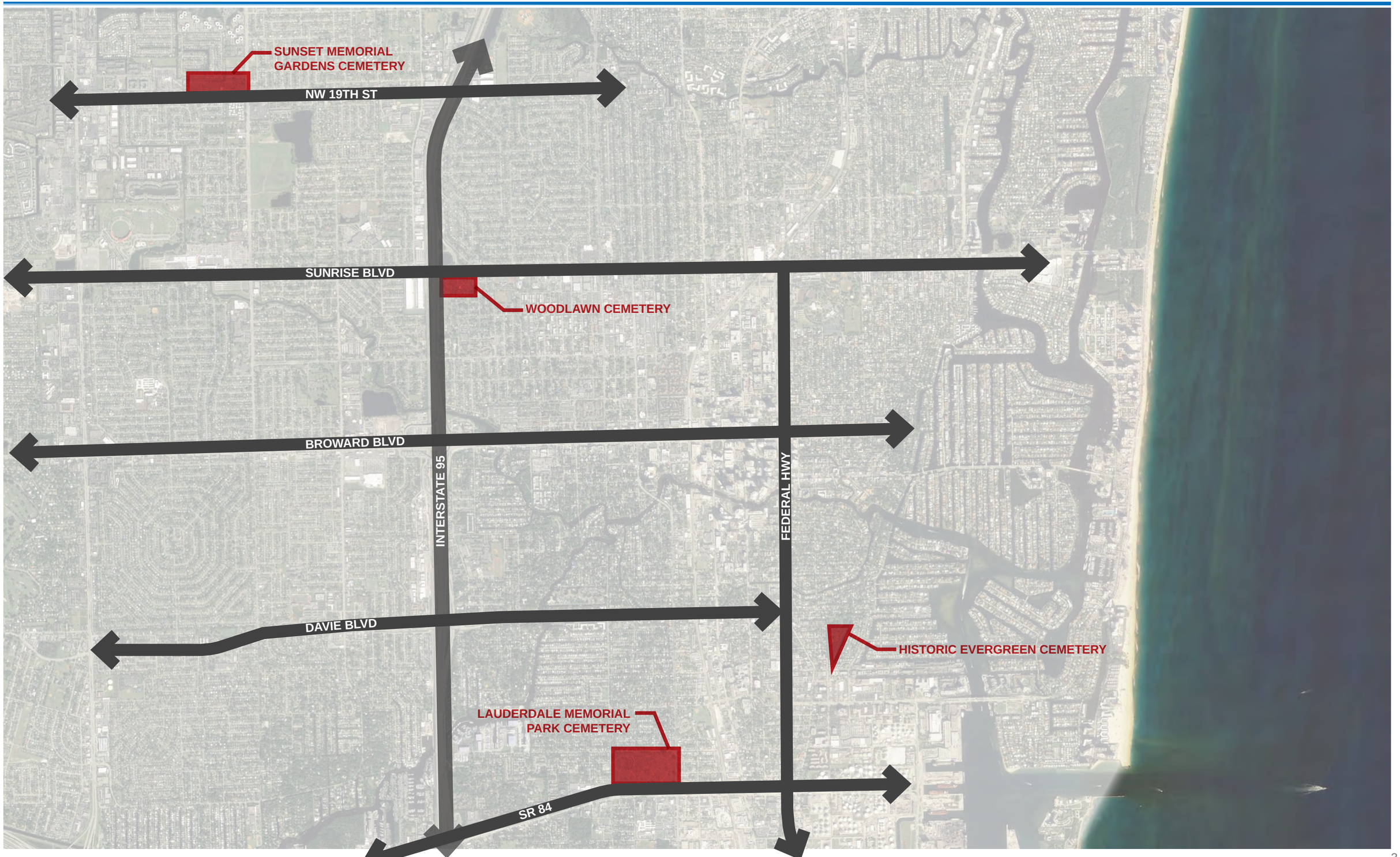
CITY MANAGER
CHRIS LAGERBLOOM

PARKS AND RECREATION DEPARTMENT
PHIL THORNBURG, DIRECTOR

CEMETERY SYSTEM BOARD OF TRUSTEES
DR. MICHAEL RUDDY, CHAIR
PATRICIA HAYES, VICE CHAIR
FRED NESBITT
DENNIS ULMER
RICHARD KURTZ
MARK VAN REES
VICKI MOWREY
PATRICIA ZEILER
JOHN LILLI

CITY STAFF
STACY SPATES
CARL WILLIAMS
TREVOR JACKSON

PROJECT SITE CONTEXT & OVERVIEW


SUNSET MEMORIAL
GARDENS CEMETERY
NW 19TH ST
SUNRISE BLVD
WOODLAWN CEMETERY
BROWARD BLVD
INTERSTATE 95
FEDERAL HWY
DAVIE BLVD
HISTORIC EVERGREEN CEMETERY
LAUDERDALE MEMORIAL
PARK CEMETERY
SR 84

EXECUTIVE OVERVIEW

The City of Fort Lauderdale owns four cemeteries within the city limits that are operated by the Parks and Recreation Department. The cemeteries range in size from five acres to fifty-six acres. The first cemetery was acquired in 1917. The City Commission established a ten member Cemetery System Board of Trustees who are responsible for overseeing the Perpetual Care Trust Fund, establishing rules and regulations and making recommendations to the city commission on development and care of the sites.

This Master Plan document aims to be a tool for the City staff and Cemetery System Board of Trustees to utilize in planning for future success of the cemeteries.

The 5 overall project goals of this Master Plan are as follows.

Goal 1: Develop a Geo-Spatial Database

- *Develop a set of databases with files that are compatible with ArcGIS version 10 Service Pack*
- *Databases will include:*

1. *All cemetery perimeter legal boundaries*
2. *Mausoleums*
3. *Buildings and facilities*
4. *Above ground infrastructure*
5. *Irrigation lines and equipment*
6. *Roadways and paths*

Goal 2: Develop Asset Condition and Assessment

- *Methodology for assessing grave sites*
- *Evaluate perimeter fencing and gateways*
- *Evaluate and give recommendations to improve road material*
- *Identify areas of persistent flooding and areas where storm water poses a threat to cemetery assets*
- *Evaluate current turf grass and provide recommendations for care and maintenance*
- *Evaluate current irrigation systems and research opportunities to reduce water consumption*
- *Evaluate sidewalks and pedestrian pathways.*

Goal 3: Develop Site Analysis and Plan

- *Recommendations to increase operational efficiency through alterations*
- *Determine the major threats to cemetery security*
- *Signage and wayfinding recommendations*
- *Recommendations for standards, specifications and siting for appropriate selection of site furnishings.*
- *Recommendations to enhance landscaping aesthetics, increase operational efficiency, decrease water consumption and ensure health of flora and fauna*
- *Provide recommendations on the impacts of surface water inundation and rising groundwater table.*

Goal 4: Develop Preservation and Conservation Policy and Funding, Specifically as Tied to the Perpetual Care Fund

- *Identify appropriate and acceptable methods of restoration and repair existing markers*
- *Provide recommendations for conservation of gravestones, resetting of gravestones, maintenance of commemorative features and monuments, and the use of herbicides and pesticides.*
- *Determine if the cemeteries and or features within the cemeteries may be eligible for local, state or federal historical designation*
- *Recommendations on the stability and viability of the Perpetual Care Trust Fund for a determination of the perpetual care requirements for each cemetery*
- *Determine if current funding levels are adequate to meet expected standard of car in perpetuity*

Goal 5: Develop and Implementation Guide

- *Provide an implementation guide with recommendations for the rehabilitation, preservation, maintenance, financial solvency, and expansion of the cemeteries in the form of a prioritized project list that includes project descriptions and probable cost estimates, potential funding sources, and start and completion dates.*

Upon extensive inventory and analysis of the 4 cemetery sites, the following general management guidelines should be considered during the planning and design review process for any treatments, alterations or proposed new projects. These general recommendations should be implemented in conjunction with the more detailed recommendations in the following sections of this master plan.

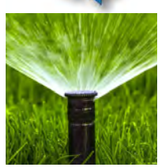
CUSTOMER CARE ENHANCEMENTS/OFFERINGS

Customer Care Experience is a high priority of the City and Cemetery Staff. The goal is to provide a seamless and efficient experience to customers during what is often a difficult time. We should also look at offerings that the Cemeteries provide in general and evaluate whether or not there are more innovative solutions or burial options that could be beneficial in the long run. Consider the following recommendations:

- *Create a comprehensive database that shows available burial plots and memorial space throughout each site, it should list burial options offered by the cemetery and should be something that is easily kept up to date by cemetery staff. This project should also create updated maps and brochures to provide to customers depicting options that are simple to interpret. These items should replace the outdated hand drafted maps that are in use currently.*
- *Given the area of the country we are in, there is a unique opportunity to provide a memorial space for those who choose to be buried at sea. It is a growing trend in society and there are businesses nearby by that offer this. This type of memorial could be in the form of a name on a plaque or memorial wall depending on availability. This provides families the comfort of a peaceful space to go and reflect on the life of their loved one and would extend the longevity of active internments throughout the cemeteries. Since Woodlawn and Evergreen have the least available space, these would be ideal sites to offer this type of memorial.*

STANDARDS OF CARE

Develop a manual of best management practices to be utilized by the maintenance staff in order to maintain the highest level of up keep. Distribute the manual to maintenance staff and ensure everyone is on the same page as far as standards of upkeep.



IRRIGATION

An extensive inventory and analysis of the existing irrigation systems for each cemetery has been completed. The Irrigation Report evaluates the age and performance of each system and provides repair and improvement needs and input on future planning, upgrades, and methods to reduce water consumption. Refer to the following Appendices at the end of this document for a comprehensive report from the irrigation experts on the design team:

- *Appendix A: Irrigation Recommendations Report*
- *Appendix B: Irrigation Specifications*

SPACIAL ORGANIZATION

The three-dimensional arrangement of all objects in the landscape. In the case of the 4 cemeteries we are referring to the organization of natural and built features on site, including but not limited to grave plots, topography, infrastructure, paths of travel, site circulation, buildings and vegetation. The following is recommended:

- *Maintain the original patterns of plot grids, cemetery sections and grave orientations and major circulation patterns throughout each cemetery.*
- *Consider the impacts future development may have on spacial organization. If a new Mausoleum is constructed, ensure the structure does not overwhelm the area in size and scale*
- *If some roads are no longer needed for vehicles, consider transforming them to pedestrian paths. See more detailed recommendations in the following sections.*
- *Ensure that if new roads are required to accommodate new uses, they are compatible with existing circulation patterns and do not negatively impact existing features to remain.*
- *Evaluate the spacial organization of non-burial space such as parking lots and maintenance yards. Consider reorganizing or minimizing to maximize usable burial/memorial space.*
- *Provide consolidated parking areas either outside the boundaries of the cemeteries, or in concentrated areas within the cemeteries depending on spacial availability.*

COMPREHENSIVE TREE CENSUS

It is recommend that a Comprehensive Tree Census be completed in collaboration with a Landscape Architect and International Society of Arboriculture (ISA) Certified Arborist. Consider the following for this study:

- *Provide a detailed inventory of the location and condition of all trees in the cemetery and tree disposition plans for each site.*
- *Abide by City of Fort Lauderdale Unified Land Development Code Requirements when it comes to preserving, removing, relocating and mitigating trees and palms.*
- *Note that a specimen tree, as defined by Sec. 47-21.2., is any tree which has a diameter of eighteen (18) inches or greater and is well shaped and in good health. It is recommended that all specimen trees be preserved on site whenever possible.*

NEW VEGETATION

Following the previously described Comprehensive Tree Census, develop Landscape Plans for each cemetery for proposed new vegetation to be implemented. It is recommended that these plans be prepared by a Professional Landscape Architect. Consider the following:

- *Ensure that the plant palette incorporates appropriate species for specific locations. Avoid species that are susceptible to disease and require constant maintenance*
- *Avoid planting species that have proven to be invasive in South Florida. Remove all new invasive species at least once a year.*
- *Consider the use of native species as much as possible*
- *All landscape material to be Florida #1 or greater.*

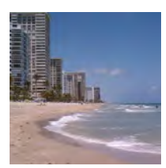
Consider that as part of the mourning process it is common for families and individuals to decorate grave plots with many different types of plantings as a sign of remembrance or special dedication. "Hedge Estates" have also proven to be popular especially in Lauderdale Memorial and Evergreen. The following is recommended while taking these items into consideration:

- *Choose appropriate species of hedge planting to be used for hedge estates. It is best to stick to the same 2 or 3 species to use throughout to maintain a cohesive identity.*
- *Develop and post cemetery rules pertaining to commemorative plantings. Clarify that the cemetery manager has the right to remove plantings if they presents a maintenance issue.*
- *Encourage visitors to refrain from leaving memorial decorations that will become litter or could be harmful to surrounding wildlife, such as balloons and non biodegradable materials*
- *Consider offering a Tree Planting Memorial Program as an option to families looking for ways to commemorate their loved ones. The cemetery staff should dictate tree species to be planted and designate a certain area for these memorials.*

FUTURE PROJECTS/UPGRADES

There are various things to be considered in every improvement project throughout the cemeteries in order to plan for a sustainable future. The following are general recommendations to consider for all 4 cemeteries:

- *Fences are important defining features of cemeteries and are also often the main representation to the public eye. The existing fences throughout the 4 cemeteries are in decent shape overall, it is recommended to continue the use of the current fence product in all cemeteries to maintain one cohesive style. Replace or repair any portions of the fence that are broken, rusted or dented.*
- *A common theme in all 4 cemeteries is that they are not very well marked with signage from the street. There are many opportunities to create welcoming signage at corner intersections, along major roads and at entrances that will provide aesthetic improvements to the city and create a more welcoming experience for visitors. Wayfinding signage could also be improved throughout the 4 sites, especially in the larger cemeteries. Signage throughout all 4 sites should be cohesive. Consider involving a graphic designer to develop a standard sign typology to be implemented throughout the 4 sites.*
- *When planning any new project it is always best practice to consider designs that will mitigate for climate change. Consider various methods that can reduce heat island effect, such as, utilizing clean asphalt, lighter colored pavements and planting more shade trees.*
- *For construction of any future paths or plaza spaces consider the application of pervious pavements to retain ground water. Also evaluate the possibility of utilizing sustainable stormwater approaches with the possibility of low impact uses for landscaping.*
- *There are many different types of site furnishing through the 4 cemeteries. Consider choosing a standard palette of site furnishings to be utilized in all 4 sites. Replace any broken benches, litter receptacles, fences and gates. Furnishings throughout all 4 sites should be cohesive.*



RESILIENCY

While the potential impacts of sea level rise on cemeteries is not unique to the City of Fort Lauderdale, the explicit inclusion of sea level rise in master planning for cemeteries has not been widely considered. Given expected changes in sea level and groundwater elevations, it is an important part of planning for the future.

NOTABLE PRECEDENTS

Inspiration can be drawn from many of these notable cemeteries around the country.

1. **ARLINGTON NATIONAL CEMETERY**
   ARLINGTON, VA
   An icon of the united states that is continuing to grow by adding modern burial trends while maintaining the history of the site to the highest standards of upkeep

3. **MOUNT AUBURN CEMETERY**
   CAMBRIDGE, MA
   A passive park-like space to honor loved ones and celebrate life

4. **GREEN WOOD CEMETERY**
   BROOKLYN, NY
   A national historic landmark where various tours and events are held to celebrate the history and tell the stories of the place

5. **AUSTIN HISTORIC CEMETERIES MASTER PLAN**
   AUSTIN, TX
   Offers a wide variety of solutions and standard practices to be implemented in the 5 historic cemeteries in Austin.

6. **HOLLYWOOD FOREVER CEMETERY**
   LOS ANGELES, CA
   A cemetery park like space in one. Local movie and music events are held here frequently.

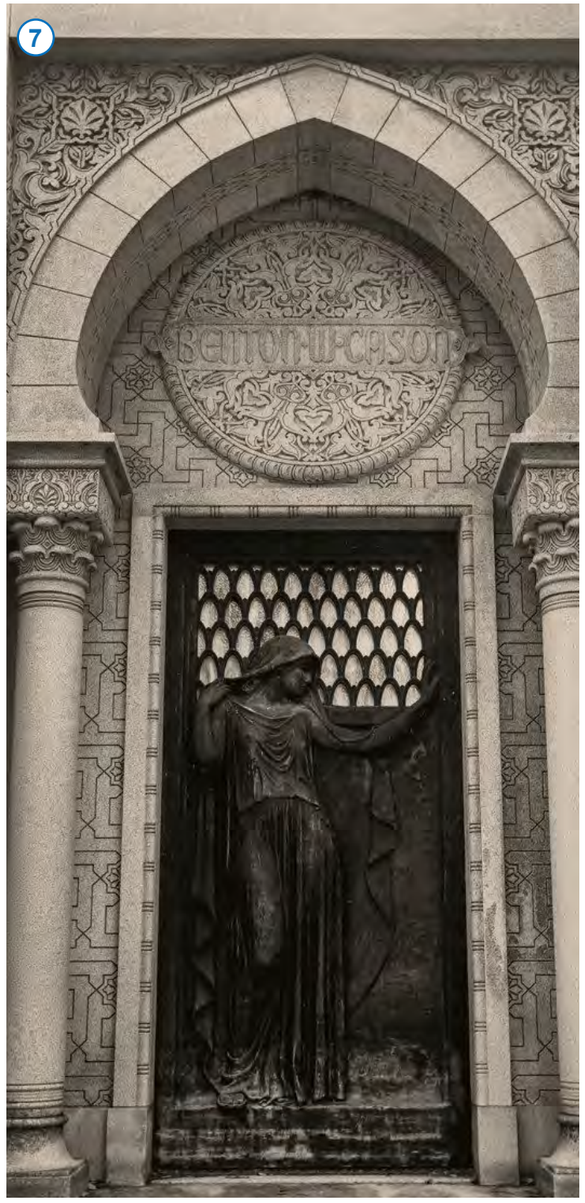
7. **METAIRIE CEMETERY**
   NEW ORLEANS, LA
   The city commissioned local artists to sculpt statues that give the space a unique identity

4

5

6

7



BURIAL TRENDS

These are examples of some of the popular burial trends that others are utilizing throughout the world.

STANDARD BURIAL
Bodies are embalmed and placed in a casket typically 6' below ground. The grave site is typically marked with a headstone. The most common burial type.

CREMATION
The body is reduced to ashes and kept in a number of ways whether that be an urn on a mantle or scattered in a special place.

MAUSOLEUM
A stately building housing a tomb or tombs of multiple family members.

COLUMBARIUM
A walled structure with compartments for urns. Often enclosed around a garden, creating opportunity for meditative space

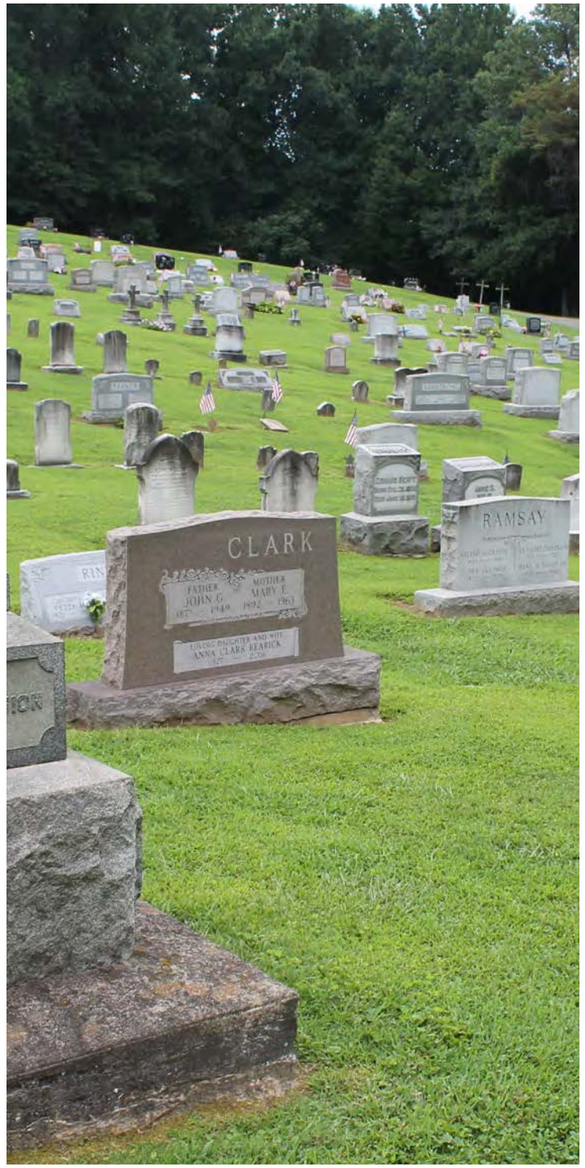
GREEN BURIAL
Environmentally sensitive burial that aims to reduce carbon emissions, preserves natural resources and preserve habitat.

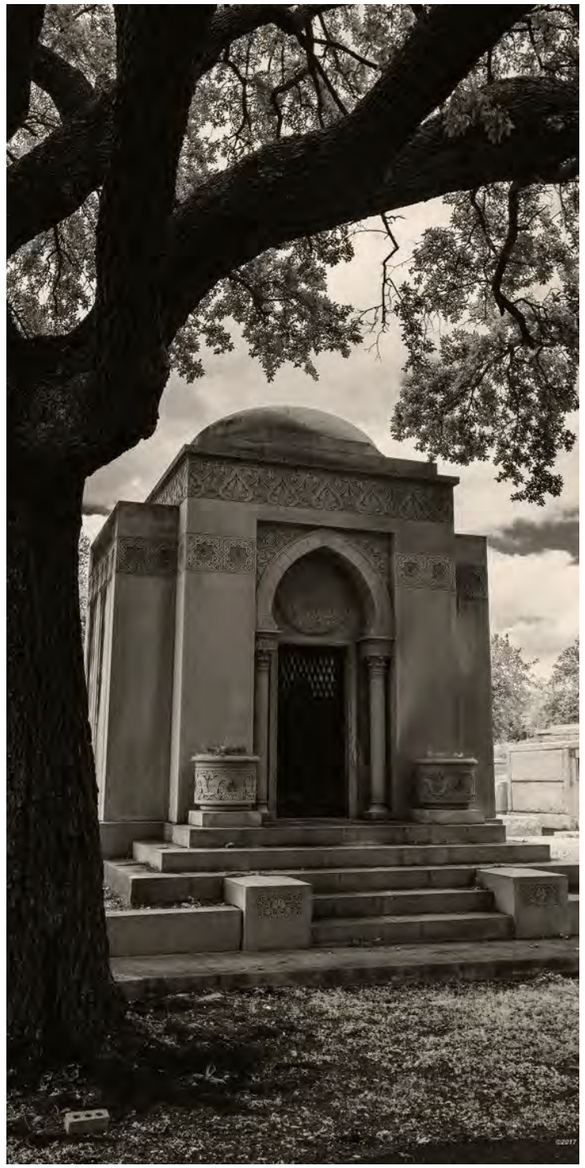
BURIAL AT SEA
Releasing of remains in the ocean usually from a ship or boat.

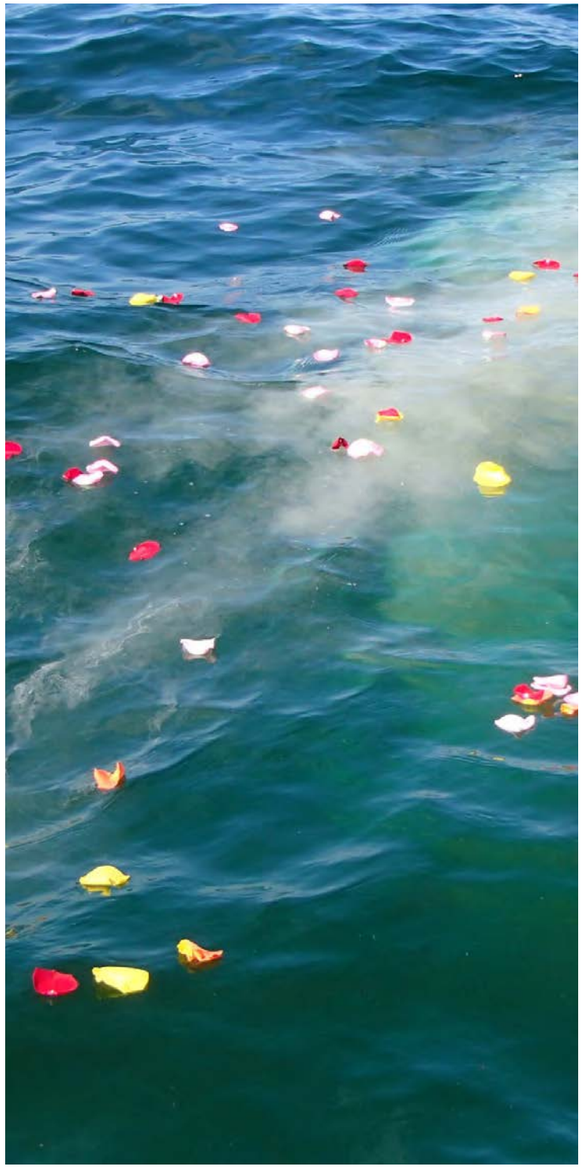
SCATTER GARDENS
Designated area to scatter ashes.

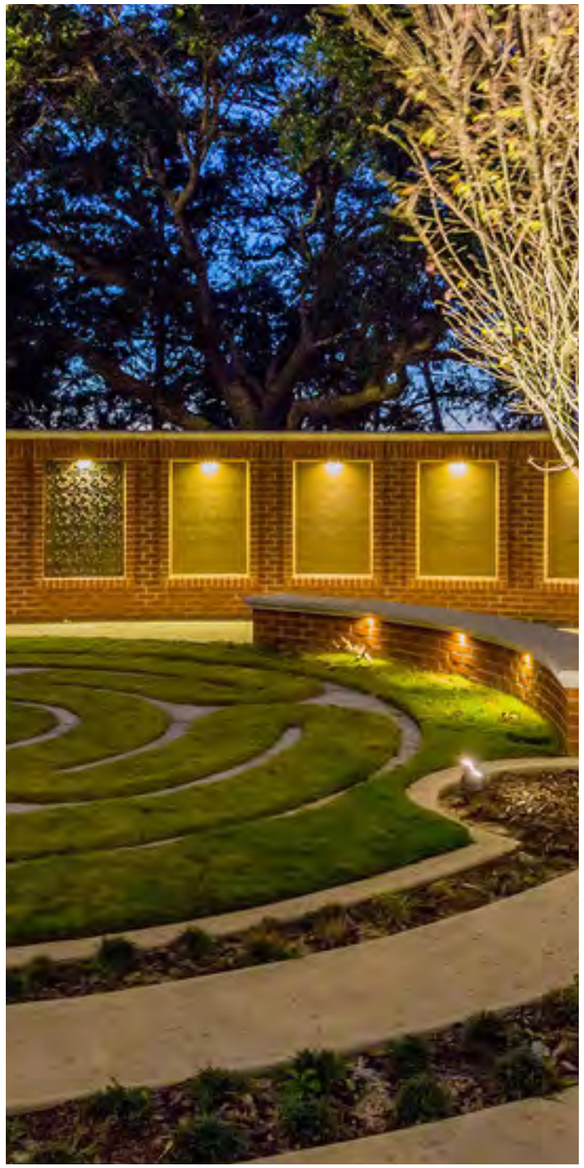
RAISED TOMBS
Above ground burial tombs. Typically in certain locations that are susceptible to flooding and sea level rise.

HI-TECH MEMORIALS
Some cemeteries have incorporated unique applications using modern technology such as touch screen monitor within a Mausoleum or smart phone applications to explore information on those buried within.









TRENDS & STATISTICS

OVERALL DATA

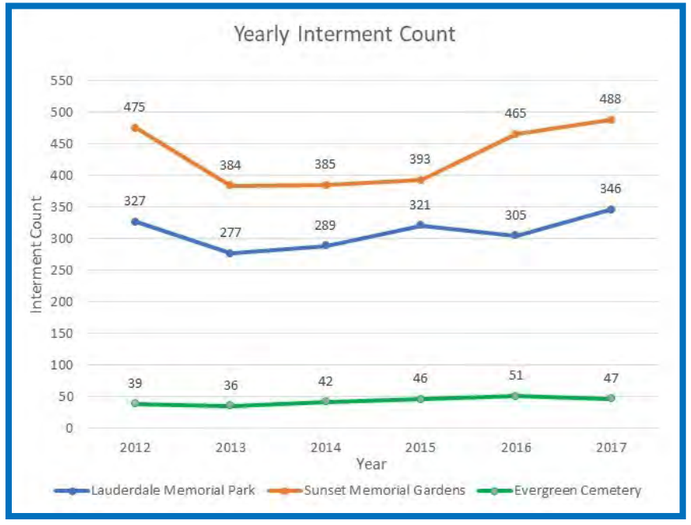
City of Fort Lauderdale has four municipal cemeteries, each one has distinct characteristics. Three of the cemeteries are active and the trend has been an increase in the number of internments every year since 2012 with 2017 being a total of 881 internments. The charts on page 11 identify the three active cemeteries (Evergreen, Sunset and Lauderdale Memorial) yearly total internments from 2012 to 2017. Woodlawn Cemetery is not included since it is not accepting internments. Individually the three active cemetery totals are shown on Exhibit 2. Data for the exhibits was provided by the city and located in the Appendix.

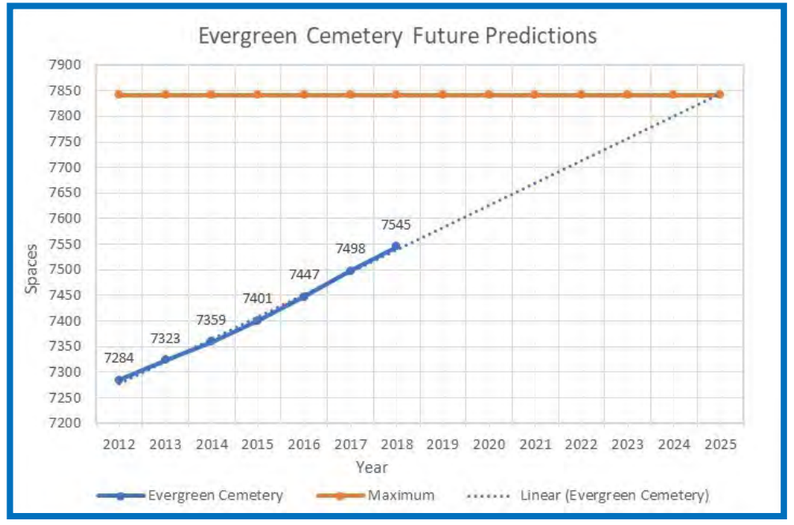
CEMETERY PROJECTIONS

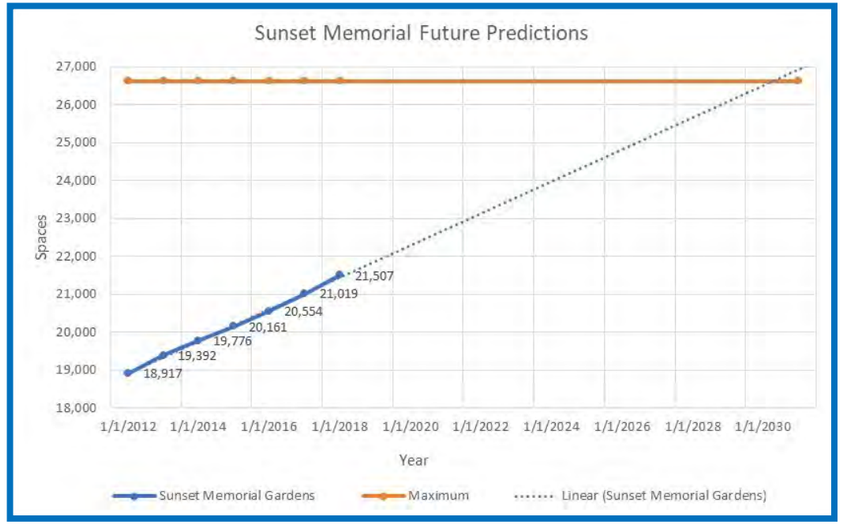
Each of the three active cemeteries have a current maximum number of interments. The number of internments for each cemetery are plotted on Exhibits 3 to 5 based on data accumulated from 2012 to 2017. Using the trend lines from each, a projection was made on the probable longevity of active internments based on the existing cap. Using the trend analysis, a straight-line projection was made for the year each cemetery would reach internment capacity.

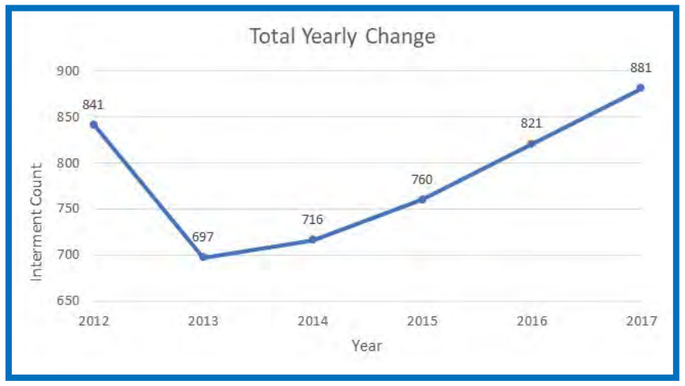
Based on the analysis Evergreen Cemetery and Sunset Memorial Cemetery have limited active periods remaining. Lauderdale Memorial Park has the longest future with the current internment mix. The years estimated to reach capacity for each are:

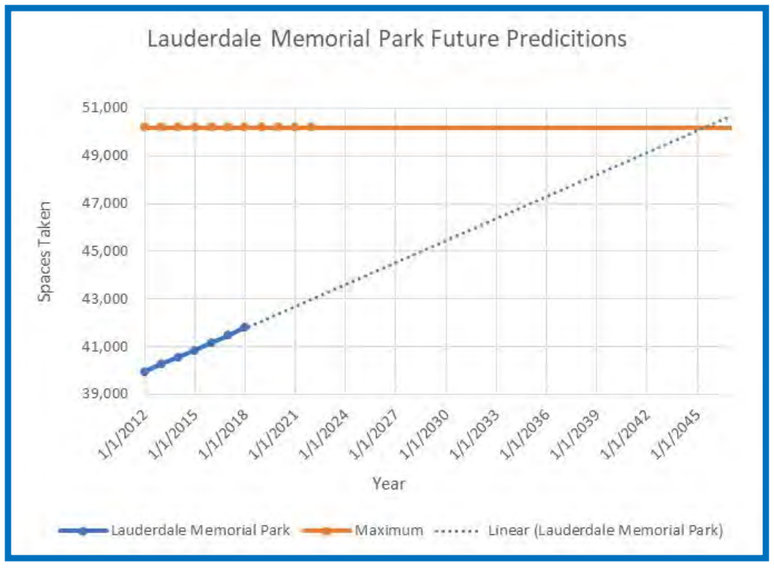
- *Evergreen Cemetery 2023*
- *Sunset Memorial Cemetery 2023*
- *Lauderdale Memorial Park Cemetery 2044*

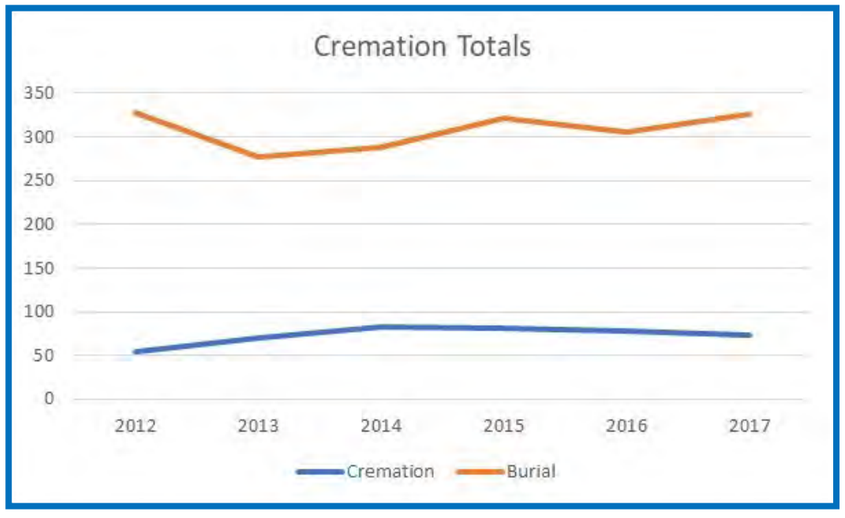

Yearly Interment Count
Interment Count
Year
2012
2013
2014
2015
2016
2017
475
384
385
393
465
488
327
277
289
321
305
346
39
36
42
46
51
47
Lauderdale Memorial Park
Sunset Memorial Gardens
Evergreen Cemetery


Evergreen Cemetery Future Predictions
Spaces
Year
7284
7323
7359
7401
7447
7498
7545
Evergreen Cemetery
Maximum
Linear (Evergreen Cemetery)


Sunset Memorial Future Predictions
Spaces
Year
18,917
19,392
19,776
20,161
20,554
21,019
21,507
Sunset Memorial Gardens
Maximum
Linear (Sunset Memorial Gardens)


Total Yearly Change
Interment Count
Year
841
697
716
760
821
881


Lauderdale Memorial Park Future Predicitions
Spaces Taken
Year
Lauderdale Memorial Park
Maximum
Linear (Lauderdale Memorial Park)


Cremation Totals
Cremation
Burial

FORT LAUDERDALE CEMETERIES & SEA LEVEL RISE

In March 2016, in Calcasieu Parish, Louisiana, flooding occurring within the cemeteries caused many concerns within the community. The buoyant force created by elevated flood levels forced caskets out of the ground. Gravesites in New Orleans are generally located above ground due to concerns with groundwater levels and the low elevation of land relative to sea level.[1] Closer to Fort Lauderdale, heavy rain in Gifford, Florida in 2011, forced several vaults to rise above ground. The cemetery noted that in 2004 a hurricane caused some vaults to float around.[2] While these examples are associated with heavy rainfall, it is essential to examine them for insight into future conditions, as sea level rise combined with Fort Lauderdale's porous limestone substrate will cause increases in groundwater elevations and reduce the storage capacity for rainfall. . Eventually, groundwater levels will be close enough to the surface to flood gravesites during excavation and may inhibit burials.

To include sea level rise, Broward County has created a Future Conditions Wet Seasons Groundwater Elevation map.[3] The estimate is for the time period of 2060-2069, roughly 50 years from now, and during the wet season, the months of May through October. "It is a modeled estimate of the groundwater elevation and should be used to consider soil saturation and ground water levels when planning for future conditions including sea level rise."

The chart below shows the estimated future conditions groundwater elevation and average ground elevation estimate at each cemetery.

The future condition groundwater elevation is projected to be within six feet of the average surface of Woodlawn, Lauderdale Memorial, and Sunset Memorial Gardens cemeteries. This is illustrated with contour maps of each cemetery depicting the difference in elevation between the existing ground surface and the projected future wet season groundwater level. Refer to maps colored with red, yellow and green in subsequent sections of this document.

Red indicates areas where the groundwater elevation is expected to be within 4 feet of the existing grade. Yellow depicts areas where the existing ground surface is expected to be between 4 and 6 feet above the groundwater level, and green indicates areas where the existing grade is expected to be greater than 6 feet above the projected groundwater level. It is recommended that areas depicted in red be explored for alternative burial options beyond in-ground interment.

There are no areas of Evergreen where groundwater is expected to be within 4 feet of the existing ground surface, shaded red on the maps. The western portion of the cemetery is expected to have groundwater within 6 feet of the surface. A significant portion of the northwestern quadrant of Lauderdale Memorial is expected to have groundwater within 4 feet of the surface, with most of the cemetery having groundwater within 6 feet of the surface by 2060. Woodlawn and Sunset are in similar situations.

Areas shaded in red or yellow could be explored for alternative burial types of uses. It is recommended that the City should consider whether groundwater inundation of gravesites will disrupt normal burial operations and adjust burial methods or operations accordingly.

In addition to the consideration of groundwater elevation, structures around the cemetery should be analyzed for flood risk and proposed structures should be built in consideration of sea level rise. The Southeast Florida Regional Climate Change Compact (SFRCC)Unified Sea Level Rise Curve adopted by the City of Fort Lauderdale, should be used for this effort. The planning document states, "the upper curve of the projection should be utilized for planning of high risk projects to be constructed after 2060 or projects which are not easily replaceable or removable, have a long design life (more than 50 years) or are critically interdependent with other infrastructure or services." Since structures associated with cemeteries are not easily replaceable or removable, the high curve should be used for planning.

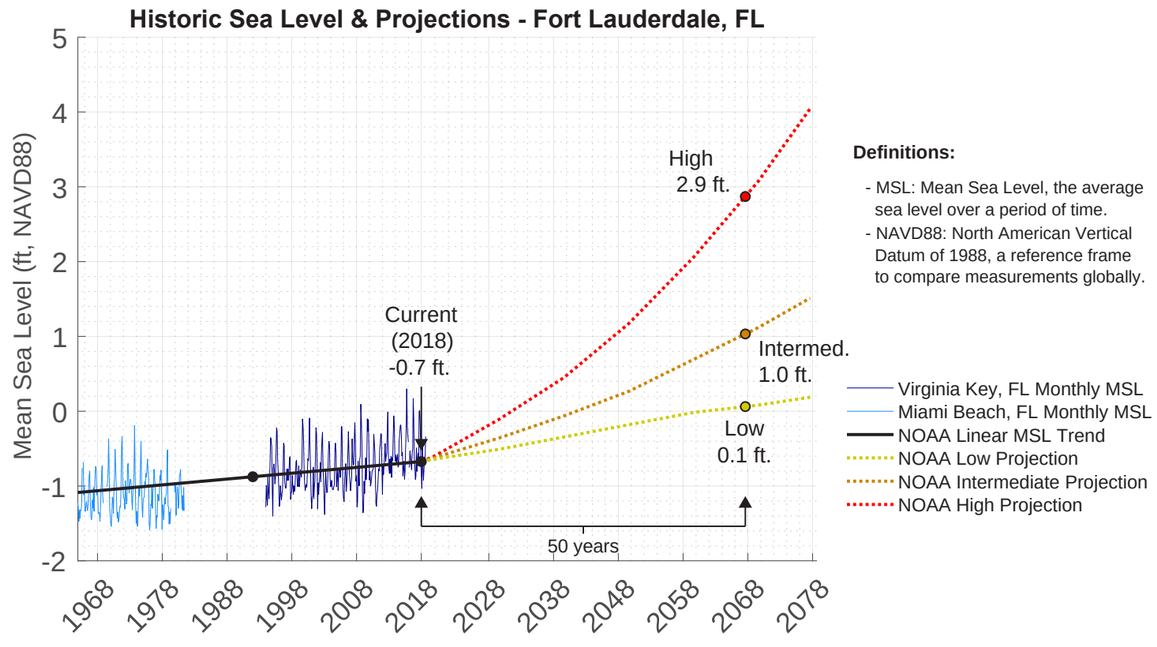
Brizaga has developed a metric called the Adaptation Action Elevation. The Adaptation Action Elevation is the highest elevation at which the tidal flooding is expected to reach during a given year, excluding extreme events like hurricanes. Currently (2018), the Adaptation Action Elevation for Broward County is 2.1 ft. NAVD. It is recommended that adaptation actions be taken now for any critical components located below this elevation. Using the high curve projection of 3.5 feet of sea level rise in the next 50 years, the 50-year Adaptation Action Elevation is 5.6 feet NAVD. Any critical building components or other infrastructure located below the 50-year Adaptation Action Elevation is recommended to be retrofitted or replaced within that 50-year timeframe to reduce risk of flood damages from tidal flooding events. However, considering the assumed permanency of cemeteries, special considerations should be taken now.

The sea level rise projections published by the National Oceanic and Atmospheric Administration (NOAA) are shown in the figure below. The high curve as indicated by the SFRCC is colored red.

[1] https://www.cbsnews.com/news/louisiana-flooding-caskets-calcasieu-parish/
[2] https://miami.cbslocal.com/2011/11/03/rain-forces-graves-above-ground-in-fla-cemetery/
[3] http://www.broward.org/Environment/Engineering/Pages/GroundwaterMaps.aspx
[4]http://www.southeastfloridaclimatecompact.org/wp-content/uploads/2015/10/2015-Compact-Unified-Sea-Level-Rise-Projection.pdf

	Future Conditions Groundwater Elevation (NAVD)	Average Ground Elevation Estimate* (NAVD)
Woodlawn	2.5 ft.	6.3 ft.
Lauderdale Memorial Park	2.5 ft.	7.3 ft.
Evergreen	1.5 ft.	8.5 ft.
Sunset Memorial Gardens	3.0 ft.	8.1 ft.

* Based on topographic survey data provided by KEITH.



Definitions:

- MSL: Mean Sea Level, the average sea level over a period of time.
- NAVD88: North American Vertical Datum of 1988, a reference frame to compare measurements globally.

Understanding historic sea level and future projections:

- Historic data is from tidal gauges and future projections are based on the best available science and models.
- The range in projections (from low to high) is mostly due to uncertainty in how much ice on land will melt.
- In the past 86 years (since 1932), we've seen 0.7 feet of sea level rise at Virginia Key, FL (0.9 in/decade).
- In the next 50 years, the best projection is for between 0.7 and 3.5 feet of sea level rise (1.8 - 8.5 in/decade).

This plot is provided by Brizaga for prelimary planning purposes only. It is based on the best-available data and science, and is subject to change. Please consult with us regarding threshold and projection selection, as well as if you require more detailed information for planning purposes. To contact us, email contact@brizaga.com or call (954) 834-3533.

Based on analyzing the four cemeteries specifically in regards to sea level rise and salt water intrusion, the following are general recommendations that should be followed in efforts of planning for the resiliency of the four cemeteries.

EXISTING INFRASTRUCTURE & BUILDINGS

It is recommended that existing structures within the cemeteries be evaluated on an individual basis for specific adaptive capacity. Overall, the structures are not expected to experience significant flooding due to groundwater inundation in the next 30-40 years. However, as previously noted, when groundwater rises, the capacity for the ground to hold rainwater also decreases. This will be the first significant flood risk due to sea level rise.

Long term, there is a concern with existing mausoleum or columbaria becoming inundated by groundwater or rainwater due to reduced groundwater capacity. Exploration of adaptation methods for these buildings, including raising the structure or relocating the lowest level columbaria slots, will have to be done on a case-by-case basis.

FUTURE INFRASTRUCTURE & BUILDINGS

It is recommended that future infrastructure and buildings be constructed in consideration of the NOAA High Curve looking as far out as the lifetime of the facility. Furthermore, the building should be built with flexible adaptability, with the ability to raise the structure or employ other methods to ensure longevity and reduce flood risk. Additional measures around the building, such as water retention areas, can also reduce flood risk.

EXISTING BURIAL PLOTS

Determining how to handle flooding concerns with existing burial plots is likely one of the most challenging question regarding sea level rise. The limestone substrate provides a unique challenge for South Florida. Once groundwater is within 6 feet of the ground surface, existing burial plots will become inundated. One concern will be regarding recently buried caskets not placed within a concrete burial vault. These caskets may be buoyant, disturbing the earth above the casket when groundwater levels get too high. However, caskets within concrete burial vaults will likely withstand any buoyancy issues due to groundwater inundation. Longer-term, the City will have to consider how to preserve sites that may be permanently inundated by groundwater.

FUTURE BURIAL PLOTS

To explore areas of the cemeteries that may have issues related to burial plot operations and maintenance, areas where future groundwater elevations are projected to be within 6 feet of the existing ground surface (the normal depth of burial) should be considered.

In addition to the City-owned cemeteries, a broader discussion on below-ground interment in the face of rising sea levels and groundwater is necessary. This may include the requirement for all caskets to be placed in concrete vaults. It does not appear that vaults are required by law or ordinance, but this measure should be considered a best practice when dealing with potential of groundwater inundation.

CASE STUDY: COHASSET CENTRAL CEMETERY

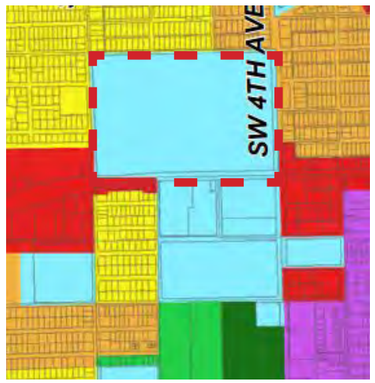
Cohasset Central Cemetery is a historic burial ground in Cohasset, Massachusetts of about 4.5 acres that slopes towards Little Harbor.[5] Tidal flooding has disrupted the low-lying areas of the cemetery, and the Board of Directors has recognized flooding and sea level rise as a primary concern. The Board of Directors is exploring options to bring in fill and raise the ground above existing burial plots up to 2 feet to alleviate flooding concerns in the near-term. The Board of Directors of the cemetery does not currently have a longer-term plan, leaving the decision to future generations.[6]

[5] *http://cohassetcentralcemetery.com/*
[6] *http://www.patriotledger.com/news/20180625/good-age-her-family-graves-are-flooding-in-cohasset*

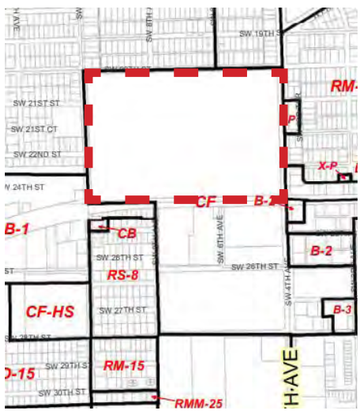
LAUDERDALE MEMORIAL PARK

2100 SW 4th AVE.

LAUDERDALE MEMORIAL PARK IS THE LARGEST OF THE 4 CEMETERIES AT *55.8 Acres. It was established in 1945 and consists of 50,181 burial locations. As of January, 2018, there were 8,381 burial spaces available. This cemetery offers full burials, a cremation garden, mausoleums, cremains niches, private hedge estates as well as private family mausoleums. This site also houses the location of the main office for cemetery staff and a maintenance building. The land use and zoning designations are Community Facilities. The site was platted in 1946 and can be found in plat book 22, page 23 as Lauderdale Memorial Park. The size and age of this cemetery both lend to its unique character . There are clusters of large mature shade trees providing a peaceful shaded atmosphere yet still much space for future growth and continued operation.*



Future Land Use: Community Facilities



Zoning Map: CF

0 100 200 400

1”=200’


2001
LAUDERDALE MEMORIAL PARK


GENTLEMAN JOE, DAD, POP-POP & FRIEND
JOEY'S PLACE, BEAVERS, POLITICS, UFFDA
BREAKFAST CLUB, APRON, DOLPHINS, VEGAS
ARE, YOU LISTENING TO ME? ZIPPER UP!
MAY GOD BLESS & KEEP YOU SAFE
WE LOVE YOU. THIS IS A TRUE STORY!
KEUPER
JOEY


ALONSO
TERESA D.
SEPT. 14, 1939
TWO SOULS
ONE HEART
TOGETHER
WITH GOD FOREVER
CAMACHO


PRIVATE ESTATES™
THIS FAMILY ESTATE IS
AVAILABLE
INQUIRE IN OFFICE
LAUDERDALE 954-745-2140


SCUDDER FAMILY

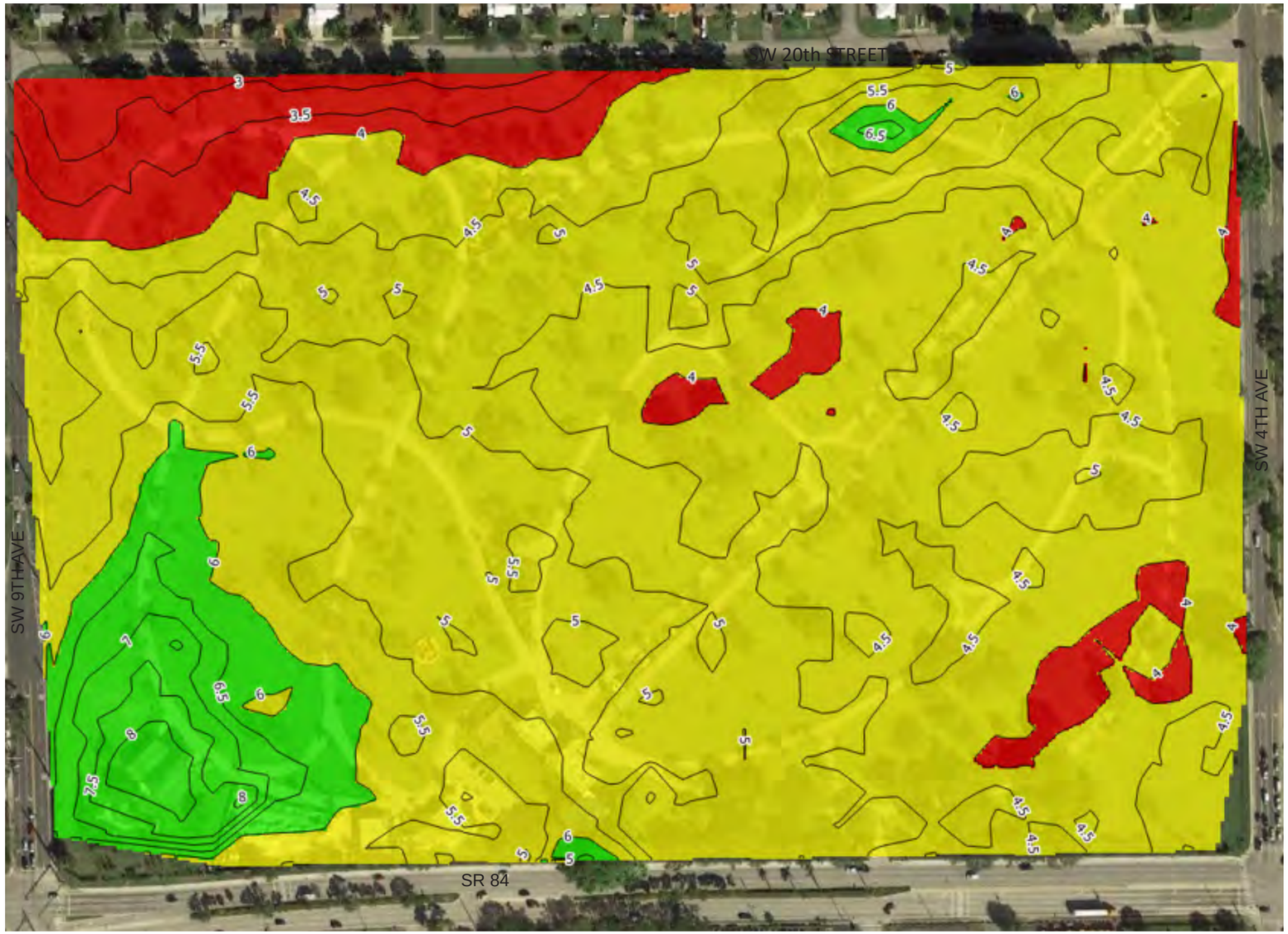
LAUDERDALE MEMORIAL PARK

A significant portion of the northwestern quadrant of Lauderdale Memorial is expected to have groundwater within 4 feet of the surface, with most of the cemetery having groundwater within 6 feet of the surface by 2060.

FUTURE CONDITIONS GROUNDWATER ELEVATION (NAVD): *2.5 FT.*

AVERAGE GROUND ELEVATION ESTIMATE* (NAVD): *7.3 FT.*

**Based on Topographic Survey Data provided by KEITH*



0 100 200 400

1”=200’

LEGEND: GROUNDWATER ELEVATIONS

within 4’ below existing grade

4’ - 6’ below existing grade

6’ or more below existing grade

LAUDERDALE MEMORIAL PARK

EXISTING INFRASTRUCTURE

- SPECIMEN CANOPY TREE TO BE PRESERVED
- WATER LINE
- VEHICULAR ENTRANCE
- VEHICULAR CIRCULATION
- BIKE LANE
- BOUNDARY LINE
- SPECIALTY AREA
- PERIMETER FENCE
- BUILDING STRUCTURE

OPPORTUNITIES

- SIGNAGE OPPORTUNITY
- PROPOSED STREET DEMOLITION
- PROPOSED PEDESTRIAN CORRIDOR
- PROPOSED PEDESTRIAN ENTRANCE
- REORGANIZED MAINTENANCE AREA
- OPPORTUNITY SPACE

0 100 200 400

1”=200’

1. **REDUCE AND REORGANIZE MAINTENANCE AREA**
   MINIMIZING THE AREA OF THE MAINTENANCE YARD BY USING A MORE VERTICAL SHELF / STACKING SYSTEM WILL CREATE MORE AREA TO BE USED FOR BURIAL SPACE AND STAFF PARKING.

2. **EXPAND EXISTING CREMATION GARDEN**

3. **EXPAND PRIVATE FAMILY ESTATE AREA**

4. **NEW MAUSOLEUM BUILDING**
   SEE EXHIBIT ON SHEET X

5. **TRANSFORM VEHICULAR DRIVES INTO PEDESTRIAN PATHS**

6. **ADD PEDESTRIAN ENTRANCES FROM NEIGHBORHOODS**

7. **ELIMINATE VEHICULAR ENTRANCE AND CREATE FOUNTAIN PLAZA**
   SEE EXHIBIT ON SHEET X

AN EXAMPLE OF A POTENTIAL PROJECT COULD BE BUILDING A NEW MAUSOLEUM AT LAUDERDALE MEMORIAL PARK.

A new Mausoleum could provide up to 200 additional internment spaces thus extending the longevity of active internments. Keep in mind the spacial organization of the area and notice how constructing an additional building in this area would enclose an area of space within the buildings that could be redesigned to provide either a passive scatter garden space or, a designated area to hold outdoor memorial ceremonies.

AN EXAMPLE OF A POTENTIAL PROJECT COULD BE TRANSFORMING THE *former entrance from SR 84 into a water feature with enhanced landscaping. This type of feature could also be a dedicated memorial for a specified group such as police or first responders lost in duty. Any future proposed features such as this should be vetted through public process and require input from the Cemetery Advisory Board as well as any other significant cemetery stakeholders.*

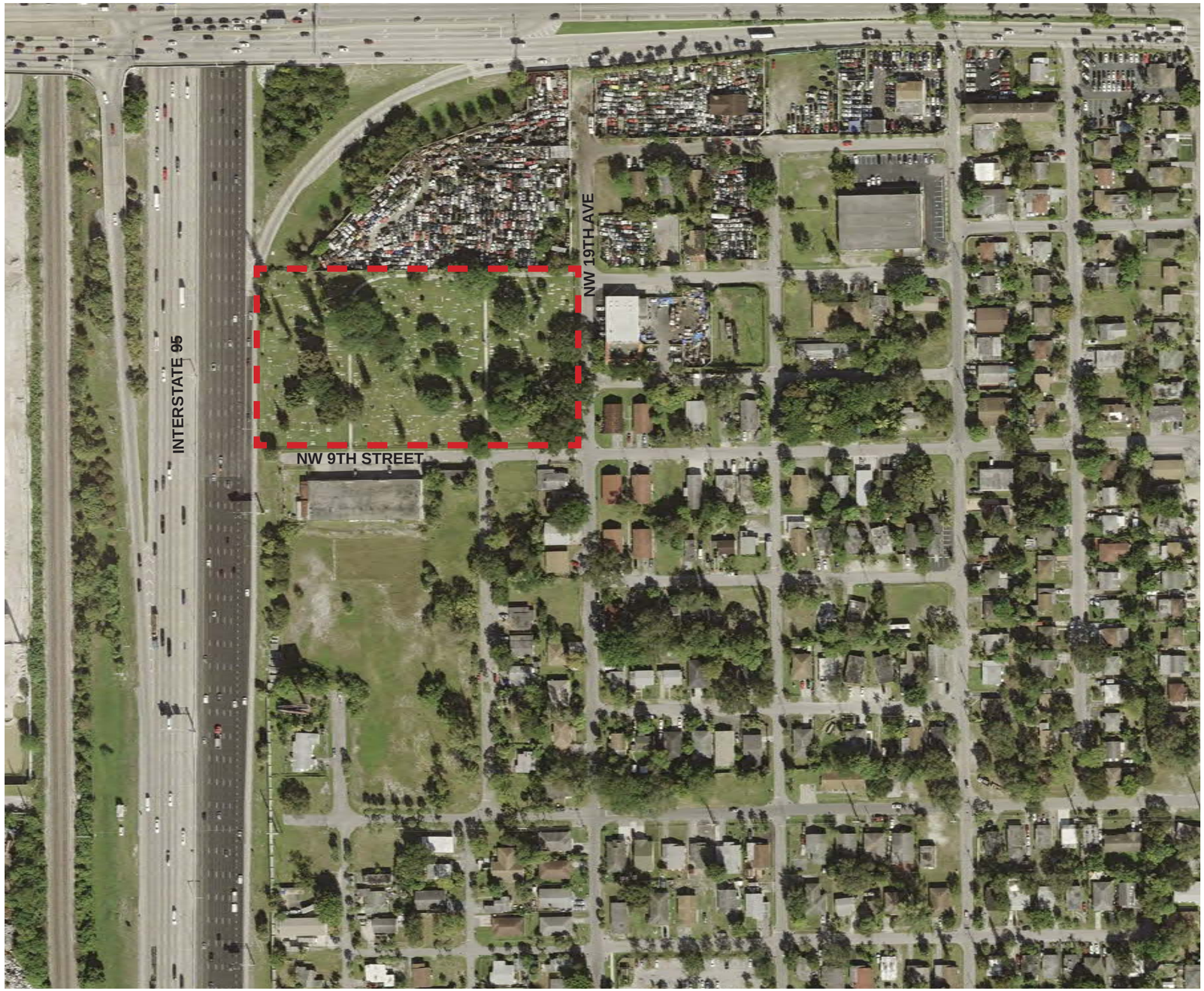
HISTORIC WOODLAWN CEMETERY

1936 NW 9TH STREET

WOODLAWN CEMETERY WAS ESTABLISHED IN 1926 AND SITS ON A 5 *acre site adjacent to I-95. In 1940 the site was platted by the Woodlawn Cemetery Association. The plat can be found in Plat Book 19, page 1. The land use designation is Northwest Regional Activity Center and is a part of the Northwest Progresso-Flagler Heights Community Redevelopment Area. Zoning designation is Community Facility. The City of Fort Lauderdale took ownership in 2002 after the property was abandoned by the previous owners. Although no official records exist, it is believed that there are approximately 2,200 burials, with only 571 graves marked. On November 29, 2017 the cemetery was officially listed on the National Register of Historic Places. Woodlawn is the historical resting place of many pioneering African-American residents. Currently, burials are not permitted in Woodlawn due to the lack of records, but this master plan provides potential opportunities for future expansion.*

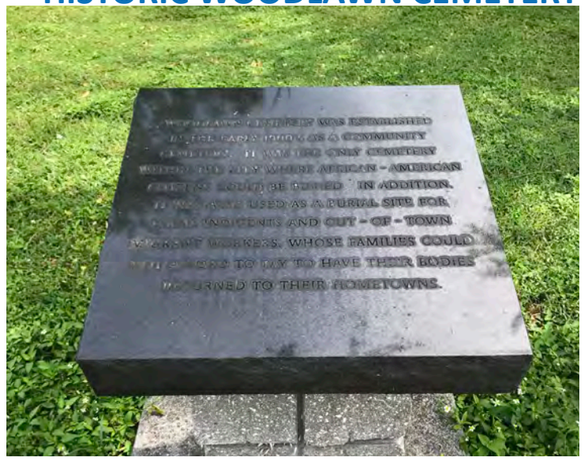
Future Land Use: South Regional Activity Center

Zoning Map: CF
North West- Progresso-Flagler Heights CRA



0 100 200 400
1”=200’

HISTORIC WOODLAWN CEMETERY



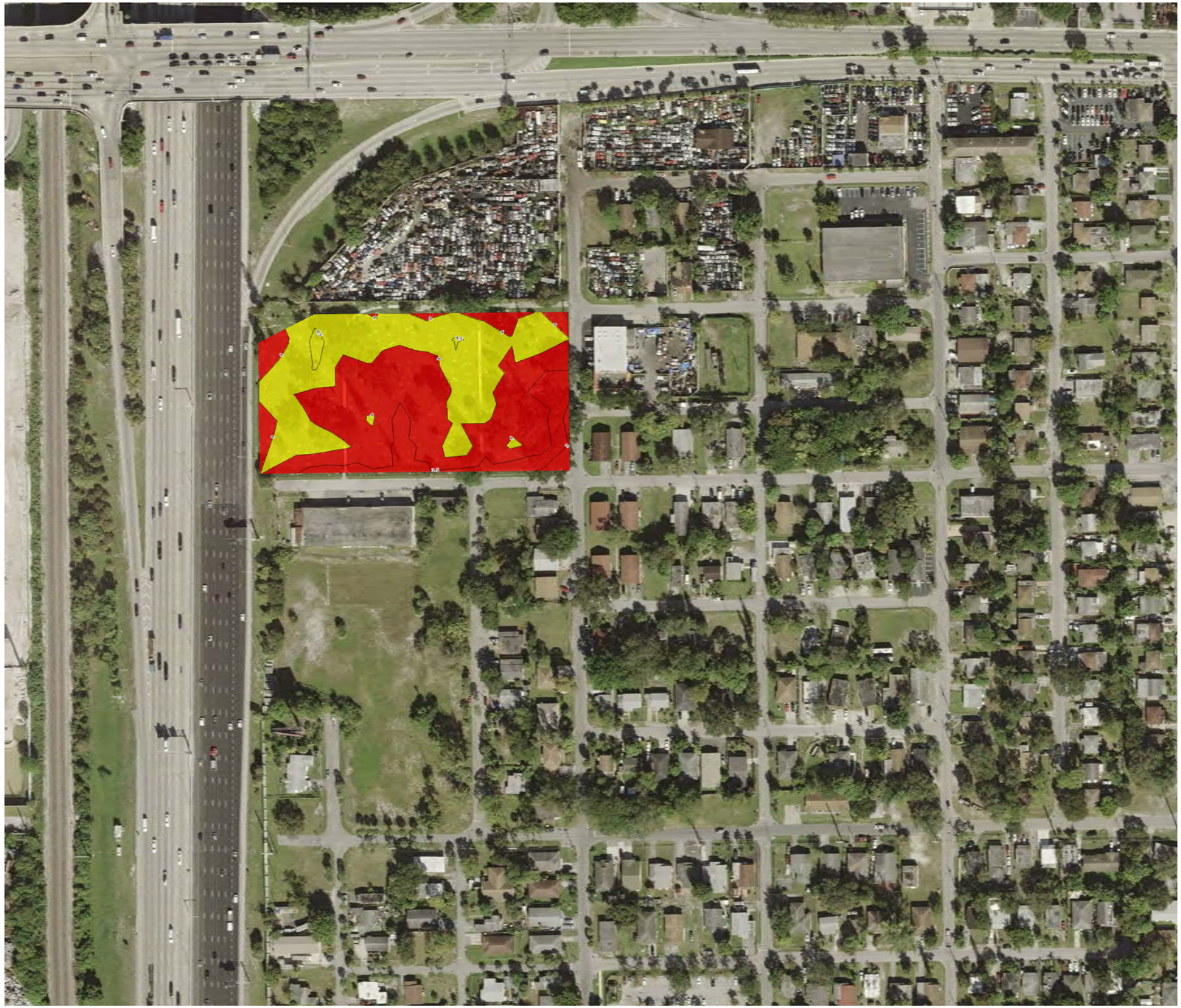
HISTORIC WOODLAWN CEMETERY

A significant portion of Historic Woodlawn Cemetery is expected to have groundwater within 4 feet of the surface, with some of the cemetery having groundwater within 6 feet of the surface by 2060.

FUTURE CONDITIONS GROUNDWATER ELEVATION (NAVD): *2.5 FT.*

AVERAGE GROUND ELEVATION ESTIMATE* (NAVD): *6.3 FT.*

**Based on Topographic Survey Data provided by KEITH*



0 100 200 400

1”=200’

LEGEND: GROUNDWATER ELEVATIONS

within 4’ below existing grade

4’ - 6’ below existing grade

6’ or more below existing grade

INVENTORY & ANALYSIS

EXISTING INFRASTRUCTURE

- SPECIMEN CANOPY TREE TO BE PRESERVED
- WATER LINE
- VEHICULAR ENTRANCE
- VEHICULAR CIRCULATION
- PEDESTRIAN CORRIDOR
- BOUNDARY LINE
- PERIMETER FENCE
- SPECIALTY AREA

OPPORTUNITIES

- SIGNAGE OPPORTUNITY
- PROPOSED PEDESTRIAN CORRIDOR
- PROPOSED PEDESTRIAN ENTRANCE
- OPPORTUNITY SPACE

0 100 200 400

1”=200’

1. PROPOSED PEDESTRIAN PATH FOR LOOPED WALK

2. SIGNAGE OPPORTUNITY FACING I-95

3. CITY OWNED PARCELS FOR POTENTIAL FUTURE CEMETERY EXPANSION

4. PARTIAL PARCEL TO BE ACQUIRED BY CITY FOR POTENTIAL FUTURE EXPANSION

5. EVALUATE THE FEASIBILITY OF ENTERING A USE AGREEMENT BETWEEN CITY AND FDOT TO UTILIZE THIS AREA AS A PEDESTRIAN CONNECTION

AN EXAMPLE OF A POTENTIAL PROJECT COULD CONSTRUCTING AN ICONIC

sign to be seen from 1-95, pointing out Woodlawn as a Historic feature of the city. Thousands of people drive by every day and are likely unaware of the History and significance they are passing on a daily basis.

AN EXAMPLE OF A POTENTIAL PROJECT COULD CONSTRUCTING AN ICONIC

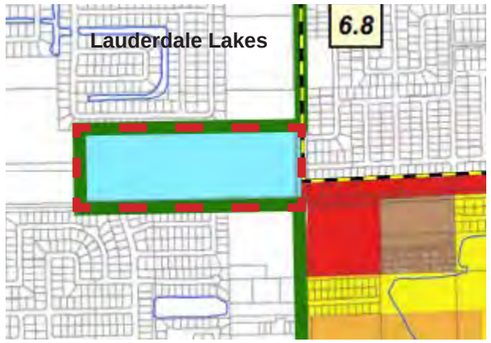
sign to be seen from 1-95, pointing out Woodlawn as a Historic feature of the city. Thousands of people drive by every day and are likely unaware of the History and significance they are passing on a daily basis.


WOODLAWN

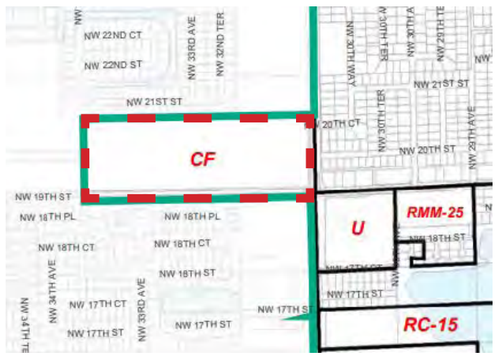
SUNSET MEMORIAL GARDENS CEMETERY

3201 NW 19TH STREET

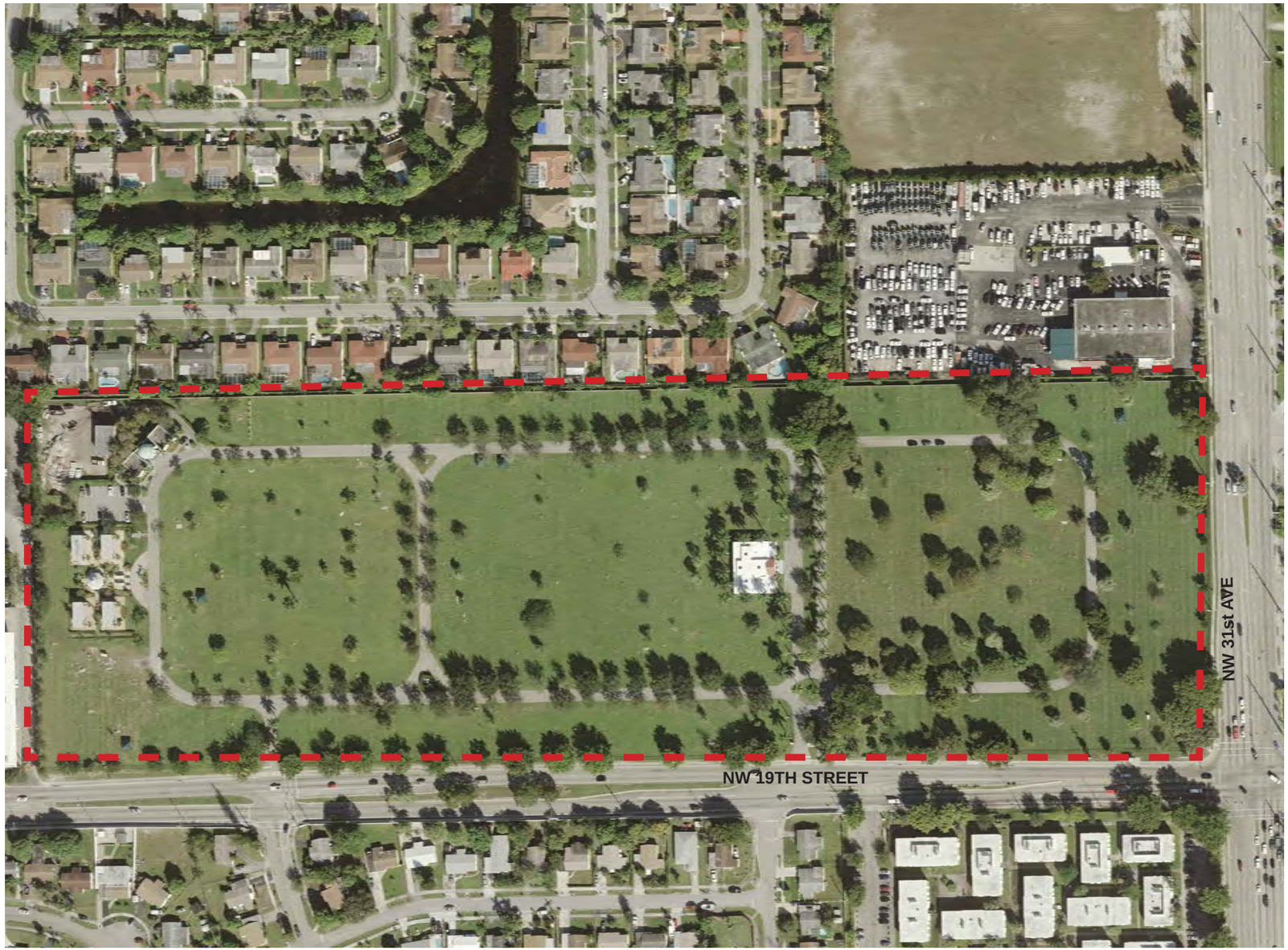
SUNSET MEMORIAL GARDENS IS THE SECOND LARGEST OF THE 4 *cemeteries at 30 acres. It was established and platted in 1961, by the City of Fort Lauderdale as Sunset Memorial Gardens, Plat Book 55, page 4. The Land Use and Zoning designations are both Community Facility. As of January 2018, 5,115 spaces of the 26,622 total burial spaces were available. Sunset currently offers full burials, a community mausoleum, cremation niches and private hedge estates. There is a business office and maintenance building on site. This cemetery hosts the area's largest luminary event annually and historically, it has been the burial grounds for the African-American Community.*



Future Land Use: Community Facilities



Zoning Map: CF



0 100 200 400

1" = 200'


3201
SUNSET
MEMORIAL GARDENS
CEMETERY & MAUSOLEUMS


MICHAELENE CLARKE


15
MILES
PER
HOUR

SUNSET MEMORIAL GARDENS CEMETERY

A small portion towards the West side of Sunset Memorial Gardens Cemetery is expected to have groundwater within 4 feet of the surface, with the majority of the cemetery having groundwater within 6 feet, or more, of the surface by 2060.

FUTURE CONDITIONS GROUNDWATER ELEVATION (NAVD): *3.0 FT.*

AVERAGE GROUND ELEVATION ESTIMATE* (NAVD): *8.1 FT.*

**Based on Topographic Survey Data provided by KEITH*

LEGEND: GROUNDWATER ELEVATIONS

within 4’ below existing grade

4’ - 6’ below existing grade

6’ or more below existing grade

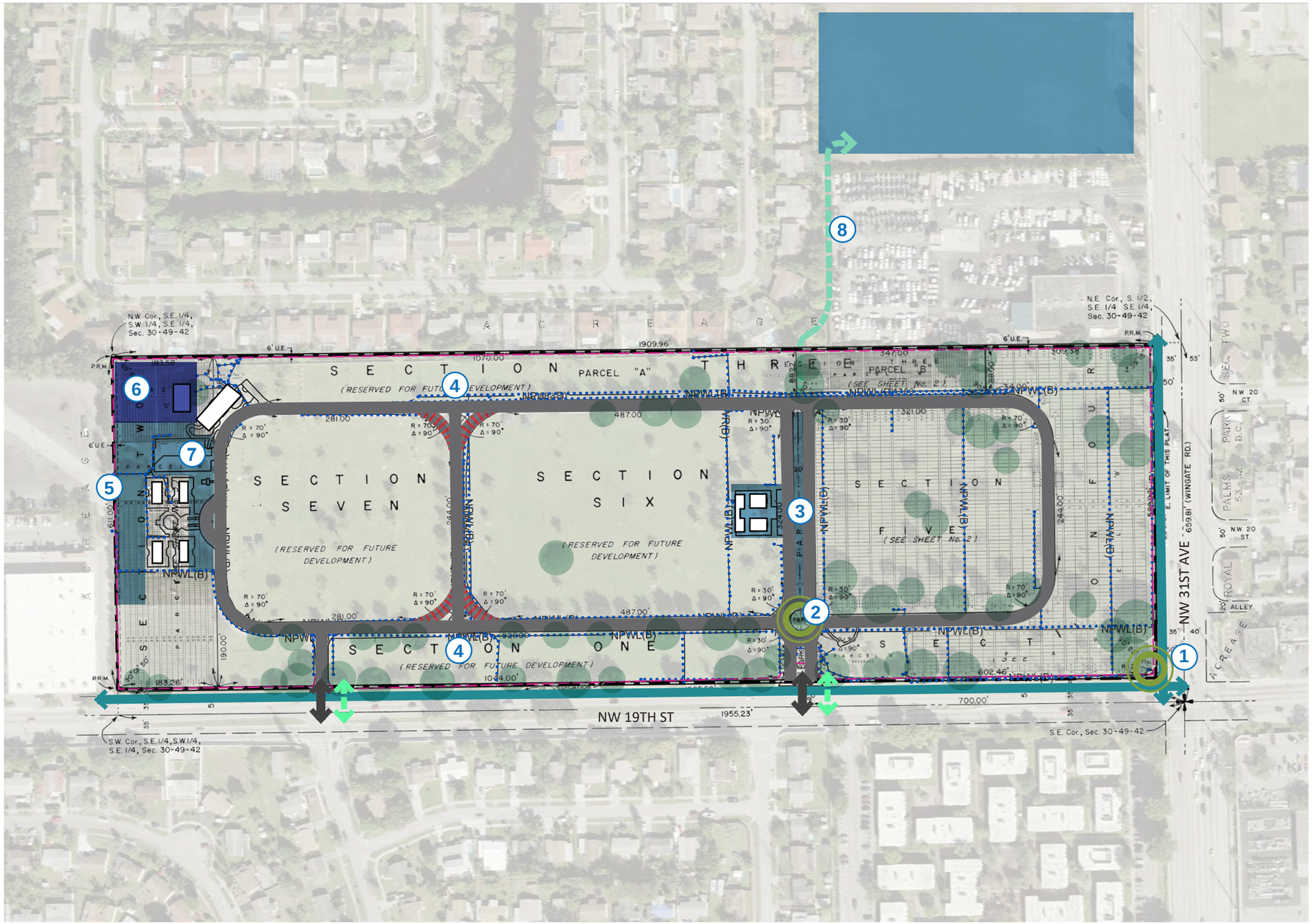
SUNSET MEMORIAL GARDENS CEMETERY

EXISTING INFRASTRUCTURE

- SPECIMEN CANOPY TREE TO BE PRESERVED
- WATER LINE
- VEHICULAR ENTRANCE
- VEHICULAR CIRCULATION
- BIKE LANE
- PEDESTRIAN CORRIDOR
- BOUNDARY LINE
- PERIMETER FENCE
- BUILDING STRUCTURE

OPPORTUNITIES

- SIGNAGE OPPORTUNITY
- PROPOSED STREET DEMOLITION
- PROPOSED PEDESTRIAN CORRIDOR
- PROPOSED PEDESTRIAN ENTRANCE
- REORGANIZED MAINTENANCE AREA
- OPPORTUNITY SPACE



0 100 200 400

1”=200’

1. SIGNAGE OPPORTUNITY ON CORNER OF NW31ST AVE AND NW 19TH ST
2. SIGNAGE OR MONUMENT OPPORTUNITY IN ROUNDABOUT AT MAIN ENTRANCE
3. USABLE SPACE IN MEDIAN
4. SIMPLIFY INTERSECTION CREATING MORE USABLE LAND FOR BURIALS
5. OPPORTUNITY FOR MEMORIAL/BUFFER WALL
6. REORGANIZE MAINTENANCE AREAS
7. SPACE FOR NEW MAUSOLEUM
8. CONNECTION TO POTENTIAL AVAILABLE PARCEL (IN CITY OF LAUDERDALE LAKES)

AN EXAMPLE OF A POTENTIAL PROJECT COULD BE CONSTRUCTING A

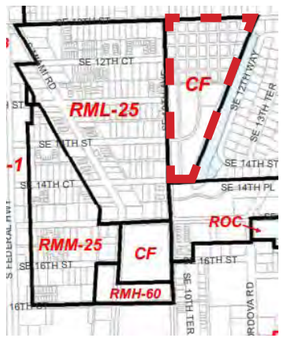
memorial wall and scatter garden at the west end of the cemetery where there is approximately 15' of usable open space. This would also provide a buffer to the adjacent neighbors which is currently an eye sore to the site.

HISTORIC EVERGREEN CEMETERY

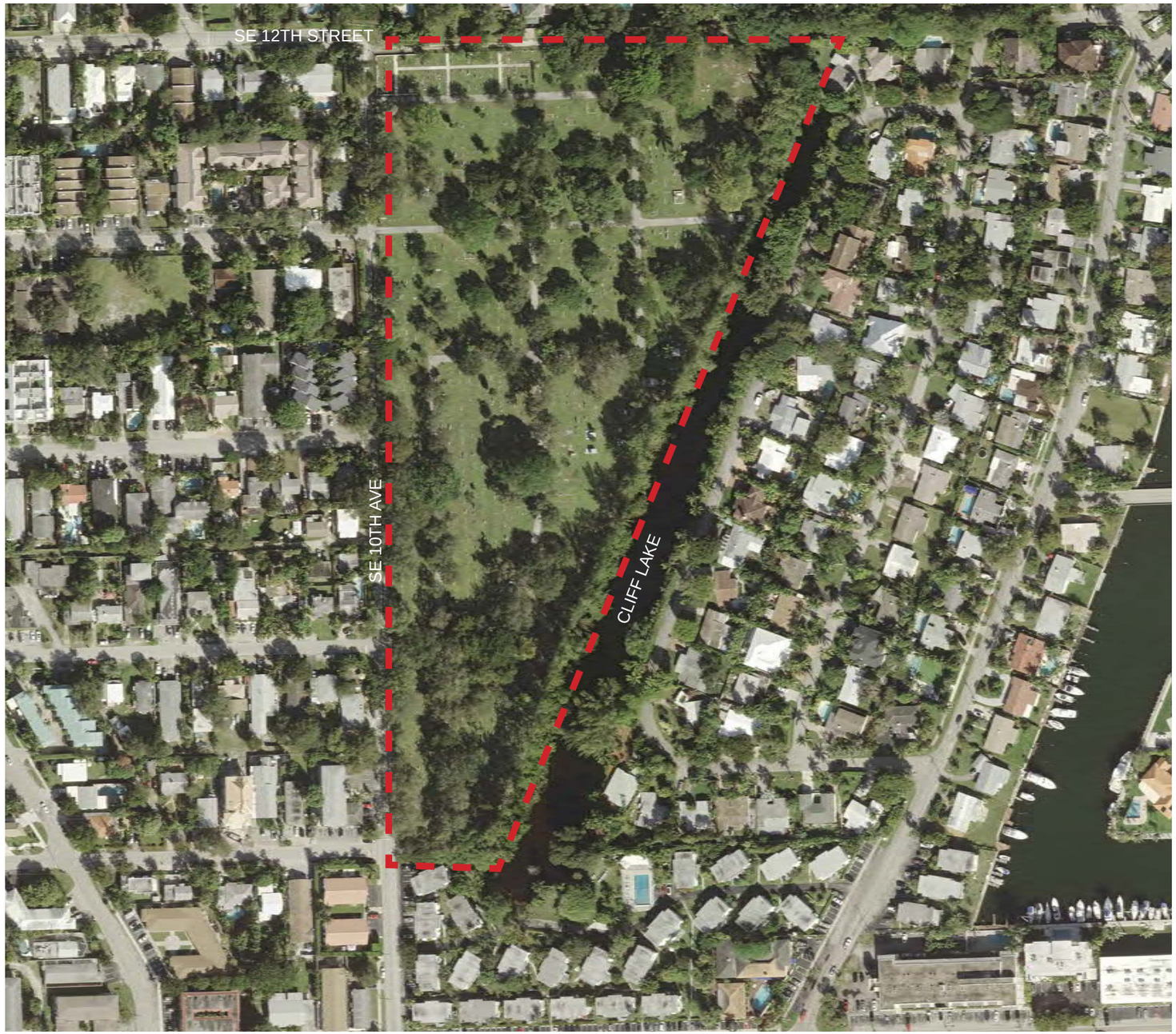
1300 SE 10TH AVE

HISTORIC EVERGREEN CEMETERY IS ONE OF THE OLDEST CEMETERIES *in Broward County, established in 1910. It is 11 acres. It was originally established as a private cemetery by a pioneering family, The Kings. The city of Fort Lauderdale began to acquire the land in 1917 one parcel at a time, hence the reason for multiple plats. Plats: Evergreen Cemetery (Plat Book 2, page 5), Evergreen Cemetery First Addition (Plat Book 19, page 7), Evergreen Cemetery Second Addition (Plat Book 22, page 21), Evergreen Cemetery Third Addition (Plat Book 73, page 7). The land use and zoning designations are Community Facilities. Today, Evergreen Cemetery is the resting place of Fort Lauderdale's pioneering families and is one of the most-admired locations because of its heritage. There are sections for congregations of the Fort Lauderdale Hebrew Association located here. Evergreen is set on Cliff Lake and the grounds are filled with lush mature trees that provide a serene setting amongst the historic monuments and markers. The cemetery currently has plots available and sites for private family mausoleums.*

Future Land Use:
Community Facilities

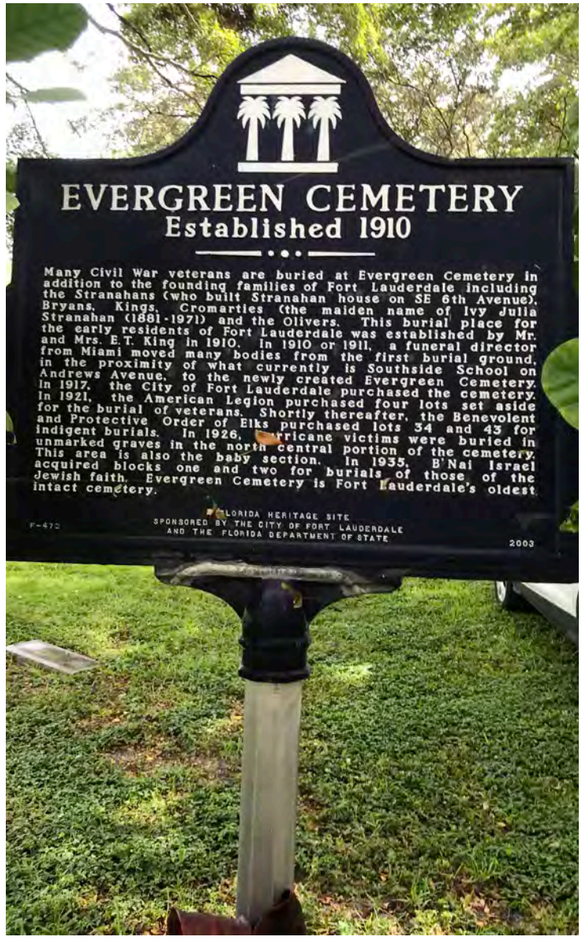


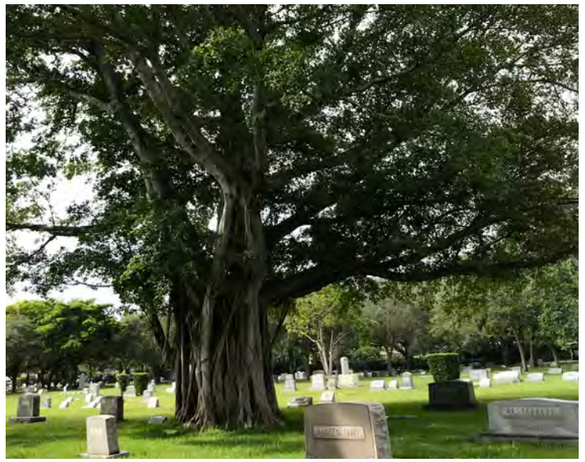
Zoning Map: CF

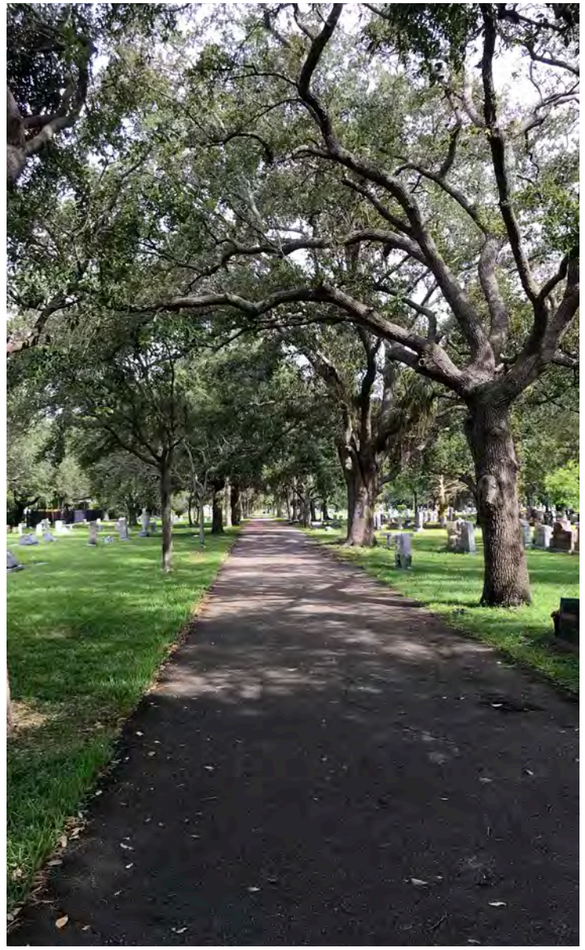


0 100 200 400
1"=200'

HISTORIC EVERGREEN CEMETERY







HISTORIC EVERGREEN CEMETERY

There are no areas of Evergreen where groundwater is expected to be within 4 feet of the existing ground surface, shaded red on the maps. The western portion of the cemetery is expected to have groundwater within 6 feet of the surface.

FUTURE CONDITIONS GROUNDWATER ELEVATION (NAVD): *1.5 FT.*

AVERAGE GROUND ELEVATION ESTIMATE* (NAVD): *8.5 FT.*

**Based on Topographic Survey Data provided by KEITH*

0 100 200 400

1”=200’

LEGEND: GROUNDWATER ELEVATIONS

within 4’ below existing grade

4’ - 6’ below existing grade

6’ or more below existing grade

HISTORIC EVERGREEN CEMETERY

EXISTING INFRASTRUCTURE

- SPECIMEN CANOPY TREE TO BE PRESERVED
- WATER LINE
- VEHICULAR ENTRANCE
- VEHICULAR CIRCULATION
- BIKE LANE
- BOUNDARY LINE
- PERIMETER FENCE
- PEDESTRIAN CORRIDOR
- BUILDING STRUCTURE

OPPORTUNITIES

- SIGNAGE OPPORTUNITY
- PROPOSED STREET DEMOLITION
- PROPOSED PEDESTRIAN CORRIDOR
- PROPOSED PEDESTRIAN ENTRANCE
- OPPORTUNITY SPACE

1. TRANSFORM VEHICULAR DRIVES INTO PEDESTRIAN PATHS

2. REMOVE ROAD

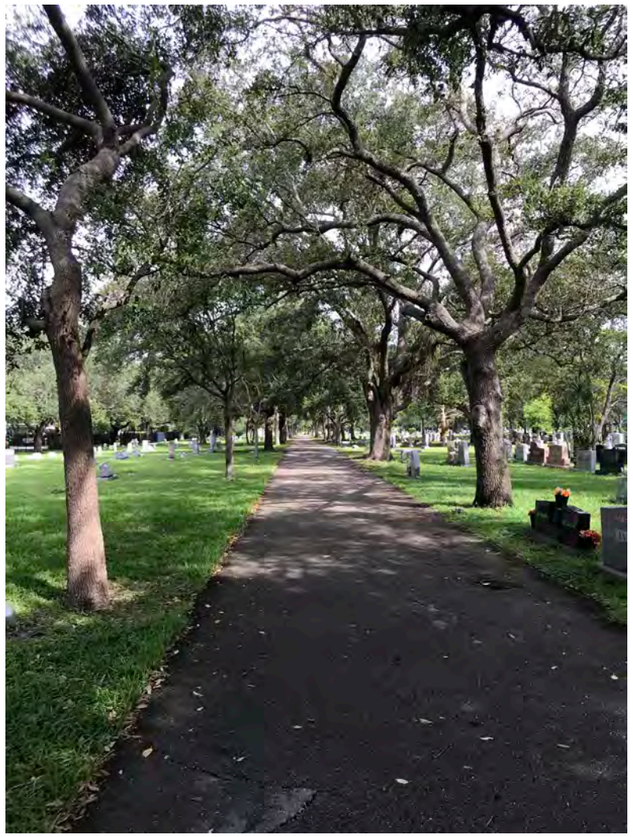
3. UTILIZE LAND FOR ADDITIONAL BURIAL SPACE/

4. INVESTIGATE EROSION CONCERNS AT EDGE OF CLIFF LAKE. CONSIDER THE USE OF OVERLOOKS/ACCESS TO THE LAKE AS UNIQUE MEMORIAL SPACE

5. NEW ENTRY AND WAYFINDING SIGNAGE THROUGHOUT

AN EXAMPLE OF A POTENTIAL PROJECT COULD BE CONVERTING SOME *OF the vehicular drives to pedestrian paths, or in some cases at evergreen, eliminate the road all together. This will provide additional burial/memorial space thus generating revenue and lengthening the active internment of the cemetery.*

BEFORE



AFTER

OVERALL, GENERAL RECOMMENDATIONS FOR IMPROVEMENTS *and growth of the four Fort Lauderdale Cemeteries can be summed up into the following three categories: Customer Care/Experience, Operations & Maintenance and Pilot Projects. It is recommended the board utilize this this list as a menu of projects to choose from when planning for the future success of the cemeteries.*

CUSTOMER CARE/EXPERIENCE

- *WEBSITE AND COLLATERAL - $125,000*
- *DISPLAY GRAPHICS AND MAPS - $25,000*
- *SIGNAGE AND WAYFINDING - $50,000*
- *DATABASE & DIGITAL INVENTORY - $25,000*
- *EXPANDED VIDEO/DIGITAL MEMORIAL OPPORTUNITIES ****** - $25,000*

OPERATIONS & MAINTENANCE

ONE TIME EXPENSES
- *IRRIGATION UPGRADES - $750,000*
- *EXISTING TREE CARE AND PRESERVATION - $25,000*
- *REPAIR AND MAINTAIN BROKEN SITE ELEMENTS - $75,000*

ANNUAL EXPENSES
- *CURRENT ANNUAL OPERATION AND MAINTENANCE EXPENSES ARE ESTIMATED AT $250,000, IT IS RECOMMENDED TO INCREASE ANNUAL EXPENSE BUDGET TO $375,000 TO CONTINUE OVERALL MAINTENANCE AND OPERATIONS OF THE 4 CEMETERIES*

PILOT PROJECTS

LAUDERDALE MEMORIAL PARK CEMETERY
- *REORGANIZE MAINTENANCE AREA ****** - $35,000*
- *NEW MAUSOLEUM ****** - $1,500,000*
- *CONVERT VEHICULAR PATHS TO PEDESTRIAN ****** - $200,000*
- *FOUNTAIN FEATURE AT SR 84 ENTRANCE DRIVE - $175,000*
- *NEW SIGN AT SR 84 - $25,000*

SUNSET MEMORIAL GARDENS CEMETERY
- *NEW SIGNAGE AT INTERSECTION OF NW 19TH & NW 31ST AVE - $25,000*
- *CONVERT VEHICULAR PATH TO PEDESTRIAN ****** - $75,000*
- *REORGANIZE MAINTENANCE AREA ****** - $35,000*
- *TWO NEW MAUSOLEUMS ****** - $1,000,000*
- *NEW MEMORIAL WALL/SCATTER GARDEN AT WEST END - $75,000*
- *EXPAND TO OPEN CHURCH PARCEL TO THE NORTH ****** - COST TBD*

HISTORIC EVERGREEN CEMETERY
- *CONVERT VEHICULAR PATH TO PEDESTRIAN ****** - $75,000*
- *BUILD MEMORIAL WALL FOR BURIALS AT SEA ****** - $50,000*
- *EXPAND TO CITY OWNED PARCEL TO THE NORTH (ALLEY) ****** - COST TBD*
- *PROVIDE ACCESS TO WATER - $35,000*
- *PROVIDE KEY SIGNAGE THROUGHOUT - $25,000*

HISTORIC WOODLAWN CEMETERY
- *ICONIC SIGNAGE FACING I-95 - $125,000*
- *NEW PEDESTRIAN PATHWAY - $15,000*
- *UPDATE WALL FOR MEMORIAL ****** - $25,000*
- *NEW SHADE STRUCTURES - $50,000*
- *EXPAND TO EXISTING CRA OWNED LAND TO THE SOUTH ****** - COST TBD*

********INDICATES PILOT PROJECTS THAT WILL PROVIDE ADDITIONAL BURIAL/ MEMORIAL SPACE THUS GENERATING REVENUE AND LENGTHENING THE ACTIVE INTERMENT OF THE CEMETERIES*

Executive Summary

The City of Fort Lauderdale Parks and Recreation department has requested the assistance of qualified professionals to aid in master planning of four existing cemeteries. As part of the overall master planning effort, Masuen Consulting (through Keith) will be providing guidance for the irrigation system planning at each cemetery.

The City has requested that the age and performance of each irrigation system be evaluated to determine repair and improvement needs. The City also desires input on future planning, upgrades, and methods to reduce water consumption.

Masuen Consulting has visited each site to inspect irrigation system equipment including existing points of connection, pumps, mainline, valves, heads, nozzles, and related irrigation infrastructure. Maintenance and management of the system has been recently transitioned from a third-party service provider to city staff. In general, much of the existing equipment is dated and is likely requiring more labor and expense to maintain and manage than what could be achieved if each system were upgraded. Further, irrigation management can likely be improved as much of the system operation is currently manual.

Recommendations in this report include a variety of improvements and upgrades to equipment in the field and modifications to management methods. The lense through which these recommendations are viewed and made is one of long term sustainability, resiliency and overall value. It is expected by incorporating these recommendations the City will save time and money maintaining these cemetery locations, provide attractive aesthetic pleasing sites, and give the city flexibility to adapt to future changes for many years to come.

Introduction

Masuen contacted the City of Fort Lauderdale and Keith staff to coordinate several site visits over a two-week period between October 26 and November 9, 2018. The primary source for information related to the irrigation system was obtained through these site visits which were partially aided by city representative Trevor Jackson. Staff guided Masuen through the sites and discussed general observations, issues, and concerns. Masuen then test-ran the systems and recorded detailed observations for all sites.

In the following report, observations have been noted for each site individually with specific recommendations outlined in order of general cost/benefit. While some modifications are more costly, other modifications, like management of the irrigation scheduling, are relatively in-expensive and can result in large water (and cost) savings.

Historic Evergreen Cemetery

Overview

Evergreen Cemetery is a smaller cemetery originally established in 1910 which still has plots available. Through purchasing of parcels, the City has slowly grown the cemetery to a total of approximately 11 acres of mostly lawn area with trees interspersed. Maps and mainline information from the City indicate the cemetery is served by a potable meter looped through cemetery rights-of-way. The existing controller is located in a small building on-site.

Figure 1 - Evergreen Cemetery Location Map. Field visit markups are available in the Appendix of this report.

Existing Condition

In general, Evergreen Cemetery was found to have more-modern equipment in relatively good condition. Irrigation is accomplished with electric valves from the irrigation controller and a map was available for staff to utilize in identifying zones. A detailed breakdown of components is shown on the following pages.

- POC (Point of Connection): 2" Neptune T-10 potable water meter (Meter No. 14001585) with 2" Febco 720 PVB backflow. Static pressure of 51 psi and dynamic pressure (while

being operated) of 48 psi were observed. Both items appeared to be in acceptable condition and functioning properly.

Figure 2 - Evergreen Cemetery point of connection.

- Mainline: Routing generally follows the map created from City GIS information (see Figure 1). Two locations were pot-holed and 3" PVC mainline was observed at both locations; however, the type of PVC (Schedule 40, Class 160, Class 200, etc.) could not be confirmed.
- Valves: Mostly 1-1/2" and 2" electronically controlled valves. Irritrol 200B series and Rain Bird PESB valves were observed throughout the site. Several valves were accompanied by free-standing hose bibs which are primarily utilized for watering flowers around headstones. Pictures of a typical valve can be found on the following page (figure 3). Flows for each valve were identified in the 40-45 gpm range by observing the water meter flow during operation.

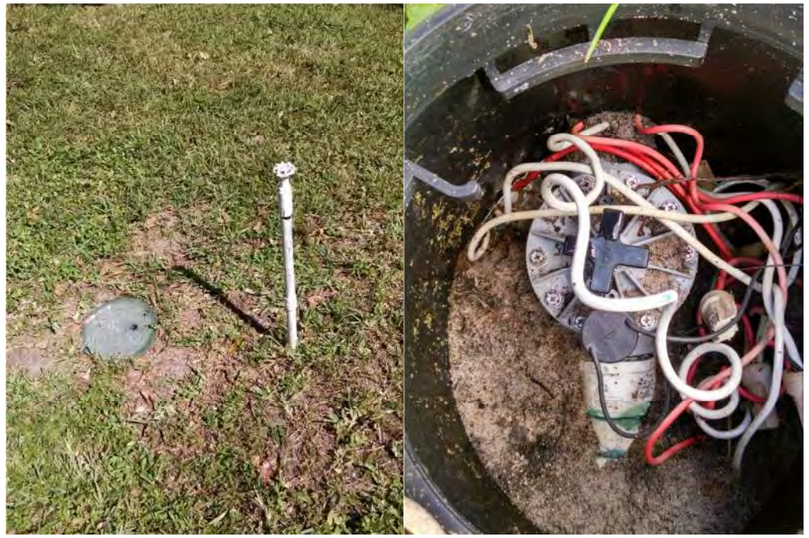


Figure 3 - Valve and hose bib (typ.) on left. Valve with associated wiring on right.

- Heads: All heads observed at this site were Rain Bird 5000 rotor heads (see figure 4) ranging in spacing from 32-48 ft. Other than some sunken/titled heads, and poor head-to-head coverage at the higher spacings (40'+), no major issues were observed. All heads utilized identical 3.0gpm nozzles for all arcs and radii of throw. Pressure ranged from 39-48 psi.

Figure 4 - Rain Bird 5000 head in ground.

- Controller: Primary controller is a Rain Bird ESP-LXME 24 station in relatively good condition with two stations open. A second Rain Bird ESP-LX 16 Plus was present, but was not powered (despite being wired) or being utilized (figure 5).

Figure 5 - Evergreen Cemetery controllers. ESP-LXME in lower left (in-use) and ESP LX-16 Plus in upper right (currently unused).

- Rain Sensor: Neither controller at the site had a rain switch connected and no rain sensors were observed.
- Management: Schedules were obtained during site visits and station schedules are shown below. Start time for all irrigation is set for 8:00PM and 4 events per week. City staff indicated that simple modifications to number of days and run time are completed based on seasonal requirements.

Table 1 - Typical Evergreen Cemetery scheduling.

STA 1 -45min	STA 2 -40min	STA 3 -20min	STA 4-20min
STA 5-20min	STA 6 -20min	STA 7 -20min	STA 8-20min
STA 9 -20min	STA 10 -20min	STA 11 –20min	STA 12- 20 min
STA 13 -20min	STA 14 -20min	STA 15 -20min	STA 16 -20min
STA 17 -20min	STA 18 -20min	STA 19 -20min	STA 20 -20min
STA 21 -20min	STA 22 -20min	STA 23 -0min	STA 24 – 0min

Recommendations

Since Evergreen Cemetery has relatively modern equipment, it is recommended a thorough maintenance effort be completed to correct minor issues with heads, nozzles, and valves throughout to get the system operating as efficient as possible with its existing configuration. A thorough wet-check will help identify minor issues and develop a strategy to address all items in the most efficient manner possible. Additional specific recommendations are listed below:

1) A rain or other environmental sensor should be added so the system can respond to changes in precipitation, at minimum. This addition is an inexpensive option that can help achieve significant water savings and is required by state law.
2) Install a GPRS module to the primary ESP-LXME controller and add the controller to an overall central control irrigation system. For a small expenditure, central control offers a plethora of benefits like remote scheduling, the ability to respond to larger environmental changes like evapotranspiration and rainfall, and easier operation, to name a few.
3) Add a master valve and flow sensor for remote monitoring purposes. These components work together to help the irrigation team effectively monitor and respond to problems with the system.

Note: Overall general design, central control monitoring, and management recommendations can be found towards the end of this report.

Lauderdale Memorial Park Cemetery

Overview

Lauderdale Cemetery is a 56-acre cemetery originally established in 1945 and is active with a large amount of plots still available. In addition to the cemetery, the park contains a veteran's garden to honor all veterans that have served the country. The park has a main office and maintenance building and consists mostly of lawn area with trees interspersed. Maps and mainline information from the City indicate the cemetery is served by two wells with pump stations serving roughly ½ of the park each (split East and West). There are also three 2" potable water meters in the SW corner of the property and another 2" in the NE corner.

Figure 6 - Lauderdale Cemetery location map. Field visit markups are available in the Appendix of this report.

Existing Condition

Lauderdale Cemetery has a mix of modern and old equipment corresponding to the pump stations that serve the East and West halves of the property. While some irrigation is accomplished with electric valves from an irrigation controller (primarily West), the remainder of the irrigation is accomplished with large impact heads connected manually via quick-coupler. City staff indicated irrigating with the large impact heads was a significant time commitment. A detailed breakdown of components is shown on the following pages.

- Well/Pump POC's (Points of Connection):
  - South Pump Station – 8" well with 5 hp Baldor jockey pump, spec #36A003R706GI. IQ Intelligent Pump Controller 1000. 40 hp North American Electric, In. Cat PE286JM-40-2 3-phase electric motor and Goulds pump 21BFKT with 9.5" impeller and IQ Intelligent Pump Controller. Operating pressure is set to be maintained at 70psi.
  - West Pump Station – 6" well with 5 hp Baldor jockey pump, spec #36A003R706GI. IQ Intelligent Pump Controller 1000. 50 hp North American Electric, In. Cat PE326JM-50-2 3-phase electric motor and Goulds pump 21BFKT with 9.5" impeller and IQ Intelligent Pump Controller. Operating pressure is set to be maintained at 70psi.

Figure 7 - Typical pump station and well configuration (West well and pump station pictured).

- Potable POC's (Points of Connection):
  - Northeast Gate – One 2" Febco 720 PVB backflow with static pressure of 54 psi and dynamic pressure of 51 psi. One 2" meter was found with no lid/number.
  - Behind Main Office – One Febco 909 RPZ backflow with static pressure of 48 psi and dynamic pressure of 46 psi.
  - Southwest Park Corner (between office and mausoleum) – One Febco 765 PVB backflow with static pressure of 58 psi and dynamic pressure of 52 psi. Three, 2"

Figure 8 - Typical water meter and backflow device (Northeast entrance POC pictured).

- Mainline: Routing generally follows the map created from City GIS information (see Figure 6). Size is known to vary between 4" and 6" PVC lines. Note that with so much interconnected mainline, it is difficult to determine how the entire pipe network may/may not be interconnected.
- Valves: Where electronic valves are utilized (West), Rain Bird 3" PGA RCV's were found. In areas with impact rotors (East), 3/4" Buckner quick couplers were observed.

Figure 9 - Quick coupler for impact rotor use.

Figure 10 - Typical Rain Bird PGA RCV, note silt/sediment depth.

- Heads: Five types of heads were observed.
  - In the older areas of the park, Nelson SR100 impact rotors are manually installed on quick couplers and moved from QC to QC by city staff. Spacing was approximately 120-130 ft; however, heads only operated with a ~90-95 ft throw distance and pressure varied from 40-60 psi.
  - Rain Bird Falcon 8005 rotors with 5" pop-up height utilizing #16 and #18 nozzles, operating at 45-50 psi, and located at 40-60' spacing.
  - Rain Bird 5004 series rotors with 4" pop-up height utilizing all 3.0 gpm nozzles regardless of arc, operating at ~40 psi, and located on 48-50' spacing.
  - Rain Bird 6504 series rotors with 4" pop-up height utilizing #14 nozzles, operating at ~40 psi, and located at 40-50' spacing.
  - Rain Bird 1804 sprays with 4" pop-up height utilizing MPR nozzles and located on 10 or 15 ft spacing

All heads irrigated turf consisting mainly of St. Augustine grass with medium to high density or shrub areas with medium density.

Figure 11 – Nelson SR 100 impact rotors found in East half of park.

Figure 12 - Rain Bird 5000 head found in West half of park.

Figure 13 - Rain Bird 1800 head found in West half of park.

- Controllers: Five controllers were observed at this site.
  - East Mausoleum – Rain Bird ESP-ME with 15 utilized stations and 12 spare wires.
  - West Mausoleum – Rain Bird ESP-ME with 3 stations utilized, 1 open, and 1 spare wire.
  - West Pump Station – Rain Bird ESP with 5 stations utilized and 4 spare wires.
  - South Pump Station – Rain Bird ESP-LXD with 9 stations utilized and 41 open.
  - Behind Main Office – Rain Bird ESP-ME with 7 stations utilized, 1 open, and 1 spare wire.

Figure 14 - Rain Bird ESP-LXD 2-wire controller at South pump station.

- Rain Sensor: None of the controllers at this site had a rain sensor connected and no rain sensors were observed.
- Management:
  - For electronically controlled areas, sample run times obtained during site visits is shown on the following page (see table 2 - all controllers showed similar parameters for this site). For the run times shown, start time is set for 12:00AM and scheduled to run 7 days per week. City staff indicated that simple modifications to number of days and run time are completed based on seasonal requirements.
  - For impact rotor areas, City staff indicated that frequency is 3 times per week and heads are moved every 45 minutes. Human error could be affecting efficiency of the system as the rotors must be manually placed on quick couplers and left for a desired amount of time.

Table 2 - Typical run times for the West Mausoleum.

STA 1 -30min	STA 2 -30min	STA 3 -30min	STA 4-41min
STA 5 – 30min	STA 6- 30min	STA 7 – 30min	STA 8- 40min
STA 9 – 40min	STA 10 – 40min	STA 11 – 40min	STA 12- 40min
STA 13 – 40min	STA 14 – 0min	STA 15 – 0min	STA 16 – 0min

Recommendations

Lauderdale Memorial park has a variety of connection points and configurations spread out over a large area. Consolidating controllers and points of connection where possible will aid in check will help identify minor issues and develop a strategy to address all items in the most efficient manner possible. Additional specific recommendations are listed below:

1) Solve potential pump/well issues. Jockey pumps had to be used to prime the main pumps. This indicates that pumps are either losing prime during the irrigation cycle or at some time during the night. During later site visits, the pump issues had vanished after a gasket was replaced. It may be possible that there are still issues remaining at the site. Pump logs should be closely monitored for further issues.
2) A rain or other environmental sensor should be added so the system can respond to changes in precipitation, at minimum. This addition is an inexpensive option that can help achieve significant water savings and is required by state law.
3) Upgrade older impact rotor portions of the system to more-modern rotors and valves using the block/valve concept. Automating irrigation will save significant amounts of time, effort, and cost.
4) Make all heads throughout the site more consistent. The wide variety of heads, nozzles, and equipment found throughout the site are much more difficult to maintain. Standardizing equipment and ensuring matched precipitation rate irrigation will help in management of the system.
5) Once an As-Built has been completed, determine ways to consolidate and combine portions of the system to more effectively manage irrigation.
6) Install a GPRS module to remaining controllers after combination or new controllers, if installed, and add controllers to an overall central control irrigation system. For a small expenditure, central control offers a plethora of benefits like remote scheduling, the ability to respond to larger environmental changes like evapotranspiration and rainfall, and easier operation, to name a few.
7) Add master valves and flow sensors for remote monitoring purposes. These components work together to help the irrigation team effectively monitor and respond to problems with the system.

Note: Overall general design, central control monitoring, and management recommendations can be found towards the end of this report.

Sunset Memorial Gardens Cemetery

Overview

Sunset Memorial Gardens Cemetery is a 30-acre cemetery originally established in 1961 and is active with a large amount of plots still available. A special luminary event occurs at the site each year. The park has a main office and maintenance building and consists mostly of lawn area with trees interspersed. Maps and mainline information from the City indicate the cemetery is served by two wells with pump stations. There are also two 2" potable water meters – one on the right side of the entrance and one at the sales office.

Figure 15 - Sunset Memorial Cemetery location map. Detailed maps are available in the Appendix of this report.

Existing Condition

Similar to the Lauderdale Memorial Park site, the Sunset Memorial Gardens Cemetery has a mix of modern and older equipment spread across the property. While some irrigation is accomplished with electric valves from the irrigation controller, the remainder of the irrigation is accomplished with large impact heads on quick couplers. Multiple points of connection and multiple controllers are present, but some controllers were found in the off position because of an

- Well/Pump POC's (Points of Connection):
  - East Pump Station – 4" well with 5 hp Baldor jockey pump, spec #36A003R706GI. IQ Intelligent Pump Controller 1000. 50 hp North American Electric, In. Cat PE326JM-50-2 3-phase electric motor and Goulds pump 21BFKT with 9.5" impeller and IQ Intelligent Pump Controller. Operating pressure is set to be maintained at 70psi.
  - West Pump Station – 6" well with 5 hp Baldor jockey pump, spec #36A003R706GI. IQ Intelligent Pump Controller 1000. 50 hp North American Electric, In. Cat PE326JM-50-2 3-phase electric motor and Goulds pump 21BFKT with 9.5" impeller and IQ Intelligent Pump Controller. Operating pressure is set to be maintained at 70psi.

Figure 16 - One of two pump stations serving site (East pump station pictured).

- Potable POC's (Points of Connection):
  - East of South Entrance – One 2" Febco 720 PVB backflow. Meter and backflow were closed because of nearby road construction.
  - Sales Office – One Febco 825Y RPZ backflow with static pressure of 68 psi and dynamic pressure of 65 psi.

Figure 17 - Potable points of connection serving site.

- Mainline: Routing generally follows the map created from City GIS information (see Figure 15). City staff indicated that repairs to this mainline have all been with 6" PVC.

- Valves: Where electronic valves are utilized in the smaller areas, Rain Bird 2" PGA RCV's were found. In general, these needed maintenance as there was significant sedimentation/silt inside valve boxes.

Figure 18 - Typical low flow valve on-site.

Figure 19 - Typical valve found on-site. Note silt/sedimentation.

- Heads: Five head types were found at this site. In general, pressure and nozzle selection for all head types was insufficient to achieve head-to-head coverage.
  - Nelson SR 100 impact rotors were found spread throughout the open lawn areas. Some of these rotors were installed permanently and others were on quick-couplers. An errant modern hunter I-90 was found on a riser. Spacing was approximately 128 ft.

Figure 20 - Above grade impact rotor and modern rotor found on-site.

- Irritrol adjustable bubblers – many of which were screwed all the way down to the "off" position.
- Rain Bird 1804 spray heads with 4" pop-up height utilizing MPR nozzles and located on 12 or 15 ft spacing.
- Rain Bird 5004 series rotors with 4" pop-up height utilizing 3.0 gpm nozzles and located on 35-45 ft spacing.
- Rain Bird Eagle 950 rotors with 2.25" pop-up height utilizing orange nozzles at 48 psi, black nozzles at 46 psi and located on ~80 ft spacing.

Figure 21 - Bubbler and spray heads found on-site.

- Controllers: Five controllers were observed at this site.
  - East Mausoleum – Rain Bird ESP Modular with 3 utilized stations and 1 open. This controller did not have power at time of observation.
  - Sales Office – Rain Bird ESP-ME with 8 utilized stations and 2 open.
  - East Pump Station 1 – Rain Bird ESP Modular with 1 utilized stations and 6 open.
  - East Pump Station 2 – Rain Bird ESP-ME with 8 utilized stations and 2 open.
  - West Pump Station – Rain Bird LXME with 32 stations utilized and zero open.

Figure 22 - One of multiple controllers found on-site (controller near mausoleum pictured).

Figure 23 - One of the controllers found in the "off" position.

- Rain Sensor: Rain sensors were not observed at this site.
- Management: Similar to the Lauderdale Memorial site, there are two management

- For electronically controlled areas, sample run times obtained during site visits is shown on the following page (see table 3 - all controllers showed similar parameters for this site). For the run times shown, start time is set for 9:00PM and scheduled to run 7 days per week. City staff indicated that simple modifications to number of days and run time are completed based on seasonal requirements.
- For impact rotor areas, frequency is similar at 3 times per week and heads are moved every 45 minutes. Human error could be affecting efficiency of the system as the rotors must be manually placed on quick couplers and left for a desired amount of time.

Table 3 - Sample run times from the West pump station controller.

STA 1 -20min	STA 2 -20min	STA 3 -20min	STA 4-20min
STA 5-20min	STA 6 -20min	STA 7 -20min	STA 8-20min
STA 9 -20min	STA 10 -20min	STA 11 –20min	STA 12- 20 min
STA 13 -20min	STA 14 -20min	STA 15 -20min	STA 16 -20min
STA 17 -20min	STA 18 -20min	STA 19 -20min	STA 20 -20min
STA 21 -20min	STA 22 -20min	STA 23 -20min	STA 24 – 20min
STA 25 -20min	STA 26 -20min	STA27 -20min	STA 28 – 20min
STA 29 – 0min	STA 30 -0min	STA31 – 0min	STA 32 – 0MIN

Recommendations

Sunset Memorial Gardens has a mix of older and more modern equipment spread across a large area. Consolidating controllers and points of connection where possible may aid in overall management of the property. Based on observations in the field, there are existing issues with the system and mainline that could be more-easily identified and responded-to with control improvements. As with all sites, a thorough maintenance effort should be completed to correct minor issues with heads, nozzles, and valves throughout. A thorough wet-check will help identify minor issues and develop a strategy to address all items in the most efficient manner possible. Additional specific recommendations are listed below:

1) A rain or other environmental sensor should be added so the system can respond to changes in precipitation, at minimum. This addition is an inexpensive option that can help achieve significant water savings and is required by state law.
2) Upgrade older impact rotor portions of the system to more-modern rotors and valves using the block/valve concept. Automating irrigation will save significant amounts of time, effort, and cost.
3) Make all heads throughout the site more consistent. The wide variety of heads, nozzles, and equipment found throughout the site are much more difficult to maintain.
4) Once an As-Built has been completed, determine ways to consolidate and combine portions of the system to more effectively manage irrigation.
5) Install a GPRS module to the primary ESP-LXME controller and add the controller to an overall central control irrigation system. For a small expenditure, central control offers a plethora of benefits like remote scheduling, the ability to respond to larger environmental changes like evapotranspiration and rainfall, and easier operation, to name a few.
6) Add a master valve and flow sensor for remote monitoring purposes. These components work together to help the irrigation team effectively monitor and respond to problems with the system.

Note: Overall general design, central control monitoring, and management recommendations can be found towards the end of this report.

Woodlawn Cemetery

Overview

Woodlawn Cemetery is a small, older 5-acre cemetery. The cemetery was acquired by the city to preserve its heritage as a historical resting place for some of the first residents of the area. The cemetery is no longer active as burial and plotting records do not exist. Maps and mainline information from the City indicate the cemetery is served by two points of connection with a linear irrigation mainline serving portions of the cemetery.

Figure 24 - Woodlawn Cemetery location map. Field visit mark-ups obtained during the site visit are available in the Appendix of this report.

Existing Condition

For an older cemetery that is no longer active, the in-field equipment was modern with electric valves controlling rotors and spray heads. Two controllers were found at the site – both of which were battery operated, but neither had power and both appeared to have been offline for some time. One of the controllers was observed on its side at the beginning of the site visit. City staff indicated that they have been unable to open the controllers as they do not have the correct keys. A detailed breakdown of components is shown on the following pages.

- POC's (Points of Connection): Two 2", Febco PVB's found near the entrance to the cemetery. Each of two 2", Neptune meters serves irrigation associated with a single controller. Both backflows showed static pressures of 66 psi and dynamic pressures of 61 and 64 psi.

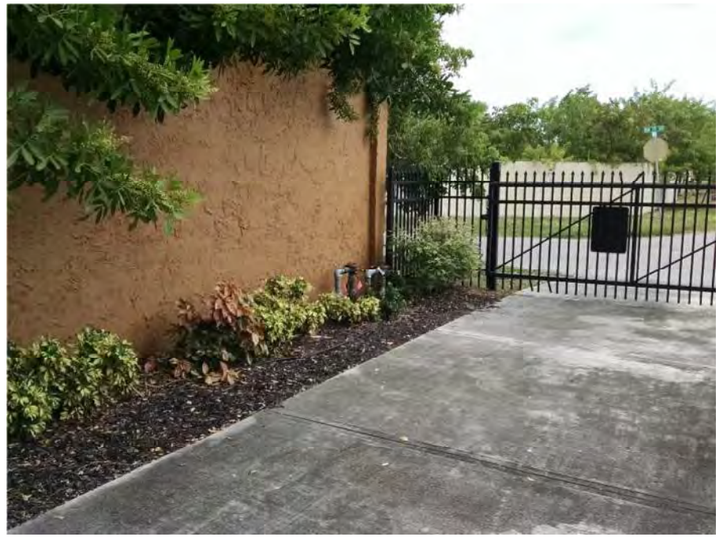


Figure 25 - Location of points of connection.

- Mainline: Routing generally follows the map created from City GIS information (see Figure 24 in overview section). A pothole was dug and confirmed a 3" PVC line of unknown type.
- Valves: All valves found at the site were Rain Bird PGA 150 valves with DC latching solenoids to operate with the battery operated controllers. Valves all flowed approximately 90 gpm which was verified by observing meter flow.

Figure 26 - Typical valves found on-site (concrete valve boxes).

- Heads: Two types of heads were found at the site.
  - Rain Bird 1804 sprays with 4" pop-up height utilizing 9' side strip nozzles and 10', 180 degree nozzles depending on coverage area.
  - Rain Bird Falcon 6504 rotors with 4" pop-up height utilizing blue and green nozzles for full circle arcs, spacing at ~50 ft and pressures of 20-30 psi.
  - 

Figure 27 - Spray and rotor heads found on-site.

- Controllers: Two Irritrol battery-operated controllers were found at the park – both of which were not operational. When discussed with City staff, it was unknown how long these controllers may have been offline as the correct keys were not on-hand.
  - Controller 1 – Irritrol IBOC+ with 7 stations utilized and 1 open.
  - Controller 2 – Irritrol IBOC+ with 5 stations utilized and 3 open.

Figure 28 - One of two controllers found on-site. Neither controller currently was powered.

- Rain Sensor: A mini-click rain sensor was present for each controller, but both were in a state of dis-repair, and neither was wired or being utilized to prevent irrigation.
- Management: Since neither controller was operational, all management information is based on City staff feedback. City staff indicated that irrigation would be scheduled to occur 3 times per week. Start time for all irrigation would be set for 12:30AM and all zones would be scheduled for 20 minutes each. Simple modifications to number of days and run time are completed based on seasonal requirements. It is unknown how long the site has been non-operational or how irrigation is currently being accomplished.

Recommendations

Woodlawn cemetery is a smaller cemetery with a fairly simple configuration; however, since the system has been non-operational for some time, there may been hidden maintenance items that need to be addressed. A thorough wet-check will help identify minor issues and develop a strategy to address all items in the most efficient manner possible. Specific recommendations are listed below:

1) Install a new controller with hard-wired power. This site has likely not operated for a long period of time. Hard-wiring power from a nearby street lamp or other source will help get this system back up and running and allow it to be connected to a central control system. A Rain Bird IQ compatible controller is recommended. *This upgrade would require the DC latching solenoids to be replaced for all valves to properly operate with an AC power source*.
2) The rain sensors found at the site should be replaced and/or upgraded so the system can respond to changes in precipitation, at minimum. This addition is an inexpensive option that can help achieve significant water savings and is required by state law.
3) Heavy maintenance. Observations indicate that the site hasn't received adequate attention in the past and likely has major maintenance issues. Included in heavy maintenance should be standardization of nozzles to ensure matched precipitation rates can be achieved.
4) Install a GPRS module to the primary ESP-LXME controller and add the controller to an overall central control irrigation system. For a small expenditure, central control offers a plethora of benefits like remote scheduling, the ability to respond to larger environmental changes like evapotranspiration and rainfall, and easier operation, to name a few.
5) Add a master valves and flow sensors for remote monitoring purposes. These components work together to help the irrigation team effectively monitor and respond to problems with the system.

Note: Overall central control, monitoring, and management recommendations can be found on the following page of this report.

Overall Recommendations

In addition to/conjunction with the site-specific recommendations found previously in the report, Masuen recommends the following overall system additions to better aid ongoing irrigation maintenance and management.

1) Create detailed irrigation as-builts of all sites. Knowing the location, size, spec, materials, routing, etc. of all sites is invaluable when troubleshooting, scheduling, and in general, managing an irrigation system. A firm should be hired to GPS as-built all existing components.
2) Re-design portions of the irrigation system which have severe coverage issues. Every site visit exhibited head-to-head coverage issues on at least a portion of the irrigation system. Some of the poor coverage is likely the result of low pressure or breaks, but much of the poor coverage is related to head layout and lateral design.
3) Create an overall "Standard Irrigation Specification". Most sites include a wide range of materials, design principles, and management protocols. Establishing a base is imperative to improve the system moving forward.
4) Implementation of a Central Control System. Based on the equipment found throughout the above sites, ease of use, and effectiveness, the Rain Bird iQ system is recommended. Central control allows for all system management to reside at a central location, and with the correct components in the field, allows users to observe and troubleshoot potential problems with each site.
5) Add a Campbell Scientific ET-107 weather station for use with central control. An accurate overall weather station will help determine a variety of overall environmental factors to aid in scheduling adjustments throughout the year. These factors include evapotranspiration, rainfall, relative humidity, temperature, and wind speed/direction.
6) Start an overall monitoring/management regimen. Utilizing a knowledgeable consultant to monitor and manage the irrigation system as a whole will improve the city's response to a variety of irrigation-specific problems. Additionally, because these sites are sensitive to schedule needs of funerals, management personnel can easily shut all or portions of the system down to prevent scheduling mishaps.
7) All control wiring should be place in 1.5" PVC gray electrical conduit using long radii sweeps to allow future ease of repair and/or replacement of wiring as technology changes.
8) All pump stations should have multiple 'primary' pumps vs a single larger pump. As an example, one fifty could be replaced by two 25hp pumps. This helps insure irrigation operation when one of the pumps goes down. When only one primary pump is used, the entire irrigation is inoperable when the pump needs repair or replacement.

Conclusion

Many of the issues found at all four sites are related to aging equipment that needs upgraded or replaced to more efficiently irrigate. Manual impact rotors were found at several sites which require a technician to physically drive to a site, and move equipment from location to location. Adding electronic valves to these areas will greatly improve efficiency of maintenance and management.

The largest improvements in all areas could be seen by implementing an overall "Standard Irrigation Specification" and transitioning to an overall centrally controlled system at all sites by allowing management personally to plan irrigation events and detect/react to issues as they occur. Central control will also allow the City to more easily adjust for various activities and events that occur at active cemetery sites. With the modernization of the system, mapping, upgrades, and improvements, significant time and costs savings should be realized.

IRRIGATION DESIGN, CONSTRUCTION, & MAINTENANCE SPECIFICATIONS

The purpose of these specifications is to inform landscape irrigation system designers, installation contractors, and maintenance contractors of the standards to which their irrigation designs, installations, and maintenance must conform to for all projects owned and/or managed by Fort Lauderdale Cemeteries, Fort Lauderdale, FL.

Included in this document are design concepts, an approved product list, and detailed installation methods that must be strictly adhered to for all irrigation systems. Approved equals will only be permitted if a formal request is submitted to Fort Lauderdale Cemeteries and is approved in writing on City letterhead.

SUMMARY:

I. Control System

a. The irrigation controller shall be a Rain Bird ESP-LXME modular in a LXMM Metal Cabinet and LXMMPED Metal Pedestal or Wall Mount or Rain Bird ESP-LXD Two wire controller in a LXMM Metal Cabinet and LXMMPED Metal Pedestal or Wall Mount.
b. For Centrally Controlled sites, utilize Rain Bird IQ Platform via cellular communication with compatible normally closed master valve and flow sensor (size/material appropriately based upon site requirements).
c. Grounding: Contractor to utilize 4"X96"X0.0625" copper grounding plates, 5/8"X10' copper clad grounding rods, 'One Strike' CAD welds at all connection points, #6 insulated copper wire, and earth contact material. Install these and other required components as outlined in the detail. Contractor to verify that the earth to ground resistance does not exceed 10 ohms. Contractor shall provide a written certification, on a licensed electrical contractors letter head, showing the date of the test, controller location, and test results. Each controller shall be so grounded and tested. Each component must have its own separate grounding grid, unless they are sitting side by side, in which case up to two controllers can share a common grounding grid.
d. Two wire path grounding - contractor shall install grounding rods every 500' (or 8 decoders, whichever is smaller) along the two wire path and at least one on any wire stub-out shorter than 500'. At each grounding rod, the contractor shall install a surge kit using a properly sized copper split bolt and grease filled water proof tube for the connection from the #6 insulated copper grounding wire from the grounding rod and the two wire path. Where acceptable, 3M-DBY/R connectors can be utilized. The connection to the grounding rod must be completed by a 'One Strike' CAD weld. This grounding effort must be in strict compliance with manufacturer's warranty requirements.
e. All Sites shall have spare wires installed per the below chart.

# RCVs	WIRE EA. WAY	WIRES TOTAL*
0 TO 8	1	2
9 TO 12	2	4
13 TO 16	3	6
17 TO 24	4	8
25 TO 32	5	10
32 TO 40	6	12

*Always 1 common, remaining hot

f. Control Wire - Use UF, 600 Volt, solid copper, irrigation control wire, sized as required, with 3MDBY or DBR connecters at all splices.
g. All control wires and spares or two wire path shall be buried in 2" Gray Schedule 40 PVC Electrical conduit with Schedule 40 Solvent-Weld fittings with long radii sweeps.
h. All ground wire and sensor wires shall be buried in 1" Gray Schedule 40 PVC Electrical conduit with Schedule 40 Solvent-Weld fittings with long radii sweeps.
i. Provide conductors of size not smaller than recommended by controller manufacturer, never smaller than 14 gauge. Install cable in separate 2 inch sleeve under paved vehicular areas
j. Baseline Soil Moisture sensor, model S100, shall be installed on each project (one per controller).
k. Hunter Rain/Freeze Clik Sensor, model RFC, shall be installed on each project (one per controller).

II. Pumps

a. All pump stations shall be Sullivan Electric Pump Stations with variable frequency drives (pumps to be customized to site requirements).
b. Redundant primary pump stations (use 2 or more primary pumps to meet peak demands vs a solitary pump.
c. Suction lines to surface water shall be HDPE with stainless steel screen. Refer to detail A1
d. Backwash lines to surface water shall be HDPE with open HDPE tee on end. Refer to detail A2.
e. Grounding: Contractor to utilize 4"X96"X0.0625" copper grounding plates, 5/8"X10' copper clad grounding rods, 'One Strike' CAD welds at all connection points, #6 insulated copper wire, and earth contact material. Install these and other required components as outlined in the detail. Contractor to verify that the earth to ground resistance does not exceed 10 ohms. Contractor shall provide a written certification, on a licensed electrical contractors letter head, showing the date of the test, pump location, and test results. Each pump control panel shall be so grounded and tested.

II. Piping Schedule:

a. Underground Irrigation mainline piping shall be DR13.5-4710 IPS H.D.P.E. mainline with fusion weld fittings.
b. Underground irrigation circuit piping/lateral piping shall be Class 200 PVC w/ SCH 40 solvent weld PVC fittings. (Size per plan; minimum pipe size shall be ¾". No ½" pipes permitted.)
c. Risers to Above-ground sprinklers shall be Schedules 40 and 80 PVC pipe and socket fittings, solvent-cemented joints and stainless-steel hose clamp attachments, refer to detail T.
d. All sleeves shall be Class 200 PVC w/ SCH 40 solvent weld PVC fittings and sized a minimum of two times (2x) the size of the pipe it is carrying.
e. Electrical Conduit shall be Gray Schedule 40 PVC with Schedule 40 PVC fittings and long radii sweeps.

V. Piping

a. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
b. Install components having pressure rating equal to or greater than system operating pressure.
c. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:
    i. Irrigation Main Piping: 160 psi

ii. Circuit Piping: 200 psi

d. Pipes shall be sized based on applicable flow and pipe type to not exceed 5 feet per second (fps).
e. Losses through mainline shall not exceed 10% of design pressure
f. Materials:
    i. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedules 40 and 80
        1. PVC Socket Fittings: ASTM D 2466, Schedules 40 and 80
        2. PVC Threaded Fittings: ASTM D 2464, Schedule 80
        3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.
    ii. PVC Pipe, Pressure Rated: ASTM D 2241, PVC 1120 compound, SDR 21
        1. PVC Socket Fittings: PE 4710 resin ASTM D 2467, Schedule 80
        2. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends
    iii. H.D.P.E. Pipe: PE 4710 resin (TR-4), ASTM D3350-05 with cell classification of PE 445474C
        1. Butt Fusion, electrofusion and socket fusion of H.D.P.E. pipe and fittings.
g. Lateral line shall be designed and sized to ensure a maximum velocity of five (5) feet per second (F.P.S.) while ensuring a maximum of 10% variation in pressures within the piping network using the 'friction factor' limiting method.
h. Lateral piping shall ensure, as much as possible, the equal splitting of flows at each tee, in both directions.
i. Piping Installation:
    i. Install piping free of sags and bends.
    ii. Install groups of pipes parallel to each other, spaced 6" apart to permit piping repair.
    iii. Install fittings for changes in direction and branch connections.
    iv. Install unions adjacent to valves and to final connections to other components with 2-1/2" NPS or smaller pipe connection.
    v. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2" or larger pipe connection.
    vi. Install underground thermoplastic piping according to ASTM D 2774 and ASTM F 690.
    vii. Lay piping on solid sub-base, uniformly sloped without humps or depressions.
    viii. Install PVC piping in dry weather when temperature is above 40° F (5° C). Allow joints to cure at least 24 hours at temperatures above 40° F (5° C) before testing.
    ix. The contractor shall have successfully installed high density polyethylene pipe in golf/turf irrigation projects. References will be required. These reference(s) must provide a satisfactory response or the experience will not be accepted. If a contractor has not previously successfully installed HDPE pipe for golf/turf irrigation projects, he will be required to have a qualified fusion technician from the pipe supplier on site during fusion for a period of three to five days (at the expense of the contractor). The length of time required for HDPE pipe (fusion and mechanical) training shall be determined by the owner or his representative. The technician must have been trained and have fusion certification.
j. Joint Construction:
    i. Ream ends of pipes and tubes and remove burrs.
    ii. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
    iii. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
        1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
        2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
    iv. PVC Non-pressure Piping: Join according to ASTM D 2855.
    v. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
    vi. Plastic, Pipe-Flange Gasket, Joint Restraints, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated
    vii. Fusion weld for H.D.P.E.: Butt Fusion, Electrofusion and Socket Fusion by certified installer.
    viii. All fused taps on HDPE pipe shall be made using Electrofusion branch saddles with IPS outlet. The pressure rating shall be equal to or greater than the pipe rating.
    ix. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe supplier's recommendations. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself.
    x. Electrofusion may be used where the butt fusion method cannot be used. Electrofusion couplings and fittings shall be PE4710 HDPE, Cell Classification of PE 445474C as determined by ASTM D3350-05. Electrofusion couplings or fittings shall have a manufacturing standard of ASTM F1055. Couplings and fittings shall have the same pressure rating as the pipe unless otherwise specified.

V. <u>Earthwork</u>

a. Provide minimum cover over top of underground piping according to the following:
    i. Irrigation Main Piping: Minimum depth of 30 inches below finished grade and 36 inches below for vehicular crossings.
    ii. Circuit Piping: Minimum depth of 18 inches below finished grade and 30 inches below for vehicular crossings
    iii. Sleeves: Minimum depth 30" below grade
b. The Back fill 6" below, 6" above, and around all piping shall be of clean sand and anything beyond that in the trench can be of native material but nothing larger than 2" in diameter. In all planting beds backfill and compact all trenches to 85% Proctor and all trenches under hardscapes to be backfilled and compacted to 95% Proctor.
c. Irrigation Contractor shall backfill all piping, both mainline and laterals, prior to performing any pressure tests. The pipe shall be backfilled with the exception of 2' on each side of every joint (bell fittings, 90's, tees, 45's, etc.). These joints shall not be backfilled until all piping has satisfactorily passed its appropriate pressure test as outlined below.

VI. <u>Valves</u>

a. Automatic Remote Control Valves (RCV):

i. RCVs 1” to 2” shall be Rain Bird PESB series with Nibco T-113 bronze gate valve upstream in Carson 1220 Jumbo valve box with bolt down lid.
ii. RCVs 3” shall be Rain Bird BPES series with Nibco T-113 bronze gate valve upstream in Carson 1220 Jumbo valve box with bolt down lid.
iii. Each RCV will have a Christy I.D. tag affixed identifying station and controller.
iv. RCVs shall be sized as listed below:
    1. 0-24.9 gpm = 1”
    2. 25-49.9 gpm = 1-1/2”
    3. 50-99.9 gpm = 2”
    4. 100-180 gpm = 3”
v. One RCV shall be installed per controller station. Two or more RCVs connected to a single station is not allowed.

b. Manual Mainline Isolation Valves
    i. Provide AVK 66 series isolation gate valves with HDPE fusible ends in Carson 1419 valve box with bolt-down lid.

VII. Valve Boxes

a. Provide Carson 1220 Jumbo Valve Box with bolt down lid for automatic control valves, standard 12” box for splices, and Carson 1419 Valve Box with bolt down lid for manual mainline isolation valves.
b. Using an electric branding iron, brand the valve I.D. letter/number on the lid of each valve box. This brand must be 2"-3" tall and easily legible. Distinguish between multiple units:
    i. RCV for Remote Control Valve
    ii. GV for Gate Valve
    iii. SPL for Splice Box
    iv. QC for Quick Coupler
    v. FS for Flow Sensor
    vi. MV for Master Valve
    vii. GR for Grounding Rod

VIII. Sprinklers

a. General Requirements: Provide 100% Head to Head coverage with minimum of 50% overlap, designed for uniform coverage over entire spray area indicated at available or designed water pressure.
b. Plastic, Pop-Up Sprinklers for Trees: provide Rain Bird 1804-SAM with PA-80 adapter with Rain Bird 1400 series bubbler to allow proper watering during an irrigation cycle, two (minimum) per each tree. Each inch of tree caliper shall receive three (3) gallons of water per cycle. Example: a 3” caliper tree shall receive nine (9) gallons of water per cycle.
c. Plastic, Pop-up Sprinklers for Turf: provide Rain Bird 1806-SAM-PRS with Hunter MP Rotator
d. Plastic, Pop-up, Sprinklers for Shrubs: provide Rain Bird 1812-SAM-PRS with Hunter MP Rotator nozzle and riser (risers not permitted adjacent to sidewalks, roadways, pedestrian paths, or any other frequented area that would create a safety hazard).
e. Plastic, Pop-up Rotors for Turf Areas over 30’ Wide: provide Rain Bird 5006-SAM-PRS rotor or Rain Bird Falcon 6504 rotor.
f. Install sprinklers after hydrostatic test is completed.
g. Install sprinklers at manufacturer's recommended heights.
h. Locate part-circle sprinklers to maintain a minimum distance of 12 inches from foundations, 4 inches from sidewalk or roadway edge with curbing, and 12-36 inches from roadway edge without curbing (based upon equipment, per plan details.)
i. Swing Pipes shall be Rain Bird SPX Series.
j. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas.
k. No rotors shall be installed in shrub beds.
l. Turf, Shrubs, Annuals, & Trees shall all be zoned separately.
m. All emitter devices must have matched precipitation rates within a zone.
n. All projects shall be designed to ensure the system can deliver .25” of irrigation water, to each zone, within one ten (10) hour watering window/day or less.

X. Quality Assurance

a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

X. Action Submittals

a. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics and furnished specialties and accessories.
b. Wiring Diagrams: For power, signal, and control wiring.
c. Delegated-Design Submittal: For irrigation systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer, Landscape Architect, or Irrigation Design professional with CID certification from the Irrigation Association responsible for their preparation.

XI. Informational Submittals

a. Irrigations As-builts: shall be provided utilizing a sub-foot Global Navigation Satellite System (GNSS) to accurately locate all mainlines, sleeves, remote control valves, gate valves, independent wire runs, wire splice boxes, controllers, high voltage supply sources/conduit path, control mechanisms, sensors, wells and water source connections in Florida East State Plane, NAD 83, and CORS 96 format. The data collected shall be in POINT format and include an ID for each data point with Manufacturer, Type, Size, and Depth. All mainline and independent runs of wire shall be located every 30' for straight runs and at every change of direction. Sleeves will be located at end points and every 20' of length. All underground items shall include depth in inch format. These POINTS once collected shall be imported into an AutoCAD DWG geo-referenced base file to be labeled accordingly. The completed AS-Built shall be a Geo-Referenced DWF file and delivered to the owner on a compact disk (CD)
b. Zoning Chart: Show each irrigation zone and its control valve.
c. Controller Timing Schedule: Prepare controller charts; one per controller. Indicate on each chart the area controlled by a remote control valve (using a different color for each zone.) Coordinate irrigation schedule of proposed controller with existing controller(s) on site to max pump efficiency and stay above the pump’s low flow requirement.
d. Provide ground certification results for each controller and pump panel grounding grid installed. This must be on a licensed electrician letter head indicating location tested (using IR plan symbols), date, time, test method, and testing result. Contractor to verify that the earth to ground resistance does not exceed 10 ohms.
e. Field quality-control reports.

XII. Field Quality Control

a. Perform tests and inspections
b. Tests and Inspections:
   i. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   ii. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
   iii. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   iv. HDPE Mainline Test: Pressure testing shall be conducted in accordance with ASTM F2164, Field Leak Testing of Polyethylene Pressure Piping Systems Using Hydrostatic Pressure. The HDPE pipe shall be filled with water, raised to test pressure and allowed to stabilize. The test pressure shall be 1.5 times the operating pressure at the lowest point in the system. In accordance with section 9.8, the pipe shall pass if the final pressure is with 5% of the test pressure for 1 hour. For safety reasons, hydrostatic testing only will be used.
   v. Operational Test: Once the mainline and lateral lines have passed their respective tests, and the system is completely operational, a coverage test and demonstration of the system is required. The irrigation contractor must demonstrate to the owner, or his/her representative, that proper coverage is obtained and the system works automatically from the controller. This demonstration requires each zone to be turned on, in the proper sequence as shown on the plans, from the controller. Each zone will be inspected for proper coverage and function. The valves must close within 10-15 second after being de-energized by the controller, adjust flow control as needed. The determination of proper coverage and function is at the sole discretion of the owner or owner's representative.
   vi. Any irrigation product will be considered defective if it does not pass tests and inspections.
c. Prepare test and inspection reports.

XIII. Closeout Submittals

a. Operational and maintenance data:
   i. Completion and acceptance of `as-built' drawings.
   ii. Acceptance of required controller charts and placement inside of controllers.

XIV. Maintenance Procedures

a. Every irrigation zone should be checked monthly and written reports generated describing the date(s) each zone was inspected, problems identified, date problems repaired, and a list of materials used in the repair. At minimum, these inspections should include the following tasks:
   i. Turn on each zone from the controller to verify automatic operation.
   ii. Check schedules to ensure they are appropriate for the season, plant and soil type, and irrigation method. Consult an I.A. certified auditor for methods used in determining proper irrigation scheduling requirements.
   iii. Check remote control valve to ensure proper operation.
   iv. Check setting on pressure regulator to verify proper setting, if present.
   v. Check flow control and adjust as needed; ensure valve closure within 10-15 seconds after deactivation by controller.
   vi. Check for leaks - mainline, lateral lines, valves, heads, etc.
   vii. Check all heads as follows:
      1. Proper set height (top of sprinkler is 1" below mow height).
      2. Verify head pop-up height – 4” for bubblers/trees, 6" in turf, 12" in ground cover, and pop-up on riser in shrub beds.
      3. Check wiper seal for leaks - if leaking, clean head and re-inspect. If still leaking, replace head with the appropriate head with pressure regulator and built-in check valve.
      4. All nozzles checked for proper pattern, clogging, leaks, correct make & model, etc. - replace as needed.
      5. Check for proper alignment - perfectly vertical; coverage area is correct; minimize over spray onto hardscapes.
      6. Riser height raised/lowered to accommodate plant growth patterns and ensure proper coverage.
      7. Verify the pop-up riser retracts after operation. If not, repair/replace as needed.
   viii. Check controller/C.C.U. grounds for resistance (10 ohms or less) once per year. Submit written reports.
   ix. Check rain shut-off device monthly to ensure it functions properly.
   x. Inspect all filters monthly and clean/repair/replace as needed.
   xi. Inspect backflow devices by utilizing a properly licensed backflow inspector. This should be done annually, at minimum.
   xii. Inspect all valve boxes to ensure they are in good condition, lids are in place and locked.
   xiii. Check pump stations for proper operation, pressures, filtration, settings, etc. - refer to pump station operations manual quarterly.
   xiv. Check and clean intake screens on all suction lines quarterly, at minimum. Clean and/or repair, as needed.
   xv. Winterize, if applicable, as weather in your area dictates. Follow manufacturer recommendations and blow out all lines and equipment using compressed air. Perform seasonal startup of system as per manufacturer recommendations.
   xvi. Conduct additional inspections, maintenance tasks, etc. that are particular for your site.

XV. Glossary

Note: *The cited terms below do not infer original development by Masuen Consulting, terms may or may not be included in specification but are provided for general informational purposes.*

backflow - Any unwanted flow of used or non-potable water or substance from any domestic, industrial or institutional piping system into the pure, potable water distribution system. The

direction of flow under these conditions is in the reverse direction from that intended by the system and normally assumed by the owner of the system.

backflow prevention device - Safety device which prevents the flow of water from the water distribution system back to the water source

check valve, spring - A spring loaded valve located in a lateral or at the base of a sprinkler that prevents water from draining through the sprinkler lowest in elevation after the irrigation cycle is complete (sometimes called an "anti-drain valve").

controller - An automatic timing device used to remotely control valves or heads (valve in head) according to a set irrigation schedule.

cycle - The operating duration of one, or more, valve(s) for one irrigation start time.

drainage – to provide channels so that excess water can be removed by surface or internal flow.

dynamic pressure - See pressure, dynamic

efficiency, irrigation system - the percent of irrigation water that is beneficially used for plant growth.

fittings - Collectively, the parts of a drip system; pipe, connecting tees, valves, emitters, etc.

flow rate - Volume of flow per unit time, such as discharge from an irrigation sprinkler or emitter; or flow into a zone.

flow sensor - A device that measures the rate of liquid flow or the total accumulated flow.

flushing - The process of washing captured particles out of a filter.

GPH - Gallons per hour, a term which specifies the rate of water flow through a pipe or the amount of water delivered by a pump.

GPM - Gallons per minute, a term which specifies the rate of water flow through a pipe or the amount of water delivered by a pump.

hardscape - Impervious surfaces within the landscape, such as concrete walkways or brick paving.

HDPE - High density polyethylene, is a hydrocarbon polymer prepared from ethylene/petroleum by a catalytic process. It is a kind of thermoplastic which is famous for its tensile strength. Its unique properties can stand high temperatures.

irrigation - The intentional application of water for purposes of sustained plant growth.

Irrigation Association (IA) - A non-profit organization formed to improve the products and practices used to manage water resources and to help shape the worldwide business environment of the irrigation industry. The association's interest in water resources encompasses the application, conservation, drainage, improvement and recovery of water for economic and environmental enhancement in agriculture, turf grass, landscape and forestry. The IA interacts with private and governmental organizations and other associations in the development of legislation and regulations to properly and appropriately ensure the availability, quality and accessibility of water supplies for, or affected by, irrigation and the efficacy of trade policies. The IA establishes and conducts authoritative educational programs to broaden and focus public awareness of issues related to water management, to provide professional certification of practitioners of irrigation-related disciplines and to ensure the accessibility of research information pertinent to industry practices and products. The IA positions itself as an effective catalyst and umbrella organization for outreach, communication and coordination among the diverse parties and interests involved in irrigation. The IA contributes to the establishment of recognized standards and guidelines dealing with irrigation-related products, engineering applications and practices worldwide.

irrigation contractor - Any person who is in the business of installing, repairing, or maintaining landscape irrigation systems. See also **Certified Irrigation Contractor**

irrigation design - Drawings and associated documents detailing irrigation system layout, and component installation and maintenance requirements.

irrigation schedule - Set of data describing when and the amount of irrigation water to be applied to each station/zone.

irrigation system - Set of components which may include the water source, water distribution network, control components and other general irrigation equipment.

> **sprinkler irrigation -** Type of irrigation using mechanical devices with nozzles (sprinklers) to distribute the water by converting water pressure to a high velocity discharge stream or streams.

line - Another term for plastic pipe or plastic tubing that is used to transport water along rows of plants or from tree to tree in a drip system.

line size - Usually the diameter of a particular pipe or tubing used to conduct water in a drip system.

matched precipitation rate - System or zone in which all the heads have similar precipitation rates is said to have matched precipitation rates.

moisture sensor – A device that monitors or measures soil water content or tension.

PVC - Polyvinyl chloride, is one of the most used plastic materials in the world. It is economical and highly resistant to chemicals.

potable water - Water from any source which has been investigated by the health agency having jurisdiction, and which has been approved for human consumption. It can be used as a source of irrigation water, but once water enters an irrigation system (and passes through the backflow device) it is no longer considered potable.

precipitation rate - Rate at which a sprinkler system applies irrigation water; also known as the application rate**.**

PSI - Pounds per square inch, a term used to specify water pressure to the amount of force pushing on the water in the pipe.

rain shut-off device, rain sensor, rain switch, rain freeze sensor - A device that causes the controller to suspend or override an irrigation cycle or that opens the circuit to a valve or set of valves when a preset amount of rain occurs or freezing conditions. Ideally, the device will also override the irrigation cycle as long as rain is withheld in the root zone and is available to the

plants. A soil moisture sensor may be considered a rain shut-off device if the sensor overrides or suspends an irrigation cycle based on the conditions above.

record drawing - Set of construction plans, mylar film, or computer file, including the original design and noting all design deviations. These drawings should also show the location of all major underground components, dimensioned from permanent features.

sprinkler - A device attached to a hose to propel streams of water into the air, thereby distribution water evenly over a lawn or garden surface.

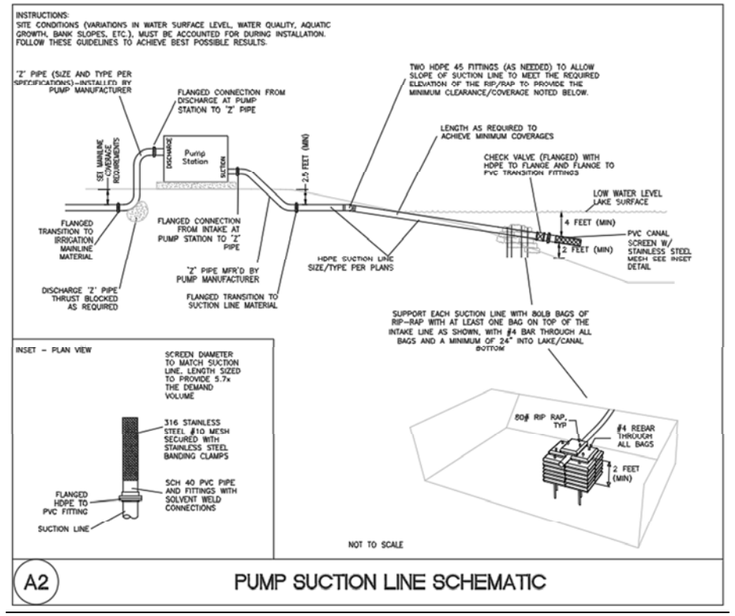
slope - Ground where grade varies or is not level.

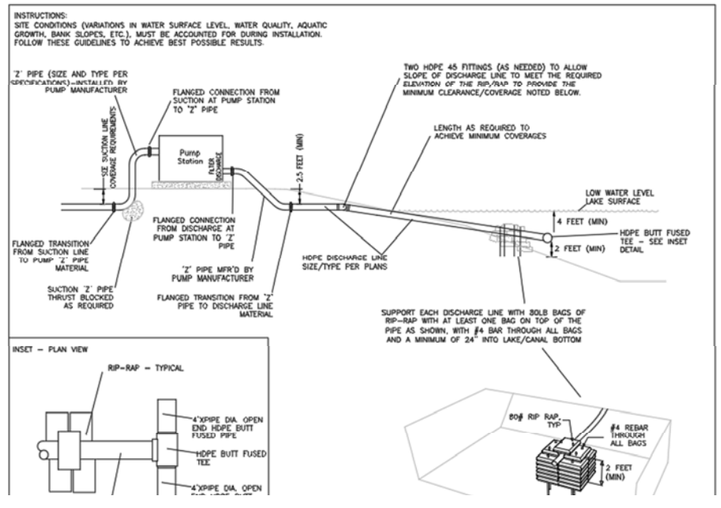
velocity, water - The speed at which water moves through the system (pipe).

watering window - The hours and days of the week available for irrigation to be completed. Site uses and local statutes may limit the time and days on which irrigation can occur.

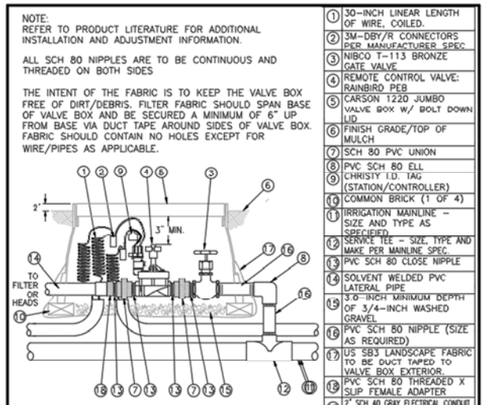
The following details shall be utilized for the installation of all irrigation components so detailed. Any components not detailed below, shall be installed per manufacturers specifications and Irrigation Association Best Management Practices.

XVI. Details

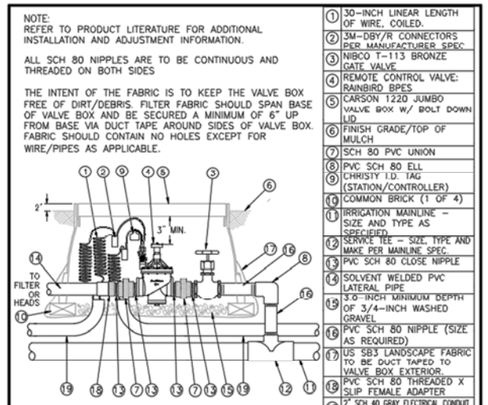




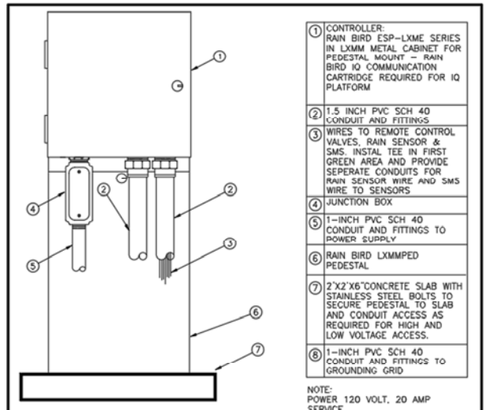
APPENDIX B: IRRIGATION SPECIFICATIONS



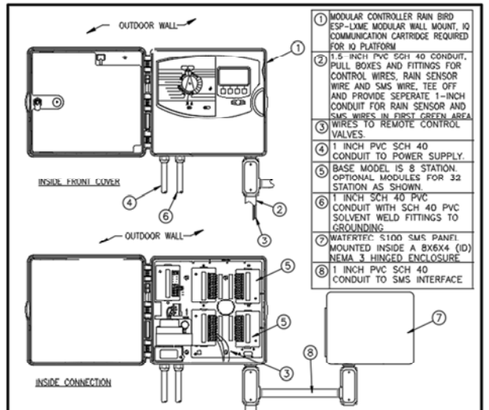
B1 RAIN BIRD RCV W/GATE VALVE



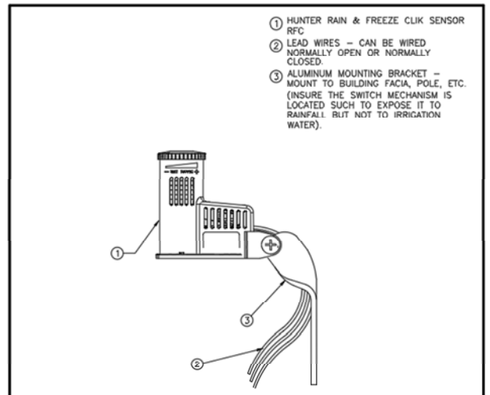
B2 RAIN BIRD 3" RCV W/GATE VALVE



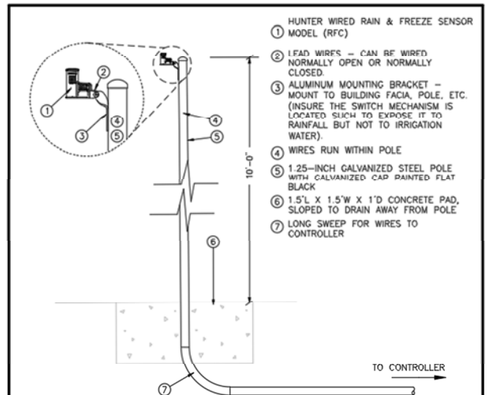
C1 PEDESTAL MOUNT ESP-LXME CONTROLLER



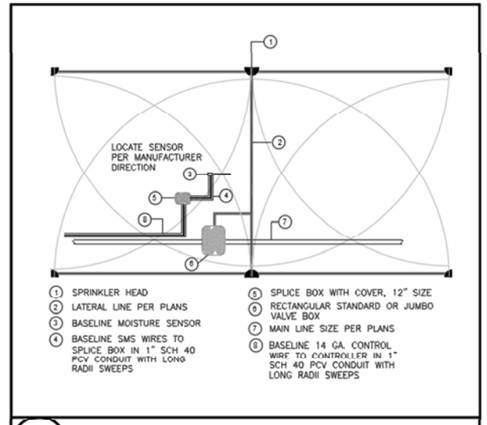
C2 CONTROLLER ESP-LXME WALL MOUNT



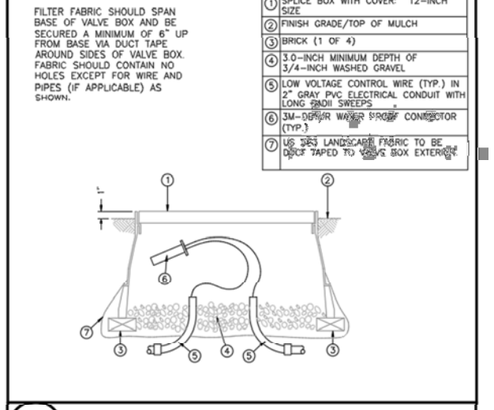
C3 RAIN CLIK RAIN/FREEZE SENSOR



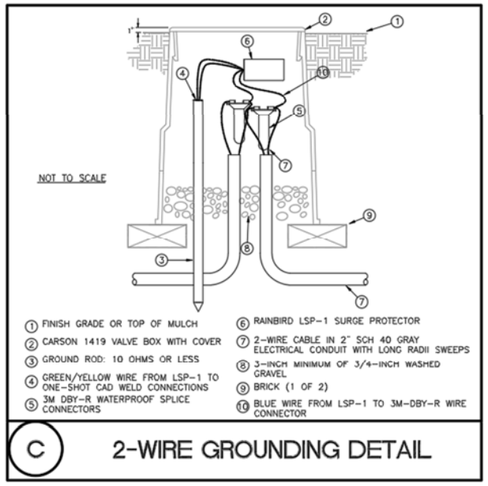
C4 POLE MOUNTED RAIN/FREEZE SENSOR



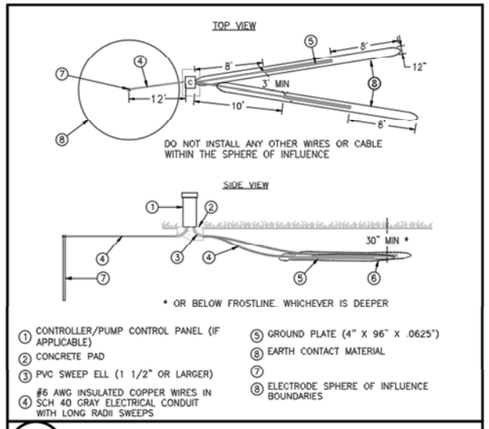
C5 SOIL MOISTURE SENSOR



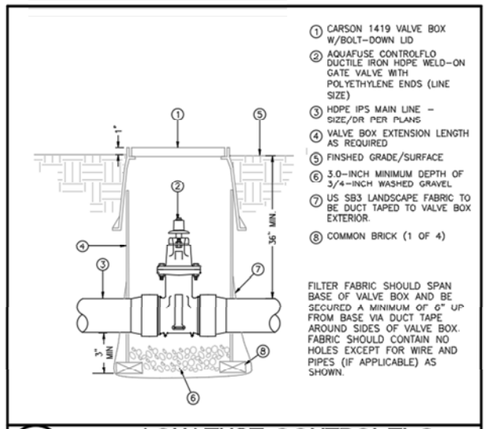
C6 WIRE SPLICE



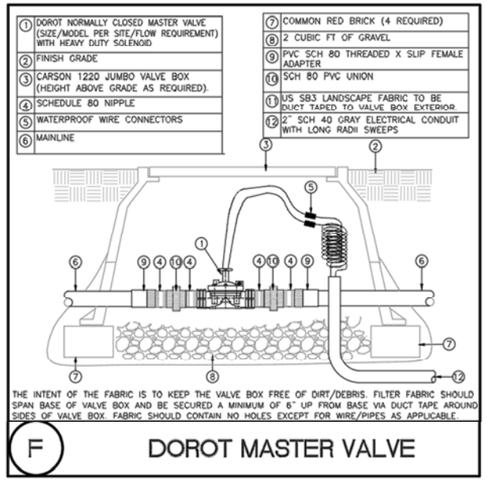
C 2-WIRE GROUNDING DETAIL



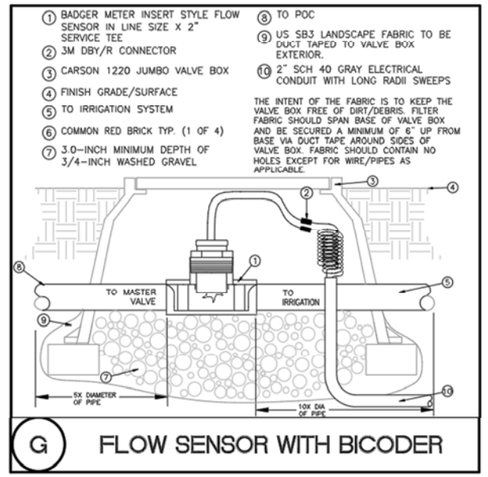
C7 GROUNDING DETAIL



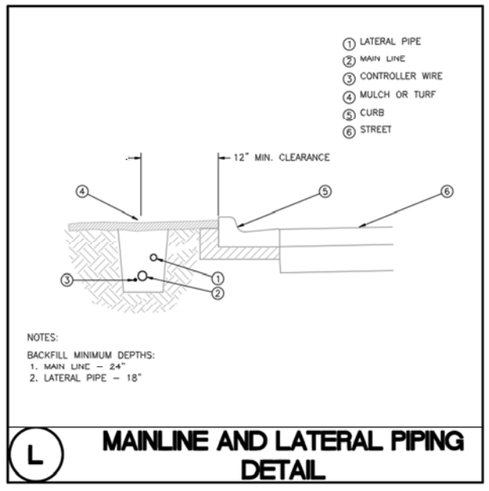
D AQUAFUSE CONTROLFLO DUCTILE IRON GATE VALVE



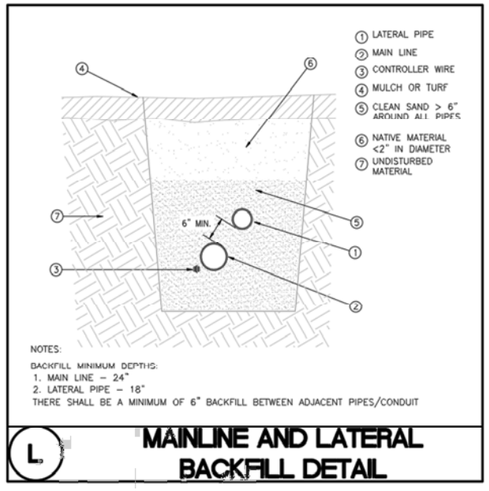
F DOROT MASTER VALVE



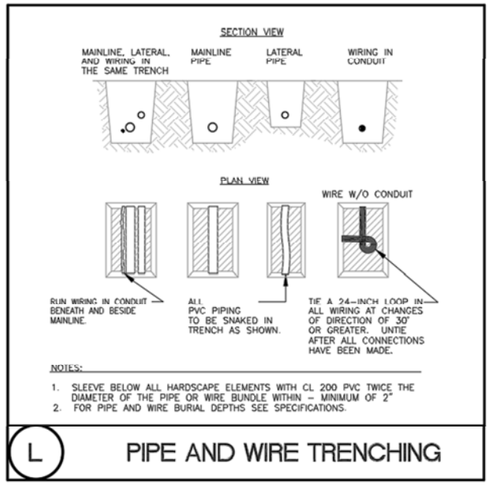
G FLOW SENSOR WITH BICODER



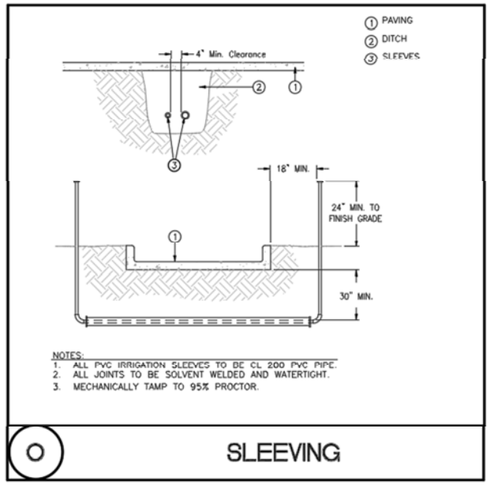
L MAINLINE AND LATERAL PIPING DETAIL



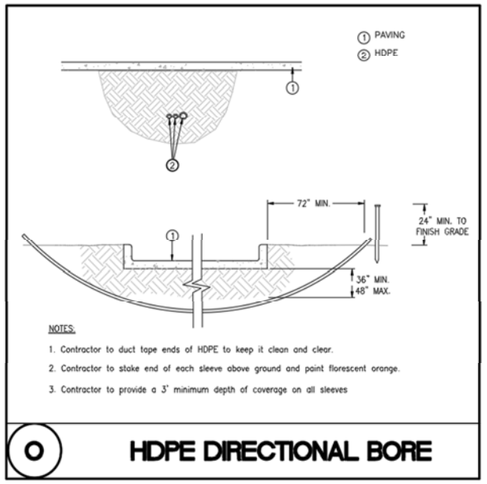
L MAINLINE AND LATERAL BACKFILL DETAIL



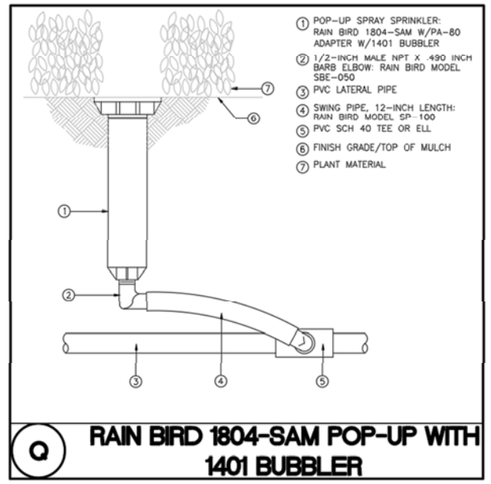
L PIPE AND WIRE TRENCHING



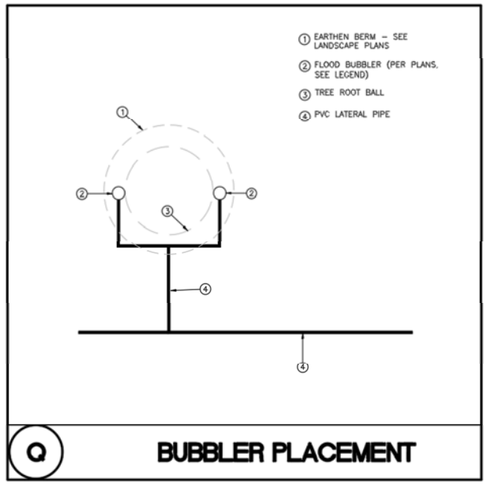
O SLEEVING



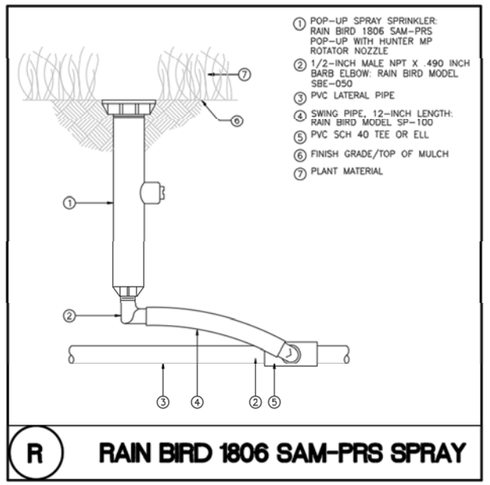
O HDPE DIRECTIONAL BORE



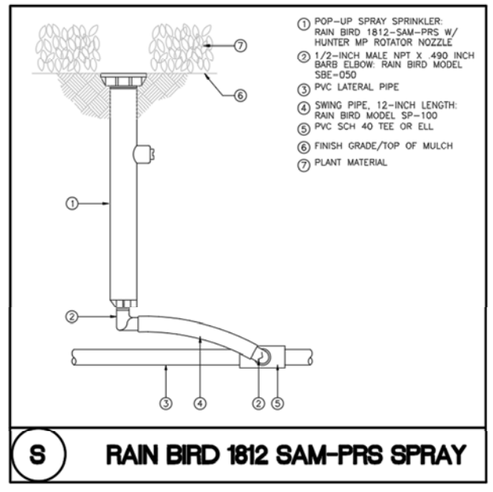
Q RAIN BIRD 1804-SAM POP-UP WITH 1401 BUBBLER



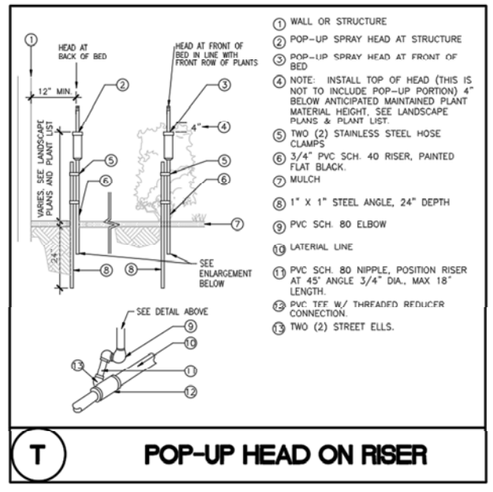
Q BUBBLER PLACEMENT



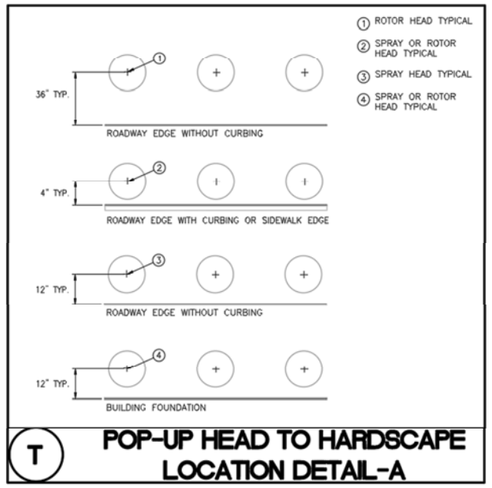
R RAIN BIRD 1806 SAM-PRS SPRAY



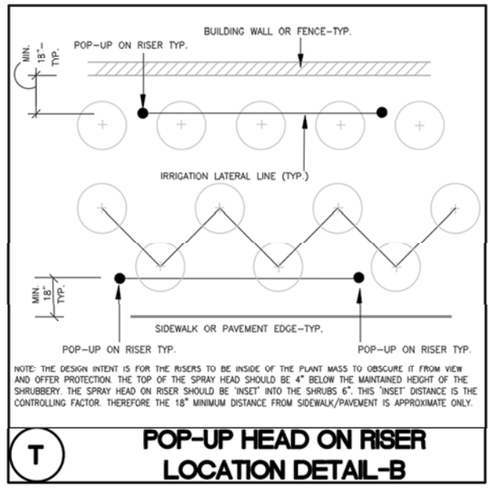
S RAIN BIRD 1812 SAM-PRS SPRAY



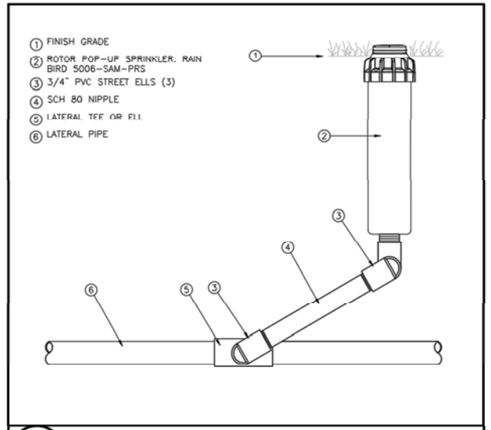
T POP-UP HEAD ON RISER



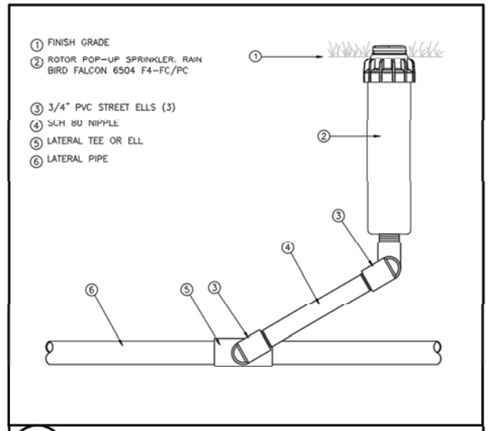
T **POP-UP HEAD TO HARDSCAPE LOCATION DETAIL-A**



T **POP-UP HEAD ON RISER LOCATION DETAIL-B**



V **RAIN BIRD 5000 W/CHECK VALVE**



V **RAIN BIRD FALCON 6504 ROTOR**

City of Fort Lauderdale

Cemetery Perpetual Care Analysis

DRAFT - Subject to Adjustment
DO NOT DISTRIBUTE

CONTENTS

Document Overview

The objective of this document is to provide leadership of the City of Fort Lauderdale ("the City") with an overview of the level of funding required to perpetually maintain the in-scope cemeteries within the City given existing perpetual care obligations. In addition, this analysis also offers recommendations for leadership's consideration in order to position the City to more effectively meet its perpetual care obligations and to favorably impact the level of perpetual care funding required to sustain its cemetery maintenance operations *ad infinitum*.

Throughout this document, the term "perpetual care" refers to the City's obligation to provide for the upkeep and maintenance of its sold inventory. The term "perpetual care assets" refers to the City's cemetery care funds that have been generated and have grown over time as a result of the cemeteries' inventory sales and investment practices.

Note: Certain values within this report have been rounded to the nearest integer to facilitate readability.

Background on the In-scope Cemeteries of the City

The City of Fort Lauderdale purchased its first official cemetery shortly after being founded as a city in 1917. The City currently owns four cemeteries within the City limits: Evergreen Cemetery, Lauderdale Memorial Park, Sunset Memorial Gardens, and Woodlawn Cemetery. These properties play an important part in serving current and future residents, as well as preserving the history of the City.

The in-scope cemeteries are currently divided into two operating hubs, captured in the table below (with each of the principal operating hubs noted in bold):

Cemetery	Location	Brief Description
Lauderdale Memorial Park Cemetery	2001 S.W. 4th Avenue Fort Lauderdale, FL 33315 954-745-2140	• Founded in 1947 • 56 acres • Offers full burials, cremation garden, mausoleums, cremation niches, private family mausoleums • 83% of inventory sold
Woodlawn Cemetery	1936 N.W. 9th Street Fort Lauderdale, FL 33311 954-745-2140	• Historical resting place of many pioneering African-American residents • No available records; new burials are not permitted
Sunset Memorial Gardens Cemetery	3201 N.W. 19th Street Fort Lauderdale, FL 33311 954-739-1488	• Founded in 1961 • 30 acres • Offers full burials, a community mausoleum, and hedge estates • 81% of inventory sold
Evergreen Cemetery	1300 S.E. 10th Avenue Fort Lauderdale, FL 33315 954-745-2140	• Founded in 1910/1911 • 11 acres • Offers full burials, private family mausoleums • 97% of inventory sold

In order to fund the cemeteries' activities, the City relies on standard operating revenue (e.g., sale of burial and entombment rights, internment/inurnment service fees, sale of memorial pieces, etc.). The revenue generated as a result of the cemeteries' ongoing sales and service operations is intended to (1) cover their associated operating expenses, (2) generate a sufficient level of surplus to enable the cemeteries to pursue additional development (i.e., new land, mausoleums, columbaria), and (3) provide funding to support the cemeteries' ongoing perpetual care obligations.

The in-scope cemeteries were recently managed by Carriage Services Inc., a cemeteries management company, per a contract with the City that expired in September 2018. Carriage Services performed cemetery management services, including maintenance and operations, and administered the purchasing of cemetery plots and interment services and merchandise. Given the importance of the ongoing care of the cemeteries, the City required that Carriage pay 19% of proceeds from all property sales, along with sales on monuments, markers, and benches into the Perpetual Care Trust Fund.

A Cemetery Advisory Board of ten trustees appointed by the Mayor and City Commissioners is responsible for overseeing maintenance and operations, as well as the Perpetual Care Trust Fund; establishing rules and regulations for management of the in-scope cemeteries; and making general recommendations to the Commission concerning their condition and development.

This report assesses the City's cemetery care funding needs as of June 2018. At that time, the total value of the perpetual care assets available to the City was $29.9 million.

PROJECT OBJECTIVES AND SCOPE

The primary objective of this assignment was to help the City obtain a more refined understanding of the long-term financial needs of its cemeteries given their existing perpetual care obligations and ongoing operations. As a result, the City seeks to answer the following questions:

- How much money should the City have on hand as perpetual care reserves given the cemeteries' anticipated future maintenance costs and care obligations?
- How does the City's current level of perpetual care funding compare to the level required to be fully funded?

The scope of this project includes a point-in-time analysis of the City's perpetual care obligations for the cemeteries listed on page 1 of this report.

PROJECT APPROACH

Our analysis focused on the following activities:

- *Understand current environment* – we collected and reviewed relevant documentation, such as financial statements, operating budgets, internal management reports, cost allocation worksheets, equipment inventory, prior consulting reports (if applicable), cemetery capacity and utilization statistics, rate schedules, sample purchase agreements, marketing materials, organizational charts, policies, procedures, etc. in order to develop an understanding of the cemeteries' financial performance, operating activities, practices, and systems.
- *Conduct interviews* – we met with key personnel in order to better understand the nature of the cemeteries' operating and perpetual care activities. In addition, we worked with City representatives to coordinate visits to the in-scope cemeteries in order to tour the grounds and to further our knowledge of each of the cemetery's grounds, operations, location, capital improvements, etc. Our interviewees included:
    - Megan Bartels, Carriage Services
    - Rowehana Faucette, Carriage Services
    - Mark Hall, SunTrust
    - Trevor Jackson, Carriage Services
    - Krause Kim, SunTrust
    - Yamilet Reina, Carriage Services
    - Stacy Spates, City of Fort Lauderdale
- *Perform perpetual care state visioning* – we collaborated with City representatives and Carriage personnel in order to determine the level of perpetual care operating and maintenance activity that would be anticipated in the future for the cemeteries. As part of this analysis, founded upon the cemeteries' present-day perpetual care activities, we partnered with the cemeteries' management to envision a future state scenario where all in-scope cemeteries are being operated exclusively for the purpose of perpetual care. As part of this exercise, we worked with Carriage personnel to consider and assess i) which operating activities would no longer be conducted in a fully perpetual care state, ii) which activities would continue to be conducted in a manner consistent with present-day perpetual care operations, and iii) which activities, although still performed, would likely be performed in a different manner or to a different extent.
- *Develop underlying assumptions and financial model* – we worked with Carriage personnel in order to assist in determining underlying assumptions (e.g., staffing levels, discount rate, cost growth assumptions, useful life of capital equipment and facility improvements, etc.) associated with the cemeteries' anticipated perpetual care operations. We then documented these assumptions and met with City representatives and Carriage personnel in a checkpoint meeting to verify that they have been recorded accurately. Utilizing these assumptions, we created a detailed base year financial model for the cemetery operations, as a "snapshot" representation of the cemeteries' anticipated perpetual care needs in the event that each of the cemeteries were to "close to gates" tomorrow. Based on our experience with other similar organizations, we also assisted management with the development of detailed assumptions regarding the cemeteries' anticipated needs for long-term capital expenditures for equipment and facility improvements (such as mowers, backhoes, roofs, fences, etc.), including useful life, present-day, and cost growth assumptions.
- *Determine perpetual care funding level* – we assisted in determining a perpetual care fund target and assessed the extent to which current perpetual care funding levels suffice to meet the anticipated future obligations.
- *Develop and present report* – we have summarized our findings, analysis, and recommendations in this report, and will share our findings and analysis with City representatives and leadership, as appropriate.

SUMMARY OF FINDINGS

In collaboration with management, we identified key assumptions, modeled cost structures, and performed related sensitivity analyses.

Key Assumptions

While there are many detailed assumptions that must be determined in order to quantify the cemeteries' perpetual care obligations in a "perpetual care only" state, the following key assumptions have been developed as part of this analysis:

- The City will perpetually maintain responsibility for the ongoing maintenance and operations of the in-scope cemeteries, not an outside party.
- There is no operating income for the cemeteries; the cemeteries will be solely reliant upon its care funds to support the upkeep of its cemeteries *ad infinitum*.
- The in-scope cemeteries would be consolidated into one operating hub. Staffing and equipment needs will be scaled back to align with this service model.
- Certain structures (e.g., offices, garages) will not be replaced due to a lack of need/use.
- Costs are projected to grow at an average rate of 2.3% per year, in line with long-term inflation rate projections[1].
- The City's perpetual care assets remain invested in equity and fixed income investment vehicles, and are projected to generate an average annual rate of return of 6.9% per year, in line with the portfolio's historical return[2].
- The cemeteries' current deferred maintenance needs do not significantly affect long-term capital expenses.

Based on the detailed assumptions developed in conjunction with management, we estimate that the in-scope cemeteries require a sum of approximately $27.1 million in care funding in order to fulfill the perpetual care obligations associated with sold cemetery inventory (as of June 2018).

Sensitivity Analysis

The total perpetual care funding level required to support future cemetery obligations is significantly influenced by the investment return assumption for the cemetery care assets. To provide perspective on the sensitivity of this projection to investment returns, we elected to "stress-test" this funding analysis by examining potential alternate scenarios. As covered earlier, a long-term 6.9% annual investment return yields a total perpetual care funding requirement of approximately $27.1 million. By adjusting the overall portfolio's returns upward and downward, we can see the impact that a relatively small change in financial return can have on the total amount of care funding required. The table below details our analysis.

#	Scenario	Investment Portfolio Annual Return[3]	Perpetual Care Funding Required (USD, millions)
1	Based on Historical Portfolio Return	6.90%	27.1
2	More Conservative Projection (with current asset allocation)	4.40%	59.3
3	More Aggressive Investment Strategy	7.50%	24.0

Note: The "more conservative" scenario is intended to illustrate an anticipated return on investment of the perpetual care assets in the current portfolio, while the "more aggressive" scenario is intended to represent a rate of annual investment returns that could be achieved from a more equities-leaning portfolio. As of June 2018, the value of the City's perpetual care assets was $29.9 million. Approximately $13.8 million of this total was invested in equities (46% of the portfolio), with an anticipated return of 6.61%; $12.9 million (43% of the portfolio) was invested in fixed income with an anticipated return of 2.75%; and the remaining $3.2 million (11% of the portfolio) was in Treasury bills with anticipated returns of approximately 1.5%. This asset allocation strategy, favoring fixed income, is more conservative than what we have observed at other cemetery operators.

Assessment of the Perpetual Care Level

Given the City's current cemetery care fund balance of $29.9 million, and the need for cemetery care funding of approximately $27.1 million (based on key management assumptions, including historical investment returns), the City is in relatively strong position to satisfy the ongoing maintenance obligations associated with its sold inventory. This said, securities markets are uncertain and the valuation of the cemetery care assets can change fairly swiftly. As the City contemplates its next steps with regard to cemetery care funding, we recommend that leadership consider the following:

- Invest perpetual care assets in a diversified investment portfolio in order to generate attractive returns while managing investment risk. Update the City's investment policy accordingly.
    - Approximately 11% of the cemeteries' care assets are currently in an account where interest rates are roughly 0.2% per year. At such rates of return, it will be impossible to adequately fund perpetual care due to the fact that the anticipated long-term rate of cost growth exceeds the rate of return of the invested assets.
    - Moreover, approximately 43% of the cemeteries' care assets are currently in fixed income investments, where returns are expected to be only slightly higher (at 2.75%) than the anticipated rate of long-term inflation (at 2.3%).
- Assess the competitiveness of the in-scope cemeteries' pricing related to burial and entombment rights, associated services, and labor fees as compared to other cemeteries in the area.
- Make best efforts to generate greater operating income from the in-scope cemeteries moving forward in order to minimize the level of withdrawal on the cemeteries' care funds. Although care funds are put aside to provide funding for long-term maintenance of the cemeteries' existing obligations, minimizing withdrawals from this fund can serve to effectively increase the funding in the Perpetual Care Trust Fund.
- Transition the City's perpetual care funding model to a fixed amount per unit of inventory (e.g., $X per grave, $Y per crypt; $Z per niche) as opposed to a percentage of the overall sale price. Consider revising perpetual care allocation based on a deeper-dive analysis of perpetual care inventory.
- Consider long-term perpetual care obligations and implications when evaluating the anticipated returns on investment of upcoming cemetery development projects (e.g., mausoleum vs. traditional graves, flat marker graves vs. monument graves).
- Share the City's learnings from this analysis with key stakeholders in order to shed light on important perpetual care-related financial and operational matters.

Appendices

The Appendices that are included in the pages that follow include:

Appendix A – Forecast of Annual Perpetual Care Expenditures

Appendix B – Headcount & Compensation/Benefits Assumptions

Appendix C – Capital Expenditure Assumptions

Appendix D – Limitations of This Work

Appendix E – Deliverable Distribution Letter

The following table details the breakdown of the annual level of cemetery care funding required to maintain the City's perpetual care obligations as of June 2018. Our analysis indicates that approximately $1.25 million per year in perpetual care funding is required to cover the ongoing maintenance expenditures associated with the cemeteries' current care obligations (including ~$117,500 annually in capital expenditures).

	Current State Annual Expenses[4]	Estimated "Perpetual Care Only" Annual Expenses
Expenses		
Cemetery Operations		
Salaries, wages, and related taxes	$580,226	$451,846
Employee benefits	$87,678	$143,595[5]
Facilities, grounds, and equipment maintenance	$120,782	$99,799
Materials and supplies	$67,027	$67,027
Fuel/gas/oil	$51,703	$47,726
Pension and Post-Retirement Benefits	$0	$40,668
Property and General Liability Insurance	*Unavailable Upon Request*	$18,000
Other General Expenses		
Utilities (electricity, water, waste removal)	$244,840	$244,840
Administrative and office expenses	$27,947	$15,089
Total Expenses	**$1,180,203**	**$1,128,588**
Capital Expenditures		
Equipment	$150,633	$56,296
Capital improvements	$61,215	$61,215
Other	-	-
Total Capital Expenditures	**$211,847**	**$117,511**

Appendix B: Headcount & Compensation/Benefits Assumptions

The following table details the overall staffing levels, comparing the 2018 headcount figures to that which would be required in a "perpetual care only" state. The City would be expected to reduce its staffing to approximately 46% of current levels, shedding approximately 9 FTEs.

In an effort to most efficiently make use of its human resources, the City has indicated that it would, in a "perpetual care only" state, employ administration and service personnel with overall management and maintenance responsibilities to serve the various needs of the individual cost centers. These resources are included in the "Administration & Central Services" personnel below:

	Current State Quantity	Perpetual State Quantity	Perpetual State Salary Totals
Parks Supervisor	1	1	$61,326
Parks Foreman	1	1	$55,806
Irrigation Repairperson	1	1	$42,016
Small Equipment Mechanic	1	1	$41,350
MM II (Hedger/Mower)	3	1	$35,651
MMW III & MM IV (Funeral Servicers)	6	0	-
MM II, MM III (Diggers)	4	3	$106,954
AMW (Weeders) (P/T)	5	5	$108,742

Other Assumptions:
Benefits were estimated to be 31.8% of salary costs, including Social Security/Medicare and health insurance. Pension contributions were estimated to be 9% of salary costs.

Appendix C: Capital Expenditure Assumptions

The following pieces of machinery/equipment are projected to be required and utilized throughout the in-scope cemeteries.

	Current State Quantity	Perpetual State Quantity	Estimated Average Cost (per unit) in FY2018 Dollars	Estimated Useful Life (years)
Backhoe	2	2	$97,500	15
Blower	4	4	$525	3
Chainsaw	5	5	$445	3
Cleaner	1	1	$700	8
Dump Truck	2	1	$58,000	10
Edger	1	1	$600	3
Generator	3	3	$1,000	8
Hedger	1	1	$530	3
Pick-up Truck	2	1	$40,000	12.5
Spreader	1	1	$8,000	5
Trimmer	2	2	$600	3
Weed Eater	9	9	$380	3
Push Mower	2	2	$400	3
Self-Propelled Vacuum	1	1	$3,800	10
Large Golf Cart (6 seater)	3	3	$13,500	5
Lawn Mower (60")	3	3	$9,500	5
SUV/Utility Vehicles	3	2	$40,667	13
Traditional Golf Cart (4 seater)	7	6	$6,900	5

Other Assumptions:
Based on expenses to-date on various improvements and facilities throughout the in-scope cemeteries ($2,703,007) and the assumptions on the estimated useful life of key assets (below), we estimate that, given the cemeteries' current run rate spend on such items and on average, $61,215 will be spent annually on other capital expenditures in order to fulfill perpetual care obligations.

Appendix C: Capital Expenditure Assumptions

The following pieces of machinery/equipment are projected to be required and utilized throughout the in-scope cemeteries.

	Current State Quantity	Perpetual State Quantity	Estimated Average Cost (per unit) in FY2018 Dollars	Estimated Useful Life (years)
Backhoe	2	2	$97,500	15
Blower	4	4	$525	3
Chainsaw	5	5	$445	3
Cleaner	1	1	$700	8
Dump Truck	2	1	$58,000	10
Edger	1	1	$600	3
Generator	3	3	$1,000	8
Hedger	1	1	$530	3
Pick-up Truck	2	1	$40,000	12.5
Spreader	1	1	$8,000	5
Trimmer	2	2	$600	3
Weed Eater	9	9	$380	3
Push Mower	2	2	$400	3
Self-Propelled Vacuum	1	1	$3,800	10
Large Golf Cart (6 seater)	3	3	$13,500	5
Lawn Mower (60")	3	3	$9,500	5
SUV/Utility Vehicles	3	2	$40,667	13
Traditional Golf Cart (4 seater)	7	6	$6,900	5

Other Assumptions:
Based on expenses to-date on various improvements and facilities throughout the in-scope cemeteries ($2,703,007) and the assumptions on the estimated useful life of key assets (below), we estimate that, given the cemeteries' current run rate spend on such items and on average, $61,215 will be spent annually on other capital expenditures in order to fulfill perpetual care obligations.

Appendix E: Deliverable Distribution Schedule

Although this report is intended solely for the use by leadership and management of the City of Fort Lauderdale, this information is being provided solely at your request for information purposes. The report is not intended to benefit or influence any third parties, and is used at your own risk.

Any projection of information contained herein to the future is subject to risk that, because of change, the description may no longer portray the finances, controls or practices in existence. Evaluating the financial position and/or potential effectiveness of specific practices and controls at the City of Fort Lauderdale, is subject to inherent limitations and, accordingly, errors or fraud may occur and not be detected. Furthermore, the projection of any conclusions, based on the findings, to future periods is subject to the risk that (1) changes made to the system of practices and controls, (2) changes in processing requirements, (3) changes in financial circumstances or statements, or (4) changes required because of the passage of time may alter the validity of such conclusions.

This report constitutes Confidential Information and its unauthorized distribution or use is strictly prohibited.

KEITH

Engineering Inspired Design.

www.KEITHteam.com