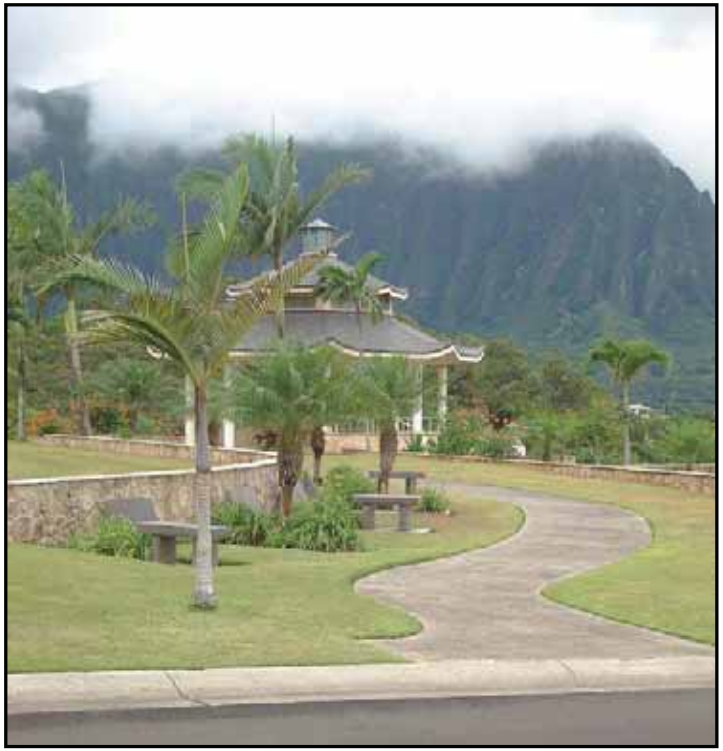
C. Final Preliminary Engineering Report

(SSFM International, Inc.)

Hawaiian Memorial Cemetery Expansion
Final Preliminary Engineering Report



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CHAPTER 1 – INTRODUCTION

1.1 GENERAL OVERVIEW

This Preliminary Engineering Report has been prepared for Hawaiian Memorial Life Plan Limited. The purpose of this report is to evaluate the engineering requirements for two proposed options: (1) Expanding the existing Hawaiian Memorial Park (HMP), an existing privately owned and operated cemetery, and (2) expanding the existing HMP combined with the construction of a 20-lot residential subdivision. The cemetery only expansion is hereinafter referenced as the "Revised Proposed Action". The cemetery expansion with the 20-lot residential subdivision is hereinafter referenced as the "Former Proposed Action".

The existing developed area of the HMP will approach full capacity within the next five to ten years. In order to continue to serve Oahu's community, HMP must expand beyond its existing developed area and is planning for the long term expansion of a portion of its remaining undeveloped property. The expansion of the existing HMP will consist of a variety of land burial plots and up to four mausoleums. Each mausoleum will be up to 3,500 square feet in size. One mausoleum may contain a restroom facility for the use by park visitors. The approximate size of each residential lot will be between 7,500 and 8,000 square feet.

This Preliminary Engineering Report presents a description of the land identified for the expansion of the cemetery and the residential subdivision, and identifies potential infrastructure and/or site development issues. Once identified, this report will detail the requirements associated with these issues for the cemetery expansion and residential subdivision. Improvements assessed include site grading, erosion control, roadways, potable and irrigation water, wastewater and storm water infrastructure.

There are two main engineering issues affecting this site's future development; (1) meeting the City and County of Honolulu drainage requirements; and (2) identifying a water source for irrigation and domestic uses. The adjacent residential areas' storm water systems, at the base of the mountain ridge, have been sized to meet existing conditions with little excess capacity available. Therefore, all increased runoff generated by the proposed development must be retained onsite. The grading plan for each phase of the project will incorporate these retention areas. Also, the City and County of Honolulu Board of Water Supply prefers that the irrigated area within the project site (approximately 30 acres of landscaping area within the cemetery expansion) utilize non-potable well water prior to consideration of additional connections to the city's potable water supply. Well water is often used for cemetery irrigation purposes and is, in fact, used for the irrigation of the adjacent Hawaii State Veterans Cemetery. Also, the existing potable water source in Lipalu Street (the nearest connection point to the residential subdivision) is inadequate to provide domestic water up to the subdivision. Constructing an on-site water system or connecting to another water source are alternatives. These issues are discussed in more detail in the following sections of this report.

A conceptual site grading and drainage layout has been developed for preliminary assessment purposes based on available GIS information. A rough order of magnitude "opinion of probable construction cost" of site development, based upon limited information, is also provided.

Table 1 provides a summary of the pertinent parcel information.

TABLE 1 - PROJECT AREA SUMMARY INFORMATION

Project Location:	The physical address is 45-425 Kamehameha Hwy, Kaneohe, HI 96744. The project area is located between H3, Kamehameha Hwy, Kaneohe Bay Drive and Mokapu Saddle Road in the Kaneohe District on the Island of Oahu.
Tax Map Key:	4-05-033: Portion of tax parcel 001
Total Land Area of Project:	"Former Proposed Action": 56.65 acres of the 164 acre parcel (35%) "Revised Proposed Action": 56.46 acres of the164 acre parcel (34%)
Existing Use:	Portions of the parcel are currently used as a cemetery; the project area is currently undeveloped.
Land Ownership:	Hawaii Memorial Life Plan LTD.
State Land Use:	Conservation
City Zoning:	P-1 Restricted Preservation
SMA District:	The project area is not located within the Special Management Area as established by the City and County of Honolulu
Flood Zone:	Zone X and Zone D

For vicinity map, courtesy of Helber, Hastert & Fee, see Figure 1 in Appendix A.

1.2 PROJECT LOCATION

HMP is in the Kaneohe community on the Island of Oahu, and consists of three separate Tax Map Key Parcels. Two of the parcels, TMK 4-5-034:13 and TMK 4-5-035:08, are situated along Kamehameha Highway, and are currently in cemetery use. A third parcel, TMK 4-5-033:001 (Parcel 1), is separated from the first two parcels by the Hawaii State Veteran's Cemetery, and is located to the north of the Hawaii State Veterans Cemetery, to the east of Mokulele Drive, and south of the Pohai Nani Retirement Community. A portion of this parcel (approximately 8 acres) is also currently in cemetery use, bringing the gross land area of the cemetery use for HMP to about 80 acres. The total area of Parcel 1 is 164 acres. A portion of Parcel 1(56.65 acres for "Former Proposed Action", 56.46 acres for "Revised Proposed Action") is intended for the future expansion of HMP and is hereinafter referenced as the "project area." For clarification of land ownership, see the Tax Map Key Figures 2-4 located in Appendix A.

The residential subdivisions to the northwest of the project area are known as "Pikoiloa 9," "Pikoiloa 10" and the "Parkway Subdivision."

1.3 EXISTING LAND USE DESIGNATION

Under Chapter 205, Hawaii Revised Statutes (HRS), all lands in the State of Hawaii are classified into four land use districts (State Land Use Districts) which are Urban, Rural, Agricultural, and Conservation. Land use district classifications are defined in HRS Section 205-2 and regulated by the State Land Use Commission (State LUC). The project area is classified Conservation and falls under the jurisdiction of the State Department of Land and Natural Resources.

For State Land Use and City and County of Honolulu Zoning, see Figures 5 and 6 in Appendix A, courtesy of Helber, Hastert & Fee.

Under Chapter 205A (Coastal Zone Management), HRS, the City is granted authorization to regulate land uses located within established Special Management Areas (SMA) for the Island of Oahu. Review of the City's SMA map for the Kaneohe area reveals that the subject property is not located within a SMA and not subject to its requirements.

Since the project area is designated "Conservation", a State Land Use District boundary amendment to Urban is required for each of the proposed actions. Also, County zoning changes to P-2 General Preservation District and R-7.5 Residential District are required for the "Former Proposed Action". The "Revised Proposed Action" will only require County zoning changes to P-2 General Preservation District. This preliminary engineering report is intended to support the requests for the land use entitlements.

1.4 DESIGN CRITERIA AND REFERENCES

The following documents and references were used to formulate the conceptual design and assumptions of this preliminary engineering report.

The City and County of Honolulu, Rules Relating To Storm Drainage Standards (dated January 2000) was used to analyze the existing and proposed drainage conditions in the proposed development. Per the City and County of Honolulu Drainage Standards, a 10-year recurrence interval is used in the storm drainage analysis. Based upon the Storm Drainage Standards, the Rational Method is used to calculate storm water runoff flow quantities.

The City and County of Honolulu, Water System Standards (dated 2002) is used to analyze and prepare a conceptual layout of the proposed water system. This project will adhere to fire protection requirements of the City and County of Honolulu Fire Department.

The City and County of Honolulu, Design Standards of the Department of Wastewater Management, Vol. 1 (dated July 1993) is used to analyze and prepare a conceptual layout of the proposed wastewater collection system.

The State of Hawaii, Soil Survey of Islands of Kauai, Oahu, Maui, Molokai and Lanai (dated August 1972) is used to formulate general soil properties, permeability rates and other assumptions to be discussed in a later chapter.

CHAPTER 2 – EXISTING SITE CONDITIONS

A preliminary assessment of existing site conditions was conducted of the parcel identified as Tax Map Key: 4-05-033:001 which contains the area of the expansion of the existing Hawaiian Memorial Park and the residential subdivision. This assessment consisted of a field inspection of the property and nearby neighborhoods, preliminary research of available information on infrastructure facilities in the area, and discussions with various City agencies.

2.1 EXISTING PHYSICAL CONDITIONS

Topography

The proposed project area is currently undeveloped with various ridges, ravines and valleys as topographic features. The ridge line of the parcel separates Kapaa Quarry from the Hawaiian Memorial Park ownership. At the base of the mountain, the parcel is bordered by the Pikoiloa 9, Pikoiloa 10 and Parkway residential subdivisions to the west. The parcel is bordered on the north by the Pohai Nani Retirement Community. The Hawaii State Veterans Cemetery is to the south.

The general terrain of this parcel consists of moderate to severe slopes. The severe slopes are found near the ridgelines. Elevations of the parcel range from 945 feet above mean sea level (MSL) near the ridgeline to 100 feet MSL at the lower boundary.

Topographic data for this site was obtained from the City's GIS website which provides contour lines at 5 foot intervals. This topographic data is not intended for the design of construction documents but reflects adequate information for conceptual planning purposes. Exact elevations and slopes will be confirmed when an aerial and/or ground topographic survey is performed for the design of construction documents.

For Slope Analysis and Elevation Analysis, see Figures 7 and 8, respectively, in Appendix B.

Soils

According to the United States Department of Agriculture, Soil Conservation Service's soil survey report for the Island of Oahu, existing soils on the parcel consist of Alealoa Silty Clay (AeE & ALF), Helemano Silty Clay (HLMG), and Kaneohe Silty Clay (KgC & KHOF).

Alealoa Silty Clay is the predominant soil located within the project site. Helemano Silty Clay is mainly located near the ridgeline. Kaneohe Silty Clay also is located in a portion of the project site.

The Alealoa Series consist of well-drained soils on the uplands of Oahu. One form of Alealoa Silty Clay, AeE, has typical slopes of 15-35% with moderately rapid permeability, medium runoff, and moderate erosion. This soil is typically found on smooth side slopes and the toe slopes of upland areas. The other version present, ALF, has typical slopes of 40-70% with rapid to very rapid runoff and severe erosion. This soil is typically found in stony areas and rock outcrops.

The Helemano Series consist of well-drained soils on alluvial fans and alluvial slopes usually found on the sides of gulches on the Island of Oahu. The type of Helemano Silty Clay found, HLMG, has typical slopes of 30-90% with moderately rapid permeability, medium to very rapid runoff, and severe to very severe erosion. This soil is typically found on the sides of V-shaped gulches, small areas of rock outcrop, steep stony land, and eroded spots.

The Kaneohe Series consists of well-drained soils on terraces and alluvial fans on the windward side of Oahu. The Kaneohe Silty Clay found on site is KgC and KHOF. KgC has medium runoff and moderate erosion. KHOF has medium to rapid runoff and moderate to severe erosion. Both soils are typically found in small eroded spots and gravelly areas.

For the Soil Conservation Survey Analysis refer to Figure 9 in Appendix B. A more detailed soils investigation will be required in conjunction with the design of construction documents for the project.

Flood Hazards

According to the September 30, 2004, Flood Insurance Rate Map (FIRM) Community Panel 15001 0270F, the project site is located in Zone D and Zone X. Zone D represents an area in which flood hazards are undetermined but possible. Zone X represents an area to be outside of the 500-year flood plain. Accordingly, the property appears to be situated outside of any flood designated boundaries. Furthermore, the project site is not situated along the shoreline at an elevation making it subject to coastal flooding.

For the Flood Insurance Rate Map, see Figure 10 in Appendix B.

2.2 EXISTING INFRASTRUCTURE FACILITIES

Drainage Conditions and Facilities

Present storm water runoff from the project site sheet flows into various valleys, channels, etc., following the existing topography. This runoff is collected and flows in storm drains within the residential areas and then discharges into Kawa Stream or various storm drain systems eventually flowing into Kaneohe Bay.

Previous hydrology studies of the immediate area were acquired through Drainage Master Plans obtained from the City & County of Honolulu's Department of Planning and Permitting (DPP), Civil Engineering Branch, Drainage Division. An approved Drainage Master Plan is required to address all storm water prior to the development of any subdivision including both existing flows onto the site and flows from the subdivision's development. Based on these documents and discussions with DPP, it appears that the collection of the existing storm water runoff quantities from the Hawaiian Memorial Park parcel were already addressed in the development of Pikoiloa 9, Pikoiloa 10, and Parkway Subdivisions via various collection points in the residential areas. Sizing of the storm drain lines from runoff of the upland area were based on the City & County of Honolulu's Standard Rational Method. The Rational Method will be further discussed and explained in Chapter 3.

Upon further evaluation of the existing storm drain infrastructure through construction documents recorded with the City and County of Honolulu's Data Accessing and Imaging Branch, a hydraulic analysis of the system was done. This system analysis, based on the existing storm water runoff quantities referenced from Drainage Master Plans and full system hydraulic flow calculations, shows that the existing drainage system is adequate for the current, undeveloped conditions within the project area but may have little excess capacity to accommodate additional peak runoff from the proposed development. For hydraulic calculations, see "Existing Hydraulic Capacity Analysis" table in Appendix C.

As stated above, the downstream system was designed to meet current, undeveloped conditions within the project area for the 10-year, 1-hour storm. The existing undeveloped conditions produce a runoff of approximately 478 cfs.

For Existing Drainage Calculations, see Appendix C.

Water Facilities

Irrigation

The irrigation system for the existing Hawaiian Memorial Park is served by the City's potable water system. The connection point is located at the entrance to HMP in the vicinity of Mahinui Road and Kamehameha Hwy. A 6" meter located on Kamehameha Highway is servicing the existing Hawaiian Memorial Park Cemetery and has a capacity of 1,000 gpm.

There is another waterline in Kumakua Place serving the irrigation system for the Ocean View Garden (a small cemetery area within the Hawaiian Memorial Park ownership). This system includes a 5/8" meter located on Kumakua Place and a 1" lateral coming off of the 5/8" meter. In discussions with the City & County of Honolulu Board of Water Supply (BWS), water quantities and pressure may be currently available to fully service approximately 30 acres of grass landscaping requiring 550 gallons per minute for the expansion area from the waterline.

There is another waterline in Lipalu Street. However, the BWS has indicated that connecting to the existing water stub out along Lipalu Street will not be possible. BWS has determined that the existing system will not have the required pressure to meet the 100+ foot elevation difference, as the existing 272' windward reservoir service limit serving the area will not be high enough to support the proposed cemetery elevations of 200'-375'. The highest elevation that can adequately receive water from the existing system is one hundred feet below the reservoir spillway at elevation 172'.

Before the project can utilize the City's potable water supply for irrigation purposes, non-potable water sources must be investigated for possible use. The BWS has indicated that non-potable wells are present near the project expansion area. According to BWS, three non-potable wells are located on State property along Kamehameha Highway near the H-3 interchange as shown in Figure 11 in Appendix D. The adjacent Hawaii State Veteran's Cemetery uses these non-potable wells as a source for their irrigation but it is unknown whether all three wells are being utilized. According to conversations with a local well driller and BWS, the non-potable well(s) servicing the Hawaii State Veteran's Cemetery were drilled in 1983. One well was test pumped at 27 gpm and the main well at 570 gpm. One well was drilled 62 feet deep. Further research and discussion with Miles Okamura, Operations Manager at the Hawaii State Veterans Cemetery, indicates that these wells have operated satisfactorily Based on the above information, it should be feasible to provide adequate water for irrigation using new wells developed by Hawaiian Memorial Park.

Domestic Water

In addition to irrigation, domestic water will be required for both the "Former Proposed Action" (residential subdivision and comfort station) and "Revised Proposed Action" (comfort station). There are no existing water lines within the proposed project area. The ideal connection point for a water system to serve the residential subdivision and comfort station would be at the existing water line stub out at the end of Lipalu Street. As stated above, since the project topography is located at higher elevations, BWS has indicated that their existing system serving the Lipalu Street area is unable to provide domestic water for both the "Former Proposed Action" and "Revised Proposed Action". However, BWS does allow residential subdivisions to be located above their service limit if the property has frontage and the meter is placed 100' below the required service limit. These conditions cannot be met at the end of Lipalu Street, as the existing elevations are approximately 190', which will not be 100' below the 272' service limit. As a result an on-site water system will be developed to provide domestic water service to the residential subdivision and comfort station.

The existing connection point at Kumakua Place will not be a possible connection point. BWS stated they will not allow the connection because they do not want to take on the burden of maintaining the transmission line from the meter to the residential subdivision due to liability concerns such as a water main break.

For communications from the Board of Water Supply, see Appendix D.

Wastewater Facilities

There are existing wastewater lines within Hawaiian Memorial Park and an 8" municipal transmission line located in Lipalu Street. There are currently no sewer lines within the project area.

Roadway Facilities

There are existing private roadways within the existing Hawaiian Memorial Park, Hawaii State Veteran's Cemetery, and Ocean View Gardens. Also, Lipalu Street (a public right of way) ends at the property line of the Hawaiian Memorial Park ownership in which the project is located.

A traffic assessment will be prepared by Perazim Consulting, LLC to discuss the impacts of the cemetery expansion and residential component.

2.3 KEY ISSUES ASSOCIATED WITH EXISTING INFRASTRUCTURE FACILITIES

Based upon the preliminary assessment of the existing site conditions, infrastructure and facilities, the major engineering issues affecting the proposed development will be: (1) retaining increases in storm water runoff onsite; (2) investigating non-potable water sources for irrigation to avoid using the City's potable water; and (3) investigating a source to provide domestic water to the proposed residential subdivision.

Based on the City's Storm Water Standards, the proposed project must be designed to handle the increased storm water runoff from a 1-hour, 10-year recurrence interval storm. There are two options to mitigate the increase of discharged runoff due to a property development, renovation, alteration, etc. The first option is to convey the increased runoff to a collection system which has adequate capacity to accept the additional flows. This would require adding storm drains below the project site or upgrading the existing storm drain system as the existing system is at or near capacity. The second option is to retain the additional storm water created from the development onsite for the duration of the 10-year, 1-hour storm. This is the most cost effective and reasonable approach to mitigating the additional runoff. Further drainage details are explained in Section 3.2 "Proposed Drainage Alternatives".

Addressing the BWS requirements for a thorough and conclusive investigation of a non-potable water source for irrigation purposes will be difficult without drilling exploratory wells. The drilling of exploratory wells will be performed in future phases of this project. As the results of drilling these wells are not available at this time, the next chapter will provide various alternatives for water availability to be further researched.

Providing a domestic water system for the proposed residential subdivision due to the existing inadequacies of the existing BWS systems to meet the flow requirements will be another key issue to be discussed in subsequent chapters.

CHAPTER 3 - SITE DEVELOPMENT ASSESSMENT

The results of this preliminary engineering analysis suggest that development of the 56.65 acre ("Former Proposed Action") and 56.46 acre ("Revised Proposed Action") project is feasible and practicable.

A conceptual site plan was prepared based on the criteria discussed in the following sections. Prior to this Final PER, a conceptual design was prepared that consisted of a cemetery expansion and 20-lot residential subdivision, also known as the "Former Proposed Action". Since then, a "Revised Proposed Action" has been implemented to incorporate a cemetery only expansion. For the conceptual site plan for both actions, see Conceptual Site Plans in Appendix F and G, respectively.

3.1 PROPOSED EROSION CONTROL MEASURES

The existing soils are classified as having moderate to severe erosion, therefore temporary and permanent erosion control measures need to be implemented as best management practices (BMP's) during construction. An additional BMP would be to begin construction during dry months of the year. Temporary erosion control measures include using silt fences, stabilized construction entrances, catch basin and inlet protection, and dust control. Permanent erosion control measures include grading to provide proper drainage. Exposed areas will be paved or grassed and/or landscaped to match adjacent landscaping. Grass sod will be planted to minimize erosion.

Proper grading, pavement and permanent grassing and landscaping over all open areas created by the grading operations will minimize soil loss from the site to acceptable levels.

The above mentioned proposed erosion control measures will minimize potential sediment runoff to existing drainage facilities, reducing the soil loss to acceptable levels. During construction, the contractor will use mulching to provide the necessary erosion control as they proceed. The permanent erosion control measures proposed will protect the site against future soil erosion.

3.2 PROPOSED INFRASTRUCTURE AND FACILITIES

Proposed Grading Concept

This PER has been prepared without a geotechnical report or detailed topographic survey. Thus, the following assumptions have been made during this planning phase:

1) All soils are identical and useable for landscaping, cemetery activities, and cut/fill,
2) All areas are gradable except the area within the cultural preservation area and historical sites including any rock crop areas,
3) Maximum slopes for the project are equal to existing slopes. Thus the maximum slopes will be established at 50% (2 Horizontal:1 Vertical),
4) All soils are ideal and will not swell or compact during grading activities,
5) Grading activities will not create any type of landslides, rock falls, erosion, flooding or dangerous situations which may affect downhill parcels, and
6) Grading will not severely alter the natural drainage ways for the project area affecting downhill residents.

This PER has been prepared with certain criteria provided by HMP for cemetery activities:

1) The maximum slope for usable cemetery plots is equal to or less than 20% (5 Horizontal :1Vertical),
2) The maximum distance to a cemetery plot is 150 feet from the roadway,
3) The overall earthwork quantity must be approximately 70,000 cubic yards of net fill, and
4) Each phase of the project must roughly equalize cut and fill quantities. Development phasing will be determined in the design phase of this project and not during the planning phase. This will allow for the detailed analysis to create a cut/fill balance with each phase.

During the grading phase, there will be no import or export of any soil during the expansion process. All soil will come from within HMP and will entirely balance within the overall HMP property. The source of the backfill will

come from the 2-3 cubic yards of soil that will be generated by each future burial in the new and existing cemetery areas.

For the proposed grading concept, see Conceptual Grading Plans in Appendix F and G.

Proposed Drainage Alternatives

The existing storm water system within the adjacent subdivisions is already at or near full capacity. Thus the volume of increased drainage runoff attributable to the expansion of the cemetery and residential subdivision will be retained onsite. The following discussion will present two alternatives to retain the increased runoff onsite.

Since the cemetery expansion is replacing "natural" vegetation with landscape material (primarily turf), there is no difference in runoff quantities other than the increase in runoff quantities generated from the impervious roadway and mausoleums within the cemetery expansion. There will also be increased runoff from the roadway and structures to be built within the residential lots. The increase in runoff was estimated using the Rational Method.

The Rational Method is used to calculate the increase in runoff based on the storm intensity, runoff coefficient, and area. The method then provides an additional safety factor by including the time of concentration. The time of concentration is the amount of time it would take a drop of water from the farthest point in a drainage basin to reach the discharge point. The maximum discharge during a storm event is at the time of concentration. The time of concentration then correlates to a correction factor giving the Rational Method the following equation:

Water Discharge Quantity, cubic feet per second = (Pavement Coefficient) x (Rainfall Intensity, in/hr) x (Area, acres) x (Correction Factor based on the Time of Concentration).

$Q=CIA(CF)$

In calculating the increased runoff, the same rainfall intensity and area boundaries were used as in the previous Drainage Master Plans to maintain consistency. This provides a layer of conservatism as some of the drainage areas were addressed in multiple Master Drainage Plans. The proposed runoff quantities are considered conservative because the maximum correction factor was used to calculate the amount of runoff needing to be retained onsite. Thus it was assumed for all drainage basins that the time of concentration was 3 minutes and a correction factor of 3 was used for the proposed calculations, which resulted in higher Q's.

Cemetery Expansion and 20-Lot Residential Subdivision

Once the conceptual site plan was established, the increased runoff from the roadways, mausoleums, and impervious portions of the residential subdivision was calculated. For calculation purposes, the assumptions are 50% of the residential lots will consist of 4000 square feet of impervious area (3000 sf one-story unit, 500 sf driveway, and 500 sf garage) and the other 50% will consist of 2500 square feet of impervious area (3000 sf two-story unit, 500 sf driveway, and 500 sf garage). A 10-year 1-hour duration storm has the potential to discharge a total of approximately 520 cfs from the contributory drainage areas in the previous Master Plans. As a result, of the proposed cemetery expansion and residential subdivision, the total runoff will be increased by approximately 42 cfs (from 478 cfs) from the 9 drainage areas. This increased runoff is approximately 153,000 cubic feet (assuming the increased runoff must be stored for one hour). See "Proposed Drainage Analysis" for hydrology calculations in Appendix C. Drainage Area "A-6" produced the largest increase in runoff and will require the most on site retention volume. Drainage Areas "D-4" and "B-7" did not produce additional increased runoff and therefore will not need on site retention systems in their drainage area.

Cemetery Expansion Only

For the "Revised Proposed Action", the only increase in runoff would come from the impervious internal cemetery roadway and mausoleums. A 10-year storm has the potential to discharge a total of approximately 520 cfs from the contributory drainage areas in the previous Master Plans. As a result of the "Revised Proposed Action", the total runoff will be increased by approximately 22 cfs (from 478 cfs) from the 9 drainage areas. The increase of approximately 22 cfs is a decrease of 20 cfs from the "Former Proposed Action". This increase in runoff from the

existing conditions generates a volume of approximately 84,450 cubic feet (assuming the increased runoff must be stored for one hour). See "Proposed Drainage Analysis" for hydrology calculations in Appendix C. Drainage Area "A-6" produced the largest increase in runoff and will require the most on site retention volume. Similar to the "Former Proposed Action", Drainage Areas "D-4" and "B-7" did not produce additional increased runoff and therefore will not need on site retention systems in their drainage area. After the increased runoff was determined, two options were considered for onsite retention: drywells and retention areas.

Drywell Alternative

Drywells are large storm drainage chambers of various sizes. Their purpose is to retain storm water and discharge it through infiltration. They would be located in the roadway and appear like storm drain inlets from the surface. The main advantage of this alternative is the fact that they would not consume any "usable" land.

For calculation purposes, we assumed a drywell with a 5' radius and 5' depth. Through a cost analysis using a typical percolation rate found in the Soil Conservation Service's soil survey report of 4 inches per hour, the number of drywells required will likely exceed 10,000. At a cost of $10,000 per drywell, this alternative is not feasible and retention areas were considered.

Retention Area Alternative - Cemetery Expansion and 20-Lot Residential Subdivision

Retention areas or basins are the most common means of controlling runoff from new development areas. For the proposed cemetery, the retention areas would consist of depressed turf or grassy planted areas that will be designed into the cemetery grounds in a manner to blend in with the general landscape appearance. The retention areas will be scattered throughout the cemetery to provide the required amount of storage while avoiding larger and deeper basins. These areas also act as a treatment process to improve water quality, as they allow the settling of fine particles and pollutants associated with storm water runoff, which is considered a measure for improving water quality per City and County of Honolulu Standards. During the design phase, the objective will be to have retention areas with a maximum depth of no more than 18" of water. However, two retention areas located northeast of the proposed cemetery grounds within the cut/fill slope may have depths up to 3'. Approximately 1.93 acres scattered throughout the development will be needed for the retention areas. The cemetery grounds will lend themselves well to incorporation of retention areas and will provide the opportunity to maximize surface area and therefore percolation and evaporation opportunities of the retained water. The final design and locations of retention areas will be prepared during the grading plan phase of the project. For the proposed drainage concept, please see the Conceptual Drainage Plan in Appendix F.

Retention Area Alternative - Cemetery Expansion Only

The retention areas will be scattered throughout the cemetery to provide the required amount of storage while avoiding larger and deeper basins. During the design phase, the objective will be to have retention areas with a maximum depth of no more than 18" of water. With an approximate required storage volume of 84,450 cubic feet to capture the increase in runoff for one hour, approximately 1.33 acres scattered throughout the development will be needed for the retention areas. The required storage volume of 84,450 cubic feet is a 45% reduction in storage volume from the "Former Proposed Action". The cemetery grounds will lend themselves well to incorporation of retention areas and will provide the opportunity to maximize surface area and therefore percolation and evaporation opportunities of the retained water. The final design and locations of retention areas will be prepared during the grading plan phase of the project.

Routine monitoring and management shall be conducted throughout all retention areas to ensure maximum storage. Also, in order to prevent a suitable habitat for mosquito breeding, all retention areas shall be dry within three (3) days. Other measures for maintenance include annual removal of emergent vegetation, chemical pesticide treatment, aeration, etc.

For the proposed drainage concept, please see the Conceptual Drainage Plan in Appendix G.

Proposed Wastewater Disposal Alternatives

Cemetery Expansion and 20-Lot Residential Subdivision

The proposed expansion of the Hawaiian Memorial Park and residential subdivision will generate wastewater from the public restroom and the 20-lot residential subdivision. Therefore, added wastewater lines and a collection system will be needed within the project area to handle this wastewater. The proposed restroom facility within the cemetery expansion area will generate approximately 13,430 gallons per day or 0.013 mgd (Million Gallons per day) of wastewater at a design flow average while the proposed 20 lot residential subdivision would generate 52,061 gallons per day (0.05 mgd). The existing 8" sanitary sewer line in Lipalu Street has the capacity to accommodate these flows. This connection has been approved by the City and County of Honolulu Department of Planning and Permitting (see Appendix E for sewer connection approval and sewer flow calculation).

For proposed sewer line alignment, see Conceptual Utility Plan in Appendix F.

Cemetery Expansion Only

The proposed "cemetery only" expansion of the existing Hawaiian Memorial Park will generate wastewater from the public restroom only. According to DOH, the only restrictions for a septic tank and leach field is that it shall be located at least five (5) feet away from the property line and proposed structure. There are no restrictions on the distance from a burial plot. Therefore, added wastewater lines and a collection system will be needed within the project area to handle this wastewater. The proposed restroom facility within the cemetery expansion area will generate approximately 13,430 gallons per day or 0.013 mgd (Million Gallons per day) of wastewater at a design flow average (based on a total capita of 100 people). The proposed septic tank and leach field shall be designed to handle these proposed flows. See Appendix E for sewer flow calculation.

For proposed sewer line alignment, see Conceptual Utility Plan in Appendix G.

Proposed Water System Alternatives for Irrigation

Irrigation

Windward Oahu receives sufficient precipitation to minimize the need for supplemental irrigation of landscaping. During dry hot periods, particularly during establishment of new landscaping, irrigation will be required. In a worst case scenario, an irrigation flow of up to 500 plus gallons per minute (gpm) could be required to keep the cemetery grounds adequately watered at full build out for both the "former" and "revised" proposed actions.

Construction of Onsite Wells

The Board of Water Supply (BWS) requires investigation of the feasibility of non-potable water sources prior to the use of potable water sources for irrigation. Cemeteries are often irrigated with well water and HMP would also prefer this method and source. The Veterans cemetery is irrigated through wells located near the intersection of the H-3 freeway and Kamehameha Highway. Additional wells could be added in this area to also supply the proposed HMP expansion per conversations with Chester Lao of BWS and local area drillers. However, the length of the pipe run to the HMP expansion area from this location would be costly. Investigations into the feasibility of drilling wells on HMP property and within or near the proposed expansion area indicate a reasonable probability of developing sufficient water supply. If several wells are required, they can be drilled coincident with the various new phases of the cemetery expansion. This will also allow continued analysis of the ongoing irrigation water needs of the expanding cemetery. Exploratory wells will be drilled prior to commencing construction of the first phase of development to determine final feasibility. See proposed waterline alignment in Appendix F and G, "Conceptual Utility Plan".

Connecting to Existing Water Alternatives

The existing Ocean View Garden area of HMP adjacent to the proposed expansion is irrigated through a potable water meter located on Kumakua Place. If a non-potable water source is found to be unavailable or infeasible, a

connection to Kumakua Place or another available BWS source may be a possible option. The BWS pressure zone for the Kumakua meter is sufficient to provide adequate pressure to the entire expansion area . If approved by BWS, the existing meter would need to be enlarged from the current 5/8" size to a 3" or 4" meter size. The supply main from the meter into the cemetery would also need to be increased to deliver the required flow if approved by BWS. There is also a potable water supply at Lipalu Street but it has insufficient pressure and size to provide water into the expansion area for irrigation purposes.

The supply system within the existing HMP area are serviced off of Kamehameha Highway could also be extended into the expansion area. This would be less cost effective since it would entail long and expensive pipe runs through the existing cemetery and across the Ocean View Garden section to the expansion area.

Proposed Water System Alternatives for Domestic Usage

Domestic Water - Cemetery Expansion and 20-Lot Residential Subdivision

Domestic water will be required for the 20 lot residential subdivision and also the proposed cemetery comfort station. The subdivision and comfort station is expected to generate a maximum daily demand of 15,000 gpd and a peak hour demand of 30,000 gpd (See Appendix D for water calculations.)

The only option for providing potable water to the residential subdivision and the cemetery restroom will be to build an onsite water system. As stated previously, connection to the existing water systems along Lipalu Street and Kumakua Place will not be possible due to water pressure, liability and maintenance issues.

Onsite Water System

The proposed onsite well systems constructed to supply irrigation water could also provide the necessary potable water supply if the water tests successfully for potability and/or if additional treatment onsite can improve minor deficiencies in the water to potable quality levels.

This potable water would be stored in an 80,000 gallon tank located in the upper developed cemetery grounds at approximately the 330 foot elevation. This will allow adequate storage and gravity pressure for domestic and fire flow volumes in the subdivision. The water treatment facility and tank will be serviced by a small paved road from the internal cemetery road network. The storage tank will be set into grade and landscaped to reduce or eliminate visibility from offsite areas.

Domestic Water - Cemetery Expansion Only

For the cemetery only expansion, domestic water will be required for the proposed cemetery comfort station. Contrary to the residential subdivision option, the domestic water servicing the comfort station will be non-potable water instead of potable water. Based on the 16.8 fixture units, the comfort station is expected to need 33 gallons/minute (See Appendix D for water calculations).

Fire Protection

The proposed mausolea structures located in the proposed expansion area are Type IV cast-in-place non-combustible structures with no assembly areas. As such, they will not require fire protection.

Proposed Roadway Access

Cemetery Expansion and 20-Lot Residential Subdivision

A proposed access road from the end of Lipalu Street will be provided for access to the residential subdivision. The proposed residential access road will have a 44' right-of-way with two 12' wide travel lanes. Also, 6" curbs will be provided on each side of the roadway. Within the residential subdivision, a cul-de-sac design is proposed and will be provided at each dead end.

Internal cemetery roadways will be provided throughout the cemetery portion of the project site. The internal roadways will be 26' wide with a 1 foot rolled curb on each side. The proposed connection point will be at the existing Ocean View Garden roadway. Also, a 12' wide road will be provided from the internal cemetery roadway to the proposed 80,000 gallon water tank located within the cemetery.

For the proposed roadway system, see Conceptual Site Plan in Appendix F.

Cemetery Expansion Only

Access to the proposed cemetery expansion area will be through the private road system through the existing Hawaiian Memorial Park, Hawaii State Veterans Cemetery, and Ocean View Garden.

Internal roadways will be provided throughout the cemetery portion of the project site. The internal roadways will be 26' wide with a 1 foot rolled curb on each side. The proposed connection point will be at the existing Ocean View Garden roadway.

For the proposed roadway system, see Conceptual Site Plan in Appendix G.

CHAPTER 4 - OPINION OF PROBABLE CONSTRUCTION COST

The following is the opinion of probable construction cost for both the "Former Proposed Action" and "Revised Proposed Action". The estimated cost for the "Former Proposed Action" and "Revised Proposed Action" totaled approximately $8,483,000 and $6,087,000, respectively.

TABLE 2 – OPINION OF PROBABLE CONSTRUCTION COST "FORMER PROPOSED ACTION"

Opinion of Probable Construction Cost – Cemetery Expansion and 20-Lot Residential Subdivision				
Description	**Quantity**	**Units**	**Unit Cost**	**Total Cost**
Erosion Control & Grading				
Mobilization/Demobilization	1	LS	$50,000	$50,000
Construction Equipment	1	LS	$80,000	$80,000
Silt Fence	2,000	LF	$5	$10,000
Dust Fence	2,000	LF	$25	$50,000
Construction Ingress/Egress	1	EA	$3,000	$3,000
Clearing & Grubbing	56	AC	$10,000	$557,500
Relocated Earthwork (Excavation/Cut)	500,865	CY	$5	$2,504,325
Fill	37,459	CY	$5	$187,295
Compaction	37,459	CY	$1	$37,459
Grading	269,830	SY	$1	$269,830
Sub-Total (Erosion Control & Grading)				**$3,749,409**
Road Improvements				
Residential				
6" Base Course	13,716	SY	$25	$342,898
2" AC Pavement	13,716	SY	$25	$342,898
6" Concrete Curb and Gutter	4,987	LF	$50	$249,365
4' Wide Concrete Sidewalk	2,217	SY	$65	$144,078
Cemetery				
6" Base Course	19,170	SY	$25	$479,255
2" AC Pavement	19,170	SY	$25	$479,255
Rolled Curbs/Gutters	4,000	LF	$50	$200,000
Sub-Total (Road Improvements)				**$2,237,747**
Utility Lines				
Residential				
Trench Excavation for Water	362	CY	$3	$1,087
Trench Backfill for Water	54	CY	$6	$326
Pipe Bedding for Water	308	CY	$50	$15,406
Compaction for Water	362	CY	$3	$1,087
8" PVC Waterline	1,409	LF	$27	$38,053
Trench Excavation for Sewer	795	CY	$3	$2,386
Trench Backfill for Sewer	477	CY	$6	$2,863
Pipe Bedding for Sewer	318	CY	$50	$15,906
Compaction for Sewer	795	CY	$3	$2,386
8" HDPE Sewerline	2,494	LF	$75	$187,024

SMH, cover & frame	5	EA	$1,600	$8,000
Warning Tape (Sewer)	2,494	LF	$0.10	$249
Fire Hydrants	4	EA	$2,500	$10,000
Fittings	1,000	LB	$3	$3,000
Testing & Chlorination	1	LS	$1,500	$1,500
Cemetery				
Trench Excavation for Water	1,325	CY	$3	$3,976
Trench Backfill for Water	199	CY	$6	$1,193
Pipe Bedding for Water	1,126	CY	$50	$56,324
Compaction for Water	1,325	CY	$3	$3,976
8" PVC Waterline	391	LF	$27	$10,553
6" PVC Waterline	4,409	LF	$19	$83,773
Trench Excavation for Sewer	88	CY	$3	$264
Trench Backfill for Sewer	53	CY	$6	$317
Pipe Bedding for Sewer	35	CY	$50	$1,762
Compaction for Sewer	88	CY	$3	$264
6" HDPE Sewerline	317	LF	$75	$23,784
Warning Tape (Sewer)	317	LF	$0.10	$32
80,000 Gallon Water Tank	1	EA	$180,000	$180,000
Booster Pump	3	EA	$3,000	$9,000
Water Treatment System	1	EA	$10,000	$10,000
Non-Potable Well	3	EA	$40,000	$120,000
Fittings	1,000	LB	$3	$3,000
Testing & Chlorination	1	LS	$1,500	$1,500
Sub-Total (Utilities)				**$798,991**
Total				**$6,786,147**
Contingency (25%)				$1,696,537
Grand Total				$8,482,684
Grand Total (Rounded)				**$8,483,000**

TABLE 3 – OPINION OF PROBABLE CONSTRUCTION COST "REVISED PROPOSED ACTION"

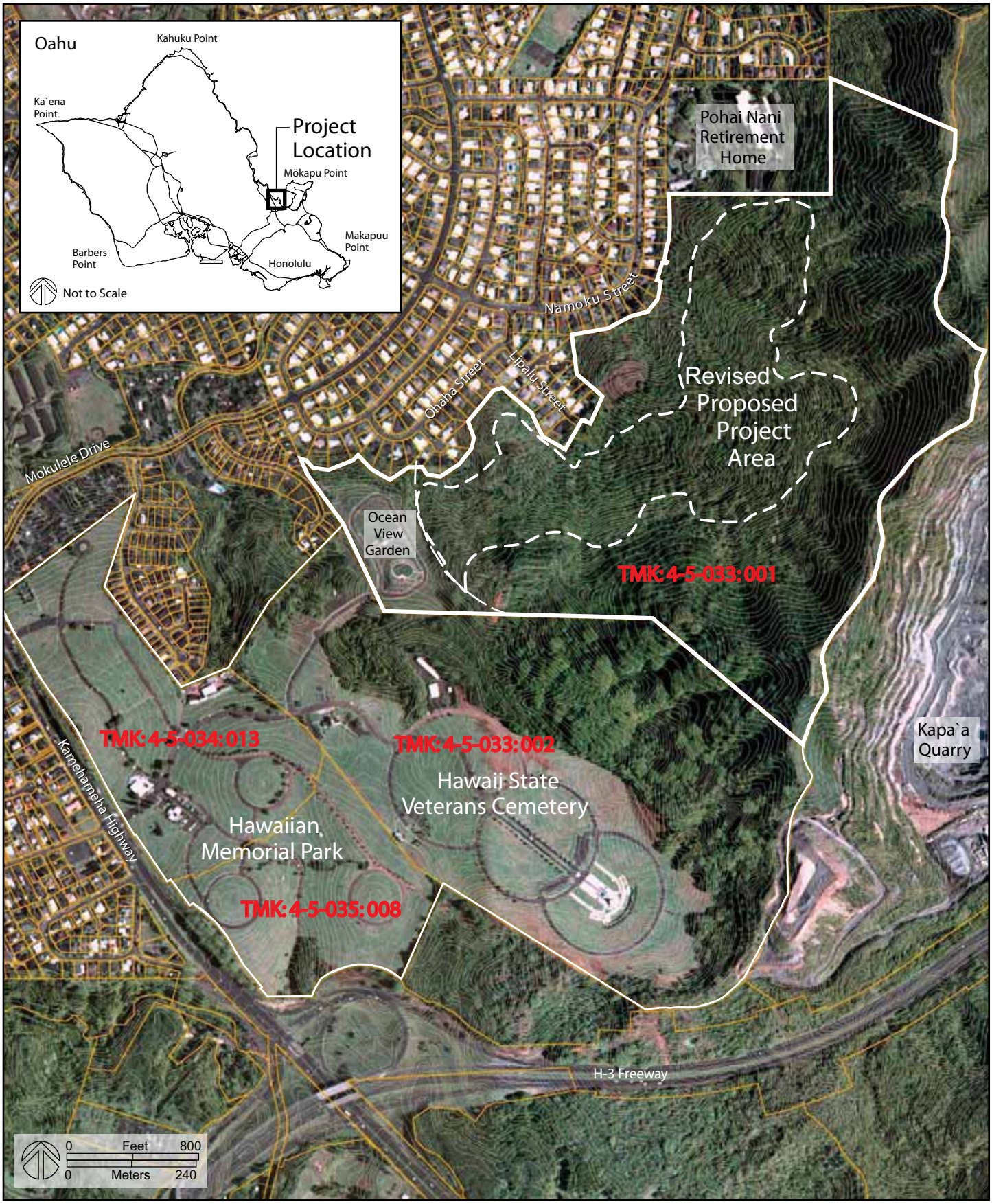
Opinion of Probable Construction Cost – Cemetery Expansion Only				
Description	**Quantity**	**Units**	**Unit Cost**	**Total Cost**
Erosion Control & Grading				
Mobilization/Demobilization	1	LS	$50,000	$50,000
Construction Equipment	1	LS	$80,000	$80,000
Silt Fence	2,000	LF	$5	$10,000
Dust Fence	2,000	LF	$25	$50,000
Construction Ingress/Egress	1	EA	$3,000	$3,000
Clearing & Grubbing	45	AC	$10,000	$450,000
Relocated Earthwork (Excavation/Cut)	363,251	CY	$5	$1,816,255
Fill	56,525	CY	$5	$282,625
Compaction	56,525	CY	$1	$56,525

Grading	217,800	SY	$1	$217,800
Sub-Total (Erosion Control & Grading)				**$3,016,205**
Road Improvements				
Cemetery				
6" Base Course	23,280	SY	$25	$582,000
2" AC Pavement	23,280	SY	$25	$582,000
Rolled Curbs/Gutters	6,850	LF	$50	$342,500
Sub-Total (Road Improvements)				**$1,506,500**
Utility Lines				
Cemetery				
Trench Excavation for Water	1,176	CY	$3	$3,527
Trench Backfill for Water	176	CY	$6	$1,058
Pipe Bedding for Water	999	CY	$50	$49,961
Compaction for Water	1,176	CY	$3	$3,527
6" PVC Waterline	5,290	LF	$19	$100,510
Booster Pump	3	EA	$3,000	$9,000
Non-Potable Well	3	EA	$40,000	$120,000
Septic Tank w/ Leach Field	1	EA	$55,000	$55,000
Fittings	1,000	LB	$3	$3,000
Testing & Chlorination	1	LS	$1,500	$1,500
Sub-Total (Utilities)				**$347,082**
Total				**$4,869,787**
Contingency (25%)				$1,217,447
Grand Total				$6,087,234
Grand Total (Rounded)				**$6,087,000**

APPENDICES

APPENDIX A

General Information



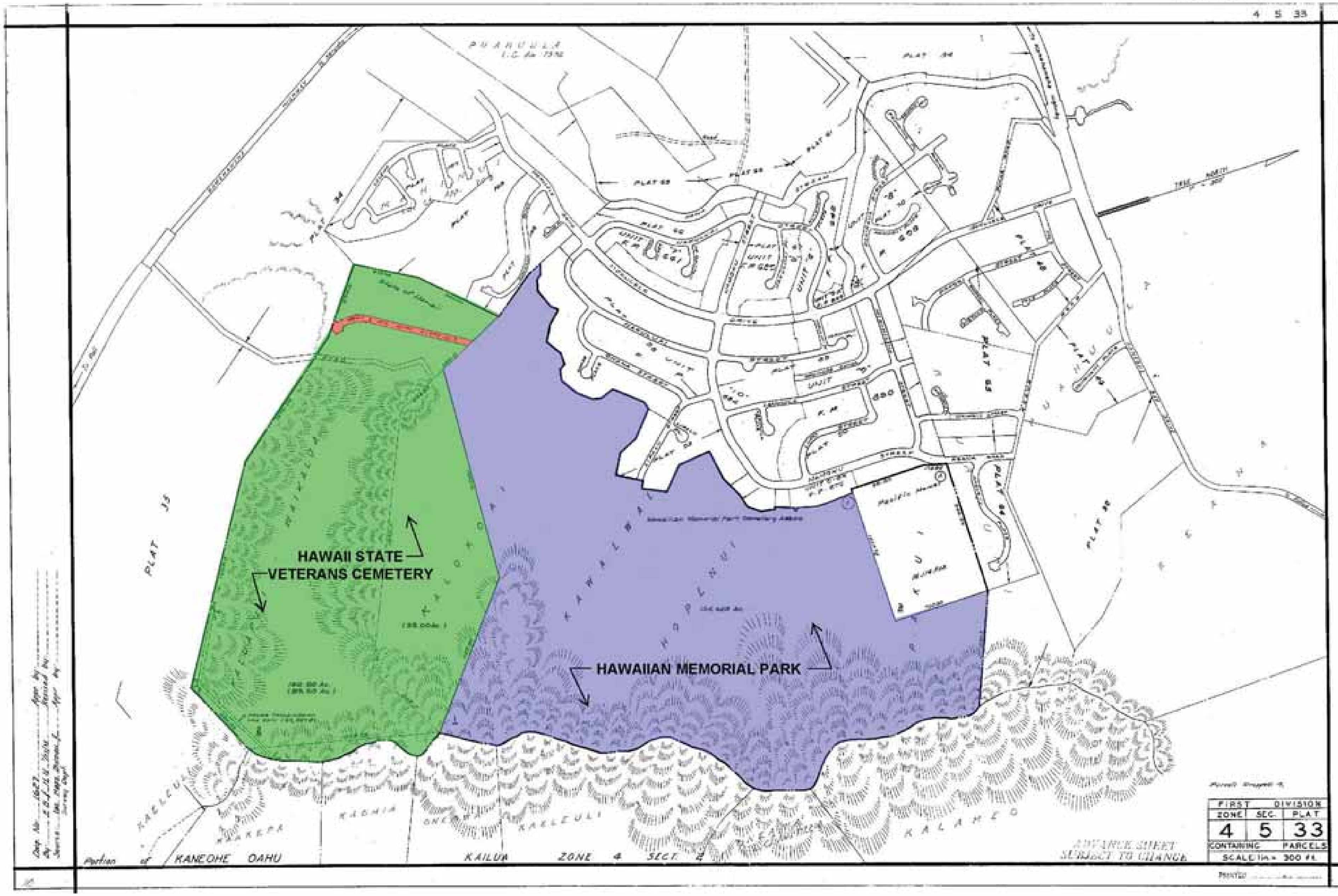
Vicinity Map

Figure 1

Hawaiian Memorial Park Cemetery Expansion

Kaneohe, Oahu

Figure 2



4 5 33
HAWAII STATE VETERANS CEMETERY
HAWAIIAN MEMORIAL PARK
PLAT 35
KANEOHE OAHU
KAILUA
ZONE 4 SECT. 5
FIRST DIVISION
ZONE 4
SEC. 5
PLAT 33
CONTAINING PARCELS
SCALE 1 in. = 300 ft.
ADVANCE SHEET SUBJECT TO CHANGE

Figure 3

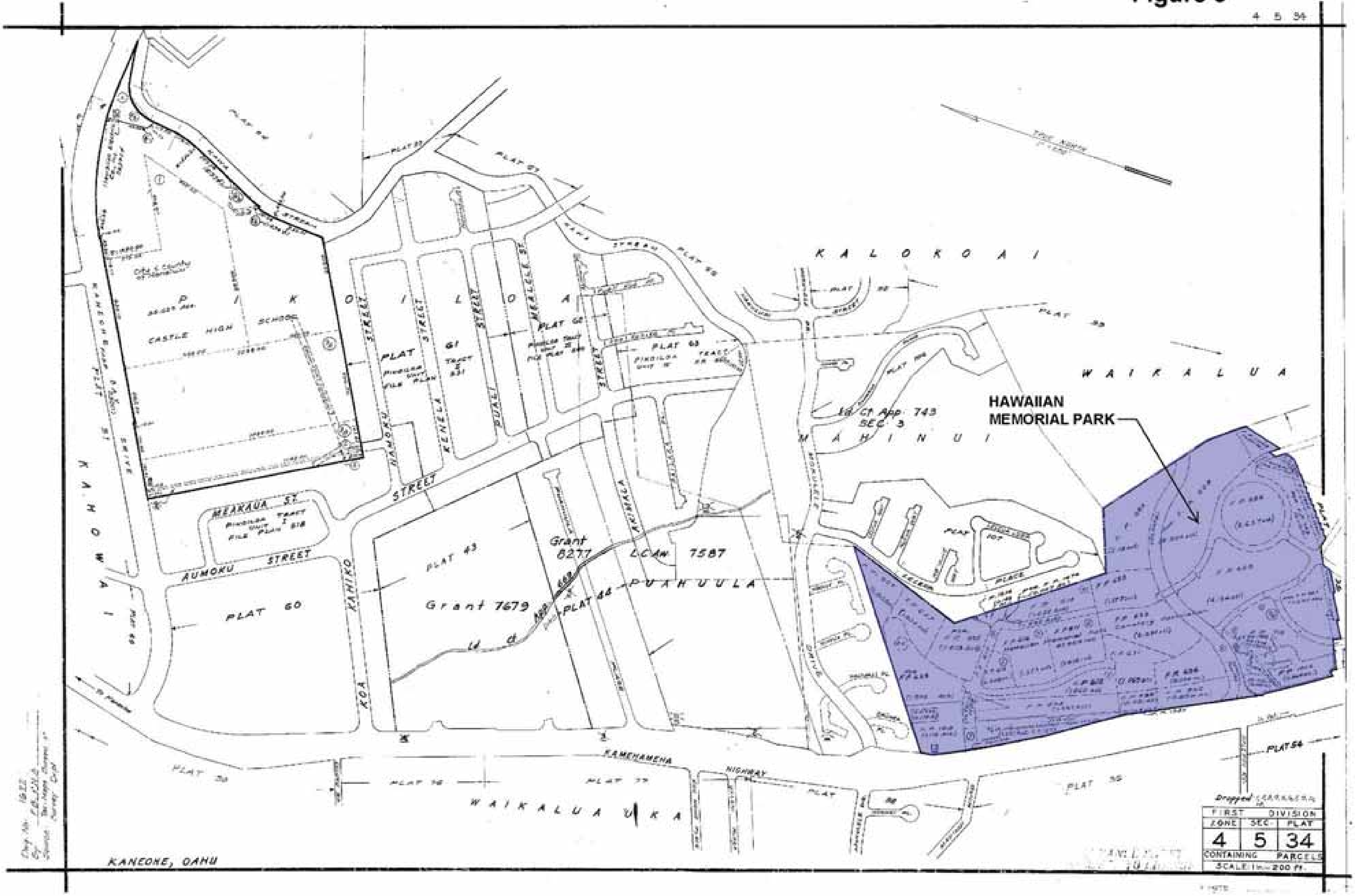
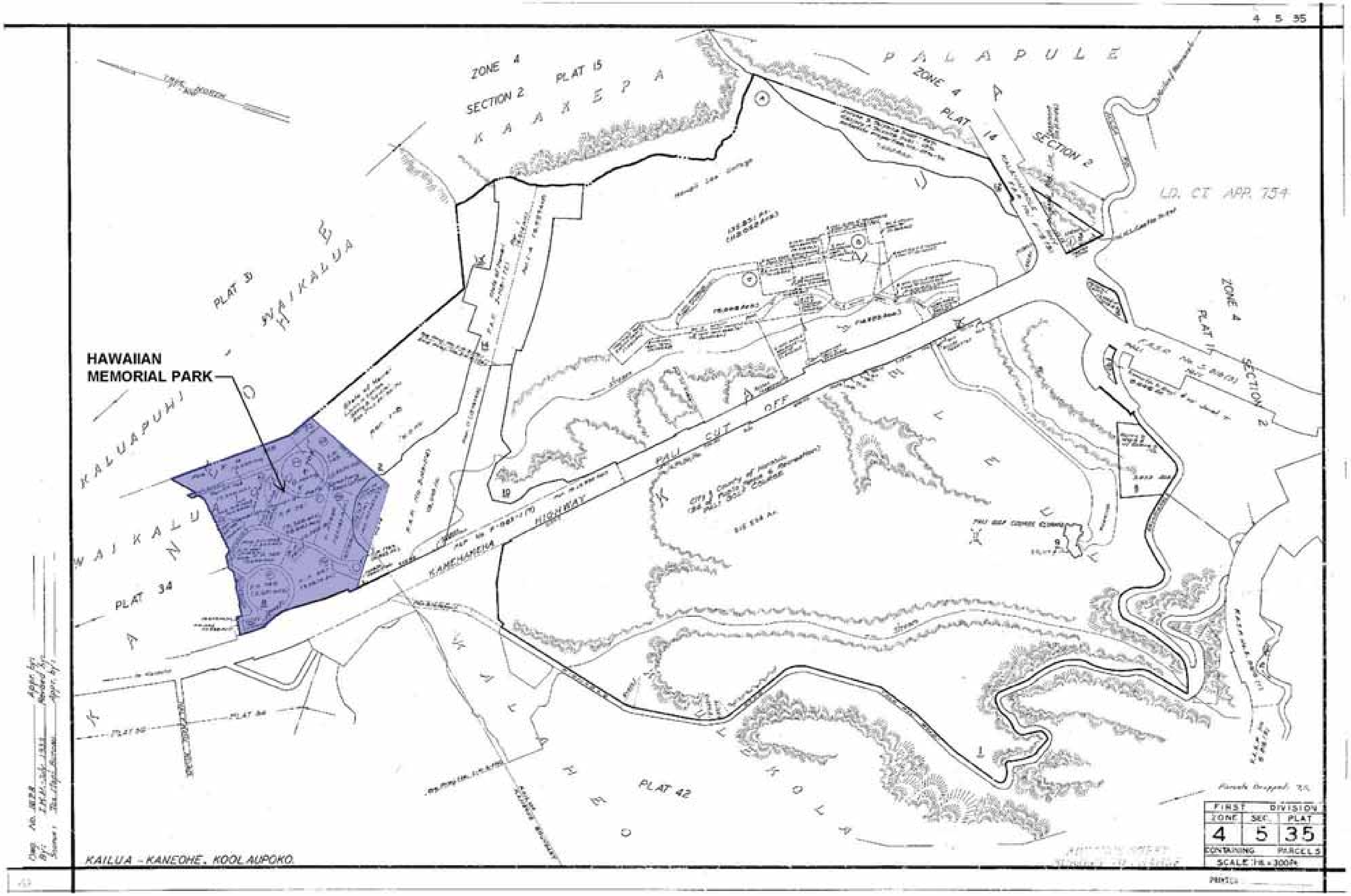
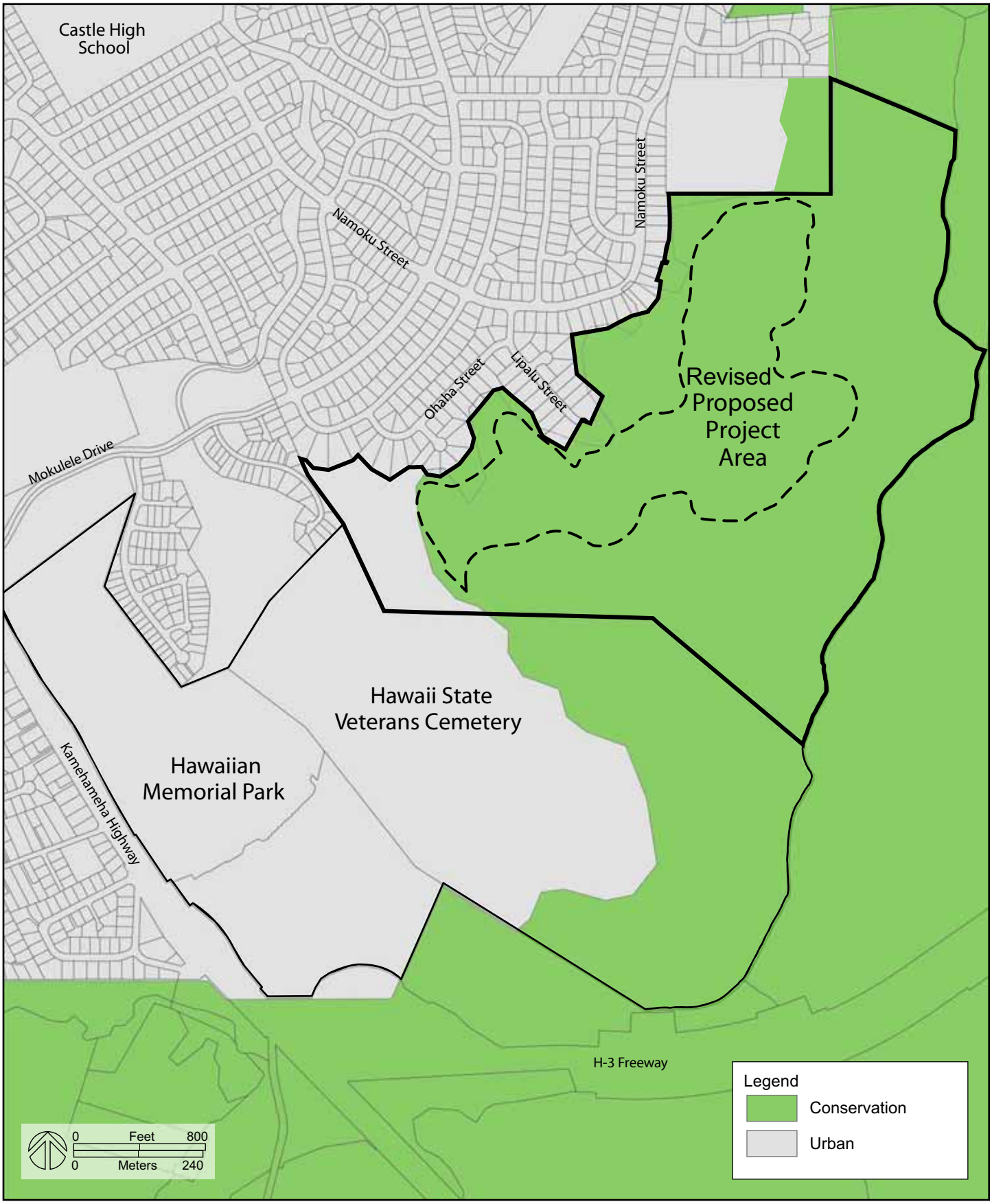

HAWAIIAN
MEMORIAL PARK
K A L O K O A I
W A I K A L U A
M A H I N U I
P U A H U U L A
W A I K A L U A U K A
K A H O W A I
P I K O I L O A
CASTLE HIGH SCHOOL
PLAT 43
Grant 7679
Grant 8277
L.C.Aw. 7587
PLAT 60
PLAT 61
PLAT 62
PLAT 63
PLAT 44
PLAT 54
PLAT 207
STREET
AUMOKU STREET
MEAKAUA ST.
KAHIKO
KOA
NAMOKU
KENELA
PUALI
MEALELE ST.
AKIMALA
KAMEHAMEHA
HIGHWAY
KANEOHE, OAHU
FIRST DIVISION
ZONE SEC. PLAT
4 5 34
CONTAINING PARCELS

Figure 4

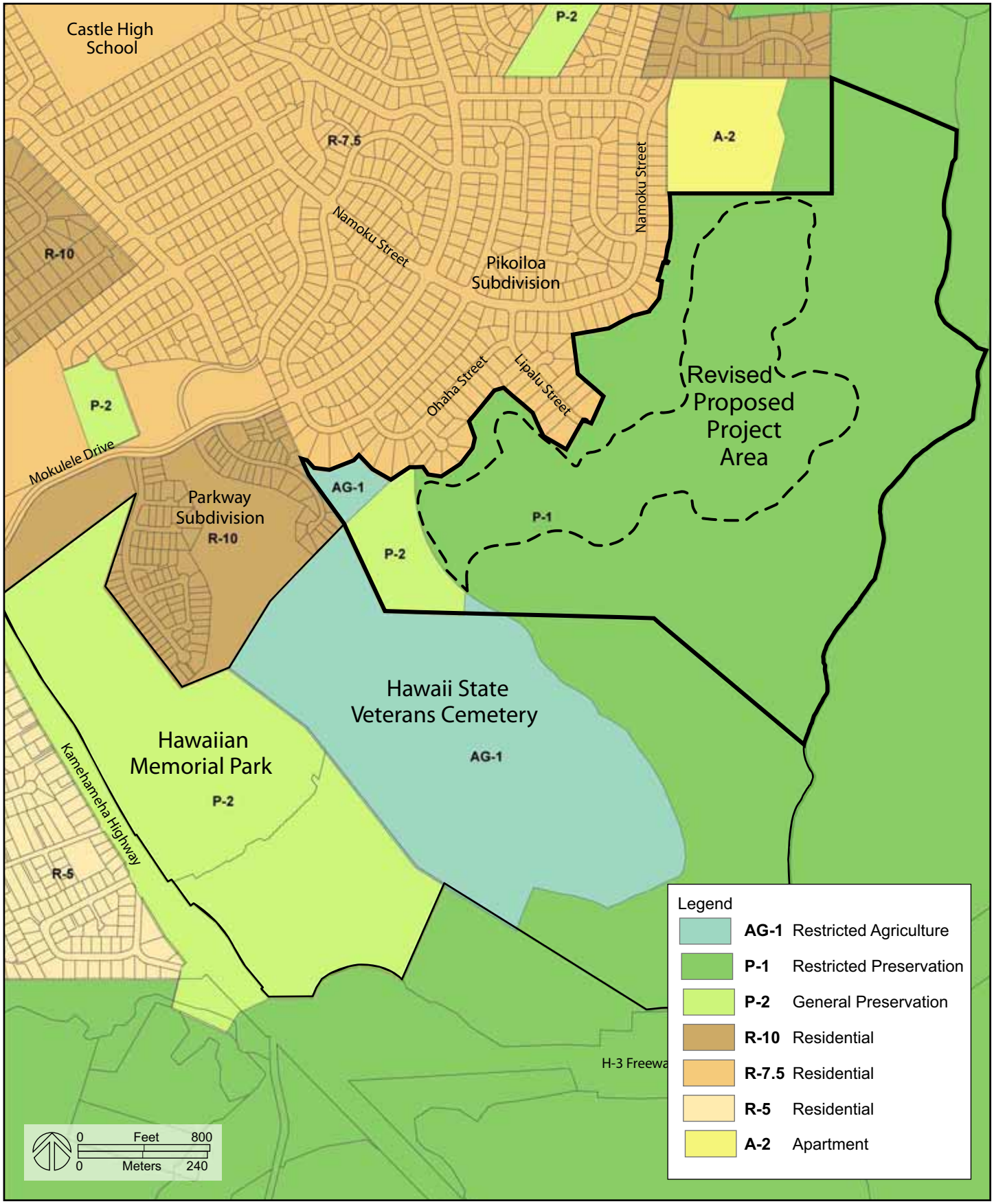

4 5 35
HAWAIIAN
MEMORIAL PARK
ZONE 4
SECTION 2
PLAT 15
K A A X E P A
P A L A P U L E
PLAT 14
PLAT 31
PLAT 34
PLAT 42
PLAT 11
LD. CT. APP. 754
KAMEHAMEHA HIGHWAY
PALI CUT OFF
KAILUA - KANEOHE, KOOLAUPOKO.
FIRST DIVISION
ZONE 4
SEC. 5
PLAT 35
CONTAINING PARCELS
SCALE 1 IN. = 300 FT.



State Land Use Districts

Figure 5

Hawaiian Memorial Park Cemetery Expansion
Kaneohe, Oahu



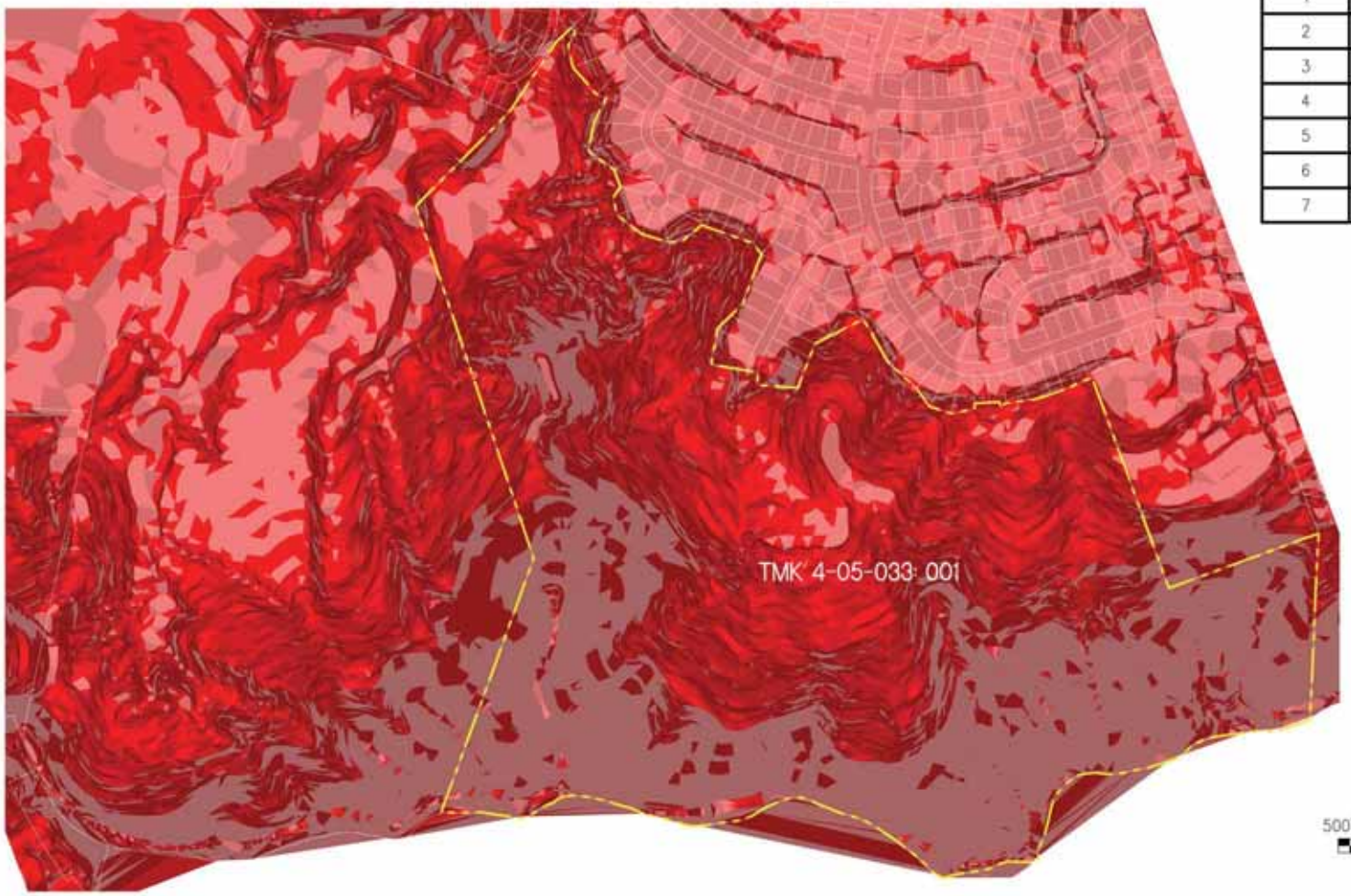
City and County of Honolulu Zoning

Figure 6

Hawaiian Memorial Park Cemetery Expansion
Kaneohe, Oahu

APPENDIX B

Existing Site Figures



SLOPES TABLE			
NUMBER	MINIMUM SLOPE	MAXIMUM SLOPE	COLOR
1	0%	5%	
2	5%	10%	
3	10%	15%	
4	15%	20%	
5	20%	30%	
6	30%	50%	
7	> 50%		

500' 250' 0 500' 1000'

SCALE: 1" = 500'

SSFM INTERNATIONAL, INC.
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

Hawaiian Memorial Cemetery Expansion
Kaneohe, Oahu

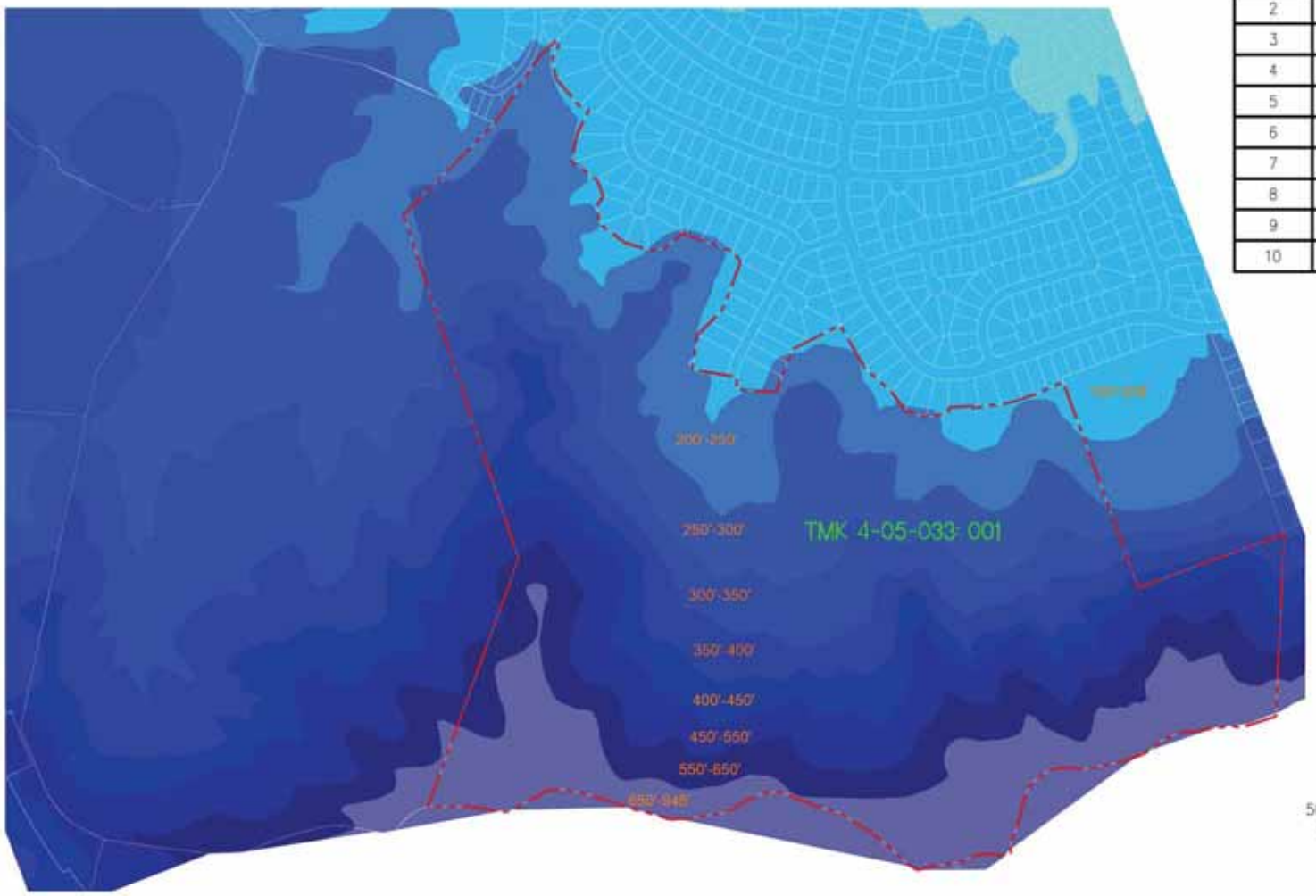
SLOPE ANALYSIS

SCALE: 1" = 500'

DATE: JUNE 2007

FIGURE 7

TRUE NORTH
SCALE: 1 in. = 500 Ft.



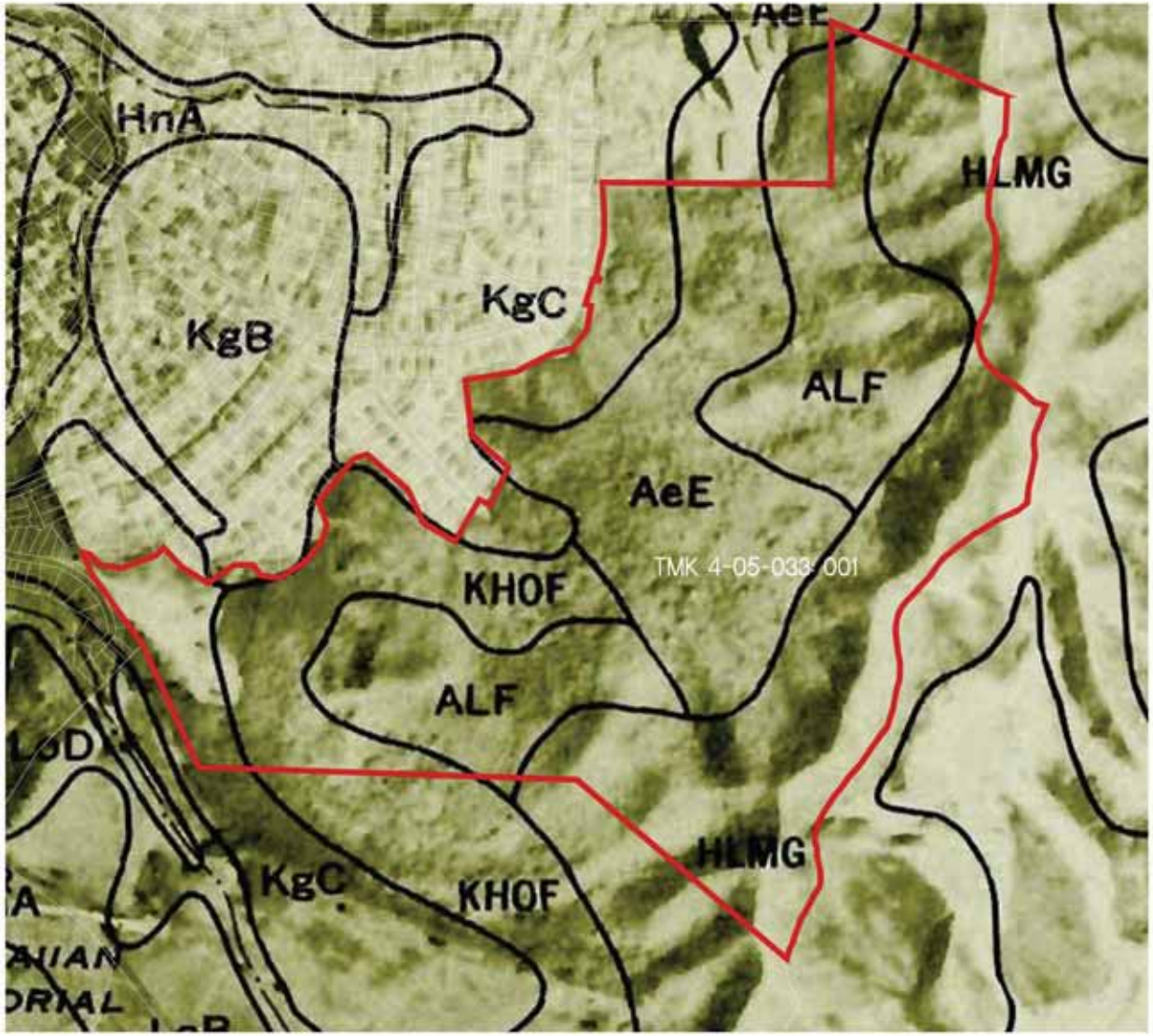
ELEVATIONS TABLE			
NUMBER	MINIMUM ELEVATION	MAXIMUM ELEVATION	COLOR
1	0'	100'	
2	100'	200'	
3	200'	250'	
4	250'	300'	
5	300'	350'	
6	350'	400'	
7	400'	450'	
8	450'	550'	
9	550'	650'	
10	650'	945'	

500' 250' 0 500' 1000'
SCALE: 1" = 500'

SSFM INTERNATIONAL INC.
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

Hawaiian Memorial Cemetery Expansion
Kaneohe, Oahu
ELEVATION ANALYSIS
SCALE: 1" = 500' | DATE: JUNE 2007

FIGURE
8



TRUE NORTH
SCALE: 1 In. = 500 Ft.

LEGEND:

AeE	ALEALOA SILTY CLAY, 15 TO 35 PERCENT SLOPES
ALF	ALEALOA SILTY CLAY, 40 TO 70 PERCENT SLOPES
HLMG	HELEMANO SILTY CLAY, 30 TO 90 PERCENT SLOPES
KgC	KANEOHE SILTY CLAY, 8 TO 15 PERCENT SLOPES
KHOF	KANEOHE SILTY CLAY, 30 to 65 PERCENT SLOPES

500' 250' 0 500' 1000'
SCALE: 1" = 500'

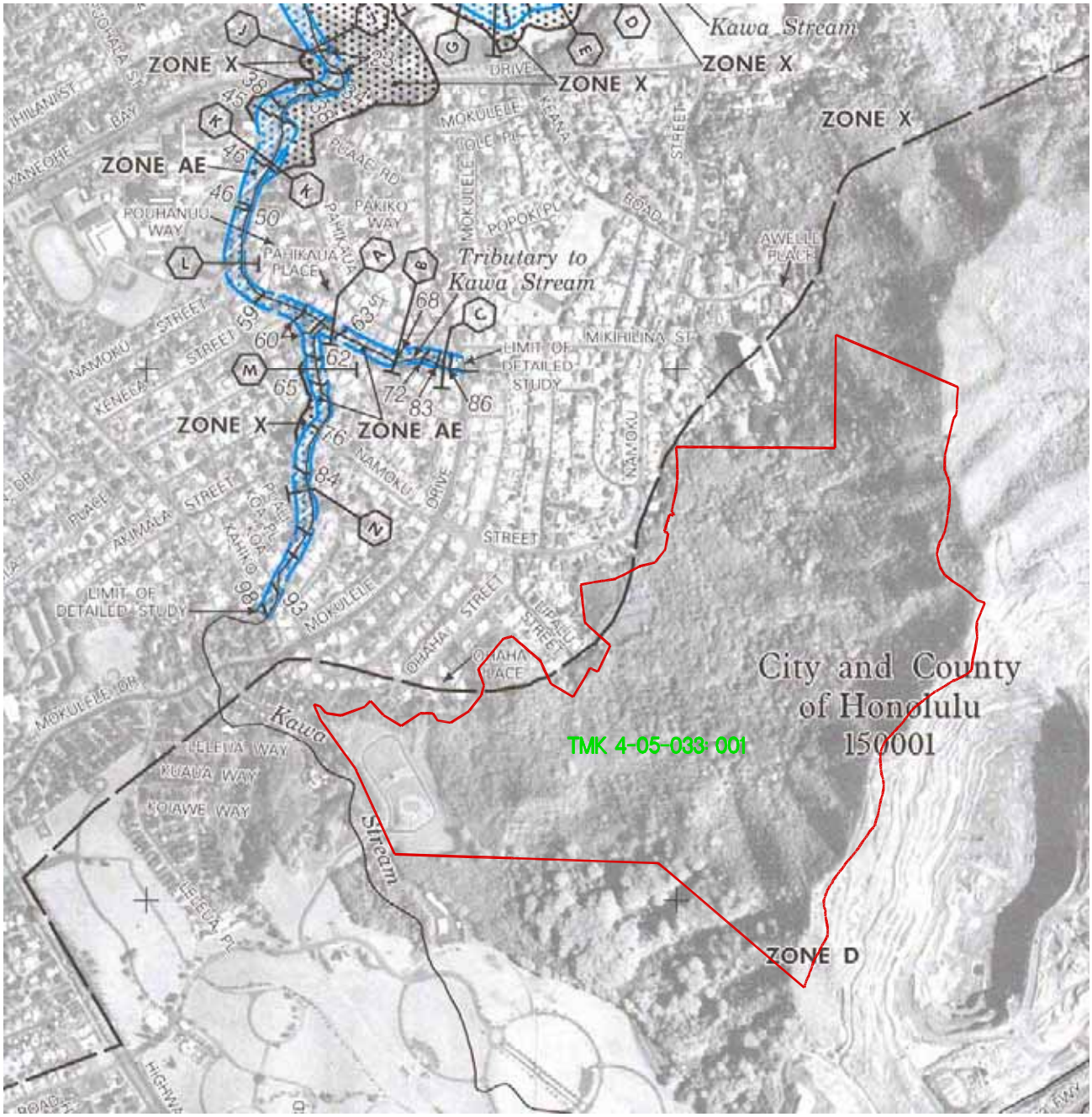
SSFM INTERNATIONAL, INC.
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

Hawaiian Memorial Cemetery Expansion
Kaneohe, Oahu

SOIL SURVEY ANALYSIS

SCALE: 1" = 500' | DATE: JUNE 2007

FIGURE 9



LEGEND:

— — — —	ZONE D BOUNDARY
ZONE D	AREAS IN WHICH FLOOD HAZARDS ARE UNDETERMINED BUT POSSIBLE.
ZONE X	AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN.

1000' 500' 0 1000' 2000'

SCALE: 1" = 1000'

MAP NUMBER 15003C0270F

SSFM INTERNATIONAL

SSFM International, Inc.
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

Hawaiian Memorial Cemetery Expansion
Kaneohe, Oahu

FLOOD INSURANCE RATE MAP

SCALE: 1" = 1000'

DATE: JUNE 2007

FIGURE 10

APPENDIX C

Drainage Calculations

SSFM International, Inc.
Hawaiian Memorial Cemetery Park Expansion
SSFM 2006_095.000
November 27, 2006

Pikoiloa 10

Existing Capacity Analysis

Ohana Place

Inlet	Drainage	Pipe Size	Existing Q	Length	Inv_up	Inv_Down	Slope	Cross-Sectional Area	n	Rh	Q_full_flow	% Full	Q_excess_capacity
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
FI C-12					168.00								
	Pikoiloa 10	24	25.2	208.3333			0.034	3.142	0.013	0.500	42	61%	16
SDMH C-11					161.00	161.00							
	Pikoiloa 10	30	36.1	87.34			0.059	4.909	0.013	0.625	99	36%	63
CB C-9					155.89	155.89							
	Pikoiloa 10	30	41.4	68.24			0.010	4.909	0.013	0.625	41	101%	0
CB C-8					155.21	154.37							
	Pikoiloa 10	30	43.5	126.25			0.011	4.909	0.013	0.625	43	101%	0
SDMH C-7					152.98	150.98							
	Pikoiloa 10	30	43.5	102.75			0.098	4.909	0.013	0.625	129	34%	85
SDMH C-6					140.88	140.88							

Drainline "C" (Near Ohana Place)

Inlet	Drainage	Pipe Size	Existing Q	Length	Inv_up	Inv_Down	Slope	Cross-Sectional Area	n	Rh	Q_full_flow	% Full	Q_excess_capacity
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
FI C-13					163.90								
	Pikoiloa 10	18	10.9	130			0.030	1.767	0.013	0.375	18	60%	7
SDMH C-11					160.00	160.00							

Portion of Drainline "C" (Near Ohana Place)

Inlet	Drainage	Pipe Size	Existing Q	Length	Inv_up	Inv_Down	Slope	Cross-Sectional Area	n	Rh	Q_full_flow	% Full	Q_excess_capacity
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
CB C-10					158.50								
	Pikoiloa 10	18	4.2	42			0.012	1.767	0.013	0.375	11	37%	7
CB C-9					158.00	158.00							

Drainline "D"

Inlet	Drainage	Pipe Size	Existing Q	Length	Inv_up	Inv_Down	Slope	Cross-Sectional Area	n	Rh	Q_full_flow	% Full	Q_excess_capacity
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
FI D-4					187.00								
	Pikoiloa 10	18	6.8	37			0.486	1.767	0.013	0.375	73	9%	67
FI D-3A					169.00	166.50							
	Pikoiloa 10	18	7.8	37			0.416	1.767	0.013	0.375	68	11%	60
SDMH D-3					151.10	151.10							
	Pikoiloa 10	18	7.8	95			0.005	1.767	0.013	0.375	8	102%	0
SDMH D-2					150.60	150.60							
	Pikoiloa 10	18	7.8	103			0.011	1.767	0.013	0.375	11	72%	3
CB D-1					149.50	148.73							
	Pikoiloa 10	18	11.4	153			0.030	1.767	0.013	0.375	18	63%	7
SDMH C-6					144.20	140.88							
	Pikoiloa 10	36	34.9	135			0.007	7.069	0.013	0.750	54	65%	19
CB C-5					140.00	133.71							
	Pikoiloa 10	36	61	38			0.008	7.069	0.013	0.750	61	99%	0
CB C-4					133.39	133.39							
	Pikoiloa 10	36	63.7	100			0.009	7.069	0.013	0.750	63	100%	0
SDMH C-3					132.49	132.49							
	Pikoiloa 10	36	67	43			0.196	7.069	0.013	0.750	296	23%	229
SDMH C-2					124.08	124.08							
	Pikoiloa 10	36	67	93			0.010	7.069	0.013	0.750	67	100%	0
CB C-1A					123.15	123.15							
	Pikoiloa 10	36	68.9	45			0.010	7.069	0.013	0.750	67	103%	-2
CB C-1					122.7	120.27							
	Pikoiloa 10	36	69.7	115			0.098	7.069	0.013	0.750	209	33%	140
Existing FI					109.00	109.00							

Drainline "A"

Inlet	Drainage	Pipe Size	Existing Q	Length	Inv_up	Inv_Down	Slope	Cross-Sectional Area	n	Rh	Q_full_flow	% Full	Q_excess_capacity
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
FI A-6					158.89								

Existing Hydraulic Capacity Analysis

	Pikoiloa 10	48	204.0	397			0.020	12.566	0.013	1.000	205	100%	1
CB A-3					159.40	150.87							
	Pikoiloa 10	48	229.8	237.27			0.025	12.566	0.013	1.000	229	100%	0
SDMH A-2					144.85	142.85							
	Pikoiloa 10	48	236.6	216			0.027	12.566	0.013	1.000	236	100%	0
SDMH A-1					137.04	134.13							
	Pikoiloa 10	48	267.5	537			0.035	12.566	0.013	1.000	268	100%	1
Special SDMH					115.48	107.20							

Portion of Drainline "A"

Inlet	Drainage	Pipe Size	Existing Q	Length	Inv_up	Inv_Down	Slope	Cross-Sectional Area	n	Rh	Q_full_flow	% Full	Q_excess_capacity
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
FI A-7					171.00								
	Pikoiloa 10	24	18.7	31.89			0.343	3.142	0.013	0.500	133	14%	114
SDMH A-7A					160.07	160.07							
	Pikoiloa 10	24	18.7	90			0.006	3.142	0.013	0.500	18	104%	-1
CB A-3					159.50	159.50							

Portion of Drainline "A"

Inlet	Drainage	Pipe Size	Existing Q	Length	Inv_up	Inv_Down	Slope	Cross-Sectional Area	n	Rh	Q_full_flow	% Full	Q_excess_capacity
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
CB A-4					160.29								
	Pikoiloa 10	18	4.6	32			0.009	1.767	0.013	0.375	10	46%	5
CB A-3					160.00	160.00							

Drainline "B"

Inlet	Drainage	Pipe Size	Existing Q	Length	Inv_up	Inv_Down	Slope	Cross-Sectional Area	n	Rh	Q_full_flow	% Full	Q_excess_capacity
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
FI B-6					167.53								
	Pikoiloa 10	24	14.6	38			0.004	3.142	0.013	0.500	14	102%	0
SDMH B-5					167.38	167.38							
	Pikoiloa 10	24	14.6	103			0.004	3.142	0.013	0.500	14	102%	0
SDMH B-4					166.97	166.97							
	Pikoiloa 10	24	14.6	283.2			0.023	3.142	0.013	0.500	35	42%	20
CB B-2					160.40	159.00							
	Pikoiloa 10	24	20.5	118.14			0.043	3.142	0.013	0.500	47	44%	27
SDMH B-1					153.92	153.92							
	Pikoiloa 10	24	20.5	236			0.048	3.142	0.013	0.500	50	41%	29
SDMH A-1					142.50	142.50							

Portion of Drainline "B"

Inlet	Drainage	Pipe Size	Existing Q	Length	Inv_up	Inv_Down	Slope	Cross-Sectional Area	n	Rh	Q_full_flow	% Full	Q_excess_capacity
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
CB B-3					161.18								
	Pikoiloa 10	18	2.2	38			0.005	1.767	0.013	0.375	7	30%	5
CB B-2					161.00	161.00							

Drainline "E"

Inlet	Drainage	Pipe Size	Existing Q	Length	Inv_up	Inv_Down	Slope	Cross-Sectional Area	n	Rh	Q_full_flow	% Full	Q_excess_capacity
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
FI E-2					121.88								
	Pikoiloa 10	18	2.4	81			0.043	1.767	0.013	0.375	22	11%	19
CB E-1A					118.40	118.40							
	Pikoiloa 10	18	5.7	65			0.003	1.767	0.013	0.375	6	98%	0
CB E-1					118.20	118.20							
	Pikoiloa 10	18	7.9	124			0.005	1.767	0.013	0.375	7	106%	0
CB "E"					117.58	116.48							

Drainline "G"

Inlet	Drainage	Pipe Size	Existing Q	Length	Inv_up	Inv_Down	Slope	Cross-Sectional Area	n	Rh	Q_full_flow	% Full	Q_excess_capacity
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
CB G-3					141.42								
	Pikoiloa 10	18	3.5	180			0.021	1.767	0.013	0.375	15	23%	12
CB G-2					137.60	137.60							
	Pikoiloa 10	18	5.6	42			0.024	1.767	0.013	0.375	16	34%	11
CB G-1					136.60	135.50							

Drainline "F"

Inlet	Drainage	Pipe Size	Existing Q	Length	Inv_up	Inv_Down	Slope	Cross-Sectional Area	n	Rh	Q_full_flow	% Full	Q_excess_capacity
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
CB F-8					128.47								

	Pikoiloa 10	18	4.2	97.2			0.012	1.767	0.013	0.375	11	37%	7
CB F-7					127.34	127.34							
	Pikoiloa 10	18	5.7	222			0.021	1.767	0.013	0.375	15	38%	9
SDMH F-6					122.77	122.77							
	Pikoiloa 10	18	5.7	143.5			0.026	1.767	0.013	0.375	17	33%	11
CB F-5					119.00	117.60							

Portion of Drainline "F"													
Inlet	**Drainage**	**Pipe Size**	**Existing Q**	**Length**	**Inv_up**	**Inv_Down**	**Slope**	**Cross-Sectional Area**	**n**	**Rh**	**Q_full_flow**	**% Full**	**Q_excess_capacity**
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
CB F-9					120.00								
	Pikoiloa 10	18	2.1	55			0.004	1.767	0.013	0.375	6	33%	4
CB F-5					119.80	117.60							

Pikoiloa 9

Drainline "C"													
Inlet	**Drainage**	**Pipe Size**	**Existing Q**	**Length**	**Inv_up**	**Inv_Down**	**Slope**	**Cross-Sectional Area**	**n**	**Rh**	**Q_full_flow**	**% Full**	**Q_excess_capacity**
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
FI C-1					153.47								
	Pikoiloa 9	36	92.0	185			0.021	7.069	0.013	0.750	97	95%	5
Drop DMH C-6					149.60	149.60							
	Pikoiloa 9	36	103.5	47			0.028	7.069	0.013	0.750	111	93%	8
DMH C-3					148.30	148.30							
	Pikoiloa 9	36	103.5	141			0.025	7.069	0.013	0.750	105	98%	2
DMH C-4					144.80	144.80							
	Pikoiloa 9	36	103.5	189			0.063	7.069	0.013	0.750	168	62%	64
CB C-1					132.90	130.10							
	Pikoiloa 9	42	108.3	89			0.015	9.621	0.013	0.875	122	89%	14
DMH C-3					128.80	128.80							
	Pikoiloa 9	36	108.3	34			0.032	7.069	0.013	0.750	120	90%	12
DMH C-2					127.70	127.70							
	Pikoiloa 9	36	108.3	132			0.033	7.069	0.013	0.750	121	90%	12
DMH C-1					123.40	123.70							
	Pikoiloa 9	36	108.3	129			0.116	7.069	0.013	0.750	228	47%	120
Drain "C" Outlet					108.70	108.70							

Portion of Drainline "C"													
Inlet	**Drainage**	**Pipe Size**	**Existing Q**	**Length**	**Inv_up**	**Inv_Down**	**Slope**	**Cross-Sectional Area**	**n**	**Rh**	**Q_full_flow**	**% Full**	**Q_excess_capacity**
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
CB C-2					136.40								
	Pikoiloa 9	18	1.5	34			0.006	1.767	0.013	0.375	8	19%	7
CB C-1					136.20	136.20							

Portion of Drainline "C"													
Inlet	**Drainage**	**Pipe Size**	**Existing Q**	**Length**	**Inv_up**	**Inv_Down**	**Slope**	**Cross-Sectional Area**	**n**	**Rh**	**Q_full_flow**	**% Full**	**Q_excess_capacity**
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
C-B C-4					151.4								
	Pikoiloa 9	18	8.5	48			0.006	1.767	0.013	0.375	8	102%	0
CB C-3					151.10	150.72							
	Pikoiloa 9	24	11.5	98			0.003	3.142	0.013	0.500	11	100%	0
Drop DMH C-6					150.47	150.47							

Drainline "B"													
Inlet	**Drainage**	**Pipe Size**	**Existing Q**	**Length**	**Inv_up**	**Inv_Down**	**Slope**	**Cross-Sectional Area**	**n**	**Rh**	**Q_full_flow**	**% Full**	**Q_excess_capacity**
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
Existing FI B-2					155.50								
	Pikoiloa 9	42	100.0	135			0.028	9.621	0.013	0.875	167	60%	67
CB B-6					153.95	151.78							
	Pikoiloa 9	42	102.6	47			0.010	9.621	0.013	0.875	102	101%	-1
CB B-5					151.30	151.30							
	Pikoiloa 9	42	104.0	82			0.015	9.621	0.013	0.875	122	85%	18
DMH B-5					150.10	150.10							
	Pikoiloa 9	36	104.0	33			0.252	7.069	0.013	0.750	335	31%	231
FI B-1					141.80	141.80							
	Pikoiloa 9	36	104.8	32			0.369	7.069	0.013	0.750	406	26%	301
DMH B-4					130.00	130.00							
	Pikoiloa 9	36	104.8	87			0.031	7.069	0.013	0.750	117	90%	12
Drop CB B-4					127.34	127.34							
	Pikoiloa 9	36	106.9	37			0.028	7.069	0.013	0.750	113	95%	6

Existing Hydraulic Capacity Analysis

Drop CB B-3					126.29	126.29							
	Pikoiloa 9	36	108.5	105			0.028	7.069	0.013	0.750	113	96%	4
DMH B-3					123.30	123.30							
	Pikoiloa 9	36	108.5	27			0.537	7.069	0.013	0.750	490	22%	382
DMH B-2					108.80	108.80							
	Pikoiloa 9	36	108.5	86			0.034	7.069	0.013	0.750	123	88%	14
Drop DMH B-1					105.90	104.73							
	Pikoiloa 9	42	120.8	162			0.014	9.621	0.013	0.875	121	100%	0
Drain "B" Outlet					102.40	102.40							

Drainline "A"													
Inlet	**Drainage**	**Pipe Size**	**Existing Q**	**Length**	**Inv_up**	**Inv_Down**	**Slope**	**Cross-Sectional Area**	**n**	**Rh**	**Q_full_flow**	**% Full**	**Q_excess_capacity**
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
CB A-2					121.40								
	Pikoiloa 9	18	4.2	34			0.001	1.767	0.013	0.375	4	104%	0
CB A-1					121.35	121.35							
	Pikoiloa 9	18	6.9	200			0.071	1.767	0.013	0.375	28	25%	21
DMH A-1					107.20	107.20							
	Pikoiloa 9	18	6.9	150			0.064	1.767	0.013	0.375	27	26%	20
Drain "A" Outlet					97.60	97.60							

Drainline "D"													
Inlet	**Drainage**	**Pipe Size**	**Existing Q**	**Length**	**Inv_up**	**Inv_Down**	**Slope**	**Cross-Sectional Area**	**n**	**Rh**	**Q_full_flow**	**% Full**	**Q_excess_capacity**
(Number)	Master Plan	(inches)	(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(sf)	(-)	(-)	(cfs)		(cfs)
CB D-1					102.00								
	Pikoiloa 9	18	5.3	124			0.058	1.767	0.013	0.375	25	21%	20
Drain "D" Outlet					94.80	94.80							

SSFM International, Inc.
Hawaiian Memorial Cemetery Park Expansion
Draft Preliminary Engineering Report
SSFM 2006_095.000
May 4, 2007

Proposed Drainage Analysis								
Inlet	**Impervious Area**	**Rainfall "I"**	**Runoff "C"**	**Time of Conc "Tc"**	**Correction Factor**	**Q_increase**	**Q_existing**	**V_store**
(Number)	(acres)	(in/hr)	(cfs)	(min)	(-)	(cfs)	(cfs)	(cf)
D-4	0	2.5	0.95	3	3.00	0.00	6.8	0
C-13	0.006	2.5	0.95	3	3.00	0.03	10.9	105
C-12	0.783	2.5	0.95	3	3.00	3.82	25.2	13,734
A-7	0.416	2.5	0.95	3	3.00	2.03	18.7	7,307
A-6	3.426	2.5	0.95	3	3.00	16.70	204.3	60,122
B-7	0	2.5	0.95	3	3.00	0.00	5.4	0
B-6	0.268	2.5	0.95	3	3.00	1.31	14.6	4,705
C-6	2.854	2.5	0.95	3	3.00	13.91	92.0	50,085
Exist. B-1	0.791	2.5	0.95	3	3.00	3.86	100.0	13,886
					Totals	**42**	**478**	**149,944**

Method:
Inlet Number and Q_Existing is based on Drainage Master Plans fror the Parkway, Pikoiloa 9, and Pikoiloa 10 Subdivisions
Impervious Area was based off of the Conceptual Site Plan
Rainfall "I" is coordinated with the "I" used in the Drainage Master Plans of the 10-year, 1 hour storm
Time of Concentration "Tc" is conservatively estimated to generate a maximum Correction Factor for all basins
Q_increase is based on the Rational Method
The Rational Method is Q=CIA(SF)
V_store is the volume required to hold the flows of Q_paved for one hour
Assumed 50% of the residential lots will consist of two-story dwelling units
One story dwelling, assumed 3000 sf house, 500 sf driveway, 500 sf garage, for a total of 4000 sf impervious area
Two story dwelling, assumed 3000 sf house (1500 sf footprint), 500 sf driveway, 500 sf garage, for a total of 2000 sf impervious area

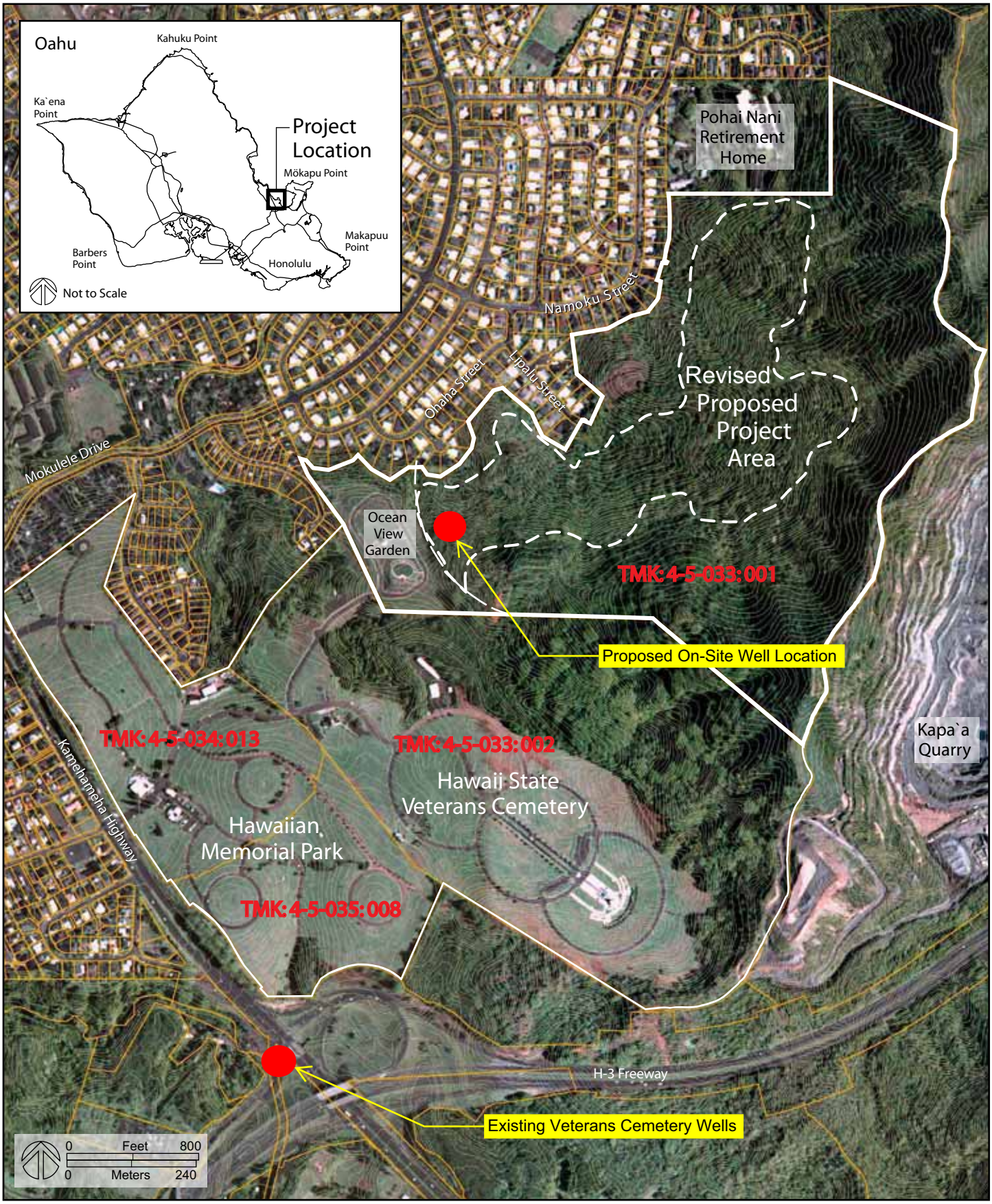
SSFM International, Inc.
Hawaiian Memorial Cemetery Park Expansion
Draft Preliminary Engineering Report
SSFM 2006_095.000
September 8 2008

Proposed Drainage Analysis Per Alternative III revised 9/04/08 from HHF - Cemetery Only Option								
Inlet	**Impervious Area**	**Rainfall "I"**	**Runoff "C"**	**Time of Conc "Tc"**	**Correction Factor**	**Q_increase**	**Q_existing**	**V_store**
(Number)	(acres)	(in/hr)	(cfs)	(min)	(-)	(cfs)	(cfs)	(cf)
D-4	0	2.5	0.95	3	3.00	0.00	6.8	0
C-13	0.006	2.5	0.95	3	3.00	0.03	10.9	105
C-12	0.783	2.5	0.95	3	3.00	3.82	25.2	13,734
A-7	0.416	2.5	0.95	3	3.00	2.03	18.7	7,307
A-6	2.265	2.5	0.95	3	3.00	11.04	204.3	39,742
B-7	0	2.5	0.95	3	3.00	0.00	5.4	0
B-6	0.063	2.5	0.95	3	3.00	0.30	14.6	1,098
C-6	1.214	2.5	0.95	3	3.00	5.92	92.0	21,306
Exist. B-1	0.066	2.5	0.95	3	3.00	0.32	100.0	1,157
					Totals	**23**	**478**	**84,449**

Method:
Inlet Number and Q_Existing is based on Drainage Master Plans fror the Parkway, Pikoiloa 9, and Pikoiloa 10 Subdivisions
Impervious Area was based off of the Conceptual Site Plan
Rainfall "I" is coordinated with the "I" used in the Drainage Master Plans of the 10-year, 1 hour storm
Time of Concentration "Tc" is conservatively estimated to generate a maximum Correction Factor for all basins
Q_increase is based on the Rational Method
The Rational Method is Q=CIA(SF)
V_store is the volume required to hold the flows of Q_paved for one hour

APPENDIX D

Non-Potable Well Figures, Board of Water Supply Documents
&
Water/Fire Flow Calculations



Proposed and Existing Well Locations

Figure 11

Hawaiian Memorial Park Cemetery Expansion

Kaneohe, Oahu

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843

October 20, 2006

FILE COPY

Mr. Edward Sakai, P.E.
SSFM International
501 Sumner Street #620
Honolulu, Hawaii 96817

Dear Mr. Sakai:

Subject: Your Letter of October 16, 2006 Requesting the Availability of Water to the Proposed Hawaiian Memorial Cemetery Expansion, TMK:4-5-33:1

Thank you for your letter on the proposed cemetery expansion.

The existing water system is presently adequate to accommodate the domestic water requirements of the proposed cemetery expansion. However, please be advised that this information is based upon current data and, therefore, the Board of Water Supply reserves the right to change any position or information stated herein up until the final approval of your building permit. The final decision on the availability of water will be confirmed when the building permit is submitted for approval.

The developer should investigate the feasibility of using non-potable water for irrigation of the proposed cemetery expansion. If non-potable water is either unavailable or infeasible, a report of the investigation including proposed irrigation demands should be submitted to us before we will consider the use of potable water.

When water is made available, the applicant will be required to pay our Water System Facilities Charges for resource development, transmission and daily storage.

The on-site fire protection requirements should be coordinated with the Fire Prevention Bureau of the Honolulu Fire Department.

If you have any questions, please contact Robert Chun at 748-5443.

Very truly yours,

KEITH S. SHIDA
Principal Executive
Customer Care Division

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843

December 15, 2006

FILE COPY

Ms. Robyn M. deHay
SSFM International, Incorporated
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

Dear Ms. deHay:

Subject: Your Letter Dated December 4, 2006 Requesting the Availability of Irrigation Water to the Proposed Hawaiian Memorial Park Cemetery Expansion, TMK: 4-5-33:1

Thank you for your letter on the proposed Hawaiian Memorial Cemetery Expansion.

Our Hydrology-Geology Section has indicated the existence of non-potable wells in the vicinity of the of the proposed cemetery expansion. We request the developer investigate the feasibility of using these non-potable wells for irrigation of the proposed cemetery expansion. If non-potable water is either unavailable or infeasible, a report of the investigation, including the proposed irrigation demands, should be submitted to us before we will consider the use of potable water.

If you have any questions, please contact Robert Chun at 748-5443.

Very truly yours,

KEITH S. SHIDA
Principal Executive
Customer Care Division

cc: Water Resources Division

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843

March 1, 2007

FILE COPY

Mr. Winston Taniguchi
SSFM International, Incorporated
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

Dear Mr. Taniguchi:

Subject: Your Letter of January 18, 2007 Requesting the Availability of Potable Water for Irrigation of the Proposed Hawaiian Memorial Park Cemetery Expansion, TMK: 4-5-33:1

Thank you for your letter requesting water for irrigation of the proposed cemetery expansion in Kaneohe.

We request that additional research be conducted to determine the feasibility of developing a non-potable water source for irrigation of the cemetery expansion. Our Water Resources Division has indicated the possibility of developing a new non-potable source in the vicinity of the proposed cemetery expansion. Chester Lao of the Board of Water Supply may be contacted at 748-5931 concerning possible non-potable well locations.

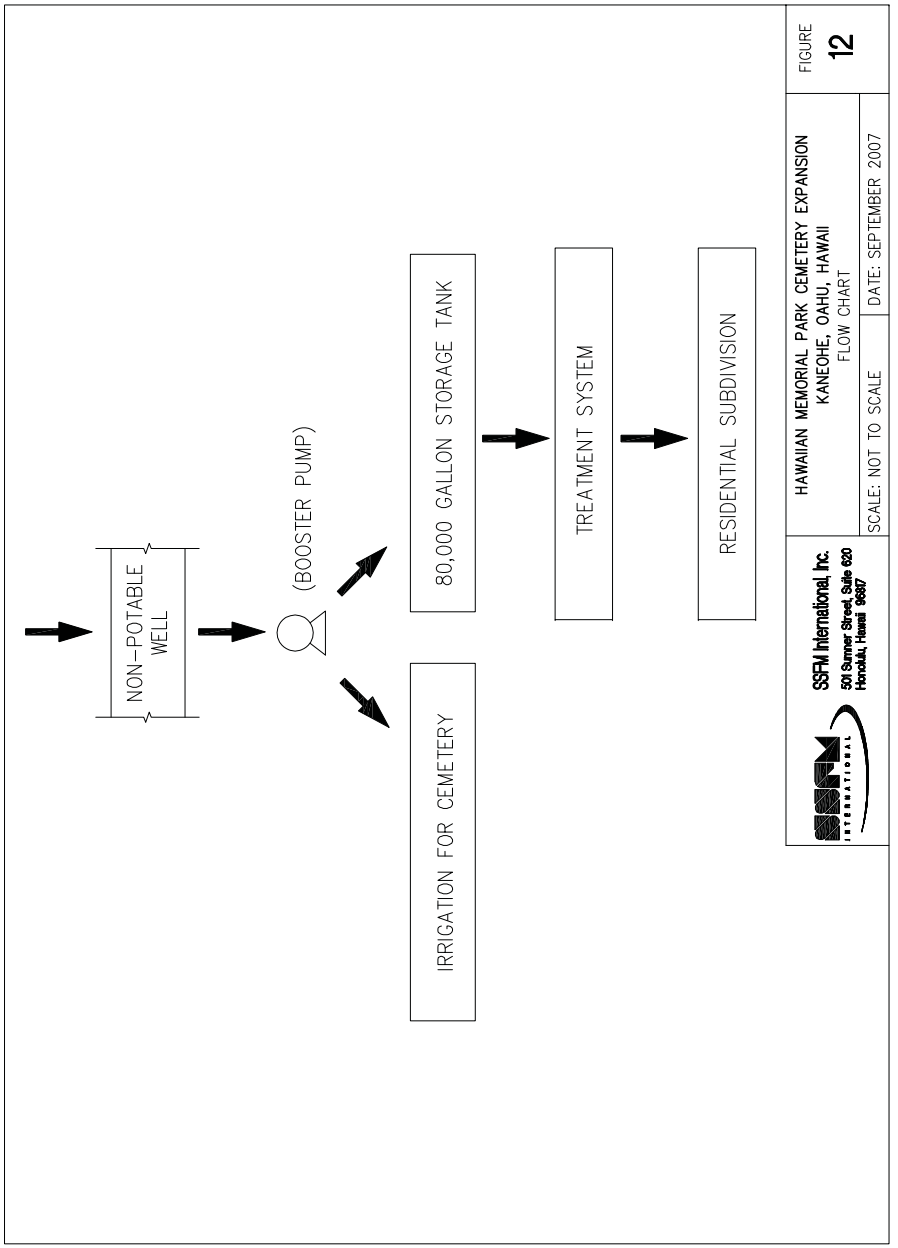
If you have any questions, please contact Robert Chun at 748-5443.

Very truly yours,

K. Shida

KEITH S. SHIDA
Principal Executive
Customer Care Division

cc: Chester Lao, Water Resources Division



"Former Proposed Action"
Domestic Water Demand
Cemetery Expansion and 20-Lot Subdivision

Hawaiian Memorial Park

Proposed Domestic Water Demand - "Former Proposed Action"

	Dwelling Units	Acres	Demand (gal/unit)	Average Daily Demand (gpd)	Maximum Daily Demand (gpd)	Peak Hour (gpd)	Notes:
Residential	20	---	500	10,000	15,000	30,000	Not included is 33 gpm accounted for the cemetery bathroom. Very minimal and therefore not included in preliminary calcs
TOTAL				**10,000**	**15,000**	**30,000**	

"Revised Propsed Action"
Domestic Water Demand
Cemetery Only Expansion

Hawaiian Memorial Park

Proposed Domestic Water Demand (Non-Potable Water) - "Revised Proposed Action"

Fixture	FU/Fixture	Quantity	Total FU		
W.C (valve)	3.40	3	10.2		
Sink	1.60	2	3.2		
Urinals	1.70	2	3.4		
			16.8	FU	
			33.0	gpm	→ 1" meter (31-50gpm)

"Former Proposed Action"
Residential Fireflow Calculations (Uphill Road)

Hawaiian Memorial Park
SSFM International, Inc.
Proposed Fire Hydrants on Uphill Road

FH near Cul-de-sac
FLOW CALCULATIONS

EQUIVALENT LENGTH IN SERIES:

Le	
L1 (ft)	800
De (in)	8
D1 (in)	8
Ce	110
C1	110
Le =	800
say	
Le =	**800.00 ft.**

Equivalent length

FORMULA:
Le = L1*(De/D1)^4.8704 * (Ce/C1)^1.852

EQUIVALENT LENGTH IN PARALLEL:

Le	
L1	400
De	12
D1	8
Ce	110
C1	110
L2	6392
D2	12
C2	110
Le =	1139.4645
say	
Le =	**1139.46 ft.**

TOTAL LENGTH OF PIPE:
LENGTHS:

800.00

TOTAL: **800.00** FT

FLOW IN GPM

Res top	360
Res bot	340
Res 3/4	355
fh ele	264
Hf	45
Lt	800.00
C	110
D (in)	8
Q =	1553.548231
say	
Q =	**1554 gpm w/o consumption**

STATIC PRESSURE (res 3/4 - fh ele)/2.31

Static Pressure = 39.39394
say
Static Pressure = 39 psi

FH# W-0690

Q = 448.895*(((D/12)^4.8704*(C^1.852)*Hf)/(4.727*L))^(1/1.852))

FH near Residential Lot 20
FLOW CALCULATIONS

EQUIVALENT LENGTH IN SERIES:

Le	
L1 (ft)	415
De (in)	8
D1 (in)	8
Ce	110
C1	110
Le =	415
say	
Le =	**415.00 ft.**

Equivalent length

FORMULA:
Le = L1*(De/D1)^4.8704 * (Ce/C1)^1.852

EQUIVALENT LENGTH IN PARALLEL:

Le	
L1	400
De	12
D1	8
Ce	110
C1	110
L2	6392
D2	12
C2	110
Le =	1139.4645
say	
Le =	**1139.46 ft.**

TOTAL LENGTH OF PIPE:
LENGTHS:

415.00

TOTAL: **415.00** FT

FLOW IN GPM

Res top	360
Res bot	340
Res 3/4	355
fh ele	263
Hf	46
Lt	415.00
C	110
D (in)	8
Q =	2240.727829
say	
Q =	**2241 gpm w/o consumption**

STATIC PRESSURE (res 3/4 - fh ele)/2.31

Static Pressure = 39.82684
say
Static Pressure = 40 psi

FH# W-0690

"Former Proposed Action"
Residential Fireflow Calculations (Downhill Road)

Hawaiian Memorial Park
SSFM International, Inc.
Proposed Fire Hydrants on Downhill Road

FH near Cul-de-sac
FLOW CALCULATIONS

EQUIVALENT LENGTH IN SERIES:

Le	
L1 (ft)	850
De (in)	8
D1 (in)	8
Ce	110
C1	110
Le =	850
say	
Le =	**850.00 ft.**

Equivalent length

FORMULA:
Le = L1*(De/D1)^4.8704 * (Ce/C1)^1.852

EQUIVALENT LENGTH IN PARALLEL:

Le	
L1	400
De	12
D1	8
Ce	110
C1	110
L2	6392
D2	12
C2	110
Le =	1139.4645
say	
Le =	**1139.46 ft.**

TOTAL LENGTH OF PIPE:
LENGTHS:

	850.00
TOTAL:	**850.00** FT

FLOW IN GPM

Res top	360
Res bot	340
Res 3/4	355
fh ele	230
Hf	79
Lt	850.00
C	110
D (in)	8
Q =	2037.424692
say	
Q =	**2037 gpm w/o consumption**

STATIC PRESSURE (res 3/4 - fh ele)/2.31

Static Pressure = 54.11255
say
Static Pressure = 54 psi

FH# W-0690

Q = 448.895*(((D/12)^4.8704*(C^1.852)*Hf)/(4.727*L))^(1/1.852))

FH near Residential Lots 8 & 9
FLOW CALCULATIONS

EQUIVALENT LENGTH IN SERIES:

Le	
L1 (ft)	650
De (in)	8
D1 (in)	8
Ce	110
C1	110
Le =	650
say	
Le =	**650.00 ft.**

Equivalent length

FORMULA:
Le = L1*(De/D1)^4.8704 * (Ce/C1)^1.852

EQUIVALENT LENGTH IN PARALLEL:

Le	
L1	400
De	12
D1	8
Ce	110
C1	110
L2	6392
D2	12
C2	110
Le =	1139.4645
say	
Le =	**1139.46 ft.**

TOTAL LENGTH OF PIPE:
LENGTHS:

	650.00
TOTAL:	**650.00** FT

FLOW IN GPM

Res top	360
Res bot	340
Res 3/4	355
fh ele	250
Hf	59
Lt	650.00
C	110
D (in)	8
Q =	2011.576128
say	
Q =	**2012 gpm w/o consumption**

STATIC PRESSURE (res 3/4 - fh ele)/2.31

Static Pressure = 45.45455
say
Static Pressure = 45 psi

FH# W-0690

APPENDIX E

Sewer Calculations

DEPARTMENT OF PLANNING AND PERMITTING

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET * HONOLULU, HAWAII 96813
Phone: (808) 527-5827 * Fax: (808) 523-4210

SSFM INTERNATIONAL, INC
RECEIVED
MAY 04 2007
Wmt

FILE

SEWER CONNECTION APPLICATION

APPLICATION NO.: **2007/SCA-0256** STATUS: **Approved with conditions**

DATE RECEIVED: **04/23/2007** IWDP APP. NO.:

PROJECT NAME: **Hawaiian Memorial Park Cemetery Expansion / Subdivision/Dwelling Unit/Cemetery**

$110,275.20
Estimated Wastewater System Facility Charge*

LOCATION:

Zone	Section	Plat	Parcel
4	5	033	001

45-425 KAM HWY **7,162,266** Sq. Ft.

SPECIFIC LOCATION: **45-425 Kamehameha Hwy**

APPLICANT: **SSFM International, Inc., Winston Taniguchi**
501 Sumner St Suite 620
Honolulu, Hawaii 96817

DEVELOPMENT TYPE: **Dwelling, Single-family** SEWER CONNECTION WORK DESIRED: **New**

OTHER USES: **Cemetery-100 people/day**

NON-RESIDENTIAL AREA: s.f. APPROXIMATE DATE OF CONNECTION:

PROPOSED UNITS	EXISTING UNITS	UNITS TO BE DEMOLISHED
No. of New Units: **20**	No. of Existing Units: **0**	No. of Units to be Demolished: **0**
Studios:	Studios:	Studios:
1-Bedroom:	1-Bedroom:	1-Bedroom:
2-Bedroom:	2-Bedroom:	2-Bedroom:
3-Bedroom: **20**	3-Bedroom:	3-Bedroom:
4-Bedroom:	4-Bedroom:	4-Bedroom:
5-Bedroom:	5-Bedroom:	5-Bedroom:
6-Bedroom:	6-Bedroom:	6-Bedroom:

REMARKS **Approval is for a 20-lot subdivision (one dwelling unit per lot) and a comfort station for the cemetery expansion project. Also, submit construction plans for review and approval.**

APPROVAL DATE: **05/02/2007**

EXPIRATION DATE:**05/01/2009**

Valid 2-years after approval date. Construction plans shall be completed and approved within this 2-year period. Construction shall commence within 1-year after approval of plans.
** Applicable WSFC shall be collected at the prevailing rate in accordance with ROH 1990, Chapter 14, Sections 14-10.3, 14-10.4, 14-10.5 and Appendix 14-D.*

REVIEWED BY: ***Arturo Saavedra Jr.***

A. Saavedra, Jr.
Site Development Division, Wastewater Branch

ExternalID: **026118988-001** JobId: **26118988**

Initial Print Date: Wednesday May 2, 2007 10:52 am

Sewer Design Peak Flow Calculations
(Cemetery Expansion and 20-Lot Residential Subdivision)

MGD = millions of gallons per day
CPA = capita per acre
GPCD = gallon per capita per day
GAD = gallon per acre per day
GPD = gallons per day

Average daily per capita flow	average flow of wastewater: 80 gpcd						
			Total Capita	GPD			
Residential (home)	no. of homes =	20	80	6400		no. of acres =	4.98
Residential (apartment)	no. of units =	0	0	0		no. of acres =	0
Central Business	no. of acres =	0	0	0			
Community Business	no. of acres =	0	0	0			
Neighborhood Business	no. of acres =	0	0	0			
Resort	no. of acres =	0	0	0			
Apartment (high density)	no. of acres =	0	0	0			
Apartment (medium density)	no. of acres =	0	0	0			
Apartment (low density)	no. of acres =	0	0	0			
General Industry	no. of acres =	0	0	0			
Waterfront Industry	no. of acres =	0	0	0			
School/Comfort Station			100	2500		no. of acres =	0.34435
Institution (hospital, etc.)			0	0		no. of acres =	0
	Total acres =	5.33	180.00				
Average Wastewater Flow				8900.00	GPD		
				0.01	MGD		
Maximum Wastewater Flow	Flow factor (Figure 22.2.4)		5	0.045	MGD		
Dry Weather Infiltration/Inflow							
Sewers laid above or below the	above		5	900.00	GPD		
normal ground water table?			(gpcd)	0.001	MGD		
Design Average Flow	0.0098	MGD					
Design Maximum Flow	0.0454	MGD					
Wet Weather Infiltration/Inflow							
Sewers laid above or below the			1250	6661.39	GPD		
normal ground water table?			(gad)	0.007	MGD		
Design Peak Flow				**52061.387**	**GPD**		
				0.052	**MGD**		

Sewer Design Peak Flow Calculations
(Cemetery Expansion Only)

MGD = millions of gallons per day
CPA = capita per acre
GPCD = gallon per capita per day
GAD = gallon per acre per day
GPD = gallons per day

Average daily per capita flow average flow of wastewater: 80 gpcd

			Total Capita	GPD		
Residential (home)	no. of homes =	0	0	0	no. of acres =	0.00
Residential (apartment)	no. of units =	0	0	0	no. of acres =	0
Central Business	no. of acres =	0	0	0		
Community Business	no. of acres =	0	0	0		
Neighborhood Business	no. of acres =	0	0	0		
Resort	no. of acres =	0	0	0		
Apartment (high density)	no. of acres =	0	0	0		
Apartment (medium density)	no. of acres =	0	0	0		
Apartment (low density)	no. of acres =	0	0	0		
General Industry	no. of acres =	0	0	0		
Waterfront Industry	no. of acres =	0	0	0		
School/Comfort Station			100	2500	no. of acres =	0.34435
Institution (hospital, etc.)			0	0	no. of acres =	0
	Total acres =	0.34	100.00			

Average Wastewater Flow 2500.00 GPD
0.00 MGD

Maximum Wastewater Flow Flow factor (Figure 22.2.4) 5 0.013 MGD

Dry Weather Infiltration/Inflow

Sewers laid above or below the	above	5	500.00	GPD
normal ground water table?		(gpcd)	0.001	MGD

Design Average Flow 0.003 MGD

Design Maximum Flow 0.013 MGD

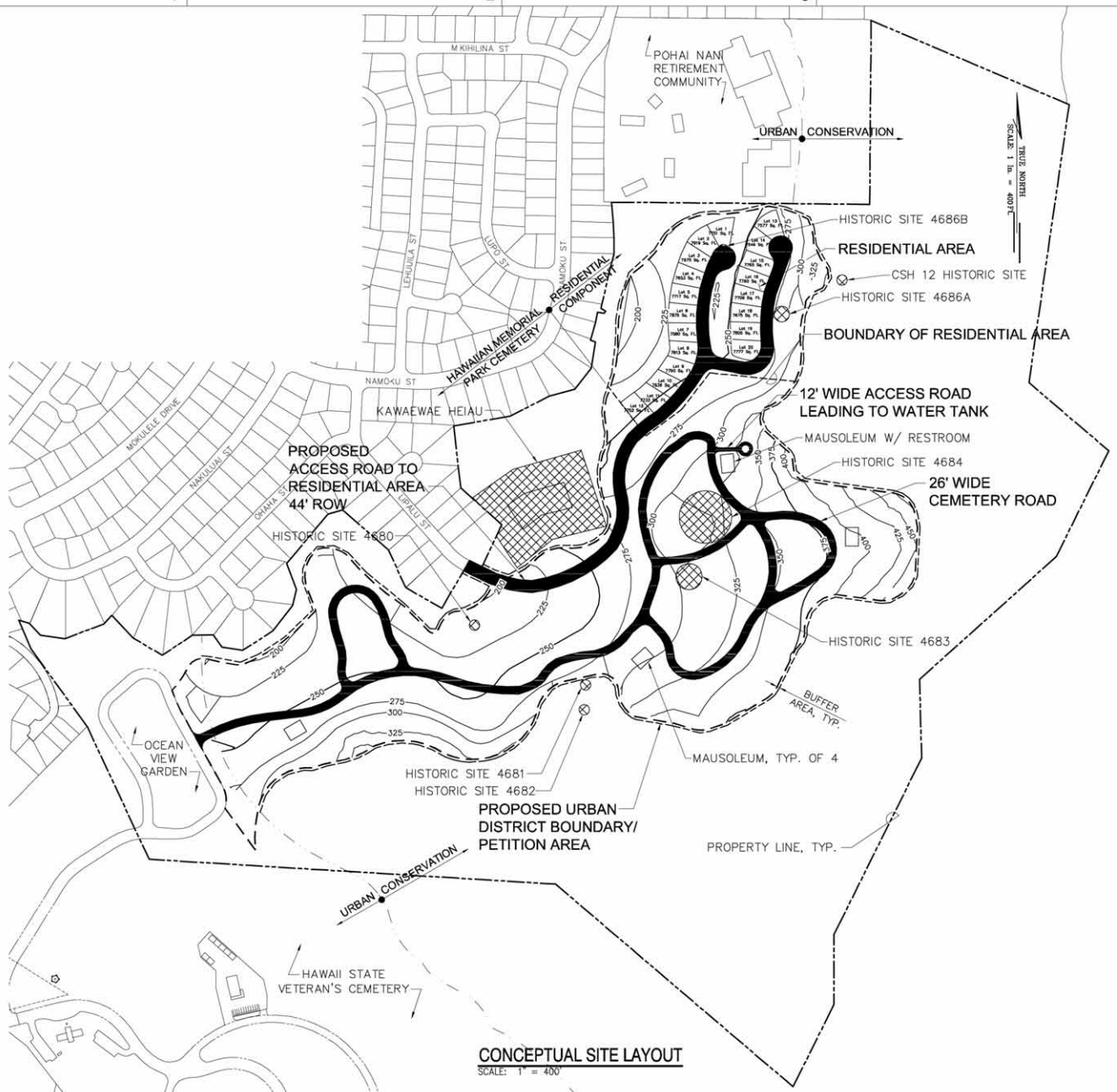
Wet Weather Infiltration/Inflow

Sewers laid above or below the	1250	430.44	GPD
normal ground water table?	(gad)	0.000	MGD

Design Peak Flow **13430.441 GPD**
0.013 MGD

APPENDIX F

Conceptual Plans – Cemetery Expansion and 20-lot Residential Subdivision
(Former Proposed Action)



LAND USE SUMMARY

DESCRIPTION	AREA (ACRE)	
CEMETERY AREA		
TOTAL NET BURIAL AREAS	27.76	
CEMETERY INTERNAL ROADWAY	3.940	
Q10 RETENTION AREAS	1.934	
MAUSOLEUMS	0.321	
SUB-TOTAL CEMETERY AREA		33.95
HISTORIC/ARCHAELOGICAL SITES		
HISTORIC SITE 4680	0.029	
HISTORIC SITE 4683	0.180	
HISTORIC SITE 4684	0.721	
HISTORIC SITE 4686A	0.065	
HISTORIC SITE 4686B	0.029	
SUB-TOTAL HISTORIC/ARCHAELOGICAL SITE		1.02
RESIDENTIAL AREA		
RESIDENTIAL SUBDIVISION	3.561	
RESIDENTIAL ACCESS ROAD	2.848	
SUB-TOTAL RESIDENTIAL AREA		6.41
TEMPORARILY DISTURBED AREA (LANDS TO BE REVEGETATED)		
CUT/FILL SLOPE	11.513	
BUFFER AREA	2.143	
OTHER	1.607	
SUB-TOTAL TEMPORARILY DISTURBED AREA		15.26
TOTAL PETITION AREA		56.65

LEGEND

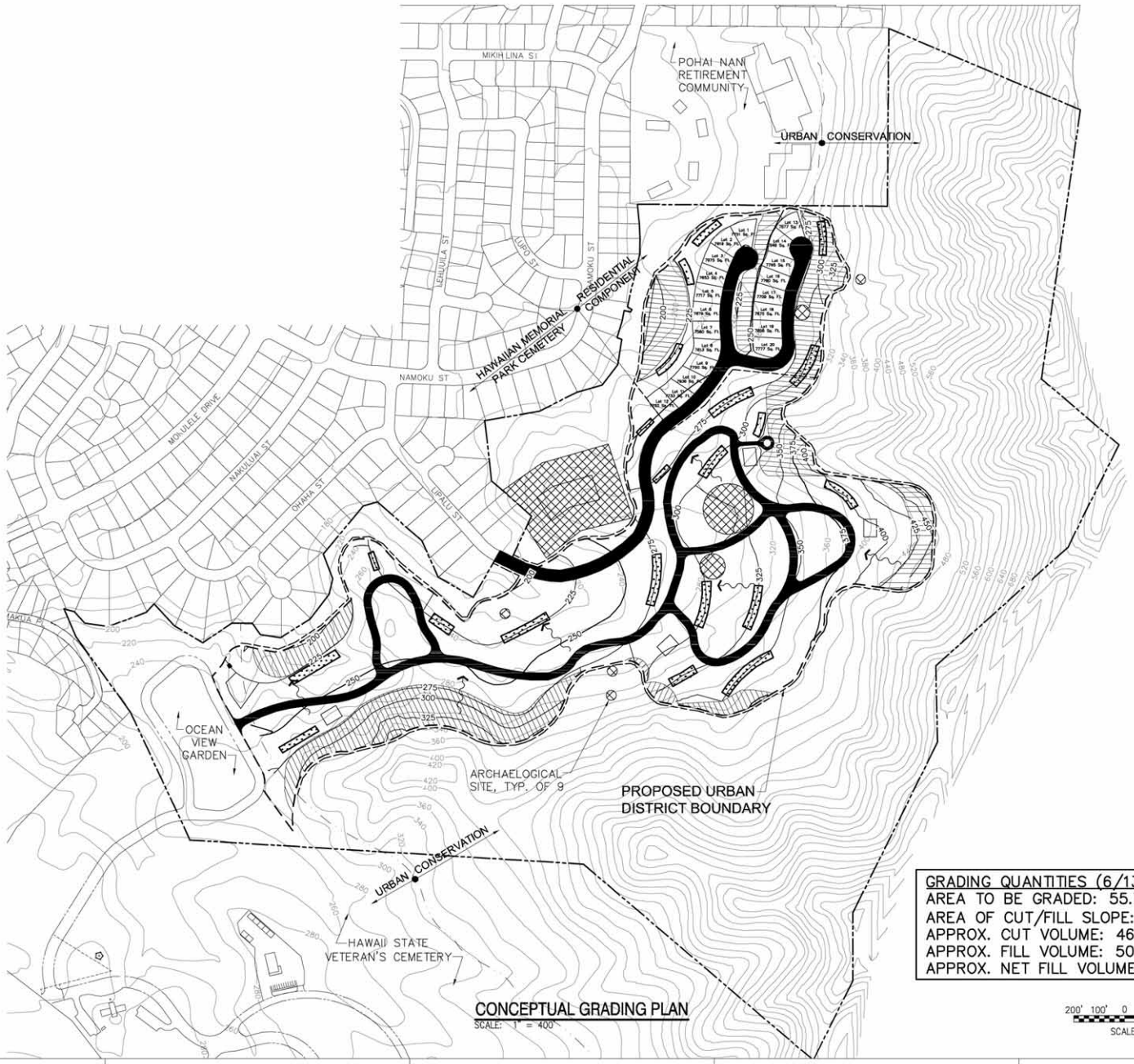
- 300 PROPOSED MINOR CONTOURS
- 250 PROPOSED MAJOR CONTOURS
- PROPOSED ROADWAY
- EXISTING PROPERTY LINE
- ARCHAEOLOGICAL SITES
- PROPOSED MAUSOLEUMS
- GRADING LIMITS
- EXISTING STATE LAND USE DISTRICTS
- PROPOSED URBAN DISTRICT BOUNDARY/PETITION AREA

SSFM INTERNATIONAL, INC.
501 SUMNER STREET, SUITE 620
HONOLULU, HAWAII 96817

HAWAIIAN MEMORIAL CEMETERY EXPANSION
PRELIMINARY ENGINEERING REPORT

CONCEPTUAL SITE PLAN

DESIGNED BY: MAT	CHECKED BY: EMS	PROJECT NO.	CLIENT
DRAWN BY: MMT	APPROVED BY: EMS	2006_085.000	CLARK & GREEN
SCALE: AS NOTED ON SHEET		DATE: 9/11/2007	FIGURE: 13

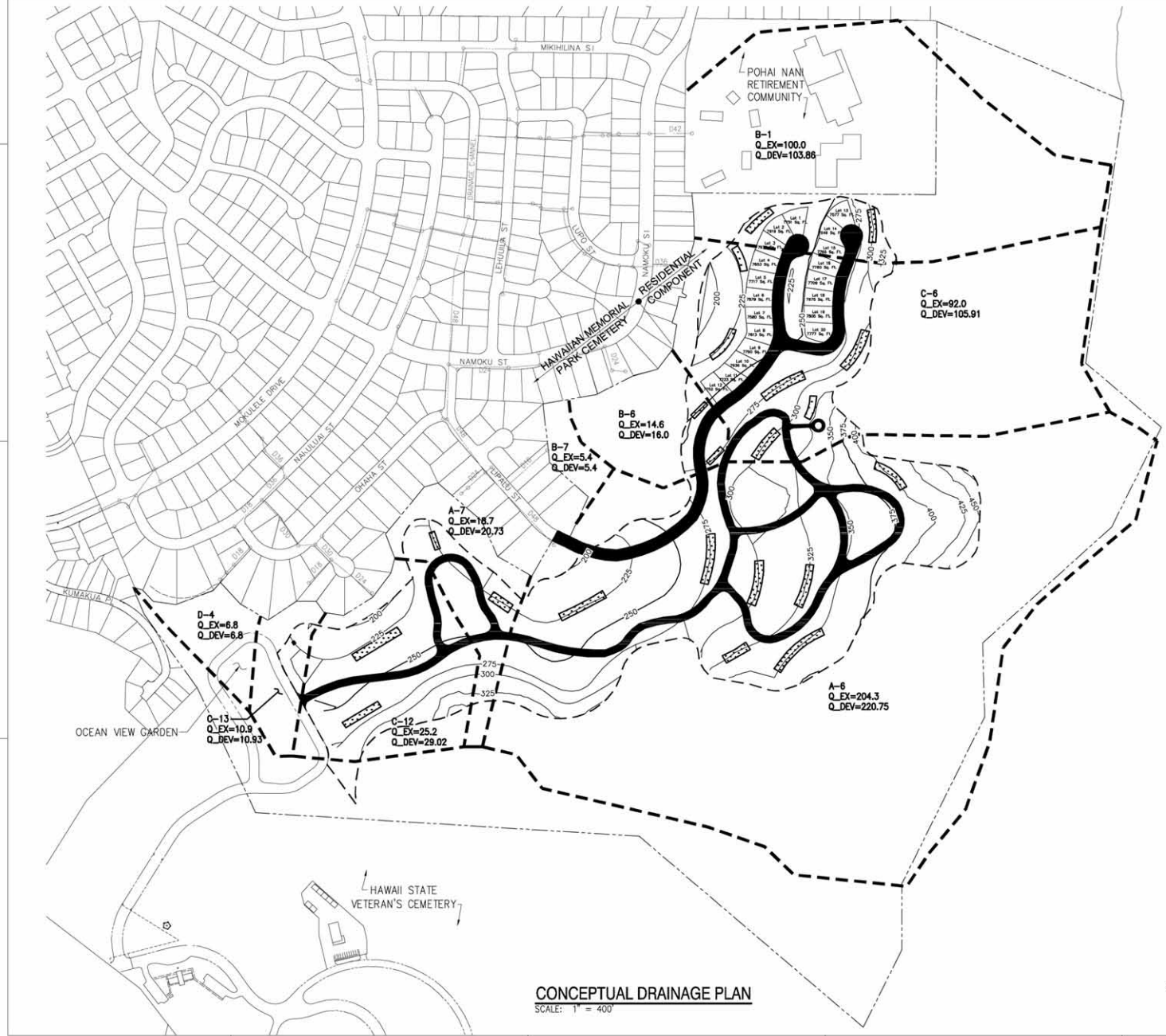


SSFM INTERNATIONAL, INC.
501 SUMMER STREET, SUITE 620
HONOLULU, HAWAII 96817

HAWAIIAN MEMORIAL CEMETERY EXPANSION
PRELIMINARY ENGINEERING REPORT

CONCEPTUAL GRADING PLAN

DESIGNED BY: MAT	CHECKED BY: EMS	PROJECT NO.	CLIENT
DRAWN BY: MMT	APPROVED BY: EMS	2006.085.000	CLARK & GREEN
SCALE: AS NOTED ON SHEET		DATE: 9/11/2007	FIGURE: 14



CONCEPTUAL DRAINAGE PLAN

SCALE: 1" = 400'

NOTES:

1. EXISTING DRAINAGE LINES OBTAINED FROM DRAINAGE REPORTS ON FILE AT DEPARTMENT OF PLANNING & PERMITTING
2. RETENTION BASINS TO BE PROVIDED TO RETAIN INCREASED RUNOFF FROM SUBDRAINAGE AREAS.

ABBREVIATIONS

Q_EX = EXISTING FLOW RATE
Q_DEV = DEVELOPED FLOW RATE

LEGEND

- EXISTING PROPERTY LINE
- D18 EXISTING DRAIN LINES
- DRAINAGE SUBASINS
- PROPOSED RETENTION AREAS
- GRADING LIMITS

200' 100' 0 200' 400'

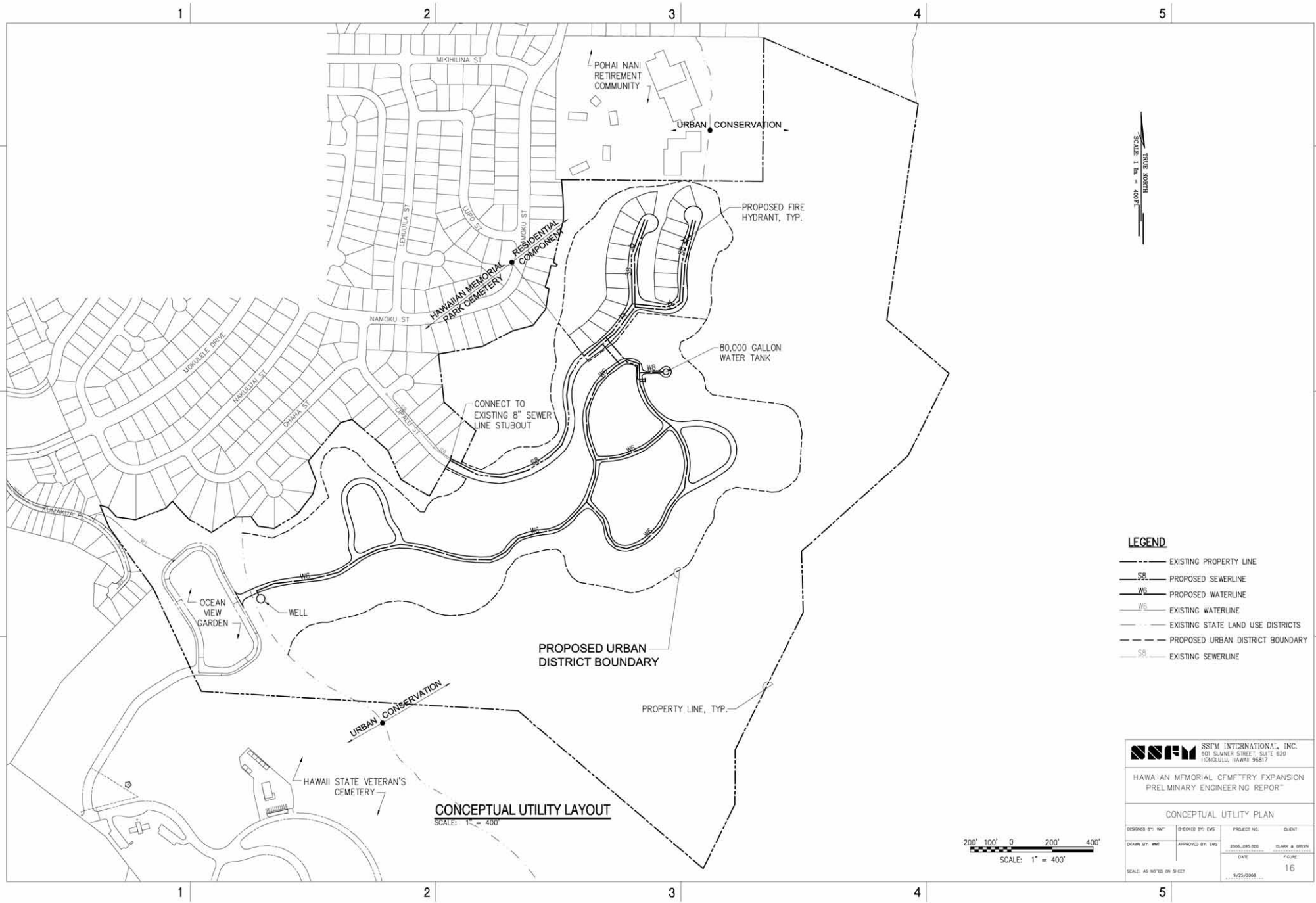
SCALE: 1" = 400'

SSFM INTERNATIONAL, INC.
501 SUMNER STREET, SUITE 620
HONOLULU, HAWAII 96817

HAWAIIAN MEMORIAL CEMETERY EXPANSION
PRELIMINARY ENGINEERING REPORT

CONCEPTUAL DRAINAGE PLAN

DESIGNED BY: RAF	CHECKED BY: EWS	PROJECT NO.	CLIENT
DRAWN BY: WMT	APPROVED BY: EWS	2006_085.000	CLARK & GREEN
SCALE: AS NOTED ON SHEET		DATE: 9/25/2008	FIGURE: 15



SSFM INTERNATIONAL, INC.
501 SUMNER STREET, SUITE 620
HONOLULU, HAWAII 96817

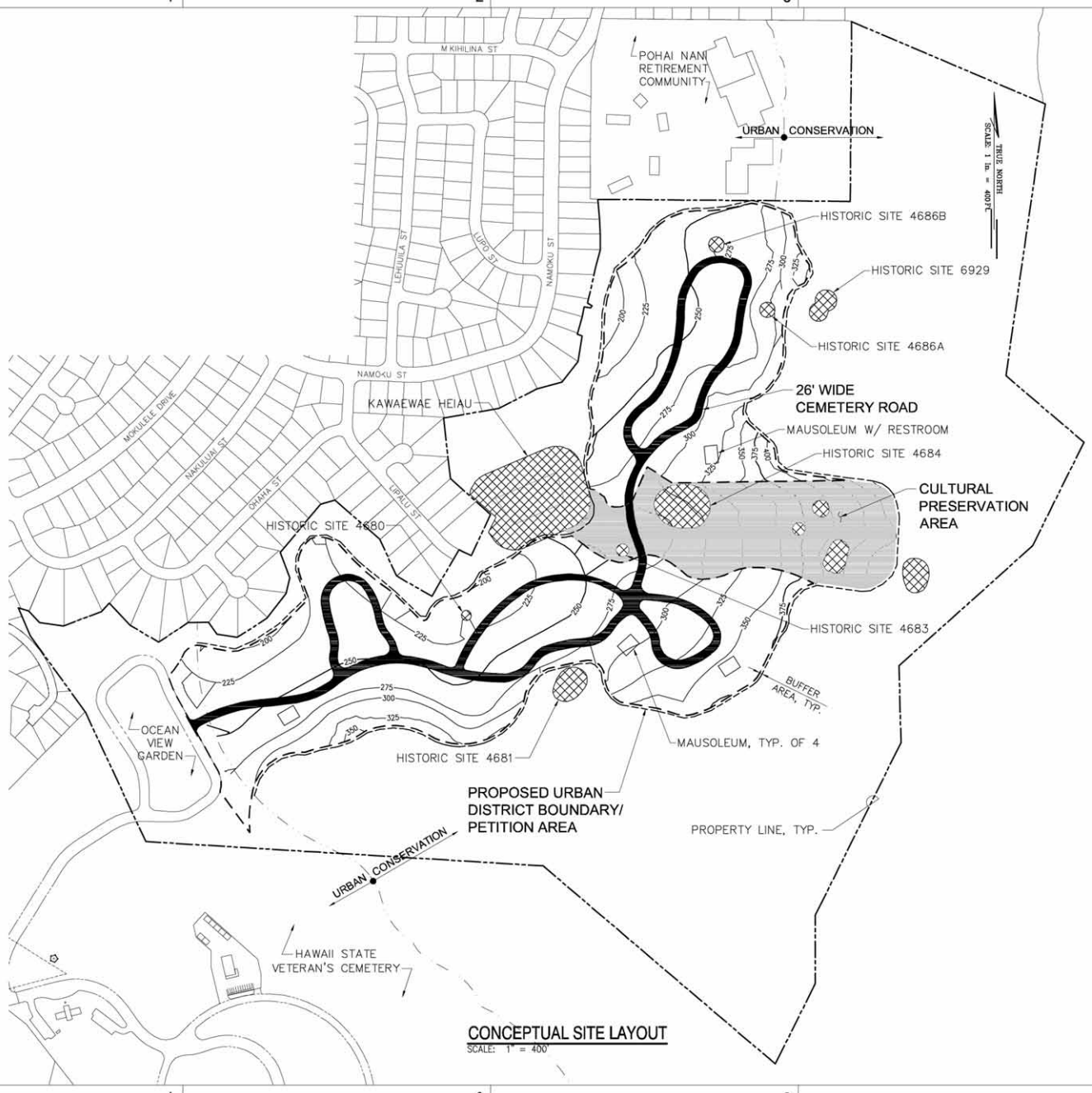
HAWAIIAN MEMORIAL CEMETERY EXPANSION
PRELIMINARY ENGINEERING REPORT

CONCEPTUAL UTILITY PLAN

DESIGNED BY: MAT	CHECKED BY: EMS	PROJECT NO.	CLIENT
DRAWN BY: MMT	APPROVED BY: EMS	2006.085.000	CLARK & GREEN
SCALE: AS NOTED ON SHEET		DATE: 9/25/2008	FIGURE: 16

APPENDIX G

Conceptual Plans – Cemetery Expansion Only
(Revised Proposed Action)



LAND USE SUMMARY		
DESCRIPTION	AREA (ACRE)	
CEMETERY AREA		
TOTAL NET BURIAL AREAS	29.50	
CEMETERY INTERNAL ROADWAY	4.44	
Q10 RETENTION AREAS	1.330	
MAUSOLEUMS	0.321	
SUB-TOTAL CEMETERY AREA		35.59
HISTORIC/ARCHAELOGICAL SITES		
HISTORIC SITE 4680	0.029	
HISTORIC SITE 4686A	0.066	
HISTORIC SITE 4686B	0.066	
CULTURAL PRESERVATION AREA	9.346	
SUB-TOTAL HISTORIC/ARCHAELOGICAL SITE		9.51
TEMPORARILY DISTURBED AREA (LANDS TO BE REVEGETATED)		
CUT/FILL SLOPE	9.612	
BUFFER AREA	1.744	
SUB-TOTAL TEMPORARILY DISTURBED AREA		11.36
TOTAL PETITION AREA		56.46

LEGEND

- 300 PROPOSED MINOR CONTOURS
- 250 PROPOSED MAJOR CONTOURS
- PROPOSED ROADWAY
- EXISTING PROPERTY LINE
- ARCHAEOLOGICAL SITES
- PROPOSED MAUSOLEUMS
- GRADING LIMITS
- EXISTING STATE LAND USE DISTRICTS
- PROPOSED URBAN DISTRICT BOUNDARY/PETITION AREA
- CULTURAL PRESERVATION AREA

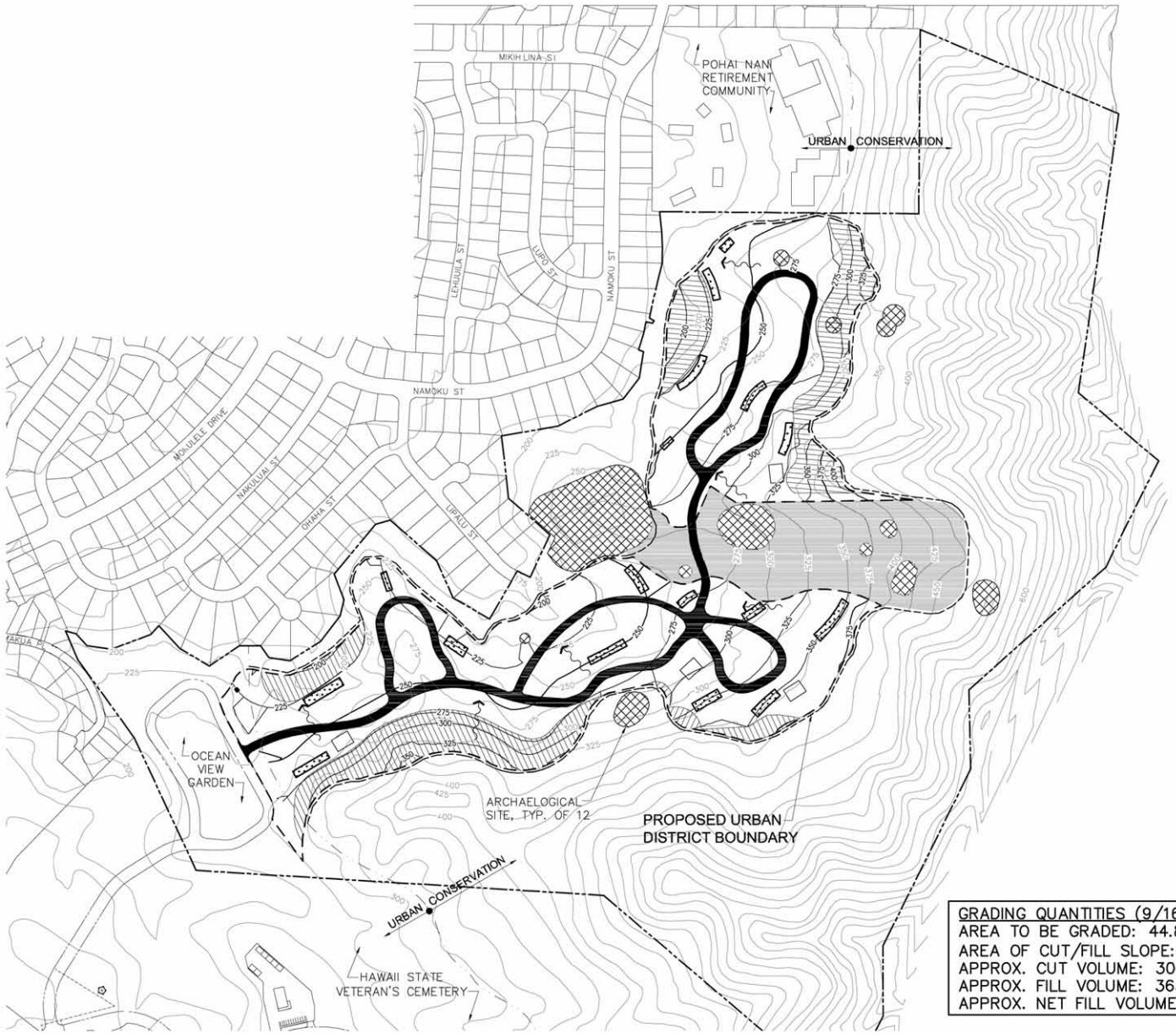
200' 100' 0 200' 400'
SCALE: 1" = 400'

SSFM INTERNATIONAL, INC.
501 SUMNER STREET, SUITE 620
HONOLULU, HAWAII 96817

HAWAIIAN MEMORIAL CEMETERY EXPANSION
PRELIMINARY ENGINEERING REPORT

CONCEPTUAL SITE PLAN

DESIGNED BY: MAT	CHECKED BY: EWS	PROJECT NO.	CLIENT
DRAWN BY: MAT	APPROVED BY: EWS	2006_085.000	CLARK & GREEN
SCALE: AS NOTED ON SHEET		DATE 9/25/2008	FIGURE 17



LEGEND

- EXISTING CONTOURS
- PROPOSED MINOR CONTOURS
- PROPOSED MAJOR CONTOURS
- PROPOSED ROADWAY
- GRADING LIMITS
- EXISTING PROPERTY LINE
- CUT/FILL SLOPE
- ARCHAEOLOGICAL SITES
- PROPOSED RETENTION AREAS
- PROPOSED MAUSOLEUMS
- FLOW DIRECTION
- EXISTING STATE LAND USE DISTRICTS
- CULTURAL PRESERVATION AREA

GRADING QUANTITIES (9/16/08)

AREA TO BE GRADED: 44.85 ACRES
AREA OF CUT/FILL SLOPE: 9.32 ACRES
APPROX. CUT VOLUME: 306,726 CY
APPROX. FILL VOLUME: 363,251 CY
APPROX. NET FILL VOLUME: 56,525 CY

CONCEPTUAL GRADING PLAN

SCALE: 1" = 400'

200' 100' 0 200' 400'
SCALE: 1" = 400'

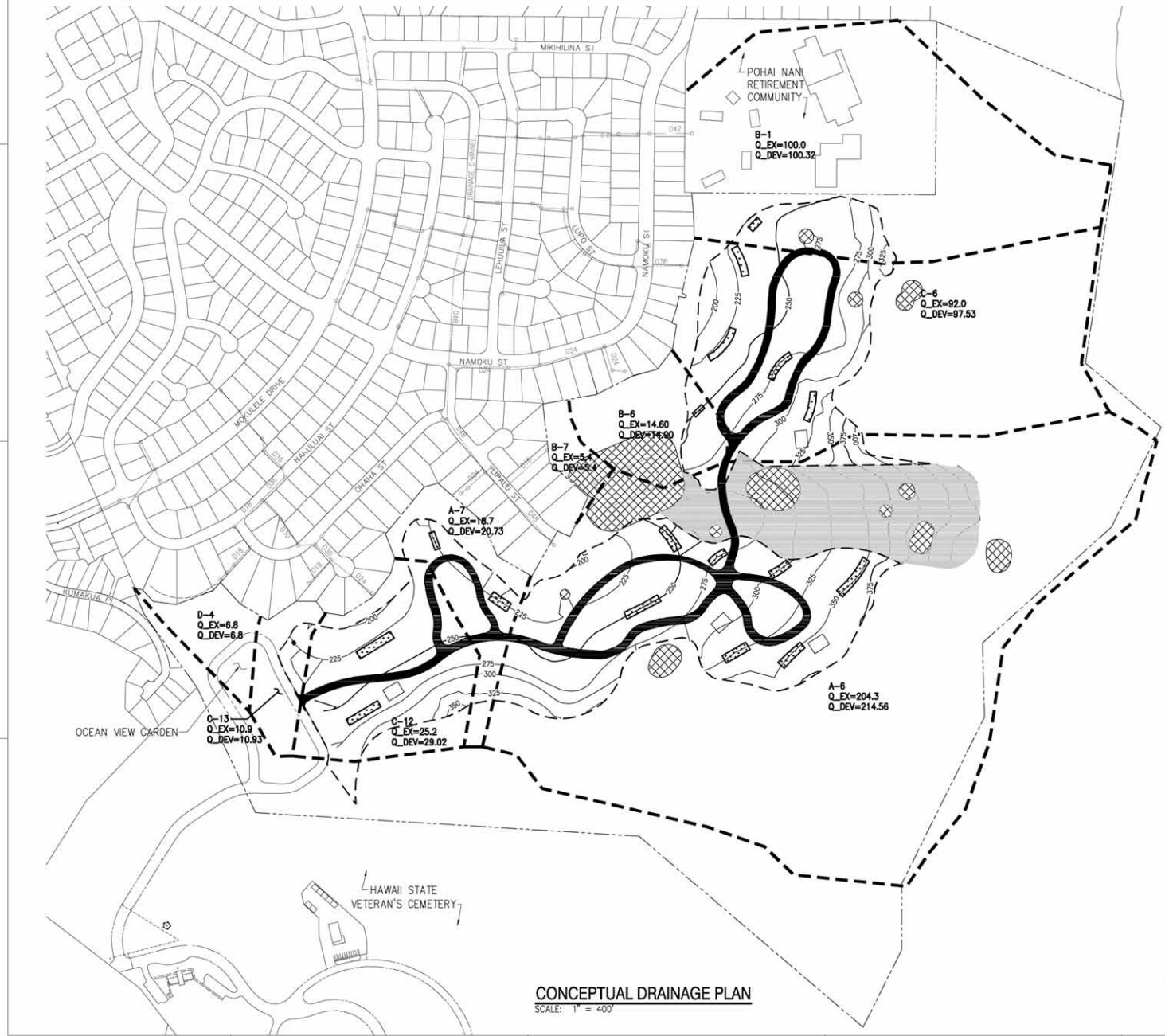
SSFM INTERNATIONAL, INC.
501 SUMNER STREET, SUITE 620
HONOLULU, HAWAII 96817

HAWAIIAN MEMORIAL CEMETERY EXPANSION
PRELIMINARY ENGINEERING REPORT

CONCEPTUAL GRADING PLAN

DESIGNED BY: MM	CHECKED BY: EMS	PROJECT NO.	CLIENT
DRAWN BY: MMT	APPROVED BY: EMS	2006_085.000	CLARK & GREEN
SCALE: AS NOTED ON SHEET		DATE: 9/25/2008	FIGURE: 18

DRAWING NAME: I:\2006\2006_085.000 HMPP HAWAIIAN MEMORIAL CEMETERY EXPANSION PEIFIG DRAWINGS\CONTRACT DOCUMENTS\GRADING PLAN.DWG EDIT TIME: 09-25-08, 1:05 PM EDITED BY: W.ANIGUCHI



CONCEPTUAL DRAINAGE PLAN

SCALE: 1" = 400'

NOTES:

1. EXISTING DRAINAGE LINES OBTAINED FROM DRAINAGE REPORTS ON FILE AT DEPARTMENT OF PLANNING & PERMITTING
2. RETENTION BASINS TO BE PROVIDED TO RETAIN INCREASED RUNOFF FROM SUBDRAINAGE AREAS.

ABBREVIATIONS

Q_EX = EXISTING FLOW RATE
Q_DEV = DEVELOPED FLOW RATE

LEGEND

- EXISTING PROPERTY LINE
- D18 EXISTING DRAIN LINES
- DRAINAGE SUBASINS
- PROPOSED RETENTION AREAS
- GRADING LIMITS
- CULTURAL PRESERVATION AREA

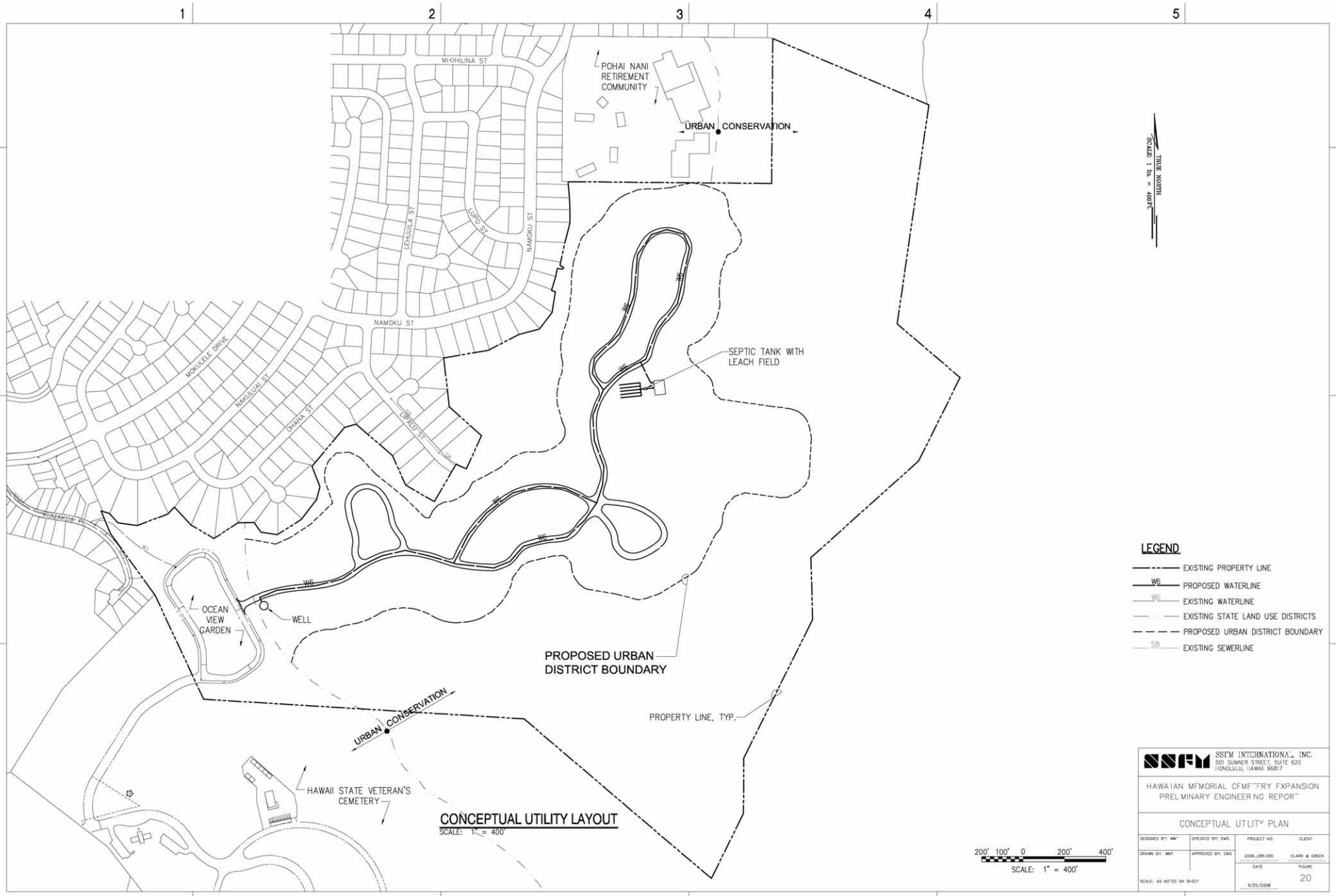
200' 100' 0 200' 400'
SCALE: 1" = 400'

SSFM INTERNATIONAL, INC.
501 SUMNER STREET, SUITE 620
HONOLULU, HAWAII 96817

HAWAIIAN MEMORIAL CEMETERY EXPANSION
PRELIMINARY ENGINEERING REPORT

CONCEPTUAL DRAINAGE PLAN

DESIGNED BY: MAT	CHECKED BY: EWS	PROJECT NO.	CLIENT
DRAWN BY: MAT	APPROVED BY: EWS	2006_085.000	CLARK & GREEN
SCALE: AS NOTED ON SHEET		DATE: 9/25/2008	FIGURE: 19



CONCEPTUAL UTILITY LAYOUT

SCALE: 1" = 400'

SSFM INTERNATIONAL, INC.
501 SUMNER STREET, SUITE 620
HONOLULU, HAWAII 96817

HAWAIIAN MEMORIAL CEMETERY EXPANSION
PRELIMINARY ENGINEERING REPORT

CONCEPTUAL UTILITY PLAN

DESIGNED BY: WMT	CHECKED BY: EWS	PROJECT NO.	CLIENT
DRAWN BY: WMT	APPROVED BY: EWS	2006_085.000	CLARK & GREEN
SCALE: AS NOTED ON SHEET		DATE 9/25/2008	FIGURE 20