### ALBIZIA EMERGENCY TREE MITIGATION AND MANAGEMENT PLAN

Prepared for: HAWAII ELECTRIC LIGHT CO., LTD.

Prepared by: ALBIZIA PROJECT COMMITTEE December 2015



#### TYPICAL ALBIZIA FOREST BEFORE:



TYPICAL ALBIZIA FOREST AFTER:

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# **PREFACE & INTRODUCTION:**

The Hawai'i Electric Light Company (HELCO), in cooperation with the County of Hawai'i Department of Public Works and State of Hawai'i Department of Transportation, and the Big Island Invasive Species Council present the Albizia Emergency Mitigation and Management Plan for the Island of Hawai'i.

Protecting the health and safety of Hawai'i Island's residents and visitors is the primary objective of this plan. The goals of this plan are to provide direction to strategically manage, maintain & control Albizia Tree growth and populations on the island of Hawai'i affecting major roadway, utility and disaster response infrastructure.

As a result of Tropical Storm Iselle in August 2014, and as reported in the Honolulu Star Advertiser, damage sustained was \$ 20 million of which 90% was caused by the Albizia Tree. *Reference: Hon. Star Advertizer Article* 8-24-15 – *Albizia Trees Can Damage Houses & Take Out Power Lines by Timothy Hurley* 

In addition, FEMA Claims totaled \$ 12 Million; included 37 homes; \$ 13.7 Million in HELCO Claims. The causes of these damages were specifically by fallen Albizia and not, as one would expect, the Tropical Storm surge. HELCO's total cost for Iselle alone was \$15 Million.

Also as reported in the "County of Hawaii Hazard Mitigation Plan 2015, the average annualized losses (which are direct economic losses) and not emergency response costs resulting from Hawaii Tropical Cyclones are an Average Annual \$69 Million Cost as reported by Mr. Gary Y. K. Chock, S.E., with a Storm return cycle of 20 years.

This Report will provide the conclusions necessary to initiate an Emergency Mitigation & Management Plan.

It is important to recognize that this Report is limited to impacts of the Albizia Trees only as determined to be a significant and unique Hazard tree. This report was prepared on the basis of "Order of Magnitude" as precise information was not available.

#### SCOPE OF WORK:

Preparation of a Report to establish a strategic & business plan to be used to fund and implement the control and removal of Albizia Trees in certain locations on the Island of Hawaii.

This plan addresses major corridors & infrastructure for facilities under the jurisdiction of HELCO, State Highways, and the County of Hawaii, the objective being to best manage the recovery of services resulting from disaster & catastrophic events to include but not limited to Hurricane, Earthquakes, Age, Termites and High Winds.

This report will identify implementation costs and the impacts that are avoided by its implementation.

# **EXECUTIVE SUMMARY:**

This Report establishes a five (5) year progressive plan to begin the removal and control of Albizia Trees located within strategic corridors that provide major utility and transportation services.

The public benefit is health and safety. Following Tropical Storm Iselle in August 2014, the damage resulting from fallen Albizia trees resulted in communities being both, inaccessible and without power for unacceptable durations of time.

Nearly all recovery operations required extraordinary resources to clear these fallen Albizia just to provide access to these areas and then begin the recovery operations.

Under this plan, it is not practical to remove 100% of Albizia Trees in 100% of the areas within the first year. As such, a five (5) year plan begins year 1 with 50% removal of Albizia Trees located within the High Density Zones (HDZ) identified as critical concentration areas along specified corridors or locations. The remaining area within each location will be chemically treated with herbicide as a Low Density Zone (LDZ) or areas of less concentration.

In the second year, this plan continues with 30% of trees within these HDZ corridors and the remaining acres being treated as Low Density Zone(Less Concentrated) being removed chemically.

In the third year, continues with 15% more of the High Density Zone (HDZ) and in the fourth year, the remaining 5% is removed and the 95% LDZ balance chemically treated.

In the fifth year, this program will be substantially established and further control would be predominantly by chemical removal as a LDZ.

#### FINANCIAL PLAN

The Table that follows concludes the following:

- 1. The Total Funds necessary to implement = 24,484,405
- 2. Also shown are Funds each for HELCO, State Highways, and County of Hawaii:
  - a. HELCO Five(5) Year Cost = \$ 10,259,586
  - b. State Highways Five(5) Year Cost = \$8,549,375
  - c. County of Hawaii Five(5) Year Cost = \$5,675,444

ALBIZIA SUMMARY ISLAND OF HAWAII December 2015		HELCO STATE HIGHWAYS 4 Locations 5 Locations		COUNTY OF HAWAII 9 Locations	TOTAL COSTS: 18 Loations
	YEAR 1	\$3,673,140	\$3,002,874	\$2,102,866	\$8,778,880
ALBIZIA COST INFORMATION	YEAR 2	\$2,616,662	\$2,159,622	\$1,473,021	\$6,249,305
	YEAR 3	\$1,793,907	\$1,503,407	\$981,919	\$4,279,233
	YEAR 4	\$1,228,862	\$1,053,420	\$643,810	\$2,926,092
	YEAR 5	\$947,015	\$830,052	\$473,828	\$2,250,895
	TOTAL TREE MANAGEMENT COST:	\$10,259,586	\$8,549,375	\$5,675,444	\$24,484,405

The Chronological Costs over this five (5) years becomes progressive less over this 5 year period.

In Year 1 =\$ 8,778,880 and progressively less ending in Year 5 =\$ 2,250,895

#### AVOIDED IMPACTS AND COSTS:

The Project Team attempted to best identify AVOIDED IMPACTS & COSTS. The Avoided Costs when shown are from available Publications, Presentations and recent past storm experiences.

The Table that follows, concludes significant Avoided Impacts and Costs that would result by implementing this "Albizia Emergency Mitigation and Management Plan.

ALBIZIA AVOIDED IMPACTS & COST PROJECTIONS:								
IF PLAN IS IMPLEMENTED: (Future Projected Impacts or Costs)	LEVEL OF IMPORTANCE:	DESCRIPTION OF AVOIDED ITEM:	IF PLAN IS NOT IMPLEMENTED: (Avoided Projected Impacts)	COST or NARRATIVE BASIS for AVOIDED COST PROJECTIONS				
Reasonable Response w/ manageable Delays.	1	Emergency Response by Police, Fire, and all Emergency Services	Significant Delays in Response Times	NA				
HELCO Reponse Manageable	1	Power Service Interuptions	Significant Disruptions w/ Response Delays	\$ 15 Million for Tropical Storm Iselle				
Minimal Impacts	1	Access to Disaster & Emergency Centers	Significant Potential for Blockages	NA				
No Impacts	1	Access to Hilo International Airport	Blockage Potential for this Access Road	Mandatory that this access always exists.				
Impacts lessened or none	1	Emergency Clearing to HELCO, State Highways & CoH Facilities	Significant Blockages by Downed Albizia	\$20 Million per Storm				
Impacts lessened or none	1	Access to Hilo Solidwaste & Landfill	Significant Blockage for Major Storm Disposal Site.	Mandatory that this access always exists.				
Emergency Response Manageable	2	Reduction in Staffing, Equipment and Cost for Emergency Call Outs	Significant Delays due to Resource Limitations,.	Est. \$ 10 - \$ 15 Million per Event Potential				
Manageable Response	2	Reduction in Need for Contractural Tree Cutting Services	Need to Prepare for & include in Emergency Response Plan	Est. \$5 - \$15 Million per Event Potential.				
Manageable Situation	3	Loss Use of Transportation Facilities	Significant Loss of Usage	Major Economic Loss				
Ordinary Budgeting Roadside & Transimission Maintenance	3	Reduction in Annual Tree Management for HELCO, State Highways, & CoH	Unplanned and Emergency Budgeting to meet this	Est. \$ 1.0 - \$ 5.0 Million per year.				

## THE ALBIZIA TREE ORIGIN & HISTORY:

*Falcataria moluccana*, commonly referred to as the Albizia Tree, is an invasive species introduced in 1917 by Hawaii Botanist Joseph Rock. 140,000 trees were planted statewide.

The Albizia is a fast growing tree that grows at a rate 10 times faster than average trees, about 20 feet per year. Growth Rates are: 1" per day, 100 feet in 10 years, 150 feet w/ 48" trunks and can reach 200' in height. This is the tree that is designated as a high risk and highly invasive species by the Hawaii-Pacific Weed Risk Assessment. Albizia is literally one of the fastest growing problems affecting Hawai'i island's roads and above ground utility lines.

Albizia also has a shallow root system & brittle heavy branches. They are often known to crash on roads, powerlines, buildings, etc. and can easily break at 35mph winds.

Germination and Recruitment (re-growth) is greatest where the ground cover is disturbed. Any existing ground cover is a good preventer.

Albizia is also easily spread by Heavy Equipment on Construction Project to Project. Photos that follow establish new Albizia locations that originated with new construction projects.

This type of Tree is a major issue. Attached as a part of the appendix is an article:

*"The Problem Whether Emergency Recovery or Other (Dr. Flint Hughes – Resource) Honolulu-Star Advertiser 8-24-15 by Timothy Hurley"* 

It is this Albizia Tree that is a major and significant problem with significant mitigation cost. They break very easily and thus this need to pursue funding to implement this Management Plan.

Hazard trees are defined in this plan as those which pose an immediate threat to roads, structures, or power lines because of close proximity. Albizia clearly fall into this category. These Albizia are those bordering public roads and primary transmission lines. These routes and transmission lines serve a major population and many of which do not have alternate routes.



Photos below are typically characteristic of the ALBIZIA tree.

Albizia Re-Growth – Trees shown are typical of growth that occurred with Heavy Equipment on this project which occurred in 2001. Thus these trees are only 14 years old maximum.



ALBIZIA OPTIMUM GROWTH – Under ideal conditions and this tree is less than 15 years old.



 $\label{eq:albor} ALBIZIA\ GROVE-Potential\ to\ block\ and\ dam\ this\ water\ way.$ 



ALBIZIA SINCE 2001 – Skyward view of Albizia resulting from that same project in 2001. These 3 trunks are from the same tree.

# ALBIZIA MITIGATION, MANAGEMENT AND FINANCIAL PLAN:

The Albizia Mitigation, Management and Financial Plan which follows will detail the following information:

- The Agency Jurisdictions to include: HELCO, State Highways and the County of Hawaii
- For each Agency the following information is in the form of tables to include:
  - 1. The locations/corridors and are identified to include the overall limits of the Albizia growths in miles.
  - 2. Each Location has been converted from Miles to Acres based on each Jurisdiction's average Typical Section. (*See Pages 14 16*)
  - 3. The Cost Analysis for each location/corridor over the five (5) year period includes 3% inflation rate for each of the succeeding years.
  - 4. For each Jurisdiction (HELCO, STATE HIGHWAYS & COUNTY OF HAWAII *See Page 13*), there are separate tables which shows:
    - All locations/corridors include for that Jurisdiction.
    - Year 1 through Year 5 Costs for all locations/corridors.
    - Total Costs for all locations/corridors.
    - Grand Totals Cost Summary.
- Operations by Civil Defense, Disaster Assistance, Airports, Solid Waste, Police, and Fire Facilities have also been addressed.

### **ALBIZIA ISLAND MAP showing LOCATIONS:**

- Island Map below shows Agency Jurisdictions and all locations by colored coded dots as follows:
  - 1. HELCO ORANGE 2. STATE HIGHWAYS PINK 3. County of Hawaii GREEN



### **COST ANAYLIS SUMMARIES FOR JURISDICTIONS:**

Conclusions based on the tables below each for HELCO, STATE HIGHWAYS AND the COUNTY OF HAWAII are:

- 1. The Mitigation Cost for each is greatest in the first year.
- 2. With each year 2 through year 5 this mitigation cost decreases as does the growth concentration of Albizia Trees.

ALBIZIA TREE MANAGEMENT SUMMARY HELCO - HAWAII ELECTRIC LIGHT CO., LTD. December 2015								
HELCO CORRIDOR NAME or I.D: (Length in Miles or		No. 1 No. 2 No. 3		No. 4	TOTAL:			
		PIIHONUA	NANAWALE	LEILANI	KAUMANA	61 Miles or 454 Acres		
		7400 12 Mile or	6500 29 Milos	8700	9200 2 Milos	ΤΟΤΑΙ		
Size	of Location in Acres)	93 Acres	or 214 Acres	or 131 Acres	or 16 Acres	COSTS:		
	YEAR 1	\$790,977	\$1,714,234	\$1,040,148	\$127,781	\$3,673,140		
∟z	YEAR 2	\$560,160	\$1,221,214	\$742,563	\$92,725	\$2,616,662		
	YEAR 3	\$380,327	\$837,265	\$510,850	\$65,465	\$1,793,907		
	YEAR 4	\$256,712	\$573,580	\$351,769	\$46,801	\$1,228,862		
IFOF	YEAR 5	\$194,876	\$442,055	\$272,503	\$37,581	\$947,015		
* ≧	TOTAL TREE MANAGEMENT COST:	\$2,183,052	\$4,788,348	\$2,917,833	\$370,353	\$10,259,586		

ALBIZIA TREE MANAGEMENT SUMMARY STATE HIGHWAYS DIVISION DECEMBER 2015										
STATE HIGHWAYS CORRIDOR NAME or I.D: (Length in Miles or Size of Location in Acres)		No. 1 No. 2 No. 3 No. 4		No. 4	No. 5	TOTAL:				
		PUAINAKOHAWAII BELT ROADKEAAU-PAHOARTE 200ROUTE 1925 Miles1 Mile or 9 Acres15 Miles or 117 Acresor 169 Acres		KEAAU-PAHOA RD	MAMLAHOA HWY	HILO AIRPORT ACCESS ROAD 2 Miles or 14 Acres	58 Miles or 395 Acres			
				ROUTE 130 25 Miles or 169 Acres	ROUTE 11 15 Miles or 87 Acres		TOTAL COSTS:			
	YEAR 1	\$97,314	\$1,091,367	\$1,254,395	\$453,409	\$106,389	\$3,002,874			
∟z	YEAR 2	\$68,415	\$763,500	\$903,136	\$346,809	\$77,762	\$2,159,622			
	YEAR 3	\$45,888	\$507,835	\$629,812	\$264,356	\$55,516	\$1,503,407			
ALBIZIA ( VFORMA	YEAR 4	\$30,386	\$331,786	\$442,419	\$208,526	\$40,303	\$1,053,420			
	YEAR 5	\$22,606	\$243,228	\$349,454	\$181,944	\$32,820	\$830,052			
	TOTAL TREE MANAGEMENT COST:	\$264,609	\$2,937,716	\$3,579,216	\$1,455,044	\$312,790	\$8,549,375			

	ALBIZIA TREE MANAGEMENT SUMMARY COUNTY OF HAWAII ROAD December 2015										
		No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	TOTAL:
0	RRIDOR NAME or I.D:	PUAINAKO EXTENS	KAHAKAI BLVD	POHOIKI ROAD	KAPOHO ROAD RTE 132	LEILANI AVE	WAIANUENUE	RAILROAD AVE	MAKUU	HILO LANDFILL	49 Miles or 226 Acres
Size of Location in Acres)		RTE 200 5 Miles or 22 Acres	6 Miles or 28 Acres	5 Miles or 18 Acres	8 Miles or 37 Acres	4 Miles or 25 Acres	2 Miles or 8 Acres	7 Miles or 30 Acres	8 Miles or 37 Acres	4 Miles or 21 Acres	TOTALCOSTS:
	YEAR 1	\$204,169	\$266,545	\$145,423	\$342,947	\$261,100	\$67,206	\$270,175	\$342,947	\$202,354	\$2,102,866
⊢z	YEAR 2	\$143,122	\$186,157	\$103,826	\$240,104	\$180,549	\$48,010	\$189,896	\$240,104	\$141,253	\$1,473,021
SOL	YEAR 3	\$95,525	\$123,465	\$71,437	\$159,912	\$117,688	\$33,064	\$127,316	\$159,912	\$93,600	\$981,919
	YEAR 4	\$62,760	\$80,285	\$49,200	\$104,699	\$74,335	\$22,804	\$84,252	\$104,699	\$60,776	\$643,810
AL BI	YEAR 5	\$46,292	\$58,549	\$38,121	\$76,934	\$52,421	\$17,693	\$62,635	\$76,934	\$44,249	\$473,828
~ 4	TOTAL TREE MANAGEMENT COST:	\$551,868	\$715,001	\$408,007	\$924,596	\$686,093	\$188,777	\$734,274	\$924,596	\$542,232	\$5,675,444

### ALBIZIA TYPICAL ZONE SECTIONS FOR JURISDICTIONS:

The results shown in the Tables above have been based on the Typical Average Sections Types of Albizia Zones each for HELCO, State Highways and the County of Hawaii.

Each is shown below:







#### **GRAND SUMMARY COST for ALL JURISDICTIONS:**

The table below is a Grand summary to include all three Agency Jurisdictions. This is the same table that is shown in the Executive Summary.

ALBIZIA SUMMARY ISLAND OF HAWAII December 2015		HELCO STATE HIGHWAYS 4 Locations 5 Locations		COUNTY OF HAWAII 9 Locations	TOTAL COSTS: 18 Loations
	YEAR 1	\$3,673,140	\$3,002,874	\$2,102,866	\$8,778,880
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	TOTAL TREE MANAGEMENT COST:	\$10,259,586	\$8,549,375	\$5,675,444	\$24,484,405

Conclusions based on the above Grand Summary are that the Total Five (5) Year Mitigation Cost = 24,484,405\*

- Note that hazardous Albizia Trees are also located beyond the Right of Way boundaries. This has been designated as the "Buffer Zone" and pose a real threat and potential of falling impacts.
- Costs include appropriate levels of contracting with arborists and professional Tree Cutters.

#### **REMOVAL AND CHEMICAL TREATMENT METHODS:**

There are two basic methods of Albizia Tree Treatment.

- 1. Hard Trim or Felling the Tree and Chemical Treatment.
- 2. Chemical Treatment with Milestone Herbicide

#### CHEMICAL MILESTONE TREATMENT:

Perhaps the most cost effective development developed during this planning and demonstration process is the low-cost method of killing non-hazard trees in natural areas developed by Dr. James Leary of the University of Hawaii at Manoa. This approach uses the herbicide Milestone<sup>™</sup>, a non-restricted use pesticide that has been reviewed and registered under the Reduced Risk Pesticide initiative of the U.S. Environmental Protection Agency. Milestone<sup>™</sup> is highly effective against Albizia trees. A minute-measured dose of undiluted herbicide is applied directly to the inner tissue of the tree at six inch intervals. At a cost of \$2-\$5 per tree, this method can be effectively and rapidly applied over large landscapes, as was done in in Keauohana Forest Reserve.

Milestone is made by Dow Agrosciences. The method is called "Incision point injection method" as follows:

- 1. Low toxicity
- 2. Dosage per Cut = 0.5 ml
- 3. Cost per Tree = 2.00 5.00

Ease of use makes this method ideal for Albizia Tree removal in non-hazardous areas. These non-hazard trees do not pose a threat to infrastructure if they fall and account for a good percentage of trees within a project corridor. These trees can be killed quickly and easily to stop their encroachment into neighborhoods and eliminate their capacity to reproduce the seeds of future infestations.

#### ALBIZIA MANAGEMENT PLAN INCLUDE THESE ELEMENTS:

- Annual Inspection & Survey is conducted at each location to best assess

   Albizia Concentrations and Densities
  - b. Buffer Zones, Fall Zone & Types The ability to create buffer zones around high-priority corridors was identified as a necessity. Generally, two types of trees fall into this category: large trees which do not yet pose an imminent hazard to infrastructure, and saplings which are sprouting up throughout the corridor.
  - c. Treatment Types to be applied.
- 2. From these Inspections, Agencies can better determine the time and effort for each year's Mitigation plan.
- 3. Permission from adjacent landowners will be necessary.

#### TREATMENT COSTS:

Based on past experience and records, the following estimates are used for this plan. Note that the cost per mile amounts below have been converted to cost per acre. This allows for better cost projections to address differences for each Jurisdiction's differing Typical Sections.

- 1. Hard Trim, Fell & Chemically Treat \$115,000 per mile
- Milestone Chemical Treatment \$ 11,000 per mile or an average cost of \$2 to \$5 per tree.

Prior to this Plan, the original BIISC Estimated Costs for Implementation of Albizia Mitigation Plan were estimate at \$6.65 million as follows:

- 1. \$2.64 million to protect 18 miles of primary electrical transmission lines.
- 2. \$2.3 million to eliminate immediate safety hazards along 22.3 miles of county roads, including the Railroad-Maku'u Emergency Access Way.
- 3. \$1.4 million to eliminate immediate hazards along 10.8 miles of state highways.

#### COMMUNITY CONCERNS REGARDING PESTICIDE USE:

In general, strong community support exists for this plan, as seen in the positive response to the Black Sands demonstration project and the high demand by communities for BIISC training workshops that are ongoing into 2015. In fact, large-scale removal of Albizia has been identified as a top priority by many residents of Puna and Hilo, prompting legislator involvement at both the County and State levels. However, any action involving the use of pesticides can elicit some level of concern to be expressed by citizens. Reception of the plan as presented publicly throughout Puna has been overwhelmingly positive.

Direct outreach and transparency about the process are critical to maintaining public support. The extremely conservative method of herbicide application--as little as half a milliliter of herbicide dropped directly into a notch in the trunk—is significant in alleviating concerns about herbicide in the environment. At community meetings, information on Milestone<sup>TM</sup>, including the product label, special local needs label, and Materials Safety Data Sheet, are provided, and information about the Reduced Risk EPA designation for the product is shared. Strong and open communication between Albizia mitigation enactors and the public is a critical aspect of the plan.

#### ENDANGERED SPECIES PROTECTION:

Two endangered species, the Hawaiian Hawk and Hawaiian Hoary Bat, are known to be present in some of the vicinity of identified project areas, and previous research has indicated that these animals may nest in Albizia. Precautions necessary to prevent negative impacts on these species will be taken.

Consultation with the US Forestry and Wildlife Service is standard practice for tree maintenance activities along infrastructure corridors, and standard no-take procedures are well established. *Felling of hazard trees <u>must be considered</u> during the summer nesting and pupping season for the two species*. Precautionary measures are in place using thermal imaging cameras and if no bats are detected then the Hardcut & Treat can proceed.

ALBIZIA PHOTOS during and after Hardcut & Chemical Treatments.



WORK CREWS clearing the fallen ALBIZIA Trees. Note the major equipment necessary.



PHOTO which shows it all. There is a road and powerline beneath these fallen Albizia Trees.



TYPICAL in many cases of how large these Iselle fallen trees were.



ALBIZIA IN HELCO TRANSMISSION-DISTRIBUTION LINES – This is the level of maintenance that occurred pre-storm.



PARTIAL TREATMENT HARDCUT FOR HELCO TRANSMISSION & DISTRIBUTION LINE. Those Albizia skeletons have been chemically treated and will die in place. Good illustration of "Buffer" Zone.



ALBIZIA CHEMICAL TREATMENT OFF KOMOHANA STREET – Shows the effectiveness of Chemical "Milestone" treatment.

# **CONCLUSIONS:**

This Report concludes the following:

- 1. The Albizia Tree is a hazard and threat to Public Health and Safety.
- 2. There are significant costs to mitigating and managing the Albizia Tree concentrations.
- 3. Major Tree populations are located within corridors and locations belonging to: Hawaii Electric Light Co. Ltd.; the Hawaii State Highway's Division, and the County of Hawaii.
- 4. These costs are offset by the Disaster Emergency Clean Up and Recovery Costs that can be expended for any post-disaster recovery.
- 5. The Avoided Impacts and Costs in total and for each Jurisdiction are significant.

## **RECOMMENDATION:**

### THIS REPORT RECOMMENDS FUNDING TO IMPLEMENT THE MITIGATION AND MANAGEMENT OF ALBIZIA TREES.

# **ACKNOWLEDGEMENTS:**

Albizia Plan Project Team:

- 1. Mr. Jay Ignacio HELCO, President
- 2. Ms. Jennifer Zelko-Schleuter HELCO, Director of Community Relations.
- 3. Ms. Springer Kaye Manager, Big Island Invasive Species Committee
- 4. Dr. Flint Hughes Research Ecologist, USDA, Forestry Service
- Representative Richard Onishi State House of Representatives, 3<sup>rd</sup> District
- 6. Mr. Rich Wlosinski HELCO, System Forester
- Mr. Brandon Gonzalez Deputy Director, County of Hawaii Public Works
- 8. Mr. Salvadore Panem, P.E. District Engineer, Hawaii District, State Highways Division, HDOT
- 9. Mr. Francis Kekaualua Maintenance Superintendent, Hawaii District, State Highways Division, HDOT
- 10. Mr. Jared Chang Deputy Manager, Planning Group, SSFM International, Inc.
- 11. Mr. Hugh Ono, P.E. Team Leader, SSFM International, Inc.

## **APPENDICES:**

#### ATTACHMENTS:

- A Cost Analysis each for all Jurisdictions:
  - 1. 1. HELCO
  - 2. 2. STATE HIGHWAYS
  - 3. 3. COUNTY OF HAWAII
- B Location Table each for:
  - 1. HELCO
  - 2. STATE HIGHWAYS
  - 3. COUNTY of HAWAII
- C "The Problem whether Emergency Recovery or other (Dr. Flint Hughes Resource)Honolulu-Star Advertiser 8-24-15 by Timothy Hurley"
- D "After Iselle: A Plan for Mitigation of Abizia Hazards across East Hawaii by BIISC (Big Island Invasive Species Council) dated May 2015.
- E "Albizia Mitigation Plan for East Hawaii" dated May 2015 power point presentation by Dr. Flint Hughes, Ms. Springer Kaye, & Franny Brewer.