Appendix 1
Honolulu Disaster Debris Management Operations Plan
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1.0 Plan Objectives and Background

In the wake of environmental hazards and/or natural disasters, one of the key items that must be addressed is the clearing, removal, and disposal of disaster debris. Debris removal often represents the first visible step towards recovery. Disaster debris management can become a highly contentious activity that impacts the political, environmental, and fiscal climate in a community for years after a disaster.

1.01 Objectives

This plan is intended to provide specific disaster debris management guidance for the City and County of Honolulu, Hawaii. Items that apply directly to Honolulu from the Hawaii Disaster Debris Management Plan (HI DDMP) are included in this plan by reference. This plan should be utilized in conjunction with the HI DDMP during the four phases of disaster debris management as outlined in the State guidance document.

1.02 Background

Honolulu, Hawaii faces unique challenges in addressing disaster debris. The Island of Oahu's location in the central Pacific makes the Island exposed and vulnerable to natural disasters, and isolated from sources of support. The Island of Oahu is generally mountainous with broad flats on the northern and southern shores (Figure 1). There are large areas of undeveloped, mountainous land surrounding the central portion of the Island. The mountainous terrain has caused development of population centers to be limited generally to the flatter areas along the shoreline and in the hills and ridges above the City of Honolulu. The primary urban center of the Island is located on the southern shores (Figure 2). The roadway system is primarily located in these flats or around the shores of the Island in the primary population centers with few mountain crossings (Figure 3). The flat areas of the Island along the shores are vulnerable to flooding associated with tsunamis and hurricanes. With this limited road network and mountainous terrain, the population centers tend to be isolated from each other. The Island of Oahu has very limited landfill capacity, and as such, advanced planning for large amounts of disaster debris is critical.

1.03 Plan Contents

In the event of an environmental hazard and/or natural disaster such as a hurricane, tornado, tsunami, or flood, this document is designed to be a comprehensive disaster debris management plan involving source reduction and recycling techniques to extend landfill life and to restore customer service to the citizens of Honolulu, Hawaii. The goals and objectives of this document are to ensure that disaster debris is processed in accordance with environmental regulations, to reduce the loading on the existing landfills on Oahu, and to provide a framework for the rapid removal of debris by efficiently utilizing contractor resources and maximizing federal reimbursement of response and recovery activities.

This plan includes disaster debris quantity calculations, Temporary Debris Storage and Reduction (TDSR) siting criteria and potential candidate TDSR sites, TDSR site operational considerations, contracting procedures and contracts for debris clearing, removal, and

processing, and general concepts of operations prior to, during, and after a disaster debris generating event.

1.04 State of Hawaii Disaster Debris Management Plan (HI DDMP)

The Federal Emergency Management Agency (FEMA) provided funds to the State of Hawaii to develop a State Disaster Debris Management Plan (HI DDMP) under the Hazard Mitigation Grant Program (HGMP). These funds were a direct result of Hurricane Iniki, which struck the Hawaiian Islands in September of 1992. Hurricane Iniki generated more than 5 million cubic yards of debris on the Island of Kauai. The disaster debris management issues associated with Hurricane Iniki stressed the importance of pre-disaster planning. The State of Hawaii Department of Health (DOH) and the Hawaii Civil Defense Agency (HCDA) have prepared the HI DDMP for guidance in preparing County-specific disaster debris management plans to pre-plan for disasters which are prone to affect the Hawaiian Islands.

In addition to providing direction for State agencies, the HI DDMP contains a template for Counties to develop disaster debris management plans to be implemented in the wake of a disaster. Specific items outlined in the HI DDMP include the calculations of expected disaster debris quantities and types, the identification of potential TDSR sites, concepts of operations prior to and following a disaster, and contracting information for debris clearing and removal.

The HI DDMP was utilized, as the guideline and framework of this plan, however, there were areas where data specific to Oahu varied from the HI DDMP. For example, the disaster debris calculations in this plan have been tailored to local conditions on the Island of Oahu, as determined through field reconnaissance and aerial photo interpretation. The processing of debris is specific to each Island's unique circumstances, and as such, there are limited processing methods available to each of the Islands. For Oahu, the preferred methods of disaster debris processing are mechanical reduction and recycling. Due to limited available land for TDSR sites, a stacking height of 20 feet has been utilized in the acreage calculations for Oahu. This stacking height is assumed only for unprocessed debris, as processed debris (particularly mulched green waste) can present fire potential when stacking heights exceed 10 to 15 feet. All other general guidance in the HI DDMP has been followed unless specifically denoted in this plan.

2.0 Disaster Debris Management Quantities and Types

2.01 Debris Estimate Basis

There are several different types of debris generating disasters that can affect the Island of Oahu. The HI DDMP discusses the amount and type of debris generated from various types of disasters in Annex I. For planning purposes, however, it is more appropriate to calculate the amount of disaster debris generated from the "worst-case" probable event that could affect the Island of Oahu. According to the HI DDMP, the design storm should be near the upper end of the range of likely events. A Category 4 hurricane on the Saffir-Simpson scale is more likely to affect the Island of Oahu than a Category 5 hurricane, and will cause more widespread impact to the Island than other disasters, excluding Category 5 hurricanes. Therefore, the disaster debris quantities for a Category 4 hurricane are utilized for planning purposes in the HI DDMP

and this document. The HI DDMP includes debris calculations for the Island of Oahu. The calculations contained in this plan have been tailored to Island specific conditions observed during field reconnaissance and review of aerial photography.

2.02 Debris Estimating Model

The United States Army Corps of Engineers (USACE) has developed a disaster debris estimating model to forecast hurricane generated debris volumes. The model is based on data from previous hurricanes and has a predicted accuracy of +/- 30%. Factors utilized in the model include the following:

- ?? Number of households
- ?? Intensity of the hurricane
- ?? Vegetative cover
- ?? Commercial density
- ?? Precipitation

The model uses the following formula to estimate disaster debris volumes:

Q = H*C*V*B*S where:

Q is the quantity of debris in cubic yards
H is the number of households determined by the population
C is the storm category factor in cubic yards
V is the vegetation characteristic multiplier
B is the commercial/business/industrial use multiplier
S is the storm precipitation characteristic multiplier

The number of households (H) is calculated by determining the population and then assuming that there are three persons per household.

Table 1 outlines multipliers for other factors in the model. The model is based on the premise that as the intensity of the storm and rainfall increase; the amount of debris generated will increase. For the purposes of this plan, it is assumed that a Category 4 hurricane will generate more debris than a tsunami, earthquake, or flood. Earthquake generated debris may be quantified depending on the intensity of the quake, but is more difficult to predict. Accordingly, this plan has selected the hurricane as the planning disaster. Therefore, to plan for the worst-case disaster debris scenario, the model for hurricane-generated debris is appropriate. However, for planning purposes debris estimates for floods and tsunamis have also been included in this plan.

Table 1. USACE Disaster Debris Model Multiplier Factors.

Hurricane Category from the Saffir-Simpson Scale	Value of "C" Factor	Vegetative Cover	Value of "V" Multiplier	Commercial Density	Value of "B" Multiplier	Precipitation Characteristic	Value of "S" Multiplier
1	2 cy	Light	1.1	Light	1.0	None to Light	1.0
2	8 cy	Medium	1.3	Medium	1.2	Medium to Heavy	1.3
3	26 cy	Heavy	1.5	Heavy	1.3		
4	50 cy						
5	80 cy						

2.03 Debris Estimates

For comparison, a listing by Census District for debris generated from all storm categories (i.e., 1 through 5) is provided in Table 2. The same basic assumptions used in the HI DDMP for vegetation, land use, and precipitation were used in generating the Honolulu debris estimates. Minor differences exist between the household information used in the HI DDMP versus this plan. The HI DDMP utilizes 1995 population data to adjust the number of households reported in 1990. The estimates for households in this plan are based strictly on population (population divided by 3 equals number of households). As more recent census data, by district, is made available, the debris estimates can be updated. Nevertheless, debris estimates from both evaluations conclude that approximately 40 million cubic yards of debris would be generated in a Category 5 hurricane.

Table Set 3 gives a detailed breakdown of the general types of debris that would be generated in a Category 5 hurricane, and provides an estimate of the amount of land required to temporarily store and process, the various types of debris generated from such a storm. Specific information regarding the TDSR site land area requirements are discussed below. The composition of the debris provided within the enclosed tables are based on the visual site reconnaissance of the Island, review of building code data, aerial photographs, the HI DDMP, and Hurricane Iniki information.

The Category 5 debris estimates (i.e., quantity and type) used in the HI DDMP were useful for comparison purposes, however, in evaluating the degree to which debris can be separated, experience has shown as the magnitude of a disaster increases, generating more debris, the opportunity for separation decreases. Basically, all materials are sufficiently commingled that separation is simply not practical. Conversely, opportunities for segregating disaster debris increases with less severe disasters.

A Category 4 hurricane was selected as the design storm, as it more closely reflects the magnitude of storm that is more likely to affect Oahu based on historical data and, therefore, is the type of event this plan is based on. As detailed within Table Set 4, the volume of debris generated in a Category 4 hurricane (approximately 26 million cubic yards) is less than two thirds of that generated in a Category 5 hurricane. The debris generated in a less severe storm can be separated more efficiently and provide a greater opportunity to recycle and reduce debris, thus reducing the potential impact to limited landfill space on the Island.

As detailed within Table Set 5 and 6, debris estimates for floods and tsunamis have been provided with their respective TDSR land area requirements. Far less debris is likely to be generated in these disasters, and as such, the land required for the temporary storage, separation and reduction of debris would be approximately 10 acres for floods and 60 acres for a tsunami. It is anticipated that a majority of the debris from these events would be construction and demolition materials, household goods and other landfillable materials.

2.04 Debris Separation

Debris separation is an important method of efficiently managing disaster debris. Debris separation can be accomplished at curbside or at TDSR sites. Effective separation of materials into waste streams that have the same or similar processing methods and/or ultimate destination points can significantly increase the efficiency of debris removal and reduction. Debris can frequently be separated into building materials, green waste, household goods, metals and white goods, garbage and putrescibles and hazardous wastes. Separation can best be accomplished at curbside for light to moderate intensity events.

As the severity of disasters and debris quantities increase, however, the viability of curbside separation is reduced due to the sheer volume of material, its unconsolidated nature and the urgent need to remove it from City streets and curbs. Curbside separation must also be balanced by the need to reduce the number of "passes" by each property following a disaster. Separation opportunities vary, but generally putrescibles and garbage are collected separately from building materials and household goods. Hazardous waste is almost always collected separately as well.

For the purposes of this plan, it is recommended that the public information campaign which would immediately precede and follow a natural disaster encourage the public to separate debris and wastes into the following basic categories:

- ?? Putrescibles (food and other perishables) and garbage (placed in authorized containers)
- ?? Green waste and vegetation (bundled or piled up)
- ?? Building materials and household goods
- ?? White goods and metals
- ?? Hazardous waste (in marked containers)

The plan discusses the handling of each of these debris streams in the discussion of debris management protocols (best management practices) below.

2.05 Debris Sheds

The debris shed concept is central to the development of contracts where contractor responsibilities are divided according to geographic boundaries, allowing the bid process to be more competitive. Furthermore, assigning one contractor to a particular area of the Island enhances overall efficiency, thus allowing the contractor to be more responsive to the needs of the City.

The calculations for a Category 4 hurricane, using the Corps of Engineer's model, show that multiple TDSR sites are required to temporarily store, sort, and process disaster debris. This plan identifies potential candidate TDSR sites in four debris areas or debris sheds.

Figure 4 exhibits the limits of the debris sheds. In general, the debris sheds are as follows:

- ?? Primary Urban District and Ewa
- ?? Central Oahu and the North Shore
- ?? East Honolulu, Koolaupoko, and Koolauloa
- ?? Waianae

The debris sheds have been delineated to define operational areas for contracts and for manageability of the plan. Generally, debris sheds represent the service areas around TDSR sites. Defining debris sheds are also designed to minimize hauling distances to TDSR sites. Table 7 details the debris quantities and acreage requirements for the debris sheds for each category of hurricane. A Category 4 hurricane will require multiple TDSR sites in each debris shed.

3.0 Temporary Debris Storage and Reduction (TDSR) Site Selection Process

3.01 TDSR Concept

TDSR sites are used following a debris-generating disaster to temporarily store, sort, and process disaster debris in an area accessible by hauling routes and within the general proximity of the debris. TDSR sites are critical to minimizing the impact a debris generating disaster has on existing landfills by redirecting waste streams to alternate destinations such as waste burning boiler facilities, recycling facilities, and in the case of mulched green waste, agricultural uses. According to the disaster debris calculations for Honolulu, a Category 4 hurricane with wet conditions would require approximately 813 acres to sort, store, and process disaster debris (the accuracy of the Corps model is +/- 30%).

3.02 Screening Criteria

Factors considered in the selection of potential TDSR sites consisted of the following:

- ?? **Topographic constraints** Sites that are geologically stable with slopes of less than six percent containing soils that are not highly erodible are preferred.
- ?? **Available acreage** A minimum of 3 acres was established as the threshold for acceptable candidate site size.
- ?? **Distance from debris sources** Haul distances less than 30 minutes from the source of the material are preferred.
- ?? **Access to the site from primary transportation arteries and availability of utilities** Candidate sites must be easily accessible from major arterials and haul routes and have water and sewer, if possible, or at least be close to a source of water for fire suppression.
- ?? **Existence and type of vegetation** Cleared sites or sites with sparse vegetation are preferred over heavily wooded sites.

- ?? **Soil types and adequacy of drainage** Stormwater should either be able to percolate into the ground or be directed as sheet flow into internal drainage features.
- ?? **Groundwater table height (UIC)** Perched, or near surface water tables present poor soil conditions and the potential for near surface aquifer contamination.
- ?? **Existence of sensitive natural resources or restricted zones,** including wetlands, protected species, water quality buffers, municipal water supply areas, floodplains, and cultural/archaeological/historical areas (Hawaiian Homelands). Siting of critical TDSR sites in floodplains and wetlands is generally inappropriate.
- ?? **Known environmental impairments** Areas with known soil and groundwater contamination should be avoided unless sufficient baseline sampling can be completed**.**
- ?? **Adjacency to residential areas, important public facilities, or sensitive populations** Because of the smoke, noise, dust, traffic and nighttime lighting required for the operation of TDSR sites, these sites should not be located adjacent to sensitive populations.
- ?? **Conflicting land uses (such as military explosives storage or runways and flight operations)** TDSR sites should avoid such features as runways, flight operations, etc.

3.03 Screening Process

Originally, the City hoped to identify a total of eight TDSR sites to service the debris management needs for the eight census districts within Oahu. However, application of the siting criteria detailed in the State DDMP to the Island of Oahu, revealed there to be only a limited number of sites available as candidate sites for inclusion in this plan. Lack of municipal lands left only state, federal and private lands available for consideration. Visual reconnaissance of the Island, and negotiations with respective property owners indicated that only state and federal lands are likely to be available as candidate TDSR sites in the near future. Consequently, a majority of the potential sites are located within military reservations. Fortunately, the candidate sites are located in relatively close proximity to the ultra urban center of Honolulu where a majority of the disaster debris would likely be generated following a natural disaster.

The lack of potential candidate sites, coupled with the estimates for quantity and composition of debris, limited haul routes, and availability of on Island contractor resources, resulted in the establishment of four debris sheds rather than the original eight proposed. As detailed in Table 8, the debris sheds were developed by grouping census districts into manageable service areas for each of the primary candidate TDSR sites. The debris shed concept allows for the efficient removal, temporary storage and processing of disaster debris by maximizing the utility of the limited haul routes. Furthermore, the composition of debris within each of the particular debris sheds is relatively uniform throughout. Finally, given the limited on Island contractor resources, the operation of eight TDSR sites is not practical.

This plan investigates potential candidate TDSR sites within each of the four debris sheds. The evaluation process included:

- ?? analysis of Geographic Information System (GIS) data,
- ?? meeting with County representatives and representatives of major landholders, and

?? Best Management Practice (BMP) considerations and siting criteria outlined in Annexes VI through VIII of the HI DDMP.

Once a preliminary list of potential TDSR sites was assembled, vehicular reconnaissance of the potential sites confirmed or refuted the data collected on the sites. From the ground-truthing of data, letters of intent were prepared for approval by each landowner for sites that appeared to be viable candidate sites.

Preliminary coordination with property owners has been initiated. A Letter of Intent (LOI) was developed to secure permission for the City and County of Honolulu to study TDSR sites under the National Environmental Policy Act (NEPA) process. This preliminary coordination does not ensure that a particular TDSR site will be a viable site, but it does allow for sites to be recommended as candidate sites for NEPA review. Negotiations with landowners for use of the TDSR sites will not proceed until the site has successfully gone through the NEPA review process.

FEMA Region 9 requires that debris management plans funded by the Hazard Mitigation Grant Program (HGMP) must comply with NEPA. This requires that all candidate sites must prepare required NEPA documentation to ensure that all environmental regulations are addressed. The NEPA process includes public involvement, such that candidate sites that are controversial in nature may not be viable sites under NEPA. The State of Hawaii has procured a contractor to prepare the necessary NEPA documentation for the environmental review of the candidate TDSR sites proposed by each county. The contractor will also facilitate the public review meetings required under NEPA.

The candidate TDSR sites may be required to obtain various environmental approvals in addition to the NEPA requirements. These approvals include Section 401 and 404 Clean Water Act Permits, air quality permits (for incineration), solid waste permits, groundwater extraction permits, or land-disturbing/erosion and sediment control permits. Environmental review of the TDSR sites is further discussed in Annex VIII-C of the HI DDMP.

3.04 Primary Candidate Sites

Table 9 details potential TDSR sites having some or all of the characteristics desirable. These have been classified as "candidate sites". Many sites were disqualified from the Table 9 list. The disqualified sites were not suitable for use as TDSR sites because of size, location, adjacency to sensitive populations or incompatible land uses, topography, or access limitations. From this list, the following sites, as shown in Figure 5, have been identified as candidates for primary TDSR sites are among those most likely to be available for debris management operations:

> Former Feed Lot in Campbell Industrial Park (TMK 91031001) – This State owned property (DLNR) is located in the southwest portion of the Island southeast of the intersection of Olai Road and Kalaeloa Boulevard, and is bound on the west by commercial property, on the east by Barbers Point Naval Air Station, on the north by commercial property, and on the south by the Pacific Ocean. The property is currently

unsubdivided, flat, vacant land. The site has approximately 50 acres of available land. Figure 6 shows this potential TDSR site.

Bellows Airfield Property (Southern Portion) (TMK 41015001) – This federally owned former U. S. Marine Corps air base is located in the southeastern portion of the Island along Tinker Road, and is bound on the west by residential property, on the east by Waimanalo Bay, on the north by the remainder of the Air Force Base (used for a military recreational facility), and on the south by forested land and residential areas. The property is currently used for Marine Corps training exercises and for recreational purposes. The site has approximately 350 acres of available land. Figure 7 shows this potential candidate TDSR site.

NAVMAG West Loch Drive Property (TMKs 91001001 and 91010011) – This federally owned Naval Preserve is located in the southern portion of the Island south of West Loch Drive, and is bound on the west by forested land, on the east by a golf course, on the north by the West Loch Naval Magazine, and on the south by forested land. The property is currently unsubdivided, flat, vacant land used to buffer explosives storage. The site has approximately 175 acres of available land. Figure 8 shows this potential candidate TDSR site.

Former Barbers Point Naval Air Station – Northern Portion (TMK 91013001) – This federally owned closed Naval Air Station airstrip is located in the southern portion of the Island west of Elrod Road and south of East Hanson Road, and is bound on the west by forested land, on the east by the Barbers Point Golf Course, and on the north and south by vacant property. The property to the south of the potential TDSR site has a history of soil and groundwater contamination. The property is currently an inactive airfield. The site has approximately 175 acres of available land. Figure 9 shows this potential TDSR site.

NAVMAG Lualualei Radio Tower Site (TMK 86002001) – This federally owned radio transmitting facility is located on the western portion of the Island southeast of the intersection of Paakea Road and Mailiilii Road, and is bound on the west by vacant property, on the north and east by the radio transmitting facility, and on the south by mountainous forested land. The property is currently unsubdivided vacant land surrounding the radio towers. The site has approximately 260 acres of available land. Figure 10 shows this potential TDSR site.

3.05 Secondary Candidate Sites

The following sites have been identified as potential secondary TDSR sites, which are less likely to be available, or may not be needed:

PVT Access Road Site (TMK 87009007) – This property, owned by the PVT Land Company, LTD. is located in the southwestern portion of the Island along Lualualei Naval Road, and is bound on the west by PVT Landfill, on the south and east by the Nanakuli residential subdivision, and on the north by open fields and foothills to the Honolulu Forest Reserve. The property is currently an unused parcel of land that is

available to the PVT Land Company, LTD for future expansion of its landfill operations. The site has approximately 180 acres of available land. Figure 11 shows this potential TDSR site.

Kapalama Yard Site (TMK 12025002) – This State owned facility was a former U.S. Army storage yard which is located in the southern portion (Port District) of the Island east of Sand Island Access Road, and is bound on the west by Keehi Boat Harbor and Keehi Lagoon, on the east by the Inter-Island Barge Operations Area, on the north by commercial property, and on the south by Kalihi Channel and Sand Island. The property contains storage buildings formerly used by the Army. The facility is paved and is surrounded by security fence. The site has approximately 32 acres of available property that could be used as an equipment staging area for government or private contractor debris clearing equipment. Figure 12 shows this potential TDSR site.

Campbell Industrial Park Site (TMK 91015001) – This privately owned property is located in the southwest portion of the Island west of Kalaeloa Boulevard and south of State Route H-1, and is bound on the west by industrial land, on the east by Kapolei Business Park, and on the north and south by vacant property. The property is currently an undeveloped parcel within the Campbell Industrial Park. The site has approximately 320 acres of available land. Figure 13 shows this potential TDSR site.

Campbell at Waipahu Site (TMKs 92001001, 91018001, 91017004, and 91018004) – This privately owned property is located in the southwest portion of the Island west of West Loch Drive, and is bound on the west by Ewa East residential development, on the north and east by West Loch Naval Magazine, and on the south by vacant land. The property is currently unsubdivided vacant land. The site has approximately 2000 acres of available land. Figure 14 shows this potential TDSR site.

Dole Fields on Kamehameha Highway (TMKs 64003001 and 64003003) – This privately owned property is located in the north central portion of the Island along Kamehameha Highway, and is bound on all sides by undeveloped agricultural land. The property is currently unsubdivided vacant land. The site has approximately 1070 acres of available land. Figure 15 shows this potential TDSR site.

U. S. Army Training Gate Site (TMK 57001021) – This privately owned property is located in the northern portion of the Island along the access road to Punamano AFS, and is bound on all sides by undeveloped forest and pasture land. The property is comprised of two unsubdivided vacant parcels of land that support scrub shrub vegetation. This site has approximately 3 acres of available land. Figure 16 shows this potential TDSR site.

Table 8 lists the primary and secondary potential candidate TDSR sites by debris shed. Note that the Central Oahu/North Shore debris shed still requires identification of one or more candidate primary TDSR site(s). Private landowners primarily own the large parcels in these debris sheds. There are candidate secondary TDSR sites in this debris shed under private ownership.

4.0 Debris Management Strategy and Concept of Operations

The strategy of the City's Disaster Debris Management Plan is to have a flexible, scalable response to a variety of natural disaster intensities which places limited reliance on City resources and maximum reliance on private contractors and federal agency assistance. This strategy recognizes the following factors affecting the City's ability to respond to natural disasters:

?? The City has very limited human and equipment resources with which to clear and process debris.
?? The City has limited available landfill capacity.
?? Contractors currently pick up and dispose of all municipal solid waste.
?? City forces will be needed to restore essential public services.
?? FEMA will not re-imburse the City of Honolulu for non "force account" labor costs associated with debris removal by City forces.

This flexible response is organized to be consistent with FEMA's four phases of disaster debris management (i.e., pre-disaster, increased readiness, response and recovery).

4.01 Best Management Practices for Debris Management

Optimum management techniques, based on the unique conditions of the City and post-disaster situations exist for all debris streams. These techniques are termed "best management practices" (BMPs) and can be generally determined prior to the on-set of a disaster.

Best Management Practices have been identified using the following criteria:

?? Processing cost
?? Capital cost
?? Debris reduction efficiency
?? Environmental acceptability
?? Effect on human health and safety
?? Availability of "end use" markets
?? Public acceptability

These factors vary according to the location of the TDSR sites selected. (Hawaii Department of Health and Office of Civil Defense, 2000). Annex VI of the State DDMP contains a series of tables detailing BMPs for managing disaster debris. Generally, non-hazardous disaster debris, including construction and demolition (C & D) debris, mixed debris, and putrescibles, that has been sorted from the total waste stream either at curbside or at a TDSR site, and if appropriate, been reduced (mechanical or incineration) will have to be disposed of at either the municipal landfill at Waimanalo or the private PVT landfill on Lualualei Naval Road north of Nanakuli. Hazardous materials sorted from the waste stream will be temporarily stored on the Island and

will be handled by the City's private hazardous waste disposal contractor or the Department of Health. In either case, hazardous waste will be transported off of the Island and will be disposed of on the mainland.

Clean, woody debris and other "green" waste (limbs, twigs, leaves, palm fronds, etc.) can generally be processed at the TDSR sites by chipping, grinding or incineration to reduce the debris to mulch or ash, or can be processed at an on-Island green waste facility such as Hawaiian Earth Products in Campbell Industrial Park. The mulch can be stockpiled for City and County landscaping needs, or can be made available to residents. The agricultural community may also have an interest in utilizing the mulch as a soil amendment. The mulch may be usable by one of the boiler facilities on the Island such as H Power. Metals and plastics that are sorted from the total waste stream will have to be temporarily stored until they can be shipped to off-Island recycling facilities if the intent is to divert those materials from the two available landfills. Aggregate and concrete that can be sorted from the waste stream can be recycled.

4.02 Capabilities Assessment

A key component to evaluating the proper management techniques for debris is to understand the capabilities of existing City resources. City resources consist primarily of personnel and equipment available for road clearing immediately after a natural disaster. These resources can be augmented using private contractors under Plan Bulldozer.

The following sections assess the debris management process and resource requirements in relationship to hurricanes of varying intensities.

4.03 Debris Clearing

The initial response phase will require that the roadway system be cleared to allow access to critical facilities and the TDSR sites. The City, in conjunction with contractor forces, will be responsible for clearing all public roads.

Road clearing activities will be completed using crews comprised of a dump truck (16-20 cu. yd.), front-end loader (3-5 cu. yd.), knuckle boom (5-10 ton lifting capacity) and a four-man chainsaw team. Initial debris clearing will take place in the more populous southern and eastern sections of the city. Conversely, the less populated northern and western areas of the city will generate less debris and will be the place to which most of the debris will be transported for separation and processing.

Interviews with debris removal contractors revealed that disaster debris clearing crews, configured as described above, could complete road-clearing operations on a four-lane road at a rate of two to three miles per day. This does not include debris removal, only pushing debris to the roadside or median to allow for one lane of traffic to pass in either direction. This type of clearing is the minimum necessary to allow access for emergency vehicles and debris removal contractors. The rate at which roads can be cleared increases to four to six miles a day for two lane roads especially for those areas within the City with minimal development.

4.04 Debris Removal and Processing

It appears, based on a preliminary evaluation of potential candidate TDSR sites, that the City has sufficient land area within its potential primary candidate TDSR sites for contractors to temporarily store, segregate, and reduce disaster debris up to a Category 4 hurricane. Collectively, the primary sites comprise approximately 1010 acres, which is somewhat more than the amount estimated as being required using the Corp Model for a Category 4 hurricane (i.e., 813 acres, Table 8). Typically however, only 50 percent of the total land area is usable for debris storage, separation and reduction when one considers the requisite buffers, haul roads and BMPs. As such, contractors will have to cycle each TDSR site several times and use 20-foot stack heights to allow for the available acreage. Furthermore, the inventory of land is significantly less than that required for a Category 5 hurricane, however, for the more significant disasters more of the debris would be transported directly to a landfill and not processed at a TDSR site.

In conjunction with, and subsequent to, the road clearing operations, debris will be removed from curbside and transported to a TDSR site for separation and reduction or taken directly to a recycling or disposal facility. It is during the initial response phase that equipment needs for debris clearing and removal are greatest.

With respect to debris removal, the primary factors affecting the rate at which these operations are completed are the number of available dump trucks and haul distance to TDSR sites, landfills or recycling facilities.

Table 4A details the equipment requirements for all categories of hurricanes, assuming twelve-hour workdays, and eight round trips from curbside to TDSR site and back per truck per day.

As Table 4A indicates, the City may have sufficient resources to respond to a minor disaster (i.e., Category 1 or less hurricane), however, it would to rely on private contractors (i.e., GCA) to manage debris generated from moderate (Category 2-3 hurricane) to severe disasters (Category 4-5 hurricane).

Once debris is collected at curbside and transported to the TDSR site(s) the process of debris separation and reduction is completed. The success with which this process is completed correlates directly with the extent to which area landfill capacity will be affected. Therefore, it is important to maximize the effectiveness of debris reduction and recycling. Where practicable, clean woody, construction and demolition (C&D) and household debris, recyclable metals and soils should be separated and where appropriate reduced.

Generally, clean woody and construction and demolition (C&D) debris can be separated and reduced in volume by 70 percent utilizing mechanical mulching and grinding methods respectively. Clean woody debris can be incinerated reducing its volume by as much as 90 percent. Once separated, household debris such as lumber, wallboard, and furniture can also be incinerated reducing its volume by 90 percent leaving only the ash to be disposed of. Metals should also be separated and recycled versus landfilling. Soil materials including sand and gravel should be sifted where appropriate and reused especially in areas where significant erosion has taken place.

Table 4B details the volume of separated and processed debris generated from each category of hurricane. The table also includes the volume by hurricane category for unprocessed landfillable debris. The processed debris volume for C&D debris is based on mechanical reduction methods and those for clean woody debris and household wastes are based on incineration.

As shown in Table 4B, for a Category 4 hurricane, the impacts to the two available landfills would be considerable (i.e., approximately 10 million cubic yards) even considering an aggressive debris separation and reduction program (including incineration as a viable BMP).

A review of the capabilities by storm intensity is as follows:

Category 1 Hurricane

As detailed in Table Sets 2, the Category 1 hurricane will generate manageable volume of debris that can be addressed utilizing existing city resources. As discussed, the City has sufficient resources to clear the primary roadway system, and then collect, transport and segregate disaster debris from a minor disaster. The City will however, need contractor support or mutual aid agreements with other municipalities for debris reduction, recycling and disposal.

Category 2-3 Hurricane

As described above, moderate disasters would require the City to rely on private contractors to remove, process and dispose of disaster debris. The City would however, potentially have available the necessary TDSR sites for their contractors to temporarily store, separate and process disaster debris. For the purpose of expediting debris response and recovery operations and enhancing the City's ability to be reimbursed by FEMA, private contractor(s) should be engaged to complete a majority of these efforts.

Category 4-5 Hurricane

As detailed in the preceding tables, severe disasters would significantly exceed the capabilities of not only the local public and private contractor resources but also the available landfill space within the County. Accordingly, for a disaster of this magnitude the city would most likely have debris management response and recovery efforts completed by the Corps of Engineers utilizing FEMA's regional contracts.

Based on the foregoing, Table 4C summarized the recommended resources to be utilized for various intensities of natural disasters

Table 4C - Basic Debris Management Responses to Various Disaster Intensities, City and County of Honolulu

Storm Intensity (Hurricane)	Max Estimated Debris Quantity (Cubic Yards)	Primary Clearing Responsibilities (0-100 hrs)	Primary Hauling Responsibilities	TDSR Site Operators	Canal Clearing	Contractor Supervision
Category 1*	1,043,851	City Forces for Primary Arteries Contractor support for Residential	City Hired Contractors	City Forces for Non-Presidential Declaration Contractor Forces if Presidential Declaration	City Hired Contractors	City
Category 2**	4,196,956	City Hired Contractors	City Hired Contractors	City Hired Contractors	City Hired Contractors	City
Category 3**	13,640,102	City Hired Contractors	City Hired Contractors	City Hired Contractors	City Hired Contractors	City
Category 4**	26,230,966	USACE Federal Contractor or City Hired Contractor	USACE Federal Contractor or City Hired Contractor	USACE Federal Contractor or City Hired Contractor	USACE Federal Contractor or City Hired Contractor	USACE or City
Category 5**	41,969,547	USACE Federal Contractor	USACE Federal Contractor	USACE Federal Contractor	USACE	USACE*

*Assumes no Presidential Declaration
** Assumes Presidential Declaration of Emergency

4.05 Concept of Operations During Disaster Phases

There are four phases of disaster debris management (i.e., pre-disaster, increased readiness, response and recovery). The following is a description debris management operations to be completed during each disaster phase including special considerations for use of each of the primary candidate sites.

4.05.01 Pre-Disaster Phase

Pre-planning for disaster debris management will allow the City and County to begin the recovery process much quicker and will maximize the use of both municipal and private contracting resources while minimizing the impact to existing landfills and fiscal resources. This plan represents a significant planning effort that will enable Honolulu to more effectively handle the disaster debris issues that arise immediately following a natural disaster such as a hurricane. This phase of disaster debris management includes the calculation of disaster debris quantities, the identification of TDSR sites, the preparation of boilerplate contracts and accounting procedures, and the quantification of on-Island contracting resources. The City should have all elements of the plan in place, complete periodic annual updates, and assign responsibilities for keeping the plan current. Section 4 of the HI DDMP discusses these action items in detail.

4.05.02 Increased Readiness Phase

With an imminent disaster such as a hurricane approaching, there are actions that must be taken to prepare for the debris management issues that will be faced after the disaster. To maximize the amount of debris clearing, removal, and processing expenses eligible for federal reimbursement, there are specific actions required during this phase. These actions are outlined in Annex IV of the HI DDMP. Action items required during this phase include reviewing and

updating this DDMOP, pre-positioning of vital personnel and equipment, alerting agencies within the disaster debris organization, reviewing and preparing materials (load tickets, time log sheets, etc.) for accounting procedures, and preparing public service announcements. The public notification in this phase should at a minimum provide basic details concerning the handling of disaster debris, for example, where to place debris for removal, how to sort debris at the curbside, etc. The concept is to bring everything to a state of readiness for implementation. Section 5 of the HI DDMP discusses these action items in more detail.

4.05.03 Response Phase

The response phase is the initial reaction to a debris generating disaster. This phase typically occurs within 70 hours following a natural disaster, however, it is dependent on the extent and amount of damage. This phase involves implementation of the debris management plan including the initial estimate of debris generated by a disaster and the clearing of essential transportation corridors for emergency access to key facilities. Key facilities include:

- ?? Emergency Services Facilities (fire stations, ambulatory facilities, police stations)
- ?? Hospitals
- ?? Government Disaster Operations Centers
- ?? Utility Plants
- ?? TDSR sites

Disaster debris clearing should be accomplished on primary arterial transportation corridors and haul routes first, then secondary transportation routes, then residential collector streets, and finally, residential neighborhood streets. Figure 3 exhibits the primary haul routes on the Island.

The clearing of the disaster debris is accomplished by simply pushing the material to the side of the transportation corridors to provide access. Only disaster debris that presents an immediate threat to human health or safety is removed during the response phase. Contracts let under this phase are typically time and materials contracts, as no significant quantities of disaster debris are removed for sorting, processing, or disposal. Contractors must be made aware of eligible and ineligible work. Generally, removal of debris on private property is ineligible for reimbursement from FEMA.

Public information is critical to the disaster debris management during this phase. Public Service Announcements (PSAs) regarding disaster debris should be released regularly and should include the following up to date information:

- ?? Curbside sorting information
- ?? Collection dates and times
- ?? Collection areas and routes
- ?? Debris eligible and ineligible for pick-up

These PSAs should be disseminated throughout collection areas by multiple media if possible. The longer the recovery period, the more important it becomes to ensure citizens that the

disaster debris is being managed in an effective manner. It should be noted that municipal solid waste collection will most likely be operational within a few days following the disaster.

Accounting procedures must be implemented for these contracts to ensure that adequate information is collected for FEMA reimbursement. Guidelines for reimbursable expenses are outlined in Annex IV of the HI DDMP. This accounting should include, at a minimum, dates and times of employees and contractors working, equipment identification numbers, and times that equipment is being utilized. Photographic evidence has been helpful to other local governments for reimbursement maximization.

4.05.04 Recovery Phase

The final phase of disaster debris management is the recovery phase during which time the debris management system is in effect for an extended period. Disaster debris is removed, sorted, processed, and disposed of during this phase. TDSR sites are opened and operated during this phase. This phase is the most visible sign of progress to the public.

Contracts let under this phase are typically quantity-based contracts for debris removal and processing. Contractors must be briefed as to what debris is eligible and ineligible. Guidelines concerning eligibility are provided in Annex IV of the HI DDMP. Accounting procedures must be implemented for these contracts to ensure that adequate information is collected for FEMA reimbursement. Guidelines for reimbursable expenses are outlined in Annex IV of the HI DDMP. This accounting should include at a minimum dates and times of employees and contractors working, equipment identification numbers, and quantities of debris collected, processed, and disposed of by category. A precise system of completing, collecting, and compiling accounting materials (load tickets, timesheets, debris quantities, etc.) must be adhered to. Photographs have been helpful as a supplementary accounting material to other local governments for reimbursement maximization.

TDSR sites are operated under this phase of disaster debris management. Annex VIII of the HI DDMP discusses operational issues of concern for TDSR sites.

General Requirements for all TDSR sites include the following:

- ?? Security fencing
- ?? Electric service or generators
- ?? Lighting
- ?? Water for fire suppression from City/County source, temporary well, or temporary tank
- ?? Sewer or portable restrooms
- ?? Covered observation tower to inspect trucks coming in to sites
- ?? Staffing for inspection, monitoring, and accounting
- ?? Temporary containment for incidental hazardous wastes

In addition to general requirements, each primary and secondary TDSR site will have specific concerns and requirements as follows:

4.05.04.01 Primary Candidate TDSR Sites

Former Feed Lot in Campbell Industrial Park (TMK 91031001) – This TDSR site has haul distances within the debris shed of up to 35 miles along H1. This site, along with the NAVMAG Property at West Loch Drive and the Barbers Point Airfield Site, will be required to handle a portion of the 18.4 million cubic yards of debris in the event of a Category 4 hurricane. This debris will have to be sorted for recycling, landfilling, and processing. Mulching or other means of mechanical reduction of green waste can be performed at this site. In the event that the State of Hawaii authorizes burning, this TDSR site would be an ideal candidate for reduction by burning given the location of the site on the leeward side of the Island and the surrounding industrial/commercial land use. The access point for this site should be located at Kalaeloa Boulevard at Olai. This site will be required to cycle debris (unprocessed debris accepted versus processed debris) in order to sort, store, and process the debris.

Bellows Airfield Property (Southern Portion) (TMK 41015001) – This TDSR site has haul distances within the debris shed of up to 35 miles along Kamehameha Highway, although the bulk of the debris (90%) is anticipated within 15 miles of the TDSR site. This site will be required to handle up to 5 million cubic yards of debris in the event of a Category 4 hurricane. This debris will have to be sorted for recycling, landfilling, and processing. Mulching or other means of mechanical reduction of green waste can be performed at this site. The access point for this site should be located at Tinker Road off of Kalanianaole Highway. This site has ample room for sorting, storing, and processing debris without cycling debris (Category 4 storm only requires 155 acres in this debris shed, this site is 350 acres).

NAVMAG Property – West Loch Drive (TMKs 91001001 and 91010011) – This TDSR site has haul distances within the debris shed of up to 25 miles along H1. This site, along with Barbers Point Airfield and the Former Feed Lot in Campbell Industrial Park, will be required to handle a portion of the 18.4 million cubic yards of debris in the event of a Category 4 hurricane. This debris will have to be sorted for recycling, landfilling, and processing. Mulching or other means of mechanical reduction of green waste can be performed at this site. The access point for this site should be located at West Loch Drive off of North Road. This site will be required to cycle debris (unprocessed debris accepted versus processed debris) in order to sort, store, and process the debris.

Barbers Point Airfield – Northern Portion (TMK 91013001) – This TDSR site has haul distances within the debris shed of up to 30 miles along H1. This site, along with the NAVMAG Property at West Loch Drive and the Former Feed Lot in Campbell Industrial Park, will be required to handle a portion of the 18.4 million cubic yards of debris in the event of a Category 4 hurricane. This debris will have to be sorted for recycling, landfilling, and processing. Mulching or other means of mechanical reduction of green waste can be performed at this site. The access point for this site should be located at Elrod Road south of East Hanson Road. This site will be required to cycle debris (unprocessed debris accepted versus processed debris) in order to sort, store, and process the debris.

NAVMAG Lualualei Radio Tower Site (TMK 86002001) – This TDSR site has haul distances within the debris shed of up to 12 miles along Farrington Highway. This site will be required to handle 1 million cubic yards of debris in the event of a Category 4 hurricane. This debris will have to be sorted for recycling, landfilling, and processing. Mulching or other means of mechanical reduction of green waste can be performed at this site. The access point for this site should be located at Paakea Road at Morse Road. This site has ample room for sorting, storing, and processing debris without cycling debris (Category 4 storm only requires 33 acres in this debris shed, this site is 260 acres).

4.05.04.02 Secondary Candidate TDSR Sites

PVT Access Road Site (TMK 87009007) – This TDSR site has haul distances within the debris shed of up to 7 miles along Farrington Highway. This site will be required to handle 1 million cubic yards of debris in the event of a Category 4 hurricane. This debris will have to be sorted for recycling, landfilling, and processing. Mulching or other means of mechanical reduction of green waste can be performed at this site. The access point for this site should be located along Lualualei Naval Road. This site has ample room for sorting, storing, and processing debris without cycling debris (Category 4 storm only requires 33 acres in this debris shed, this site is 179 acres).

Kapalama Yard Site (TMK 12025002) – This TDSR site has haul distances within the debris shed of up to 25 miles along H1. This site, along with Barbers Point Airfield, NAVMAG Property at West Loch Drive, and the Former Feed Lot in Campbell Industrial Park, will be required to handle a portion of the 18.4 million cubic yards of debris in the event of a Category 4 hurricane. This site would primarily be used for staging equipment, however, it could be used for temporarily storing debris already sorted for recycling, and disposal (e.g., metallic and hazardous wastes). Mulching or other means of mechanical reduction of green waste cannot be performed at this site. The access point for this site should be located at Sand Island Access Road off Nimitz Highway. This site will be required to cycle debris, as the available space is very limited.

Campbell Industrial Park Site (TMK 91015001) – This TDSR site has haul distances within the debris shed of up to 35 miles along H1. This site, along with the NAVMAG Property at West Loch Drive, the Former Feed Lot, and the Barbers Point Airfield Site, will be required to handle a portion of the 18.4 million cubic yards of debris in the event of a Category 4 hurricane. This debris will have to be sorted for recycling, landfilling, and processing. Mulching or other means of mechanical reduction of green waste can be performed at this site. In the event that the State of Hawaii authorizes burning, this TDSR site would be an ideal candidate for reduction by burning given the location of the site on the leeward side of the Island and the surrounding industrial/commercial land use. The access point for this site should be located at Kalaeloa Boulevard at Opakapaka. This site will be required to cycle debris (unprocessed debris accepted versus processed debris) in order to sort, store, and process the debris.

Campbell at Waipahu Site (TMKs 92001001, 91018001, 91017004, and 91018004) – This TDSR site has haul distances within the debris shed of up to 25 miles along H1. This site, along with Barbers Point Airfield, NAVMAG West Loch site, and the Former Feed Lot in

Campbell Industrial Park, will be required to handle a portion of the 18.4 million cubic yards of debris in the event of a Category 4 hurricane. This debris will have to be sorted for recycling, landfilling, and processing. Mulching or other means of mechanical reduction of green waste can be performed at this site. The access point for this site should be located at Iroquois Point Road off of Plantation Road. This site will be required to cycle debris (unprocessed debris accepted versus processed debris) in order to sort, store, and process the debris.

Dole Fields on Kamehameha Highway (TMKs 64003001 and 64003003) – This TDSR site has haul distances within the debris shed of up to 15 miles along Kamehameha Highway. This site, the only candidate TDSR site within Debris Shed II, will be required to handle the entire 1.7 million cubic yards of debris in the event of a Category 4 hurricane. This debris will have to be sorted for recycling, landfilling, and processing. Mulching or other means of mechanical reduction of green waste can be performed at this site. The access point for this site should be located off of Kamehameha Highway just west of the Helemano Military Reservation. North Road. This site will not be required to cycle debris in order to sort, store, and process the debris.

U. S. Army Training Gate Site (TMK 57001021) – This TDSR site has haul distances within the debris shed of up to 35 miles along Kamehameha Highway. A bulk of the debris (90%) is anticipated over 15 miles away from this candidate TDSR site. This site, due to its size will principally be used as an equipment staging area. This use is most practical as the northern portion of the Island may lose vehicular access especially in the event of a Category 4 hurricane. The access point for this site should be located at Charlie Road off of Kamehameha Highway. This site has ample room for sorting, storing, and processing debris without cycling debris (Category 4 storm only requires 155 acres in this debris shed, this site is 350 acres).