Hurricane Katrina Disaster Debris Management: Lessons Learned from State and Local Governments

BRIEFING REPORT

September 21, 2005

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1.0 INTRODUCTION

The thoughts and prayers of the members of the Solid Waste Association of North America (SWANA) are with those who have been impacted by Hurricane Katrina.

SWANA is a 40-year professional association with a membership of over 7,200 solid waste managers and practitioners in the United States and Canada. In the aftermath of Katrina, many of our members expressed a desire to share the experience and lessons learned by those who have previously had to deal with the management of disaster debris with the state and local government managers now charged with removal and cleanup of the solid wastes caused by the hurricane.

In this regard, an email was forwarded to SWANA on September 13, 2005 from the ***State of Louisiana Department of Environmental Quality*** requesting assistance.

> *"Louisiana is very interested in hearing from other state and local governments on their "lessons learned" from disaster debris handling."*
>
> *"Our need is urgent as we have little time to waste."*
>
> *"Specific subject areas included are:*
> - *School laboratories*
> - *Household hazardous materials*
> - *Automobile salvage (tires, lubricating fluids, mercury switches, lead acid batteries, contaminated gasoline/diesel)*
> - *Propane tanks*
> - *White goods (freon recovery and mercury thermostats)*
> - *Electronic wastes."*
>
> *"It looks like many communities in the New Orleans region will have to implement a building to building assessment and material removal before demolition. If anyone has experience with the issues surrounding abandoned vehicles and condemned buildings, please forward that too."*
>
> *"We are attempting to develop a debris removal strategy that will maximize diversion as much as possible, considering the circumstances. Concrete will be used as rip rap or ground up, tires will be chipped and ground, wood waste will be ground where there is a grinder, etc."*
>
> *"Any insight will be will be greatly appreciated."*

Following the receipt of this email, SWANA sent out a request to each of its eight technical divisions requesting information.[1]

The purpose of this report is to respond to the Louisiana DEQ's request by summarizing the responses received from SWANA members, as well as other referenced documents, regarding the management of disaster debris.

This document was compiled by the staff of SWANA's Applied Research Foundation.

2.0 RESOURCE MATERIALS

The following documents should serve as valuable resources to state and local solid waste managers charged with the responsibility for the management of disaster debris from Hurricane Katrina.

These resource materials can be easily accessed in the following ways:

- **Attachments** – Some resource documents have been included as attachments to this report.
- **Internet** – A number of the resource documents are available, free of charge, through the internet. In such cases, the internet address where the document can be retrieved is provided with the description of the document.
- **SWANA's E-Library** – Some of the resource documents can be accessed and/or downloaded from SWANA's E-Library. Since the E-Library is a "members-only" service of SWANA, solid waste managers involved in the Katrina cleanup who are not SWANA members can simply email Hugh Scott (hscott@swana.org) and request a temporary Identification Name and password to access the E-Library. (SWANA is delighted to be able to offer this service free-of-charge as a donation in response to the Katrina disaster.)

2.1 Planning For Disaster Debris (US EPA, 1995)

This 30-page document provides a framework for the development of a disaster response plan. The document includes general information on what to expect from different types of disasters (including hurricanes and floods), as well as recommended planning actions and brief case histories (including the 1993 Midwest Floods and the 3 major hurricanes).

[1] SWANA has eight Technical Divisions: Planning and Management; Waste-to-Energy; Waste Reduction, Recycling and Composting; Special Waste Management; Landfill Management; Communications, Education and Marketing; Landfill Gas; and Collection and Transfer. The request for information was e-mailed to the members of each of these Technical Divisions.

This document is available free of charge on the internet and can be accessed from the following web address: http://www.epa.gov/epaoswer/non-hw/muncpl/disaster/disaster.txt

2.2 Disaster Debris Management – Planning Tools (Reinhart and McCreanor, 1999)

This 33-page report, while focusing on the recycling of disaster debris, provides an excellent summary of the recent literature regarding disaster debris management. It includes case studies that address both hurricane and flood debris.

This document can be downloaded in PDF format, free of charge, from the following web address: http://people.cecs.ucf.edu/reinhart/DDfinalreport.pdf.

2.3 SWANA Executive Manager's Summit on Debris Management (SWANA Florida Chapter – 2005)

On January 12, 2005 a summit was held in Altamonte Springs, Florida at which Florida solid waste managers were invited to discuss management strategies and lessons learned during the clean-up efforts associated with the management of disaster debris from the four hurricanes which hit Florida in the summer 2004. The one-day summit was attended by about 40 persons.

The 74-page report documenting the summit contains 14 pages of report text and 60 pages of attachments, which include copies of contracts that were used by local governments to procure hauling, processing and disposal services for the disaster debris. The report documents numerous lessons learned by the state and local government managers who were responsible for managing the disaster debris.

This document can be downloaded from the SWANA E-Library. www.swana.org. (Please note: If you are not a SWANA member, please email Hugh Scott at SWANA (hscott@swana.org) to request a temporary ID and password to access the SWANA E-Library).

2.4 Disaster Debris Best Management Practices (State of Hawaii, 2005)

This 16-page draft document is an appendix to the draft ***Hawaii Disaster Debris Management Plan*** which was prepared in 2005. The appendix contains concise, one-page sheets recommending best management practices for the following waste types:

- Greenwaste
- Metals
- Mixed Debris
- Woody C&D Debris
- Asphalt Roofing

- Gypsum
- Plastics, including:
  - Plastic Sheeting
  - Plastic Water Jugs
- Aggregate and Rubble
- Household Furnishings and Belongings
- Hazardous Wastes:
  - Household Hazardous Wastes
  - Fugitive, Commercially-Generated Hazardous Debris
  - C&D Debris including Asbestos and Lead Paint
- Putrescible Wastes

This document was emailed to SWANA by Gerry Friesen of G. Friesen Associates, Inc. and is presented as ***Attachment 1*** to this report.

2.5 Katrina Response Waste Processing Priorities (Monterey Regional Waste Management District, 2005)

This 3-page memorandum was developed by the staff of the Monterey Regional Waste Management District (MRWMD) specifically for the solid waste managers responsible for managing the disaster debris from Hurricane Katrina. The MRWMD provides regional solid waste management services to communities on the Monterey Peninsula in California. These services include the management and operation of an 1,100 tons per day landfill.

The memorandum provides recommendations for staging and processing areas, equipment deployment, and the handling of specific waste streams, including C&D wastes, disaster-created MSW, household hazardous wastes, school laboratory materials, automobile wastes, propane tanks, white goods and electronic wastes.

This document was emailed to SWANA by the MRWMD and is presented as ***Attachment 2*** to this report.

3.0 LESSONS LEARNED

3.1 General

- The main priority is to focus on those recovery and collection activities that will be the quickest to implement, with the least amount of human exposure to any hazardous or toxic materials present in the waste stream. Following collection efforts, materials are to be recycled if feasible, or transported to an appropriate disposal facility. (Ref. 5).

- Typically, there will be two major phases to a debris management strategy. The first is the removal of debris which could cause an immediate threat to public safety (highly unstable structures, clearing of roadways, etc.). Generally, the opportunities for diversion and recycling during this phase will be limited. The second phase is long-term debris removal associated with recovery. This phase provides the greatest opportunity for diversion and recovery." (Ref. 2).

- Wastes vary significantly but generally consist of the following categories: concrete, asphalt, metals, green waste, plastic, sandbags, soil and rock, wallboard, glass, white goods, brown goods, bricks, household hazardous wastes, furniture and personal belongings such as clothing. (Ref 2).

- Conventional waste collection equipment will have limited use during initial stages of disaster debris clean-up. Target large areas with "collection zones" set –up for efficiency assigned to one contractor. Establish multiple zones within close geographic areas so contractors do not interfere with each other during collection. Utilize ***end-dump trucks and tracked excavators with grapples and/or wheeled bucket loaders*** to handle large scale debris clean-up. After a couple of passes, traditional collection assets such as ***roll-off containers and rear and front end loading packer trucks*** can swing into service for individual clean-ups. (Ref. 5).

- Develop multiple staging areas around hurricane-impacted areas with targets in mind for materials to be processed. Set up areas for concrete and asphalt crushing close to areas accessible for future construction areas, wood and tree grinding in areas that will need organic supplements or slope stability improvements, metal and vehicle processing as close to Port of New Orleans as possible since eventual markets will probably be off-shore or at least transported by ship. (Ref. 5).

- Set up industrial hazardous materials processing sites near commercial/industrial areas. Do not waste resources on retrieving small quantities of household hazardous waste (HHW). Target those larger quantity generators for special handling and allow small quantities of

HHW commingled with other debris to move to regular MSW landfills with composite liners. (Ref 5).

- Conventional waste collection equipment will have limited use during initial stages of disaster debris clean-up. Target large areas with "collection zones" set –up for efficiency assigned to one contractor. Establish multiple zones within close geographic areas so contractors do not interfere with each other during collection. Utilize ***end-dump trucks and tracked excavators with grapples and/or wheeled bucket loaders*** to handle large scale debris clean-up. After a couple of passes, traditional collection assets such as ***roll-off containers and rear and front end loading packer trucks*** can swing into service for individual clean-ups. (Ref. 5).

- Handle all soft goods such as bedding, mattresses, curtains, carpet, clothes as soon as possible. No salvageable material will be collected from these items. These items will be extremely heavy and hard to handle and will need to be mechanically loaded by ***bucket loaders and/or excavators with grapples***. (Ref. 5).

- In Kauai, HA, residents were asked to place residential debris into five piles at the curb: green waste; metals and appliances; wood debris; aggregate materials (including toilets, tile roofing and concrete) and mixed debris. (Ref. 1).

3.2 Management of Specific Wastes

3.2.1 School Laboratory Materials

- School laboratory materials in small quantities (less than 220 pounds per school) can be commingled with other debris and handled by conventional waste collection methods and disposed of in municipal solid waste (MSW) landfills. (Ref. 5.)

3.2.2 Household Hazardous Materials

- Household hazardous materials can be commingled with other debris and handled by conventional waste collection methods and disposed of in municipal solid waste (MSW) landfills. (Ref. 5.)

3.2.3 Automobile-Related Materials (Tires, Lubricating Fluids, Mercury Switches, Lead-Acid Batteries, Contaminated Gasoline/Diesel Fuel)

- Whole car and truck bodies can be handled through establishment of additional processing areas as identified above. Any household or consumer auto type wastes can be handled safely enough through regular conventional waste collection. (Ref. 5).

3.2.4 Propane Tanks

- Need to be segregated and removed to a processing facility where they are emptied and recycled. Best handled with white goods on a house-by-house basis. (Ref. 5).

3.2.5 White Goods (Freon Recovery and Mercury Thermostats)

- Need to be segregated and removed from homes individually – a very labor intensive process. These products will need to be placed curbside and handled with the combination of mechanical loaders and roll-off and/or end-dump trucks.. Quantities will probably exceed the local capacity to process scrap metal. Additional outside processing capacity will likely be needed. (Ref. 5).

3.2.6 Electronic Products

- Computers, TV's, monitors, and other electronic devices pose no real hazard to landfills. Limited resources available to Katrina Recovery should target other materials that are more harmful to the environment, or are easily recyclable. Most e-waste can be easily handled within conventional waste collection and disposal methods. (Ref. 5).

3.2.7 Gypsum Wallboard

- Gypsum wallboard (commonly referred to as "drywall") has two components: a heavy paper backing and a 3/8 inch layer of gypsum. These materials must be separated and recycled separately, an extremely difficult task if the material is wet. (Ref. 2).

- The landfilling of gypsum wallboard can lead to the production of hydrogen sulfide in MSW landfills. Therefore, one respondent suggested that wallboard be kept out of landfill to the maximum extent possible to avoid sulfide production.[2]

[2] Email to Jeremy O'Brien of SWANA from Dr. Morton Barlaz of North Carolina State University, 9/14/05.

- Some have expressed concern about the potential for hydrogen sulfide to be generated within piles of wet drywall that have been constructed and are awaiting transport to a disposal facility. However, in the opinion of at least one expert, there is no need for debris workers to worry about the H2S production from wallboard debris during the debris removal phase[3].

3.3 Other Lessons Learned

3.3.1 Suspension of Regulations

- After a flood, the State of Missouri temporarily set aside its recycling policy so that communities could landfill leaves and yard wastes. (Ref. 1).

- State solid waste agencies could temporarily lift permit requirements for solid waste facilities. (Ref. 1).

3.3.2 Use of Air-Curtain Incinerators

- In Miami, FL, the use of air-curtain incinerators that met all federal and state requirements led to many complaints from the public and environmental activists. As a result, county commissioners shut down all debris burn operations. (Ref. 1).

3.3.3 Miscellaneous

- Asphalt roofing can be separated at Temporary Debris Staging Sites for recycling. (Ref. 4).

4.0 REFERENCES

The following references were used to compile this report.

1. U.S. Environmental Protection Agency. ***Planning For Disaster Debris***. 1995.
2. Reinhard, D. and P. McCreanor. ***Disaster Debris Management – Planning Tools.*** U.S. EPA Region IV. September 24, 1999.
3. ***SWANA Executive Manager's Summit on Debris Management***. January 12, 2005.
4. ***Annex VI- Disaster Debris Best Management Practices: Mangement Techniques For Debris Types***. (Appendix in draft 2005 Hawaii Disaster Debris Management Plan).

[3] Email to Jeremy O'Brien of SWANA from Dr. Jenna Jambeck of the University of New Hampshire, 9/21/05. On this issue, Dr. Jambeck reports that "In many states drywall has been kept separate for collection and transport and I have not heard of any H2S problems. I have also visited piles of drywall waiting for recycling and they have not had any odor. The only thing different is that disaster debris drywall may be soaked (the drywall I have seen may have been exposed to rain, but not soaked in flood waters when piled up). There may be a little sulfate-reducing biological activity in pockets if the pile was dense enough, but I don't think it would be a big issue. Because this situation has never really happened before, I think it would be safe to say that, due to the strict anaerobic nature of sulfate reducing bacteria, piles of drywall open to the atmosphere are not likely to develop the necessary environment to generate large quantities of hydrogen sulfide."

5. Monterey Regional Waste Management District. ***Katrina Response To Waste Processing Priorities (Draft Memorandum).*** September 15, 2005.
6. Swan. R. ***Planning For The Temporary Disposal of Disaster Debris: "Where Are You Going To Put It".*** SWANA Winter Technical Symposium, West Palm Beach, FL, Feb. 7-12, 2005.

If you have any questions regarding the contents of this report or would like additional information, please feel free to contact: Jeremy K. O'Brien, P.E., Director of Applied Research, SWANA at 704-906-7269 or jobrien1@swana.org.

Attachment 1

Hawaii Disaster Debris Management Plan – Final Draft (2005): Annex VI – Best Management Practices

ANNEX VI

DISASTER DEBRIS BEST MANAGEMENT PRACTICES

MANAGEMENT TECHNIQUES FOR DEBRIS TYPES

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DISASTER DEBRIS BEST MANAGEMENT PRACTICES

1 — INTRODUCTION

This Annex includes Best Management Practices (BMPs) for specific material types of disaster debris. Annex VII presents protocols for management activities – collection, storage at TDSR sites, processing – for practical groupings of these material types. The protocols are based on these BMPs and they define how groupings of specific types of materials should be mixed and/or kept separate.

The pages that accompany this Annex address individual debris types. Tables that evaluate a range of alternative management techniques are provided when reasonable alternatives exist. Each page presents a recommended BMP for each type of debris.

These BMPs and the protocols in Annex VII are guidelines provided by the State. In pre-disaster planning the County should consider these guidelines and decide how to handle debris based on the conditions, needs, and policies of the County.

2 — DEBRIS TYPES

The following material types are those most commonly generated in a disaster event. They are derived from analysis of the clean up after Hurricane Iniki and from disasters in other localities. The actual types of debris that are generated in different types of disasters vary greatly.

Some of these materials are selected because of their potential for diversion, or the need for proper handling. The potential for diversion from landfill, however, must be carefully evaluated in consideration of the conditions following a disaster. Since a disaster can rapidly consume years' worth of landfill volume, diversion may be a high priority. However, human health and safety, and community recovery will take precedence under certain circumstances. Only practical diversion activities are recommended, and the counties must evaluate the recommended BMPs in light of actual events and local conditions.

The following materials are addressed in the BMP pages that follow:

1. Greenwaste
2. Metals
3. Mixed Debris
4. Woody C&D Debris
5. Asphalt Roofing

6. Gypsum
7. Plastics, including:
    a. Plastic Sheeting
    b. Plastic Water Jugs
8. Aggregate and Rubble
9. Household Furnishings and Belongings
10. Hazardous Wastes
    a. Household Hazardous Wastes
    b. Fugitive, Commercially-Generated Hazardous Debris
    c. C&D Debris including Asbestos and Lead Paint
11. Putrescible Wastes

3 — MANAGEMENT TECHNIQUES FOR DEBRIS TYPES

The recommended best management technique(s) is (are) printed in bold type in the tables that follow. Several techniques may be designated as feasible in the second column. More than one technique may be recommended for implementation if event conditions, such as storm size, could affect the selection of a technique, or if they could occur in parallel.

Each cell in columns three through nine includes a designation of “High”, “Moderate” or “Low”. These are based on professional judgement. “High” is in all cases intended to be good or best, so that the table can be quickly scanned to compare techniques. Thus the column that deals with cost is defined as “Cost Feasibility”. This way a “High” in the “Cost Feasibility” column is preferred. (Just like a “High” in “Debris Reduction Efficiency” is preferred.) That is, it means that the cost is low.

Note that all management techniques must comply with applicable laws and regulations. For example landfilling should only include disposal in a permitted MSW or C&D landfill.

GREENWASTE

Definition: Tree limbs, stumps, and leaves; brush, grass and incidental soil

RECOMMENDED BMP:

Objective: Efficient and cost effective recovery and diversion-from-landfill.

Response Phase: Source separate greenwaste during response, with possible exception of first 24 hours if public health and safety is endangered by limited access from roadways. Remove greenwaste from roadways and separate it prior to collection to facilitate diversion.

Recovery Phase: Source separate greenwaste as early as possible in collection process. Remove greenwaste from roadways and separate it prior to collection to facilitate diversion. Citizens should separate for collection at the curbside. If mobile chippers are available, greenwaste may be chipped at the time of collection. Process greenwaste upon arrival at TDSR site for use as compost or fuel for a biomass boiler, depending on cost effectiveness of composting and the availability of markets and practical end-uses. "Compost" is used in this Plan to include mulch, which is not a fully matured product and is used for ground cover and erosion control. I n the event that disaster is severe with major downage of vegetation, greenwaste may be air curtain incinerated at TDSR, at county's option.

Management Techniques	Feasible Option?	Cost Feasibility	Capital Cost Feasibility	Debris Reduction Efficiency	Environmental Friendliness	Human Health and Safety	Current Availability of Resources/Markets	Public Acceptability
Source Separation for Composting or Incineration in Biomass Boiler	Yes	**High** Small additional labor cost	**High** Use existing equipment	**High** Best efficiency	**High**	**High**	**High** Existing composting market may be limited, and could be negatively damaged by production of too much product; Incineration is a back-up market	**High**
Air Curtain Incin-eration at TDSR Site	Yes	High **Cheapest method of reduction**	High **Low cost**	**High**	**Low** Particulate emissions	**Moderate**	Moderate **Needs to be imported from mainland**	Low
Processing from Mixed Materials for Composting or Incineration	No	**Low** Large additional labor cost	High **Small capital cost**	Low	High	**Moderate** Health and safety risks involved	**High** Existing market that is supply limited	High **Acceptable in emergency**
Landfilling with No Reduction/Processing	**Yes**	**Moderate** Lost opportunity cost	**High**	Low	Low	High	**Moderate** Landfill capacity varies by island	**Low** Potentially controversial

NOTE: Recommended Management Technique(s) is (are) bolded; "High" in cell is good.

METALS

Definition: Primarily ferrous metals including metal roofing, white goods, junk autos, and miscellaneous ferrous scrap. Also includes nonferrous metals such as copper wire.

RECOMMENDED BMP:

Objective: To divert as much as possible from landfill through recycling.

Response Phase: Segregate major items such as junk autos and appliances on TDSR sites.

Recovery Phase: Source separate all recyclable metals for separate collection from curb. Recover large metal items such as metal roofing, and appliances through processing of mixed debris. Store metals separately on TDSR. Process ferrous and nonferrous metals for recycling.

Management Techniques	Feasible Option?	Cost Feasibility	Capital Cost Feasibility	Debris Reduction Efficiency	Environmental Friendliness	Human Health and Safety	Current Availability of Resources/Markets	Public Acceptability
Source Separate for Recycling	Yes	High Scrap value can pay costs of separation and processing	Moderate Requires shredding & densification	High	High	Moderate Requires worker health & safety (H&S) planning	High	High
Post Collection Separation at TDRS for recycling	Yes	Moderate Higher processing costs than source separated	Moderate	High	High	Moderate Requires worker H&S planning	High	High
Landfilling with No Reduction/Processing	Yes	Moderate Market revenue lost	High	NA	Low	High	High	Low
NOTE: Recommended Management Technique(s) is (are) bolded; “High” in cell is good.								

MIXED DEBRIS

Definition: Mixed debris consists of materials from all the other disaster debris categories. Does not include MSW or putrescibles, but may include many of the same materials, such as C&D debris, household items, mixed plastics, that are generated as debris during a disaster event.

RECOMMENDED BMP:

Objective: Divert as much as possible from this category. Reduce the volume of debris landfilled.

Response Phase: Where it is impractical to avoid creating mixed waste, strive to keep any material that could be separated into other components free of contaminants (e.g. putrescibles). Deliver directly to landfill for removal efficiency, or to TDSR sites for reduction.

Recovery Phase: Deliver material directly to landfill for removal efficiency, or to TDSR sites for recovery and/or volume reduction. Process for segregation of recyclable materials (conveyor with sorting), screen off fines, and grind for volume reduction. If air curtain incineration is feasible, process material to remove non-combustibles and incinerate.

Management Techniques	Feasible Option?	Cost Feasibility	Capital Cost Feasibility	Debris Reduction Efficiency	Environmental Friendliness	Human Health and Safety	Current Availability of Resources/Markets	Public Acceptability
Processing for Recycling	Yes	Moderate	High	Moderate	High	Mod	Moderate For aggregate, OCC, metals, greenwaste	High
Processing for RDF	Yes - Oahu No elsewhere	Moderate	Moderate	High	Moderate Requires pollution control	Moderate	High at H-POWER (if capacity exists) Low elsewhere	Moderate
Source Separation for Recycling	Yes	Moderate	Moderate	Low	High	High	High Depends on type and condition of products	High
Air Curtain Incineration at TDSR Site	No	High Cheapest method of reduction	High	High	Low Numerous problem emissions, Unlikely to be permitted.	Low	Moderate Needs to be imported from mainland	Low
Incineration Using Biomass Combustor	No				Low Not permitted			
Landfilling with No Reduction/Processing	Yes	Moderate	High	Low	Moderate	High	Moderate Will consume landfill capacity	Mod

NOTE: Recommended Management Technique(s) is (are) bolded; "High" in cell is good.

WOODY C&D DEBRIS

Definition: Principally treated dimensional lumber and engineered wood products, frequently mixed with non-wood materials. Treated wood is mostly comprised of chromated-copper-arsenate (CCA) treated products, with some pentachlorophenol, creosote, etc.

RECOMMENDED BMP:

Objective: Minimize landfill space utilization. Treated wood is non-recyclable in most applications.

Response Phase: Post collection separation at TDSR for incineration.

Recovery Phase: Source separation for reuse and incineration. Post collection separation at TDSR for incineration. Salvage by positive sorting intact dimensional lumber. Production of fuel. Air regulations continue to tighten – even under emergency permits, regulators can be expected to closely examine emissions data. Old sugar mills have permits with broader allowable emissions than new mills if equipment not modified and may qualify for temporary burn permits. H-POWER can burn treated wood, but capacity is limited.

Management Techniques	Feasible Option?	Cost Feasibility	Capital Cost Feasibility	Debris Reduction Efficiency	Environmental Friendliness	Human Health and Safety	Current Availability of Resources/Markets	Public Acceptability
Source Separation for Recycling & Incineration at Controlled Facility	Yes	Moderate Depends on structure type and percentage treated wood	High Low if new pollution control required	High	Moderate Emissions from treated wood. Must meet DOH air standards.	Moderate Airborne toxics	Moderate Biomass burners need permit modifications High at H-POWER (if capacity exists)	Moderate
Post Collection Separation at TDSR Site for Incineration at Controlled Facility	Yes	Moderate Involves labor and high-wear mechanics	Moderate heavy-duty sorting equip	High	Moderate Emissions from treated wood	Moderate Airborne toxics	Moderate Biomass burners need permit modifications High at H-POWER (if capacity exists)	Moderate
Mixed Wood Debris Air Curtain Incineration at TDSR Site	No	High	Moderate	High	Moderate Smoke and Particulates	Low Airborne toxics, not legal	Moderate Needs to be imported from Mainland	Low
Re-Use / Salvage of Materials	Yes	High Positive Sort	High	Moderate Limited volume	High	High	Moderate In conjunction with Re-Use store operations	High
Shredding at TDSR Site and Landfill Disposal	Yes	Moderate	Moderate	Moderate	High	High	Moderate Heavy grinders	High
Landfill, No Reduction	Yes	High	High	Low	Moderate	High	NA	Moderate

NOTE: Recommended Management Technique(s) is (are) bolded; "High" in cell is good.

ASPHALT ROOFING

Definition: Roofing waste consisting of residential asphalt roofing (3-tab shingle type), commercial asphalt roofing and various non-asphalt roofing products in small percentages. Asphalt roofing is assumed to include all residential roofing debris and only commercial asphalt roofing that is free of asbestos hazard. Asphalt roofing consists of fiberglass or plant fiber mat, asphalt and inert granular materials.

RECOMMENDED BMP:

Objective: Minimize landfill space utilization.

Response Phase: Post collection separation at TDSR for recycling.

Recovery Phase: Source separation for recycling. Post collection separation at TDSR for recycling.

Management Techniques	Feasible Option?	Cost Feasibility	Capital Cost Feasibility	Debris Reduction Efficiency	Environmental Friendliness	Human Health and Safety	Current Availability of Resources/Markets	Public Acceptability
Source Separation for Recycling	Yes	High Fairly easy to isolate	High	High	High	High Asbestos certified inspectors required	Moderate Combine with aggregates for road base or paving mix	Moderate
Post Collection Separation at TDSR Site for Recycling	Yes	Moderate Involves labor and high-wear mechanics	Moderate heavy-duty sorting equip	High	High	High Asbestos certified inspectors required	Low Combine with aggregates for road base or paving mix	Moderate
Mixed Asphalt Debris Air Curtain Incineration at TDSR Site	No	High	Moderate	High	Low Smoke and Particulates	Moderate	Moderate Needs to be imported from Mainland	Moderate
Landfilling with No Reduction/Processing	Yes	High	High	Low	Moderate	High	NA	Moderate

NOTE: Recommended Management Technique(s) is (are) bolded; "High" in cell is good.

GYPSUM

Definition: Old material is frequently limited to small broken pieces and large pieces that are still fastened to framed structures, and typically painted or otherwise laminated with surface treatments. Clean gypsum scrap free of contaminants is generated from reconstruction.

RECOMMENDED BMP:

Objective: Minimize landfill space utilization by recycling clean scrap from reconstruction.

Response Phase: Deliver to landfill with no reduction/processing, or store for surge capacity at TDSR.

Recovery Phase: Source separate clean gypsum scrap, including only new material from reconstruction, for recycling with green waste. Landfill old scrap with no reduction/processing.

Management Techniques	Feasible Option?	Cost Feasibility	Capital Cost Feasibility	Debris Reduction Efficiency	Environmental Friendliness	Human Health and Safety	Current Availability of Resources/Markets	Public Acceptability
Source Separation for Recycling with green waste	Yes (clean scrap only)	Moderate Hand sorted	High	High	High	High	Moderate Can be combined with green waste composting	High
Landfilling with No Reduction/Processing	Yes	High	High	Low	Moderate	High	NA	Moderate
Post Collection Separation of old scrap at TDSR Site for Recycling	No	Low Pieces too small	NA	High	Moderate	Moderate	Low No uses for painted & contaminated scrap	High
Mixed Debris Air Curtain Incineration at TDSR Site	No	Low	Moderate	Low Calcium carbonate does not burn well	High	High	Moderate Needs to be imported from mainland	Low

NOTE: Recommended Management Technique(s) is (are) bolded; "High" in cell is good.

PLASTIC SHEETING

Definition: Mixed grades of plastic sheeting used to cover roofs following storm event. Most is supplied by FEMA or USACE. Possibly includes several resin types. When disposed can be dirty and degraded by UV exposure.

RECOMMENDED BMP:

Objective: To reduce landfill space utilization if possible, and to recover energy.

Response Phase: Not applicable.

Recovery Phase: If event is large and number of households using sheeting is large, material may be stored at TDSR mixed with combustible debris or separated in covered drop boxes and incinerated in a boiler with adequate pollution controls, such as H-POWER. Resident drop-off at TDSR is possible. Otherwise material should be landfilled.

Management Techniques	Feasible Option?	Cost Feasibility	Capital Cost Feasibility	Debris Reduction Efficiency	Environmental Friendliness	Human Health and Safety	Current Availability of Resources/Markets	Public Acceptability
Post Collection Storage at TDSR Site for Possible Incineration at H-POWER (if capacity exists)	Yes	Moderate When volumes are great. Labor intensive	High	Moderate Could exceed 300 tons on Oahu	High Includes pollution control	High	High Feasible to incinerate, possibly at H-POWER (if capacity exists)	High
Landfilling with No Reduction/Processing	Yes	High	High	Low	Moderate	High	NA	?
Source Separation for Recycling	No	Low Costs of collection & processing not covered by market value	Moderate Must dedicate collection equipment	Moderate Quantities not great, except in large event.	High	High	Moderate Markets exist, but prices paid are modest.	High
Mixed with Debris for Incineration in Biomass Boiler	?	High	High	Moderate	Low Possible PVC presence requires pollution control.	Low	High	High

NOTE: Recommended Management Technique(s) is (are) bolded; "High" in cell is good.

PLASTIC WATER JUGS

Definition: Polyethylene water jugs. Most water supplied in liter bottles, resin unknown. Excludes large, 5-gallon, blue-tinted water jugs, which cannot be recycled together with polyethylene plastics.

RECOMMENDED BMP:

Objective: Recycle where feasible locally.

Response Phase: Include in mixed debris for landfilling.

Recovery Phase: If event is large and amount of supplied water is large, jugs may be source separated and dropped-off at TDSR site, stored in covered drop boxes. No separate collection. Material can be recycled presently on Maui, but also request bids from mainland markets and plastics brokers. If bids are not cost-effective, incinerate at H-POWER or landfill.

Management Techniques	Feasible Option?	Cost Feasibility	Capital Cost Feasibility	Debris Reduction Efficiency	Environmental Friendliness	Human Health and Safety	Current Availability of Resources/Markets	Public Acceptability
Source Separation for Recycling	Yes	Moderate Easily source separated & dropped off by users.	High	Moderate H. Andrew reported 17 tons of water jugs recycled.	High	High	High Processor on Maui can accept large quantities.	High
Mixed with Debris for Incineration in Biomass Boiler	?	High	High	High	Moderate	Moderate Some unacceptable resins may be mixed in	High	?
Source Separation for Incineration in Biomass Boiler or H-POWER (if capacity exists)	Yes	Moderate Easily source separated & dropped off by users.	High	Moderate	Moderate	High	High	?
Post Collection Separation at TDSR Site for Possible Incineration at H-POWER	No	Low Difficult to separate once mixed s	High	Low Capture rate would be low.	High	High	High	High
Landfilling with No Reduction/Processing	Yes	High	High	Low	Moderate	High	NA	?

NOTE: Recommended Management Technique(s) is (are) bolded; "High" in cell is good.

AGGREGATE

Definition: Mixed aggregates including rubble, masonry, paving material, and concrete components typically include steel-reinforcement. Paving materials include asphalt, often mixed with some dirt and rock. Masonry materials include bricks, concrete masonry units (CMUs), and various roofing tiles.

RECOMMENDED BMP:

Objective: To reduce transportation costs, utilize processed material in reconstruction activity, and minimize landfill space utilization.

Response Phase: Source separate for direct transportation to pre-designated quarry sites for processing. Resident drop-off (non-commercial loads) at TDSR. Some storage of commercial loads at TDSR may be necessary during response phase.

Recovery Phase: Source separate for direct transportation to pre-designated quarry sites for processing. TDSRs could be designated to receive contractor and commercial loads at county's option and processed with a mauler for use as aggregate. Resident drop-off (non-commercial loads) at TDSR. Salvage network for certain brick masonry products should be established.

Management Techniques	Feasible Option?	Cost Feasibility	Capital Cost Feasibility	Debris Reduction Efficiency	Environmental Friendliness	Human Health and Safety	Current Availability of Resources/Markets	Public Acceptability
Source Separation for Recycling	Yes	High Can best minimize costs by diverting	Moderate to High Must add process equipment	Moderate No major reduction in volume possible	High	High	High Several quarries already have basic processing equip, and market channels for crushed aggregate products	High
Post Collection Separation at TDSR Site for Recycling	Yes	Moderate Involves labor and high-wear mechanics	Moderate heavy-duty sorting equip	Moderate	High	High	Low Requires a complete C&D sorting line with picking and trommels	High
Re-Use / Salvage of Materials	Yes	High Positive Sort	High	Moderate	High	Low	High - possible direct sales from TDSR sites	High
Landfilling with No Reduction/Processing	Yes	Moderate High collection cost	High	NA	Moderate	High	NA	?

NOTE: Recommended Management Technique(s) is (are) bolded; "High" in cell is good.

HOUSEHOLD FURNISHINGS AND BELONGINGS

Definition: Furniture, mattresses, carpets, textiles etc.

RECOMMENDED BMP:

Objective: Couches, mattresses, carpets, textiles etc. disposed of after a disaster event are not recyclable due to bulk and contamination. The primary processing objective for these types of materials is to reduce their volume prior to loading onto trucks headed to the landfill and to minimize the volume of landfill space that they occupy.

Response Phase: Couches, mattresses, carpets, textiles etc. to be delivered to the TDSR sites and stockpiled separately.

Recovery Phase: Couches, mattresses, carpets, textiles etc. will continue to be delivered to the TDSR sites as buildings are demolished/rehabilitated and household furnishings are replaced. Bulky materials should be reduced in volume at the TDSR sites prior to hauling and disposal at the landfill.

Management Techniques	Feasible Option?	Cost Feasibility	Capital Cost Feasibility	Debris Reduction Efficiency	Environmental Friendliness	Human Health and Safety	Current Availability of Resources/Markets	Public Acceptability
Separation, Crushing at TDSR Site & Landfill Disposal	Yes	High	High	Moderate	High	High	High Tracked dozers or track hoes used for crushing	High
Source Separation for Recycling	No						Low Technology/Markets not currently available	
Air Curtain Incineration at TDSR Site	Yes	High if used for other materials	Moderate	High	Moderate Smoke and Particulates	Moderate Airborne Toxics	Moderate Needs to be imported from mainland	Low
Incineration Using On-Island Biomass Boiler	No	Low Material Processing Costs are High	Low	High	Low Smoke and Particulates	Moderate Airborne Toxics	High Biomass Boilers with permits and air pollution control equipment	Moderate
Shredding at TDSR Site and Landfill Disposal	Yes	Moderate	Moderate	Moderate	High	High	Moderate Heavy duty grinders required	High
Landfilling with No Reduction/Processing	Yes	Moderate	High	Low	High	High	High Will utilize valuable landfill disposal capacity	Moderate

NOTE: R ecommended Management Technique(s) is (are) bolded; "High" in cell is good.

HOUSEHOLD HAZARDOUS WASTE

Definition: Household hazardous waste (HHW) includes products commonly used in the home that display one or more of the following characteristics; ignitability, corrosivity, reactivity or toxicity. Examples include batteries, motor oil, automobile products, paint and paint-related products, household cleaners and drain openers, swimming pool chemicals, pesticides, and herbicides.

RECOMMENDED BMP:

Objective: Reduce the potential for these materials to threaten human health and safety, or the environment.

Response Phase: Where practical, segregate HHW from other debris. Inspect HHW product containers to confirm their integrity. If necessary, place damaged containers in plastic buckets, tubs, or garden bags.

Recovery Phase: Direct residents to bring HHW to collection events and not to set it out at curb. Minimize HHW coming to TDSR sites. Locate temporary storage units and supplies at TDSR sites for HHW that is received. Sort it from incoming debris when identified and temporarily store HHW until contractor can process material. Only properly trained individuals should perform final characterization, packaging, and disposal.

Management Techniques	Feasible Option?	Cost Feasibility	Capital Cost Feasibility	Debris Reduction Efficiency	Environmental Friendliness	Human Health and Safety	Current Availability of Resources/Markets	Public Acceptability
Separate from Debris & Store HHW at TDSR to be Processed by Qualified Contractor for Disposal and/or Reuse of Certain Items	Yes	Moderate Cost similar to conventional management practice	High Low capital cost for materials	Low HHW is small part of waste stream	High	Moderate Some risk involved, but high if properly managed	High Contractors available; disposal on mainland	High
HHW Neighborhood Collection Events	Yes	Mod. to Low Events are expensive but common.	Moderate Contractor will supply equipment	Low	High	Moderate Some risk involved, but high if properly managed	High Contractors available	High
Inspection of Structures for Hazardous Materials prior to Demolition	Yes	Moderate Need experienced contractor	Moderate Contractor will supply equipment	Low	High	Moderate Some risk involved, but high if properly managed	High Contractors available	High
Landfilling with No Segregation or Processing	No	High	High	NA	Low Identified HHW not in MSW landfill	Low HHW is a threat to human health and safety	NA	Low

NOTE: Recommended Management Technique(s) is (are) bolded; "High" in cell is good.

FUGITIVE, COMMERCIALLY-GENERATED HAZARDOUS DEBRIS

Definition: Fugitive, commercially-generated hazardous waste includes materials and items that display one or more of the following characteristics – ignitability, corrosivity, reactivity or toxicity – and that have escaped from commercial properties with no identifiable source. For example, fugitive drums that have been washed onto public properties. Only items for which no source is identifiable are included in this category. If a source is identifiable, that source shall be immediately notified and held responsible. This category also includes any downed electrical transformers that have not been properly tested for presence of PCBs.

RECOMMENDED BMP:

Objective: Reduce the potential for these materials to threaten human health and safety, or the environment.

Response Phase: Identify any materials or items potentially meeting hazardous waste characteristics. Observe for potential release of contents from the maximum distance feasible. If a release is in progress or imminent, call EOC and request immediate assistance from a hazardous materials team. If containers are not in immediate danger of rupture or release record the location and report to EOC or hazardous materials teams. Clearly mark the area surrounding the materials with temporary fencing or barrier tape and post warning signs to prevent public contact.

Recovery Phase: Identify source or generator of hazardous materials from labels or location of materials. Notify owner or generator of hazardous materials if possible, or hazardous waste contractor if no generator can be identified. Only properly trained individuals should handle or dispose of these materials. The details of handling and disposal of hazardous materials shall be the responsibility of the owner or generator. Hazardous materials will not be accepted at the TDSR sites. For electrical transformers, notify electric utility. If a transformer appears to be leaking and does not have a sticker declaring that it is PCB-Free, immediately notify the EOC and the electric utility, then restrict access to the area using temporary fencing or barrier tape.

C&D DEBRIS INCLUDING ASBESTOS-CONTAINING MATERIALS AND LEAD PAINT

Definition: Damaged or demolished buildings, or other debris may contain asbestos that is friable and lead pant. Asbestos may be included in older products such as insulation, tiles, roofing, or other building materials.

RECOMMENDED BMP:

Objective: Reduce the potential for these materials to threaten human health and safety or the environment.

Response Phase: Generally not practical to accurately identify these materials during response phase. If debris is suspected to include asbestos that is friable it should be subject to the minimum amount of handling required to clear easements and protect public health. If it is absolutely necessary to move or collect C&D debris during the response phase, this work should be performed by a contractor licensed to handle asbestos containing materials.

Recovery Phase: Where practical, identify and segregate debris that may contain asbestos from other debris for testing by hazardous waste contractor. When buildings are identified to be demolished, potential asbestos should be identified by a licensed contractor and removed prior to demolition of the structure,. No materials suspected to contain asbestos should be processed at the TDSR by grinding or incineration. Only properly trained individuals should perform final characterization and disposal. Lead based paint chips may be disposed in the general waste stream so long as they are not segregated from C&D debris.

PUTRESCIBLE WASTES

Definition: Matter that rots or decays rapidly. Items may include fruits, vegetables, meats etc. from grocery stores restaurants and residents.

A putrescible surge occurs after a disaster when residents and businesses throw away food and other putrescible material stored in freezers and refrigerators because electrical power was interrupted for an extended period of time. After electrical power has been restored, residents and businesses will continue to throw away putrescibles that will be collected on normal refuse collection routes or at the counties' transfer stations.

RECOMMENDED BMP:

Objective: Prevent contamination of other debris with putrescible wastes. Dispose of putrescibles as quickly as possible to reduce odor problems and potential environmental contamination.

Response and Recovery Phases: Putrescibles should be disposed of at municipal solid waste (MSW) landfills that are available on each island. Putrescibles should only be accepted at the temporary debris storage and reduction sites if the MSW landfills are inaccessible. If this occurs, putrescibles should be temporarily buried and than removed and disposed of at the MSW landfill after access has been restored.

Putrescibles should be collected when rubbish service resumes. If rubbish service is not quickly resumed, drop boxes for putrescibles and other household rubbish should be stationed in neighborhoods and their availability promoted to residents.

FUTURE OPTION:

Composting Potential: Composting of putrescibles from the MSW waste stream is not currently practiced on a significant scale within any of the counties. If organics composting programs are developed, selected putrescibles from grocery stores or restaurants could be diverted to the composting operation. Alternatively, where a rendering plant exists, rendering of unusable foodstuffs may be a significant method for diversion of putrescibles.

Attachment 2

Monterey Regional Waste Management District – Katrina Response Waste Processing Priorities

DRAFT

KATRINA RESPONSE WASTE PROCESSING PRIORITIES

Submitted By Monterey Regional Waste Management District

September 15, 2005

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Overview

The main priority is to focus on those recovery and collection activities that will be the quickest to implement, with the least amount of human exposure to any hazardous or toxic materials present in the waste stream. Following collection efforts, materials are to be recycled if feasible, or transported to an appropriate disposal facility.

Processing

- Develop multiple staging areas around hurricane-impacted areas with targets in mind for materials to be processed. Set up areas for concrete and asphalt crushing close to areas accessible for future construction areas, wood and tree grinding in areas that will need organic supplements or slope stability improvements, metal and vehicle processing as close to Port of New Orleans as possible since eventual markets will probably be off-shore or at least transported by ship.
- Set up industrial hazardous materials processing sites near commercial/industrial areas. Do not waste resources on retrieving small quantities of household hazardous waste (HHW). Target those larger quantity generators for special handling and allow small quantities of HHW commingled with other debris to move to regular MSW landfills with composite liners.

Equipment

- ***Tow trucks*** will be required to removing cars and trucks left behind. Local neighborhood staging areas should be established to give insurance companies the ability to capture multiple cars in one location before being shipped out for scrap. Towing companies should be assigned to handle certain areas to allow for streets to be cleared in order for the next stage of debris collection and street cleaning to occur.
- Conventional waste collection equipment will have limited use during initial stages of disaster debris clean-up. Target large areas with "collection zones" set –up for efficiency assigned to one contractor. Establish multiple zones within close geographic areas so contractors do not interfere with each other during collection. Utilize ***end-dump trucks and tracked excavators with grapples and/or wheeled bucket loaders*** to handle large scale debris clean-up. After a couple of passes, traditional collection assets such as ***roll-off containers and rear and front end loading packer trucks*** can swing into service for individual clean-ups.
- Handle all soft goods such as bedding, mattresses, curtains, carpet, clothes as soon as possible. No salvageable material will be collected from these items. These items will be extremely heavy

and hard to handle and will need to be mechanically loaded by ***bucket loaders and/or excavators with grapples***.

- ***Street sweepers and vacuum trucks*** will need to follow initial collection of bulky debris by end-dumps and wheeled loaders. ***Pressure washing*** streets after initial passes by this equipment will help next collection phase.

Waste Designation

- **C & D waste** – Establish multiple areas for processing as close to areas for eventual rebuild as possible with greatest amount of storage space available to allow for time delay between take down and rebuild. Concentrate on concrete, asphalt, large size organic debris such as stumps and trees and large dimensional lumber (non-contaminated). Whole trees that can be easily segregated should be processed through grinding equipment.
- **Disaster-created MSW** (food waste, wet carpeting, etc.) - Target for conventional waste collection ASAP.
- **HHW** – Small quantities of HHW commingled with other debris can be handled by conventional waste collection methods and disposed in regular composite-lined MSW landfills.
- **School Laboratory Materials** – Same methodology as above, unless quantities are significant, and retrieval is feasible.
- **Automobile Wastes** – Whole car and truck bodies can be handled through establishment of additional processing areas as identified above. Any household or consumer auto type wastes can be handled safely enough through regular conventional waste collection.
- **Propane Tanks** – Need to be segregated and removed to a processing facility where they are emptied and recycled. Best handled with White Goods on a house-by-house basis.

- **White Goods** –Need to be segregated and removed from homes individually – a very labor intensive process. These products will need to be placed curbside and handled with the combination of mechanical loaders and roll-off and/or end-dump trucks.. Quantities will probably exceed the local capacity to process scrap metal. Additional outside processing capacity will likely be needed.
- **"E"-waste** – Computers, TV's, monitors, and other electronic devices pose no real hazard to landfills. Limited resources available to Katrina Recovery should target other materials that are more harmful to the environment, or are easily recyclable. Most e-waste can be easily handled within conventional waste collection and disposal methods.

Summary

The overriding consideration should be given to the safety of the collection personnel and the protection of the environment. The next consideration is to provide for the efficient clean-up of the infrastructure so that the communities can be re-established as quickly as possible. Material recycling and re-use should receive secondary consideration and be contemplated only when it is easily implemented, financially viable, and operationally possible. The establishment of zones for collection and waste processing will maximize the limited amount of collection assets and personnel assigned to areas.

Viable markets should be in place before any particular waste stream is targeted for recovery. Tax credits and other forms of financial incentives should be quickly established to motivate potential buyers into receiving recovered materials for reuse and/or recycling.

Remaining waste capacity of local landfills should be determined and site life projections assessed after the impact of waste disposal from Katrina Recovery is completed. Additional capacity or expansion of

local landfill assets should be done in conjunction with recovery process and pass under Federal mandate – bypassing traditional permitting processes, if perfunctory environmental review reveals no "environmental flaws" – not political ones.

Neighborhood or area type assessments should be done with collection and processing experts to determine what areas can be handled first without any extreme assistance.
Areas that need major road repairs and clearing, major housing and business demolitions, essentially the severely affected areas, need a strategic and coordinated plan. Assessments for processing capabilities and market absorption of targeted recoverable materials should be determined prior to collection efforts. Environmental priorities for disposal or reuse/recycling should be grounded in good science and communicated to the public up front so expectations are clear and achievable.

Attachment 3

Planning For The Temporary Disposal of Disaster Debris: "Where Are You Going To Put It?"