# A Decision Support Tool (DST) for Disposal of Residual Materials Resulting from National Emergencies

**Paper # 214**

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## ABSTRACT

After a building or water treatment/distribution facility has gone through decontamination activities following a contamination event with chemical/biological warfare agents or toxic industrial chemicals, there will be a significant amount of residual material and waste to be disposed. A contamination event could occur from terrorist activity or from a natural disaster such as the recent hurricane events in the Gulf Coast where mold and pollutants from damaged chemical and industrial facilities have resulted in significant quantities of contaminated materials. It is likely that much of this material will be disposed of in permitted landfills or high-temperature thermal incineration facilities. Data has been collected from the open literature, from state and federal regulatory agencies, and from waste management and water utility industry stakeholder groups, to develop technical guidance for disposal of these residues. The information is available in a web-based application that will be centrally updated as new information becomes available, and old information (such as contact information for key personnel) changes. The primary audience for this tool will be: 1) emergency response authorities who have to decide the most appropriate decontamination methods and disposal of the resulting residues; 2) state and local permitting agencies, who have to make decisions about which facilities will be allowed to dispose of the materials; and 3) the waste management and water utility industry, that needs to safely dispose of decontamination residues without affecting the operation of their facilities and without violating any relevant environmental permits.

## INTRODUCTION

Because of the anthrax attacks on various government and news media buildings in 2001, the EPA created a new organization within its Office of Research and Development, the National Homeland Security Research Center (NHSRC). NHSRC provides R&D support to the Agency and other parts of the federal government to address issues related to the EPA's responsibilities under Homeland Security Presidential Directives (HSPDs) 7, 8, 9, and 10 [1, 2, 3, 4]:

- HSPD 7: Critical Infrastructure Identification, Prioritization, and Protection - Specifically designates EPA as the agency responsible for infrastructure protection activities for the nation's drinking water and wastewater systems.

- HSPD 8: National Preparedness - Establishes policies to strengthen the preparedness to prevent and respond to threatened or actual domestic terrorist attacks, major disasters, and

other emergencies by establishing mechanisms for improved delivery of federal preparedness assistance to state and local governments.

- HSPD 9: Defense of United States Agriculture and Food - EPA is to develop a robust, comprehensive surveillance and monitoring program to provide early warning in the event of a terrorist attack using biological, chemical, or radiological contaminants. HSPD 9 also directs EPA to develop a nationwide laboratory network to support the routine monitoring and response requirements of the surveillance program.

- HSPD 10: Biodefense for the 21st Century - Provides directives to further strengthen the Biodefense Program through threat awareness, prevention and protection, surveillance and detection, and response and recovery.

In the event of an incident of national significance involving the deliberate or accidental contamination of buildings, transportation infrastructure, or water treatment/distribution infrastructure, there will be a process of cleaning up the contaminated site and restoring it to normal operation. Disposal is the final step in the restoration process, after the initial response and decontamination activities have taken place. However, issues related to disposal are inextricably linked with the entire clean up process, including:

- Impact of event containment activities on waste quantities and level of contamination;
- Impact of decontamination technologies on waste quantities and characteristics;
- Impact of tradeoffs between decontamination costs and disposal costs; and
- Impact of decontamination effectiveness and residual contamination levels on waste classification for transportation and disposal.

Although decontamination processes may have been completed, the properties of some materials are such that no guarantee can be made that no residual agent is present (e.g. porous materials). . As such, the decontaminated materials must be characterized to determine the waste class (e.g., hazardous waste, solid waste, special waste), so that disposal options can be explored.

The primary decision makers in the disposal process will be: 1) emergency response authorities, and property owners who have to decide the most appropriate decontamination methods and disposal of the resulting residues; 2) state and local permitting agencies, who have to make decisions about which facilities will be allowed to dispose of the materials; and 3) the waste management industry, that needs to safely dispose of decontamination waste materials without affecting the operation of its facilities and without violating any of its environmental permits.

The individuals tasked with removal and disposal of these materials will need to access a great deal of technical information, regulations, and guidance to work through the series of decisions needed to assure safe and efficient removal, transport, and disposal of these materials.

This paper describes a currently available web-based decision support tool (DST) being developed by the EPA to assist all of the previously listed decision makers through the process of planning the disposal of residual materials from restoration of contaminated buildings and water treatment/distribution infrastructure. This tool has been developed by close collaboration with stakeholders representing all of the important decision making entities [5] as part of a larger program to investigate issues related to disposal of materials from these Incidents of National Significance [6].

Data has been collected from the open literature, from state and federal regulatory agencies, and from landfill and incinerator industry stakeholder groups, to develop technical guidance for disposal of decontamination residues. Periodic stakeholder meetings have been held to gather stakeholder feedback and suggestions for future progress. This project addresses the following issues:

- Estimation of waste quantities and characteristics, for the purposes of generating waste profile information;
- Available disposal options and capacity for the different categories of waste on a geographical basis (currently limited to incinerators, landfills, and wastewater treatment facilities), including contact information for the range of potential disposal facilities;
- On-site preprocessing and packaging of waste materials to make the material more amenable for disposal in a given facility;
- Guidance related to transporting the waste materials;
- Guidance to minimize risk to workers handling the waste materials, to the disposal facility workers, and to people along the transportation route to the disposal facility, and to minimize potential for contaminating the disposal facility; and
- Crude initial estimations of disposal costs.

The information is available in a web-based application (access granted upon request to NHSRC) that will be centrally updated as new information becomes available, and old information (such as contact information for key personnel) changes. This paper discusses the various features of the tool.

## GENERAL OPERATION OF THE TOOL

The DST is a password-protected web-based tool that allows the user to create a decision scenario and save it for later reference or revision. Each user has their own username/password combination and is assigned to one of three user groups:

- EPA/Federal;
- State/Local; and
- Other.

At the user's discretion, the decision scenarios can be private, shared among the user's group, or shared among all users.

The DST makes the assumption that the decision to dispose has been made, and the purpose of the tool is to facilitate carrying that decision to its successful conclusion.

To begin creating a scenario, users need the following information:

- Incident location; and
- Type and characteristics of waste material (selected from the building residue database).

The process of creating and completing a decision scenario involves the following nine steps:

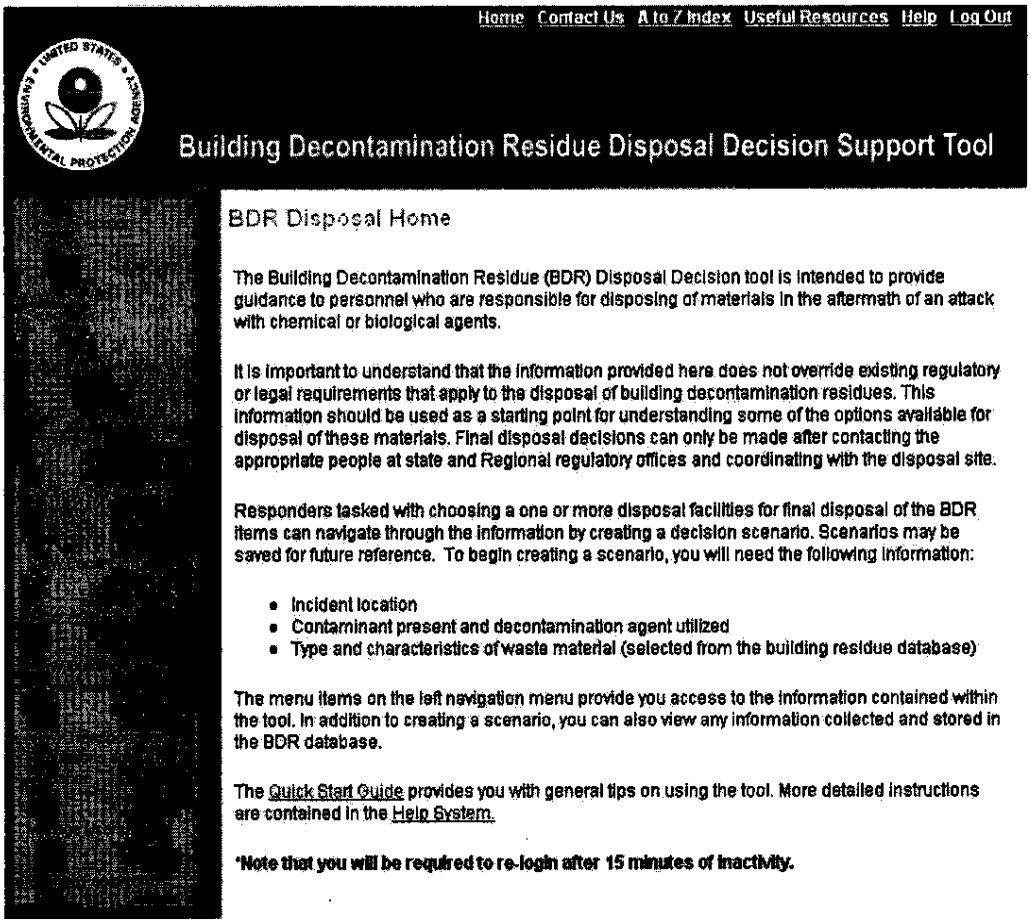
- Step 1: Enter Scenario Information;
- Step 2: Contaminant/Decontaminant Selection;
- Step 3: Back-of-the-Envelope Estimator Parameters;

- Step 4: Disposal Specifications;
- Step 5: Back-of-the-Envelope Estimator Results;
- Step 6: Inventory Information;
- Step 7: Inventory Summary (access to candidate disposal facilities);
- Step 8: Plan Transportation; and
- Step 9: Scenario Summary.

It must be noted that not every facility will be restored – some will be demolished and the site itself restored. Currently the DST does not address this situation, although this might be an issue addressed in future versions of the tool.

In addition to using the scenario creation method to help make a decision, all of the primary features of the DST are also available at any given time using alternative navigation features (i.e., left menu buttons or the A to Z Index that contains quick links). For example, it is not necessary to create a scenario and a waste inventory in order to query the tool for disposal facility information. Figure 1 illustrates the home page of the BDR DST.

**Figure 1: BDR DST Home Page**



## WASTE QUANTITY ESTIMATION

One of the critical pieces of information the decision makers need in order to properly dispose of waste materials is a fairly detailed inventory of the waste. This information is needed in order to assess costs of removal/decontamination, to assess fees for the disposal facilities, and to estimate storage, packaging, and transportation needs.

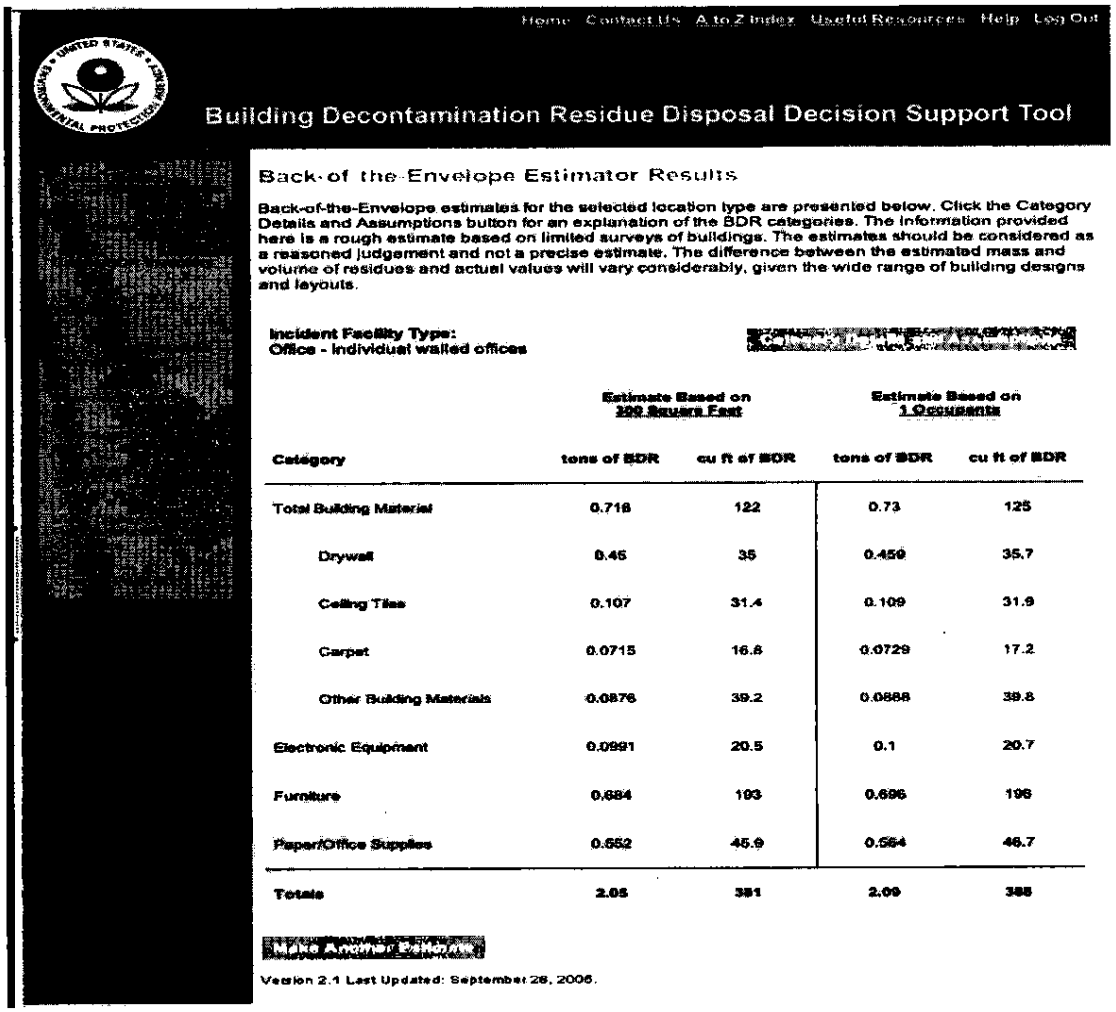
There are two methods for creating a waste characterization inventory: 1) the back of the envelope estimator (BoEE); and 2) building an inventory using the item database. The back of the envelope estimator provides a very rapid estimate of debris quantities for a limited number of facility types, based on easily accessible size information. Table 1 lists the available BoEE estimates in the DST and the type of information required to generate the waste estimate. Future versions of the tool will include additional facility types for the BoEE estimator.

**Table 1.** Back of the Envelope Estimators and Example Inputs

| **Estimator** | **Example Inputs** |
|---|---|
| Hotel | Number of standard rooms<br>Number of extended stay rooms<br>Square footage of conference areas<br>Number of restaurant seats |
| Office | Walled office or cubicles?<br>Office square footage<br>Number of office workers |
| School | Elementary, middle or high school?<br>School square footage<br>Number of Students |
| Theaters | Number of Seats<br>Number of Screens |

Figure 2 presents the results of a back of the envelope estimate generated for an Office.

**Figure 2: BoEE Office Results**



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Building Decontamination Residue Disposal Decision Support Tool

Back-of-the-Envelope Estimator Results

Back-of-the-Envelope estimates for the selected location type are presented below. Click the Category Details and Assumptions button for an explanation of the BDR categories. The information provided here is a rough estimate based on limited surveys of buildings. The estimates should be considered as a reasoned judgement and not a precise estimate. The difference between the estimated mass and volume of residues and actual values will vary considerably, given the wide range of building designs and layouts.

**Incident Facility Type:**
**Office - individual walled offices**

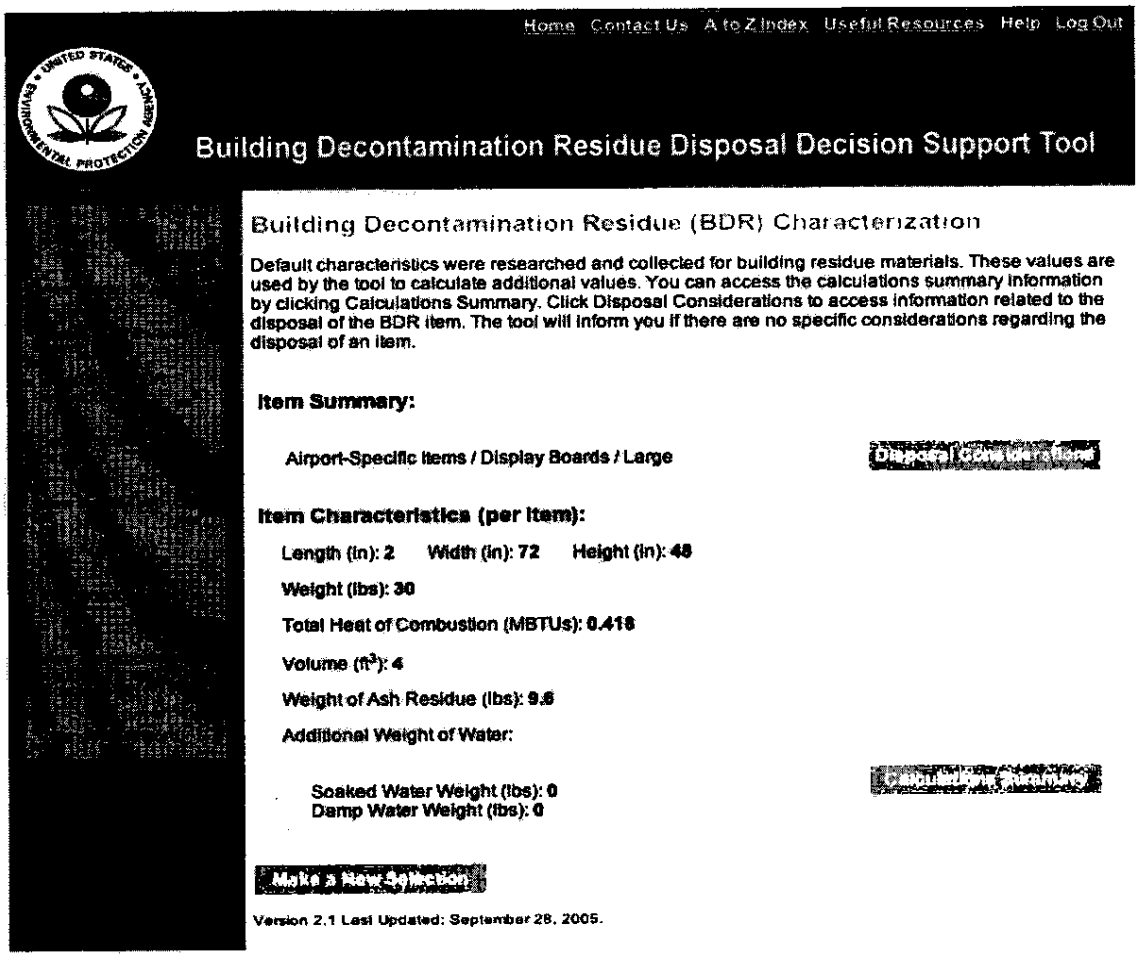
| Category | Estimate Based on 200 Square Feet | | Estimate Based on 1 Occupants | |
|---|---|---|---|---|
| | tons of BDR | cu ft of BDR | tons of BDR | cu ft of BDR |
| Total Building Material | 0.718 | 122 | 0.73 | 125 |
| Drywall | 0.45 | 35 | 0.459 | 35.7 |
| Ceiling Tiles | 0.107 | 31.4 | 0.109 | 31.9 |
| Carpet | 0.0715 | 16.8 | 0.0729 | 17.2 |
| Other Building Materials | 0.0876 | 39.2 | 0.0888 | 39.8 |
| Electronic Equipment | 0.0991 | 20.5 | 0.1 | 20.7 |
| Furniture | 0.684 | 193 | 0.696 | 196 |
| Paper/Office Supplies | 0.552 | 45.9 | 0.564 | 46.7 |
| Totals | 2.05 | 381 | 2.09 | 388 |

Version 2.1 Last Updated: September 28, 2006.

The other method of estimating waste quantities involves using a "shopping cart" type feature, were a substantial database of items specific to certain types of facilities (e.g., restaurants, airports, offices, etc.) is accessed to build an inventory. The item database includes such information as item size, item mass, and disposal-specific information such as the heating value and ash content. All default values in the database can be modified by the user to adapt to any unique situation.

Figure 3 shows a sample screen dump from the inventory-building module.

**Figure 3. Sample BDR Inventory Item**




The reporting function of the DST can be used to create a detailed waste profile, suitable for export into a word processing document for later editing.

## GUIDANCE FOR SELECTION OF AVAILABLE DISPOSAL OPTIONS

In the event of an incident that results in a significant amount of potentially contaminated materials, the waste disposal facility is an important stakeholder. The facility needs to be able to evaluate the materials that they are potentially going to accept so that they can assess their own permitting issues, operational issues, worker safety issues, and potential liability issues. The DST contains detailed databases of disposal facilities, complete with geographic information, capacity information, permitting information, and most importantly, contact information for the facility. Table 2 lists the types of disposal facilities that are currently contained in the DST. These disposal facilities can be filtered based on location, state, and EPA region.

**Table 2.** Types of Disposal Facility Databases Contained in the DST.

| Facility Type | Facility Subtype |
|---|---|
| Combustion Facilities | Hazardous waste combustors |
| | Municipal solid waste combustors |
| | Medical/Biohazardous waste incinerators |
| Landfills | RCRA Subtitle C landfills |
| | RCRA Subtitle D landfills |
| | Construction and Demolition (C&D) landfills |
| Wastewater Treatment Facilities | Centralized waste treatment (CWT) facilities |
| | Federally owned treatment works (FOTW) |
| | Publicly owned treatment works (POTW) |

## PACKAGING GUIDANCE

Selection and use of the appropriate packaging for a hazardous material are essential to ensure that a hazardous material is not released during transportation. Only packaging authorized by the Hazardous Material Regulations may be used to package hazardous materials for transportation. The shipper must ensure that the selected packaging will retain its contents during temperature variances, changes in atmospheric pressure, vibration, or other conditions that may be encountered during normal conditions of transport. Packaging requirements are based on the Packing Group of the material, its vapor pressure, and chemical compatibility between the package and the hazardous material. Non-bulk packaging standards are based upon a number of performance tests. In addition to United Nations (UN) Recommendation performance oriented tests, a vibration test for non-bulk packaging is required domestically.

The DST provides direct external links to the relevant packaging regulations, and gives guidance on performance requirements for containers. Finally the DST has a list of possible suppliers of hazardous material transport containers.

Once a potential disposal facility has been located, maximum container size requirements for that facility can be combined with the waste inventory database to estimate whether additional size reduction will need to be performed prior to shipment to the disposal facility. A list of potential methods for size reduction is presented, along with potential suppliers for the size reduction equipment.

## TRANSPORTATION GUIDANCE

Once the user decides to examine the transportation issues related to delivering the waste contained in the inventory to the selected disposal facility of choice, the DST contains external links to the various transportation regulations as well as transportation companies suitable to haul the materials to the disposal facility. The DST has an external link to "SafeStat", where potential haulers can be evaluated for their safety records. Finally, the DST provides a link to the Department of Energy's Transportation Routing Analysis Geographic Information System

(TRAGIS) tool [7], a Geographical Information Systems (GIS) based tool that allows appropriate transportation routes to be created. The link to TRAGIS requires that the user create a separate account on the TRAGIS system.

## WORKER SAFETY GUIDANCE

In addition to the hazards posed by the chemical or biological agent and decontamination agents involved in an event, removal workers may also be exposed to hazards related to the specific removal or size reduction techniques used in the operation and to other site-specific conditions. For example, use of a reciprocating saw for size reduction efforts may result in the generation of airborne dusts (perhaps resuspending residual chemical or biological agents) and may pose other hazards such as point of operation (sharp saw blade) and electrical hazards. Similarly, specific site conditions such as high bay facilities or other types of facilities with high ceilings could require work on elevated platforms, thus, presenting fall hazards. To ensure workers are protected from these task and site-specific hazards, removal managers should perform a job hazard analysis covering each task or activity associated with the removal operation to identify potential hazards and to establish related controls. The DST provides:

- A brief discussion on how to perform a job hazard analysis;
- Actual examples of job hazard analyses prepared for BDR removal operations conducted as part of the anthrax decontamination activities at the US State Department SA-32 Sterling Postal Facility; and
- Additional references for use in preparing job hazard analyses.

The DST provides a brief overview of how to prepare a job hazard analysis and walks you through the process of identifying certain types of hazards that could be associated with your tasks or activities. For more detailed guidelines on the development of job hazard analysis, the user can refer to the sources listed on the DST web page.

## FUTURE ENHANCEMENTS

One of the key issues regarding a tool such as the one described in this paper is to get it into the hands of prospective users prior to the next event for which it might be used. That way, disposal considerations can be included as part of contingency planning. A communications strategy is being developed to help achieve this goal.

As the tool is used and stakeholder input is received, potential future enhancements are considered. Inclusion of enhancements is constrained by availability of information and limitations of resources. However, features being considered for future versions of the DST include:

- Additional disposal facility types (e.g., autoclaves, industrial boilers)
- Additional BOEEs (e.g., shopping malls)
- A module to address disposal of residues resulting from a radiological dispersion device (RDD) event
- A module to address disposal of agricultural residues (e.g., foot and mouth disease event)
- A module to address disposal of residues from natural disasters (e.g., hurricanes)

## CONCLUSIONS

EPA's Office of Research and Development has developed a web-based decision support tool that will assist responders and other decision makers address issues related to disposal of materials resulting from cleanups of contaminated buildings and water infrastructure. This tool, rather than telling the decision makers what to do, facilitates the decision making process by presenting options, offering potential solutions, examining cost tradeoffs, and supplying current contact information. It also aids the decision makers by preparing waste profiling and characterization information that can be shared with facilities, and transportation companies.

## REFERENCES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**Key Words:** waste, disposal, chemical, biological, decontamination, restoration