

# Debris and waste management

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## Executive summary

A comprehensive Government strategy for debris and waste management is highly needed. A prioritization of sites to start with the cleaning up is indispensable to ensure that the most urgent sites are cleaned first. It is highly recommended to visualise the operation on a map showing hotspots of the damage, land ownership, and actors and their intervention zones for facilitation the implementation of the debris and waste management plan. A communication campaign is urgently needed to alert private landowner on the cleaning process and its timing to get their permission for cleaning to avoid delaying the cleaning up.

The total amount of debris might be roughly estimated at 150,000 m<sup>3</sup> for Abaco based on the UNDP preliminary assessment. UNDP is currently updating this figure. The reuse of the debris offers an excellent opportunity to create additional income to local enterprises and employment for local people (cash for work). The sorting of material for the reuse should happen on the spot (timber, boards, organic material...) as much as possible.

The large quantities of dry wood in the pine and broad-leaved forests pose a high fire hazard in the coming winter dry season with the risk of widespread wild fire. The fallen / broken timber and the dry wood in the pine and broad-leaved forests have to be removed for reuse before the coming dry season and firebreaks have to be established, respectively reinforced.

## 1) Introduction

In agreement with UNDP, the DDSA in the debris and waste management sector will focus a) on the reuse of debris and waste in the Abacos including environmental considerations and income generation opportunities to support the local communities and b) on the appropriate strategy to guide the implementation of a debris and waste management plan in the field. Consequently, the report structure differs from the proposed reporting template for the DDSA.

This sectoral report aims to support the implementation of the waste management plan from the Department of Health and Environmental Services (DHES) of the Ministry of Environment & Housing. At the time of the CDEMA assessment, this plan was not yet released by the Government of the Bahamas. The debris and waste management report may serve as a discussion paper for the humanitarian actors' group on debris management at national level led by UNDP, and for the local debris management groups in Abaco (lead CORE) and on Grand Bahamas (lead tbd) for supporting the Government in the implementation of its waste management plan.

At the arrival of the DDSA team at Abaco on 18th September 2019, access to most areas has been re-established under the lead of the Ministry of Public Works supported by armed forces, international relief organisations, private companies, NGOs, and others. This included the cleaning of roads, public buildings, rehabilitation of bridges, and harbours. Debris and waste management is part of the Emergency Support Function (ESF 3) which is

under the lead of the Ministry of Public Works and facilitated by UNDP. For the detailed assessment of HazMat we refer to the ESF 10.

The two existing preliminary quantitative damage assessments from UNDP and CORE served as a basis for this complementary assessment. UNDP is further working on the refining of the debris and the cost estimations (necessary equipment) for the recovery of the affected areas by hurricane Dorian.

## 2) Limitations

Several limitations have to be considered when taking into account the results of this sectoral assessment and suggested strategy for an appropriate debris and waste management in the areas affected by the hurricane Dorian:

- Lack of comprehensive Government strategy for debris and waste management as the waste management plan from DHES is still awaiting at the time of the DDSA.
- Local production of goods is not a common practice on the Bahamas where almost all goods are imported. This renders the development of income generation activities based on the reuse of materials difficult.
- Absence of many residents from the Abacos since many affected people have not yet returned back home after the disaster.
- Lack of local counterparts from technical services for supporting and accompanying the mission team in its assessment.
- Lack of continuous logistical support from CDEMA in the field what hindered the assessment considering the shortness of the mission (four field days).

## 3) Methodology

Practically, a mixed assessment has been applied including document reviews (including preliminary debris estimation from UNDP and rapid debris assessment from CORE for the Abacos, and sitreps) as secondary data and interviews and direct on-site observations from the field mission as primary data. The assessment focussed on evidence-based data that is credible, reliable and useful. The triangulation of multiple data sources allowed verifying or cross-checking the data to ensure the validity of the findings.

During the field visit the following sites have been visited:

- Marsh Harbour including several townships, the mud and the peas (slum of the Haitian community) and the harbour area;
- The landfill outside Marsh Harbour;
- The affected pine forests and mangrove stands between Marsh Harbour and Treasure Cay;
- Coopers Town;
- Treasure Cay (Ocean Villa area);
- The Haitian communities at Sandbank and Farm Road;
- Elbow Cay with Hope Town.

The assessment approach was as much as possible participatory involving the key actors of the debris and waste management sector in the analysis of the data and in the discussion on the appropriate strategy for debris and waste management. Findings and recommendations

from the visit of Elbow Cay and Hope Town have been shared with the EOC in Marsh Harbour. Key elements of the debris and waste management strategy have been presented in the UNDP debris and waste management group at national level in Nassau on 23<sup>th</sup> September. The persons met during the assessment are listed in Annexe 1.

#### 4) Damage assessment

Based on the information available up to 12<sup>th</sup> September 2019, UNDP estimated roughly the debris from damaged buildings and debris/green waste from building's surroundings in Abaco (see Table 1). Please note that UNDP is currently updating the figures.

**Table 1: Rough estimation of damages and debris/green waste for Abaco**

District	#Buildings	Debris (m <sup>3</sup> )	Green waste (m <sup>3</sup> )
Hope Town	3 175	39 700	88 900
Central Abaco	5 757	71 975	161 200
North Abaco	1 238	15 475	34 650
South Abaco	383	4 800	10 700
<b>Total</b>	<b>10 553</b>	<b>131 950</b>	<b>295 450</b>

The total amount of debris might be roughly estimated at **150,000 m<sup>3</sup>** considering that there might be residential and commercial buildings with more than 2 floors what has not taken into account in the estimation. About one third of the total debris and green waste occurred on the islands (cays) what poses a particular challenges regarding available space on the islands for recycling and disposal and the removal of debris and regular municipal solid waste by boat to the mainland.

**Table 2: Debris to be collected by trucks**

Debris to be collected			
Total generated (m <sup>3</sup> )	#Truck loads		
	(10m <sup>3</sup> )	(12m <sup>3</sup> )	(20m <sup>3</sup> )
150 000	15 000	12 500	7 500

Information about HCW (Health Care Waste), Agriculture Waste (affected agriculture fields that need to be cleared for new crops), Industrial Waste, and Damaged Vehicles (cars, trucks, boats, etc.) is not yet available.

In addition, the monospecific pine forests (*Pinus caribaea* var. *bahamensis*) between Marsh Harbour and Coopers Town and the broad-leaved forest on the islands have been heavily affected. It is roughly estimated that in the pine forests at least half of the trees will die what may result in about 50 m<sup>3</sup> of wood per ha which may be reused for timber or charcoal (see below).

The large quantities of dry wood in the pine (*Pinus caribaea* var. *bahamensis*) and broad-leaved forests on the islands pose a high fire hazard in the coming winter dry season with the risk of widespread wild fire. Therefore, the fallen / broken trees and the dry wood in the pine and broad-leaved forests have to be removed for reuse before the coming dry season and firebreaks have to be established, respectively reinforced.

Affected pine trees cannot resprout by shoots and suckers and have to be replaced either by existing seedlings in the stands or by planting new trees (see also experiences of decaying stands of *Pinus occidentalis* after the hurricane Matthew in Haiti in 2016). On the other hand, the broad-leaved forests may regenerate and first shoots are appearing. The regeneration of the heavily affected mangroves, fulfilling important ecosystem functions, is very uncertain.

The health of the affected forests and mangroves should be monitored to assess the afforestation needs for the stands which are dead and cannot regenerate naturally. This can be done by using a vegetation index (e.g., NDVI) reflecting the health of the photosynthetic activity. Vegetation indices are one of the more popular and extensively studied products of remote sensing, and use transformations of spectral bands of the electromagnetic spectrum that are measured as reflectance from the Earth's surface by satellites. A request at no cost can be submitted to the Copernicus Emergency Management Service (European Union) for carrying out the analysis. Copernicus is a global, versatile and operational tool for emergency managers and disaster risk reduction stakeholders. For the interpretation of the results an experienced ecologist should be associated.

## 5) Strategy for debris and waste management

For this assessment four categories of debris have been distinguished:

- Construction material
- Organic material
- White waste / metals
- Not reusable

It would be helpful for the operation, if all actors in the debris and waste management sector could adopt the same terminology for the different categories of debris.

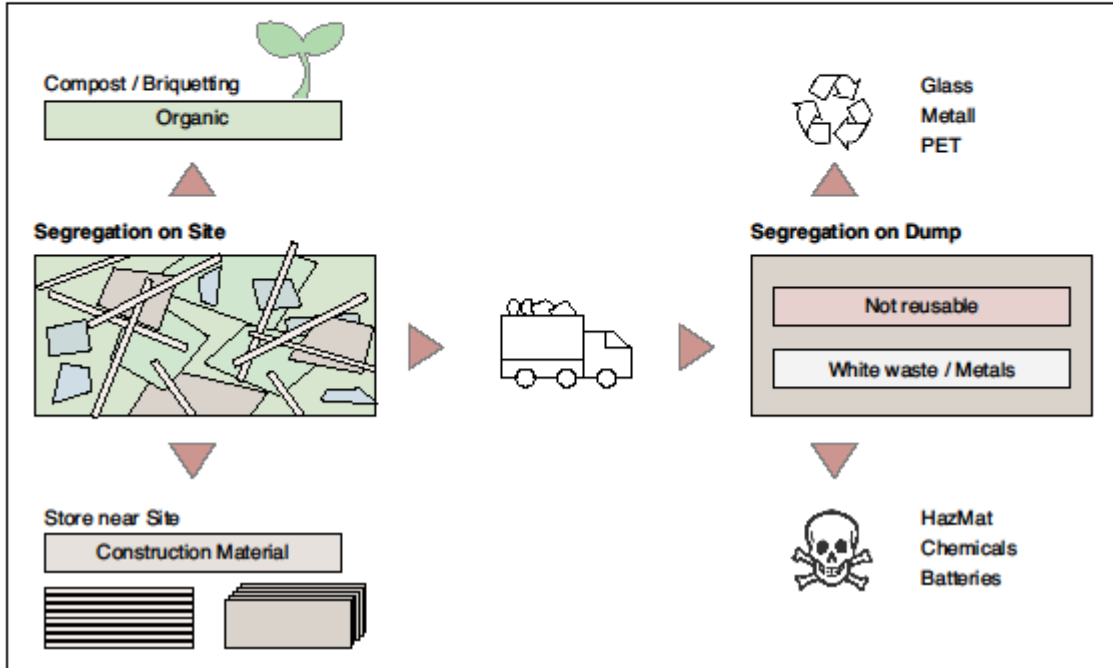
The debris from the settlements includes large quantities of reusable materials. In addition, huge amounts of fallen wood are accumulated in the pine forests. Wood, concrete and other materials could be reused in the reconstruction, while organic material can produce mulch/compost (fertiliser for agriculture and home gardening). In addition, small wood debris could be used to produce charcoal using improved kilns (needs to be supervised and guided by the forest service). The reuse of the debris offers an excellent opportunity to create additional income to local enterprises and employment for local people (cash for work).

The sorting of material for the reuse (timber, boards, organic material...) should happen on the spot as much as possible. A schema for the reuse, recycling and disposal of debris focussing on the sorting of the material on the spot is presented in Fig. 1 below. Hurricane Dorian is also an opportunity to enhance the recycling of waste (see well-functioning system of collecting garbage and recycling of organic material for mulch and compost in Hope Town prior to hurricane Dorian which may serve as an example).

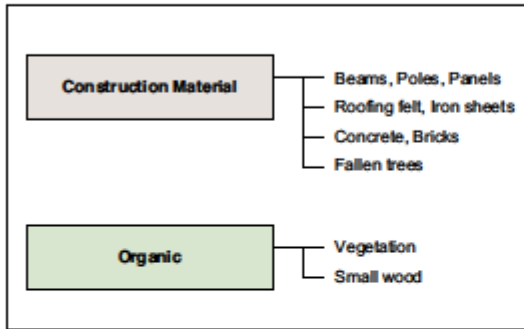
The field assessment and the multiple discussions with actors of the debris and waste management sector allowed to identify key elements to consider in the elaboration of a comprehensive strategy for debris and waste management (see Table 3). This compilation of key principles of the strategy is intended to stimulate the discussion among actors of the debris and waste sector for further refining the strategy.

# Reuse, Recycling and Disposal of Debris

## Sorting of Waste



## 4 Types of Waste



## Potential Reuse / Recycling

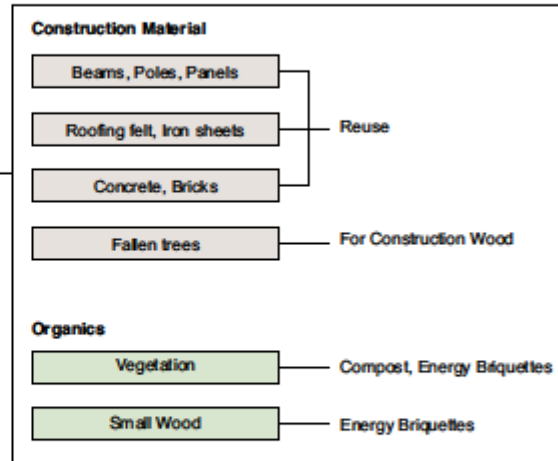


Fig. 1: Schema illustrating the reuse, recycling and disposal of debris

**Table 3: Key elements for the debris and waste management strategy**

<b>Principles</b>	<b>Rationale</b>	<b>Opportunities</b>	<b>Challenges / Risks</b>
<u>1) Prioritization of sites</u>	Set up a priority list for sites to be cleaned first on public and private land considering all information available with a focus on potential hazardous sites	- Engage transparent process for sustainable land management	- Quality of the data (assessment) of all sites; missing information
<u>2) Operational plan</u>	A visualised plan (map) with damage hot spots and land ownership greatly facilitate the implementation	- Clearly defined role of each actor facilitates the coordination - Participatory elaboration increases accountability of partners	Has to be flexible for regularly adapting to the current situation
<u>3) Definition of debris categories</u>	Common terminology	- Joint definition of debris categories facilitates the understanding among all actors	- Different approaches and operational objectives may hinder The use of a common terminology
<u>4) Communication campaign</u>	Alert private landowner on cleaning process and its timing to get their permission for cleaning	- Coordinated cleaning on private land	- Owner not reachable - Unclear ownership
<u>5) Environmental safe landfills</u>	Avoid environmental risk of contamination of aquifer and burning (supervised site)	- Establish and manage environmentally safe landfills for Abaco	- Risk of aquifer contamination (porous limestone) - Fire
<u>6) Reuse of material</u>	Large quantities of debris can be reused	- Potential to develop income generating activities for local enterprises and communities (cash for work) - Sustainable reuse of construction material (local natural resources)	- Mixed debris of various material - Strictly avoid to reuse contaminated material (HazMat)
<b>A) Settlement debris</b>			
Sorting of debris	Sorting of debris on the spot facilitate recycling process	- Less transport of materials	- Needs space for sorting - Private landowners must be informed on time and have to agree (communication campaign)
	Large amount of reusable timber, beams, board, panels, poles...	- Involve professionals for checking wood quality (carpenter)	- Lack of professionals
	Large amount of reusable waste wood	- Produce charcoal in energy-efficient and climate friendly kilns (release of little amount of greenhouse gases)	- Close supervision of the forest service needed - Lack of technology knowledge (energy-efficient stoves)
	Large amount of reusable concrete, bricks	- Sustainable reuse of local natural resources for gravel	- Not appropriate to be reused for production of new concrete
<b>B) Fallen / broken timber in pine forests</b>	Large quantity can be used as high quality construction wood	- Potential to develop income generating activities for local enterprises using (chainsaw milling)	- Risk of felling standing timber if no supervision - Lack of qualified people for chainsaw milling
	Small wood can be used for making charcoal	- Produce charcoal in energy-efficient and climate friendly kilns (release of little amount of greenhouse gases)	- Close supervision of the forest service needed - Lack of technology knowledge (energy-efficient stoves)

A prioritization of sites to start with the cleaning up is highly needed to ensure that the most urgent sites are cleaned first. The implementation of a debris and waste management plan is complex considering the magnitude of the impact of the hurricane Dorian, the relatively vast area, the logistic challenge for accessing the islands (cays) and the multiple actors participating in the operation. Therefore, it is highly recommended to visualise the operation on a map showing hotspots of damage, land ownership, and actors and their intervention zones for facilitation the implementation of the debris and waste management plan.

A communication campaign by the local authorities is urgently needed to alert private landowner on the cleaning process and its timing to get their permission for cleaning. This process may take time and it is highly suggested that the local authorities launch the communication campaign as soon as possible to avoid delaying the cleaning up.

The cash for work approach offers an excellent opportunity for supporting the local communities (see for example “trash for cash” in the Philippines 2013 in the aftermath of typhoon Haiyan). To ensure a harmonised approach UNDP will elaborate guidelines on cash for work for the partners.

## 6) Recommendations

### General

- 1) Set up a priority list for sites to be cleaned first on public and private land considering all information available with a focus on potential hazardous sites.
- 2) It is highly recommended to visualise the waste and debris management on a map showing hotspots of damage, land ownership, and actors and their intervention zone for facilitation the implementation of the debris and waste management plan.
- 3) The local authorities should launch a communication campaign for the private landowner as soon as possible to avoid delaying the cleaning up.

### Specifically for the affected forests and mangroves

- 4) Assess the quantity of fallen / broken timber in the pine forests for the reuse of the material using remote sensing.
- 5) The fallen / broken timber and the dry wood in the pine and broad-leaved forests have to be removed for reuse before the coming dry season and firebreaks have to be established, respectively reinforced.
- 6) Monitor carefully the fire hazard in the broad-leaved forests on the islands (cays) and in the pine forests on the Abaco mainland. Dry wood has to be removed from the forests prior to the coming dry spell in the winter months to reduce the fire risk.
- 7) Monitor the environmental health of the pine forests and mangroves along time series (before and after Dorian) using a vegetation index (e.g. NDVI) for defining the forest areas which have to be afforested. This study could be done by the Copernicus Emergency Management Service (European Union) support by an ecologist.

### **Specifically for Elbow Cay (Hope Town)**

- 8) As a first priority the household garbage at the dump area (all containers are full) are to be removed and transported by flat barge to Marsh Harbour.
- 9) As a second priority the hazardous material (mainly from the households) in the mixed debris has to be addressed.

## **7) Conclusions**

Despite the short mission period, the CDEMA assessment allowed to get a good overview of the current situation and of challenges of the sector for implementing a comprehensive strategy. Multiple discussions and suggestions with the key actors in debris management allowed to strengthening the coordination mechanisms at local and national level. Furthermore, the mission helped SDC in defining their support for this sector including the secondment of a technical expert to IOM and a financial contribution to CORE of CHF 175,000 for starting a debris removal project using the cash for work approach.



## Annexe 1: Organisations and people met

Big Cat Company	Mr Andrew Brown
CERES Environmental	Mr Karl Dix, Director of Client Services
CORE	Mrs Ann Lee
	Mr Jerome Lebleu, Chief Operating Officer
	Mr Ralph Kilian
	Mr. Jerrold Lauture, Logistician
Disaster Arborist Response Team	Mr Andy Mac Pherson
Department of Health and Environmental Services	Mrs Melony Mc Kenzie, Director
	Mrs Thomasina Wilson, Deputy Director
	Mr Andrew Thompson, Deputy Director
	Mr Christopher Russell, Director of Forestry
ECC	Mr Richard Ebel, Vice President, International Development
EOC Abaco	Mr Algernon Cargill, Local Administrator
EOC Hope Town	Mr Mike Hague, Chief
	Mr Clay Wilhovti
GER	Mrs Margaret Bacon, Program Coordinator
IOM	Mr Jan-Willem Wegdam, Team Leader
	Mr Joseph Ashmore, Global Shelter Cluster Coordinator Focal Point
Jamaica Defence Force	Major Damian Bromley
MAERSK	Mr Robin Townley, Senior Director
Ministry of Foreign Affairs	Mrs Sharon Brennen-Haylock, Director General
NEMA	Captain Stephen Russell, Director
	Mrs Chrystal Ginton, Deputy Permanent Secretary
SDC	Mr Christian Coquoz, Honorary Consul
	Mr. Sebastian Eugster, Team Leader
	Mr Patrizio Jellici, Shelter Expert
UNDAC / JEU	Mrs Margherita Fanchiotti, Environmental Expert
UNDP	Mrs Rita Missal, Recovery Advisor
	Mrs Sasha Shirley
	Tim Walsh, Consultant

## Annexe 2: List of abbreviations and acronyms

CORE	Community Organized Relief Effort
DDSA	Detailed Damage Sectoral Assessments
DHES	Department of Health and Environmental Services
EOC	Emergency Operation Center
ESF	Emergency Support Function
GER	Global Emergency Relief
HazMat	Hazardous Material
IOM	International Organization for Migration
JEU	UN Environment / OCHA Joint Unit
NEMA	National Emergency Management Agency
SDC	Swiss Agency for Development and Cooperation
UNDP	United Nations Development Programme