

### Construction and Demolition (C&D) waste;

Construction and Demolition (C&D) waste is generated by activities such as construction, demolition and maintenance of civil infrastructure and facilities. The local authorities do not have accurate data on C&D waste, despite the fact that there is a dedicated service for collection and removal of this waste stream under implementation, there are no separate collection points and there is lack of infrastructure.

Removal is made based on occurring needs and not on proper planning. Therefore this specific stream is reported by all stakeholders as a growing problematic in terms of the high expenditures that collection and transportation services require. Due to the lack of specific locations and suitable containers for the removal of this specific stream, the risk that citizens and private businesses deposit their C&D waste (small non-industrial quantities) in a centralized collection place or mix it with common household waste. It is not a seldom practice to encounter piles of C&D waste that is illegally disposed at by the sides of road axes. A special on demand pick-up service for bulky and C&D waste is installed by WAMCO, and some of the industries might bring bigger quantities to the transfer station site in Male.

C&D waste is identified as a priority stream because of the high recycling and reusing potentials. Special C&D elements can be used for road construction and maintenance, draining projects, etc. In addition to this, the current technologies for segregation and recovery of these fractions have advanced. The C&D stream can be easily accessed and is relatively cheap.

Construction and Demolition waste has been estimated from the observation and asset of previous docking station dedicated exclusively for Industrial and C&D waste (October/November 2016).



Figure 1: Industrial and C&D Waste transport at Male' City

A series of surveys on estimating amount of construction and demolition waste generated in Male' were conducted 1 year later, to estimate the average composition and amount of the construction and demolition waste brought to

the Male' transfer station. The waste transfer station is opened to incoming vehicles from 06.00 am to 02.00 am. Construction and demolition waste, Household and other waste is the loaded onto a vessel and taken to Thilafushi. The size of vehicles that carry C&D waste varies from 350kg to 5T.

Survey 1 was conducted on 29th October 2017 at Male' transfer site by 5 members from Water Solutions. A total of 41 vehicles containing C&D waste were surveyed and its content were recorded.

A method of visual characterization of disposed waste from construction and demolition activities produced for the State of California in October 2006 was used as a model in this survey to estimate the composition of C&D waste. This generally involves measuring the volume of the waste loads and visually characterizing the waste to a set of materials which were categorized by this method. The volumes measure were converted to mass using industry-accepted density values. The volume was measured when the trucks arrive and stop to make the entrance payment. The length and width of the loading section of the truck was recorded and an average from two readings for the height of the waste pile was taken to calculate the volume. An excel tool was also provided with the instructions for said method. This was used to estimate the percentage composition of the different materials.

The following estimates in [figure 35](#) were generated by the aforementioned excel tool. About 92% of the C&D waste was aggregates and dirt, which is mainly concrete from houses that have been demolished, sand and rocks after excavations from foundation works. Most of the plastic was from polypropylene woven sacks that contained sand, rocks and small pieces of concrete. The wood materials were mostly pallets and lumber beams; however, sawdust and wood shavings from carpentries were also included. Paper materials were mostly just cardboard boxes.

<b>Estimated Composition by Weight for All Loads</b>			
<b>Paper</b>	<b>0.5%</b>		
Unwaxed OCC	0.5%		
RC Paper	0.0%		
<b>Plastic</b>	<b>0.5%</b>		
Non-bag Film	0.5%		
Polystyrene Packaging	0.0%		
Rigid Plastic	0.0%		
RC Plastic	0.0%		
<b>Metal</b>	<b>0.2%</b>		
Major Appliances	0.0%		
HVAC Ducting	0.0%		
Other Ferrous & Non-Ferrous	0.0%		
RC Metal	0.2%		
<b>Organic</b>	<b>0.0%</b>		
Prunings, Trimmings, Branches, Stumps	0.0%		
RC Organic	0.0%		
<b>Carpet</b>	<b>0.0%</b>		
Carpet	0.0%		
Carpet Padding	0.0%		
RC Carpet	0.0%		
<b>Aggregates &amp; Dirt</b>	<b>91.8%</b>		
Dirt, Sand, Soil	41.0%		
Concrete	42.6%		
Asphalt Paving	0.0%		
Brick, Ceramic, Porcelain	0.0%		
Rock, Gravel	8.1%		
RC Aggregates & Dirt	0.0%		
<b>Roofing</b>	<b>0.0%</b>		
Roofing	0.0%		
RC Roofing	0.0%		
<b>Insulation</b>	<b>0.0%</b>		
Insulation	0.0%		
RC Insulation	0.0%		
<b>Wood</b>	<b>7.1%</b>		
Clean Recyclable Lumber, Pallets, Crates	7.1%		
Other Untreated & Recyclable Wood	0.0%		
Painted, Stained, Treated Wood	0.0%		
RC Wood	0.0%		
<b>Gypsum</b>	<b>0.0%</b>		
Clean Gypsum Board	0.0%		
Painted Gypsum Board	0.0%		
RC Gypsum	0.0%		
<b>Misc. C&amp;D</b>	<b>0.0%</b>		
<b>Glass</b>	<b>0.0%</b>		
<b>Electronics</b>	<b>0.0%</b>		
<b>HHW</b>	<b>0.0%</b>		
<b>Special</b>	<b>0.0%</b>		
<b>Mixed Residue</b>	<b>0.0%</b>		
<b>TOTAL</b>	<b>100.0%</b>		

Figure 2 Estimated composition of C&D waste from Male' Transfer Station



Figure 3: Barge at Male' TS that contains a mixture of C&D waste and household waste

The mass of the waste load was calculated for individual materials by using their density values.

Sample no	Materials	Volume (m <sup>3</sup> )	Mass (kg)	MAM of Vehicle (kg)	Difference
6	Aggregate and Dirt-Concrete	5.02	4,300	2,000	2,300
8	Aggregate and Dirt- sand	4.3	3,900	2,000	1,900
11	Aggregate and dirt, Wood	6.1	4700	1,500	3,200
17	Dirt, Wood, Plastic	7.68	5,820	1,500	4,320
19	Dirt Wood plastic	3	2,900	350	2,550
23	Aggregate & dirt	7.14	6,100	2,000	4,100
28	Wood, metal	3.9	645	350	295
31	Aggregate & Dirt	6.2	5,300	5,000	300
36	Plastic, cardboard, wood	1.49	340	350	-10
39	Aggregate and dirt	5.8	5,400	5,000	400

Table 1: Mass of waste and MAM for randomly selected trucks.

The calculated mass for the waste was observed to be much higher than the Maximum Authorized Mass (MAM) of the vehicles. A vehicle could carry more than the MAM, but some reading showed values that were more than twice, even thrice of the amount. Hence, these results are not reliable. These overestimated values maybe due to the empty areas in volume that was not accounted for when converting to mass.



Figure 4: (a) Aerial view of a 2T truck containing concrete waste (b) Truck containing sand and rocks in polypropylene woven sacks with wooden pellets on top (c) Aerial view of a 2T truck containing concrete waste (d) Truck containing soil.

Date	No. of trucks carrying Concrete							No. of trucks carrying Wood					No. of trucks carrying Sand			
	350 KG	1.5 Ton	2 Ton	3 Ton	4 Ton	5 Ton	Total (Ton)	350 KG	1.5 Ton	2 Ton	4 Ton	Total (ton)	1.5 Ton	2 Ton	4 Ton	Total (ton)
27/10/17	6	4	25	6	1		80.1	11	1	4		13.35				0
28/10/17	8	12	71		3	2	184.8	6		3		8.1		6		12
29/10/17	9	15	59			14	213.7	4	2	3	1	14.4	1	14	1	33.5

Table 2 Number of different sized trucks carrying concrete waste, wood, and sand, and their total tonnage from MAM of the trucks

The entrance posts at the transfer station keep logs of the time, plate number, MAM and the type of waste. The three types of waste that were considered to be C&D waste in these logs were concrete, wood and sand. *Table 10* shows the number of truck of each size that carried a certain material of waste. By adding up the frequency and capacity of these trucks we get 93.45T for 27th (Friday), 204.9 for 18th (Saturday) and 261.6 for 29th (Sunday) of C&D waste.

About 92% of the C&D waste was comprised of 'Aggregates and dirt', which refers to the demolished concrete waste, rock, and sand from excavation works. However, most of the loads that contain sand, rocks, and even smaller concrete that have been smashed to smaller pieces are packed into polypropylene woven sacks and then transferred. This obstructed us to see exactly what was in these sacks and if all the sacks has the same content. We also asked the drivers about the contents and if its demolition waste, they would say it is either wood, Gaakundi (Dhivehi word for demolition waste and similar material) or sand.



Figure 5: (a) Soil and rock in polypropylene sacks (b) truck overflowing with wooden pellets and other mixed waste (c) Large pieces of demolished concrete (d) Truck overflowing with mostly wooden pellets with some metal containers on top.