School of GeoSciences

Dissertation
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MSc in Carbon Management

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MOTT MACDONALD

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Calculating the carbon impacts associated with surface flooding induced damage and disruption to transport systems within the City of Leeds using carbon foot-printing life cycle assessment.

A preliminary investigation aligned with Mott MacDonald's Leeds Flood Alleviation Scheme.

By Alexander Boden

ABSTRACT

The carbon impact associated with the clear-up, repair and disruption to transport services is an important, yet currently unexplored, consideration regarding the costs and benefits associated with disaster mitigation projects. This impact is being explored by the engineering firm Mott MacDonald, who are interested in determining the carbon benefits associated with the installation of the second part of their Leeds Flood Alleviation Scheme (LFAS2).

The aim of this dissertation is to investigate the carbon impact, in terms of Global Warming Potential (GWP) associated with the damage and disruption to transport infrastructure from future surface water flooding events in the city of Leeds, that would occur in the absence of LFAS2. This will provide an estimate of the afforded carbon benefit of LFAS2, which will prevent future flooding within Leeds up to a 1-in-200yr event. In addition, this dissertation will establish a set of carbon emissions benchmarks related to road and rail travel disruptions, to help quantity the carbon costs and benefits associated with future flood prevention. To achieve this, a carbon foot printing LCA method was employed. This employed primary transport damage data associated with the 1-in-200yr Storm Eva floods in 2015 and modelled flood extent data that incorporated the first phase of the Leeds Flood Alleviation Scheme (LSFA1). Additional information was extracted through interviews and literature review to aid method construction. The analysis identified debris disposal, infrastructure repair and transport disruption as the three major greenhouse gas related processes regarding surface water flooding events.

The results of the LCA showed that the total GWP associated with damage and disruption to transport networks, in a future 1-in-200yr flood event within the City of Leeds in the absence of LFAS2, was 3615.4t CO2e. Transport disruption and debris treatment comprised the largest contributions to the total GWP at 71.6% and 28.3% respectively. This result was likely an underestimate as the carbon foot-printing methodology only encompassed first order carbon impacts. In terms of justifying flood mitigation, as the construction of LFAS2 encompassed 27,700t CO2e, the carbon benefit afforded by protecting transport only equated to 13.1% of its own carbon cost and cannot justify mitigation from an environmental perspective.

The study did establish carbon benchmarks related to the additional GWP associated with disruption to rail and road travel per individual commuter. This was 4kg CO2e per disrupted commuter via road and 11kg CO2e per disrupted commuter via rail.

The study also highlighted the necessity of detailed record keeping in order to facilitate accurate estimates of GWP, as a limitation of this study was the lack of access to detailed information. Therefore, a record matrix was created to facilitate an accurate estimate of GWP in future floods.