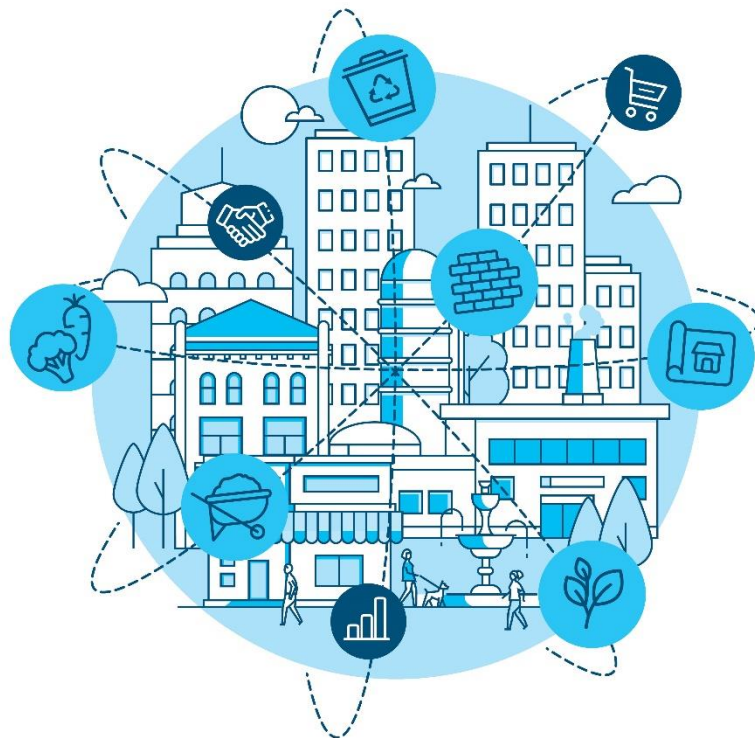




# Circular soil handling in Roskilde

Extract from the Demonstration Report

Municipality of Roskilde, Denmark



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This text describes Roskilde's experience in recycling concrete in a car park construction. The sections come from Roskilde's CityLoops demonstration report available [here](#).

# Circular soil management in Hall 11/12 area

In the test area Musicon, soil is treated like any other waste stream: it is kept separate and kept track of. The LCA calculations proving the environmental impact of excavation and moving of masses are used as arguments for planning and decision making to keep soil in the ground or use it on-site. In the Hall 11/12 area, the plan is to keep soil on-site.

In 2020-2021 initial investigations were conducted on the Musicon area covering Hall 11/12. The geotechnical and environmental parameters for the soil were measured and mapped in order to combine and use data in the planning process along with mapping of the other waste/material streams in the project area. After determination of the planning process further investigations have been completed in order to qualify the amount and quality of soil to be handled in the specific areas for the different developers. For instance, the soil streams for an area planned for a future parking house has been further investigated in close cooperation with the developer, the consulting engineer and the environmental authorities since the area is polluted. CO<sub>2</sub> calculations have been conducted and focus on soil balance has been kept as an overall goal for the project.

In connection with the project, it is expected to excavate approximately 4,800 m<sup>3</sup> of soil from the area and remove approximately 670 m<sup>3</sup> of pavement, concrete, and foundations.

It is planned to reuse suitable clean and slightly contaminated soil excavated from the area under the upcoming parking garage and in the drainage project on the remaining part of Hall 12, property number 9k.

For the construction of the parking garage, intermediate building, and parking area outside the building, an estimated 5,070 m<sup>3</sup> of backfilling is required. The drainage project is expected to be able to accommodate approximately 1,000 m<sup>3</sup> of soil from the parking garage. Similarly, it is expected that approximately 1,800 m<sup>3</sup> of crushed concrete from existing pavements can be incorporated into the future subbase construction under the parking garage, of which approximately 670 m<sup>3</sup> comes from pavements within the parking garage.

In the initial pre-classification, 420 m<sup>3</sup> of contaminated soil was identified, which needs to be disposed of from the site. This corresponds to 10% of the total pre-classified amount of soil. Assuming a similar distribution in the upcoming supplementary pre-classification, it is estimated that 480 m<sup>3</sup> of contaminated soil should be removed from the site. Similarly, it is expected that up to 4,320 m<sup>3</sup> of clean and slightly contaminated soil can be reused under the parking garage and in the drainage project.

Based on the estimated excavation quantities and backfilling capacity, a soil balance has been prepared for soil and crushed concrete from the parking garage project and the surrounding drainage project, see Table 7-1.

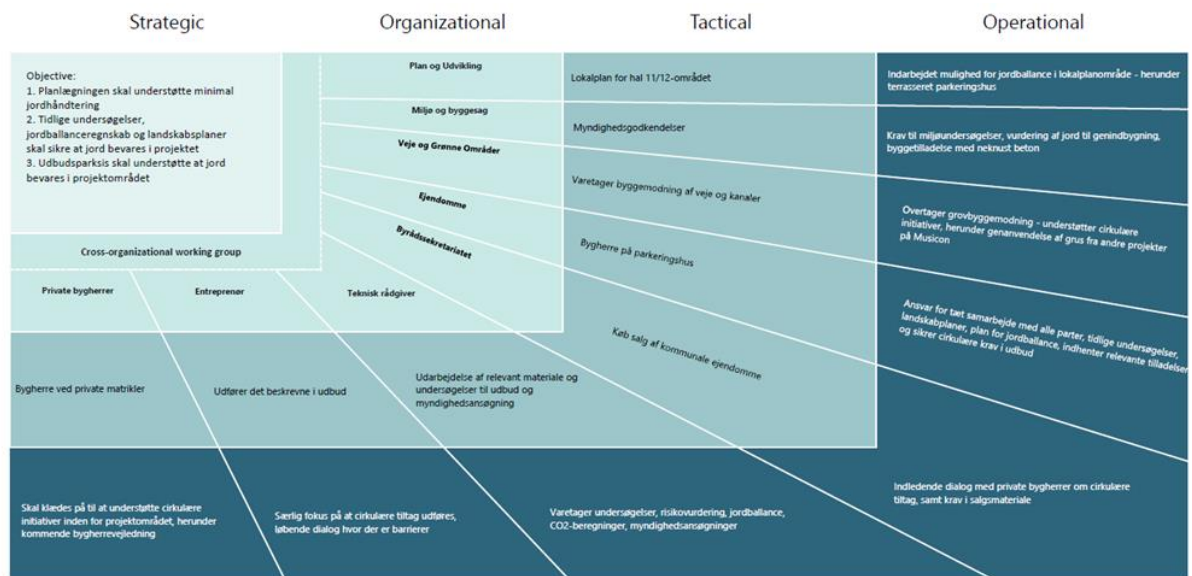
Tabel 7-1: Jordbalance fra de forventede afgravnings og genindbygnings mængder fra P-huset og omkringliggende afvandingsprojekt

	Jord m <sup>3</sup>	Knust Beton m <sup>3</sup>	Totale mængder m <sup>3</sup>
Afgravning fra P-husprojekt	-4.800	-670	-5.470
Afgravning udenfor P-husprojekt	0*	-1.130	-1.130
Genanvendt under P-husprojekt	3.270	1.800	5.070
Genanvendt i afvandingsprojektet	1.050	0	1.050
Bortkørsel til jordmodtager	480	0	480
<b>Jordbalance</b>	<b>0</b>	<b>0</b>	<b>0</b>

\*Afgravning af jord ifm. afvandingsprojektet ikke estimeret men antages genindbygget i projektet

## Roadmap for soil management

The roadmap has proved to be useful on an initial stage in any given project involving possible soil excavation. The roadmap was useful on project level to secure an overall designation on all the involved authorities, advisers, builders, developers and so on. An initial roadmap for the project involving Musicon Hall 11/12 project area is shown below.



This template for an interactive roadmap was developed in Denmark by "CityLoops" and "Partnerskab for overskudsjord og ressourcer" in cooperation with the Capital Region of Denmark. The named parties cannot be held responsible for any use of the template. Use of the template is not restricted.



## Interviews identifying barriers

Roskilde, in cooperation with Roskilde University, the Municipality of Høje-Taastrup and Capital Region Denmark, has performed a series of interviews with stakeholders about the barriers to implementing a great degree of soil reuse on site. Barriers to soil reuse have shown to be lack of initial investigations regarding pollution and geotechnical soil parameters.

Cooperation between the consulting engineer and the authorities have proved to be essential for optimising soil reuse and at the same time secure people and the environment. It is important to commit the developer to keep focus on the potential for reuse by presenting CO<sub>2</sub> calculations for soil handling along with calculations for handling the other material streams on the building site. Finally, retention of knowledge and ongoing focus on the goal for circular soil reuse has shown to be improved by keeping the same consulting engineer and keeping an ongoing inclusion of the environmental authorities and the developer. The results are currently used in the applicable estate management strategies conducted by Roskilde Community.

## Instrument for predicting future excavated soil production

Roskilde has used this tool to predict annual volumes of future excavated soil within a period of 12 years (2020-2031). It will be evaluated by comparing predicted soil volumes with annual soil volumes reported. The prediction is based on a “business as usual” scenario, considering a situation where municipal planning and construction activities are performed without paying special attention to excavation and production of excavated soil. It is based on historical analysis and knowledge of major construction projects that will take place in the future.

The report on making a prognosis for Roskilde is available [here](#) (in Danish).

YEAR	TON
2020	150.000
2021	250.000
2022	200.000
2023	250.000
2024	200.000
2025	300.000
2026	300.000
2027	200.000
2028	150.000
2029	100.000
2030	100.000
2031	100.000

Total	2.3 million tonnes
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Table 1- prognosis for amounts of excess soil from construction and infrastructure projects in Roskilde Kommune

Roskilde has evaluated the tool by comparing predicted soil volumes with annual soil volumes notified and reported in the registration system Flytjord.dk. Registration of soil transportation notified to the Municipality of Roskilde in 2022 amounts to 1.7 million tonnes of soil and it is estimated that approximately 1.2 million tonnes of soil have actually been loaded on trucks and transported to a reception facility in or outside the Municipality of Roskilde. This amounts to a calculated CO<sub>2</sub> load from soil transportation at 3400 tonnes CO<sub>2</sub>. The registration system Flytjord.dk has a built-in uncertainty since not all soil transportation must be notified and the amount of soil actually transported is not always reported. Independent of this uncertainty it is clear that the evaluation showed that the soil prognosis underestimated the amount of soil transported from locations in Roskilde municipality. Possible sources of errors in Roskilde are that a major part of the building activities in Roskilde are conducted on areas that were already developed several years ago. Since the prognosis focuses on new development areas this is not included. Furthermore, big amounts of soil are transported between the approved soil handling sites, and this also leads to an underestimation of the transported soil amounts in Roskilde.

In the CityLoops demonstration phase, the prognosis has been used to explore what can be done on an overall view. If a certain development area potentially can generate big amounts of soil, then it can be useful to mobilise planning efforts to avoid soil excavation and transportation outside the project area – creating both economic and CO<sub>2</sub> savings.

The results indicate that the tool underestimated the annual amount of soil handled in Roskilde. However, the cases on Musicon have shown a big potential for minimising soil handling by incorporating local reuse of soil on the project site.

## Framework for circular soil management

Roskilde is currently in progress with incorporating the results of a circular soil strategy in urban development strategies as well as real estate management strategies. It will be a set of levers, procedures or tools that are developed as they go according to how to address each identified barrier. The overall bearing mark is to rank soil management in order to promote soil handling linked with the CO<sub>2</sub> load.

For tendering, prices are needed to be able to calculate more accurately the economic potential of circular soil management in the future. The effect of the circular soil strategy will be evaluated on an annual basis by comparing predicted soil volumes (tool 4) with soil volumes actually produced in corresponding years.

Current project status concentrates on the description of the procedure regarding necessary steps in the initial work prior to the project planning, and simultaneously with the construction process.

The introduced barriers have been designated and incorporated in Roskilde's work with a new builder's guide, which address how these barriers can be pinpointed and minimised in order to advance circular soil management. A final draft of Builders guide will be introduced ultimo 2023.



# CITYLOOPS

CityLoops is an EU-funded project focusing on construction and demolition waste (CDW), including soil, and bio-waste, where seven European cities are piloting solutions to be more circular.

Høje-Taastrup and Roskilde (Denmark), Mikkeli (Finland), Apeldoorn (the Netherlands), Bodø (Norway), Porto (Portugal) and Seville (Spain) are the seven cities implementing a series of demonstration actions on CDW and soil, and bio-waste, and developing and testing over 30 new tools and processes.

Alongside these, a sector-wide circularity assessment and an urban circularity assessment are to be carried out in each of the cities. The former, to optimise the demonstration activities, whereas the latter to enable cities to effectively integrate circularity into planning and decision making. Another two key aspects of CityLoops are stakeholder engagement and circular procurement.

CityLoops started in October 2019 and will run until September 2023.



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**Disclaimer:** The sole responsibility for any error or omissions lies with the editor. The content does not necessarily reflect the opinion of the European Commission. The European Commission is also not responsible for any use that may be made of the information contained herein.