



# Collecting data in Griffiersveld Apeldoorn

Organisations: Municipality of Apeldoorn and Saxion UAS

Name: Bram Entrop

Date: December 7<sup>th</sup>, 2021



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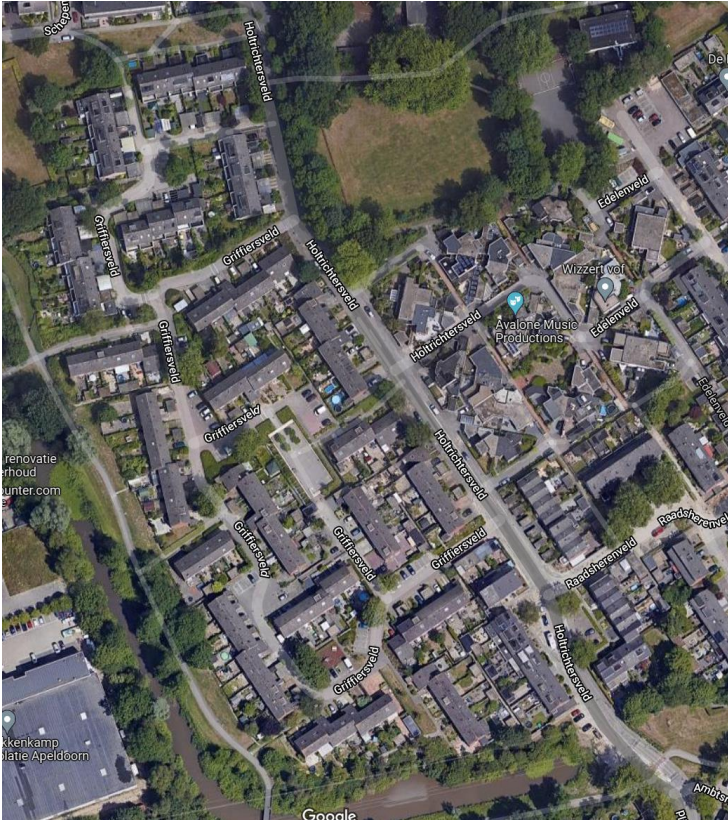
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5. CO<sub>2</sub> indicator
6. Closure





# Introducing the case

3000 m<sup>2</sup> of pavement, sidewalks, green space, and parking space along the residential street Griffiersveld in Apeldoorn will be redesigned and reconstructed in a circular way.



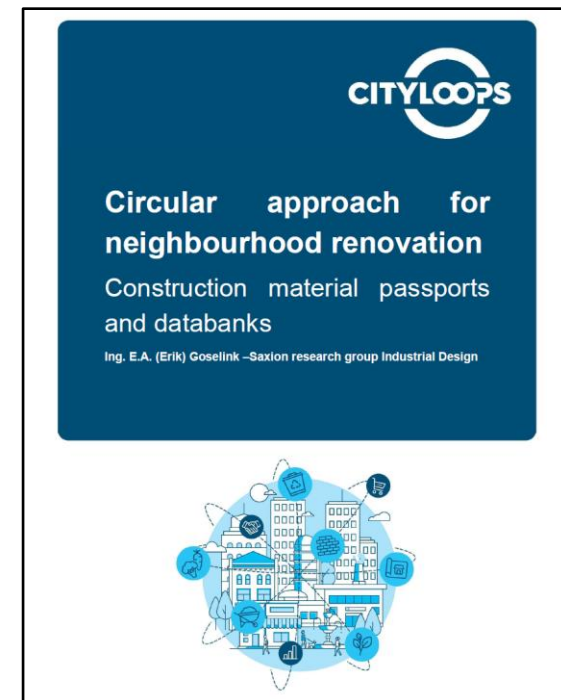


# Material & project passports

The top five requirements for a material passport are (Goselink, 2021):

1. Includes bill of materials (BOM) with quantities, material composition, and location (GIS) of the materials on site;
2. Includes inspection and maintenance history of the materials on site (ideally inspect more often when end of life approaches in order to repair at the right moment);
3. Includes technical lifetime expectancy of materials on site;
4. Includes 'End of life options' of the materials;
5. Complies with a uniform system (data stored for structured output).

In the field of road maintenance soil/sand, concrete, baked clinkers and asphalt (hot or cold) can be distinguished as the main streams.



# Storing data

Apeldoorn has a project passport available in the form of a GIS-based asset management software GBI.

Approximately every two years a visual inspection is being conducted.

Every road section can be assessed by 53 characteristics and this number can be increased upto 200 characteristics.

The characteristics address a.o. the road section's identity, location, typology, inspection date, year of origin, maintenance year, appearance, safety level, width, surface and perimeter.

The structure to store data is available, but not all data is collected.









Microsoft Excel ribbon showing Font, Alignment, Number, Styles, Cells, Editing, Analysis, and Sensitivity tabs. The Styles tab is active, showing Conditional Formatting, Check Cell, Explanatory, Input, Linked Cell, and Note options.

Worksheet name: Z1. Formula bar: Randschade asfalt.

	A	B	E	F	G	H	I	J	L	M	N	O	P	R	U	X	Y	AA
1	ID	OBJECT_GUID	Inspectiedatum	Onoffenheden elementen	Verhardingstype	Verhardingsfunctie	STD_Ondergrond	Binnen bebouwde kom	KL_Inspectiegebied	Openbare ruimte	Verhardingssoort	Dwarsonvlakheid elementen	Oppervlakte	Breedte	Buurt	STD_Rijstrook	Wijk	Wegtype
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4	17966	CCCE0CFB606B4B02E0400A0A57322187	18-4-2019 00:00:00	0	Elementen	voetpad	Zand	Y	Elementen	Looiersdreef	Tegels 30x30	0	83,22	2,12	Matendreef	links	Zuidoost	weg in verblijfsgebied
5	18107	CCCE0CFB60F54B02E0400A0A57322187	22-4-2019 00:00:00	4	Elementen	voetpad	Zand	Y	Elementen	Heemradenlaan	Tegels 30x30	1	162,97	1,42	Matenhoeve	links	Zuidoost	weg in verblijfsgebied
6	304985	FF436F5666E3DC1DE040007F01017A5A	17-4-2019 00:00:00	0	Elementen	parkeervak	Zand	Y	Elementen	De Voorwaarts	BSS overig	0	89,84	4,97	De Voorwaarts		Zuidoost	weg in woongebied
7	8123	CCCE0CFB370C4B02E0400A0A57322187	23-4-2019 00:00:00	4	Elementen	voetpad	Zand	Y	Elementen	Sluiswachtershoeve	Tegels 30x30	0	102,54	2,14	Matenhoeve	beide	Zuidoost	weg in verblijfsgebied
8	304986	FF436F5666E4DC1DE040007F01017A5A	17-4-2019 00:00:00	0	Elementen	parkeervak	Zand	Y	Elementen	Zuthphensestraat	BSS overig	0	183,44	9,79	De Voorwaarts		Zuidoost	weg in woongebied
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15	304982	FF436F5666E0DC1DE040007F01017A5A	17-4-2019 00:00:00	0	Elementen	parkeervak	Zand	Y	Elementen	De Voorwaarts	BSS overig	0	118,52	5	De Voorwaarts		Zuidoost	weg in woongebied
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17	16636	CCCE0CFB5BE44B02E0400A0A57322187	17-4-2019 00:00:00	5	Elementen	parkeervak	Zand	Y	Elementen	Imkersdreef	BSS overig	0	72,8	5,63	Matendreef	links	Zuidoost	weg in woongebied
18	13203	CCCE0CFB4D3C4B02E0400A0A57322187	24-4-2019 00:00:00	8	Elementen	parkeervak	Zand	Y	Elementen	Pottenbakkersdonk	BSS keiformaat	0	29,92	4,57	Matendonk	beide	Zuidoost	weg in woongebied
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20	18890	CCCE0CFB62964B02E0400A0A57322187	18-4-2019 00:00:00	0	Elementen	voetpad	Zand	Y	Elementen	Zadenlaan	Tegels 30x30	0	30,02	1,1	Matendonk	links	Zuidoost	weg in verblijfsgebied
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22	6600	CCCE0CFB32D44B02E0400A0A57322187	24-4-2019 00:00:00	0	Elementen	rijbaan	Zand	Y	Elementen	Holtrichtersveld	BSS keiformaat	0	81,32	4,8	Matenveld	beide	Zuidoost	licht belaste weg
23	304984	FF436F5666E2DC1DE040007F01017A5A	17-4-2019 00:00:00	0	Elementen	parkeervak	Zand	Y	Elementen	De Voorwaarts	BSS overig	0	91,12	4,93	De Voorwaarts		Zuidoost	weg in woongebied
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27	6102	CCCE0CFB2F364B02E0400A0A57322187	23-4-2019 00:00:00	0	Elementen	parkeervak	Zand	Y	Elementen	Bouwmeestershoeve	BSS keiformaat	0	58,04	4,94	Matenhoeve	rechts	Zuidoost	weg in woongebied
28	5827	CCCE0CFB2FCA4B02E0400A0A57322187			Elementen	inrit	Zand	Y	Geen inspectie	Arthurgaarde	BSS keiformaat	7,72	1,67	Matengaarde	links	Zuidoost	weg in woongebied	
29	10192	CCCE0CFB401E4B02E0400A0A57322187	22-4-2019 00:00:00	0	Elementen	voetpad	Zand	Y	Elementen	Gildenlaan	Tegels 30x30	0	13,77	3,11	Matengaarde	rechts	Zuidoost	weg in verblijfsgebied
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35	13262	CCCE0CFB4E184B02E0400A0A57322187	18-4-2019 00:00:00	5	Elementen	rijbaan	Zand	Y	Elementen	Heelmeestersdreef	BSS keiformaat	0	24,1	3,91	Matendreef	beide	Zuidoost	weg in woongebied
36	23594	CCCE0CFB76A04B02E0400A0A57322187			Elementen	inrit	Zand	Y	Geen inspectie	Barnewinkel	BSS keiformaat	30,7	4,18	Groot Zonnehoeve	rechts	Zuidoost	weg in woongebied	
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39	7134	CCCE0CFB357D4B02E0400A0A57322187	24-4-2019 00:00:00	7	Elementen	rijbaan	Zand	Y	Elementen	Pottenbakkersdonk	BSS keiformaat	0	255,62	6,99	Matendonk	beide	Zuidoost	weg in woongebied
40	320644	30623910FFF8F6D1E050007F01010E97	23-4-2019 00:00:00	0	Elementen	parkeervak	Zand	Y	Geen inspectie	Ferguutgaarde	BSS keiformaat	0	13,51		Matengaarde		Zuidoost	weg in woongebied
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42	15909	CCCE0CFB58BC4B02E0400A0A57322187	19-4-2019 00:00:00	7	Elementen	voetpad	Zand	Y	Elementen	Houtsnijdershorst	Tegels 30x30	0	89,21	1,5	Matenhorst	beide	Zuidoost	weg in verblijfsgebied
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# Collecting data



## De Wegenscanners

Date scan 7<sup>th</sup> of April 2020

Gamma spectrometer and IDS RIS Hi-Pave ground penetrating radar system

Output: digitally in PDF and in ArcGIS (shapefiles)

Costs: € 2750,- (excl. VAT)

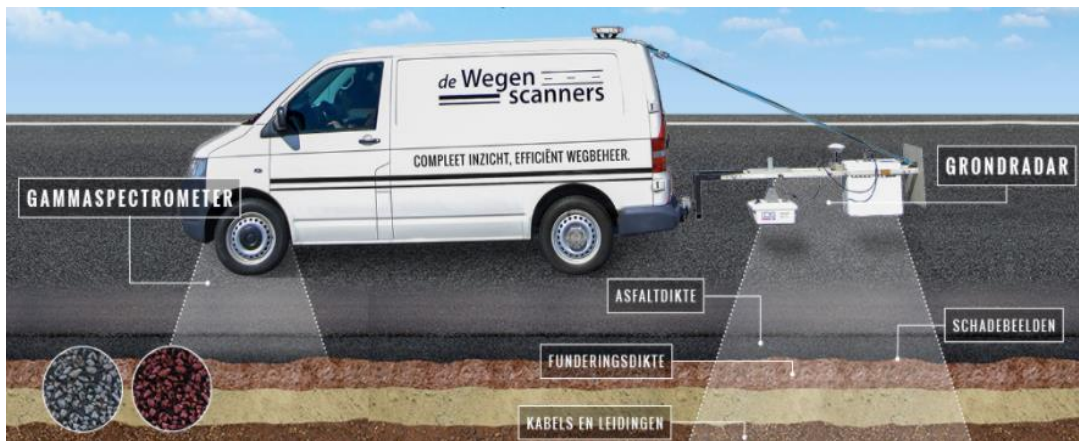
## InfraFocus

Data scan 17<sup>th</sup> of June

LiDaR and panoramic hi-res camera

Output: report in PDF, quantities in Excel and GeoJSON, pointcloud LAS-file and digital panoramic images

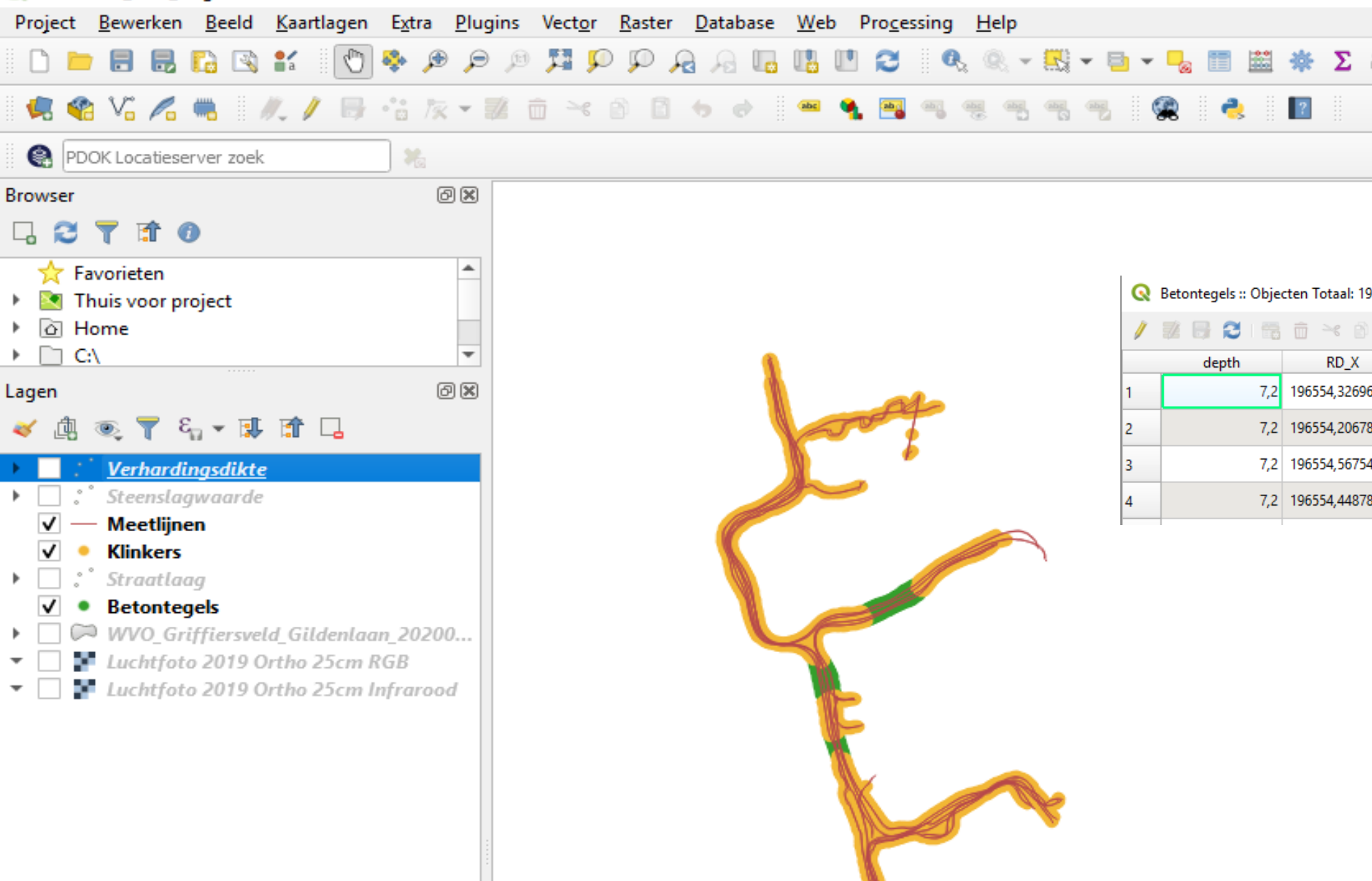
Costs: € 6795,- (excl. VAT)







De Wegenscanners

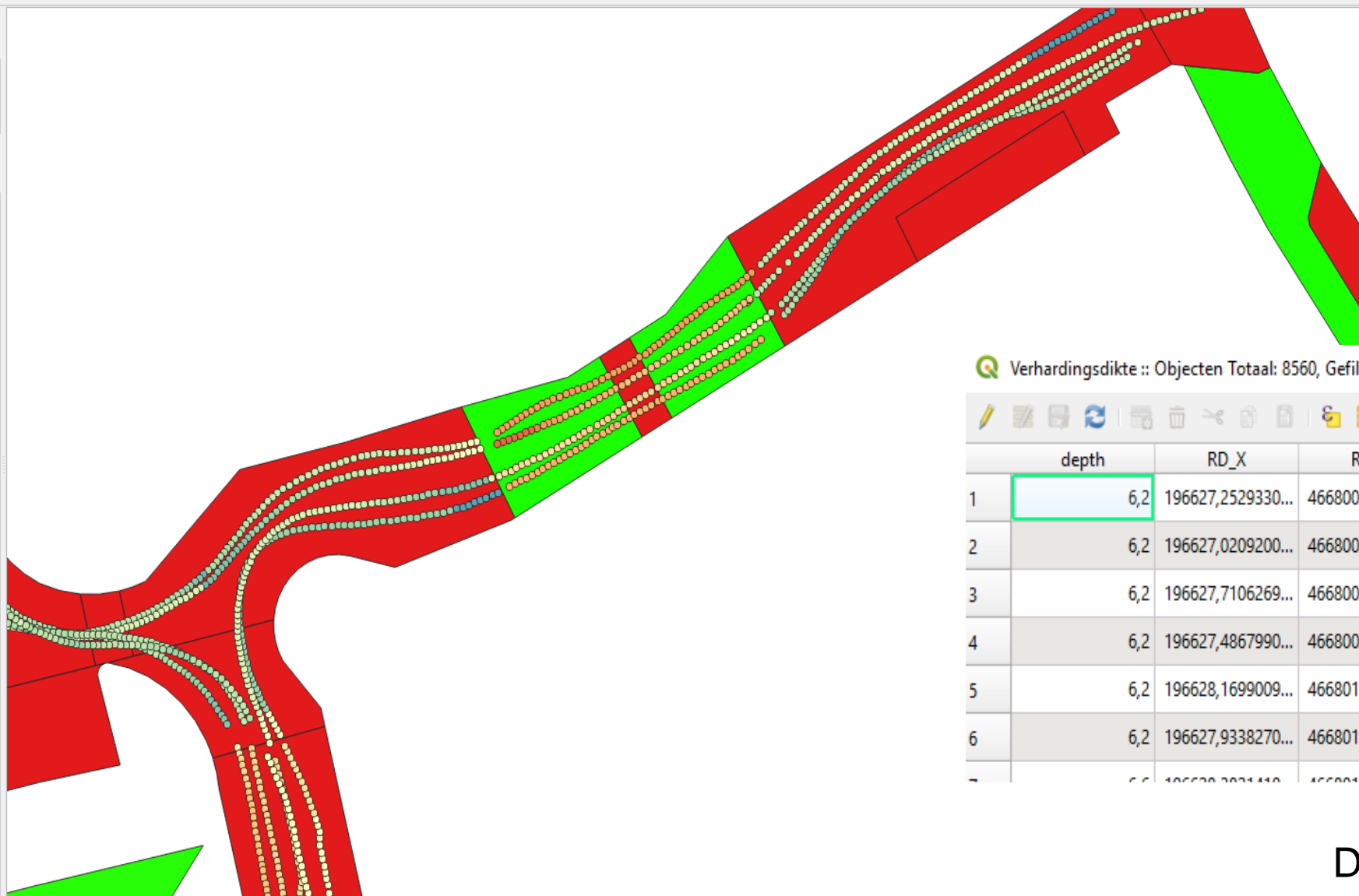


Betontegels :: Objecten Totaal: 1922, Gefilterd: 1922, Geselecteerd

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2	7,2	196554,2067870...	466785,5353550...
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De Wegenscanners





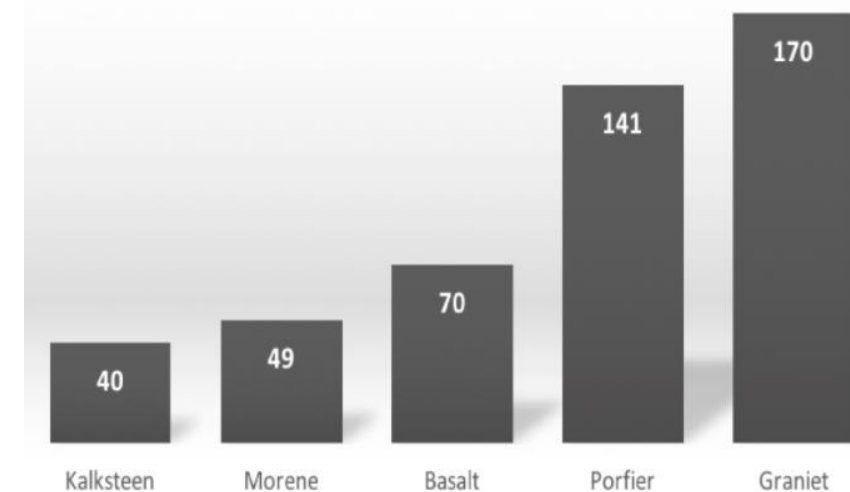
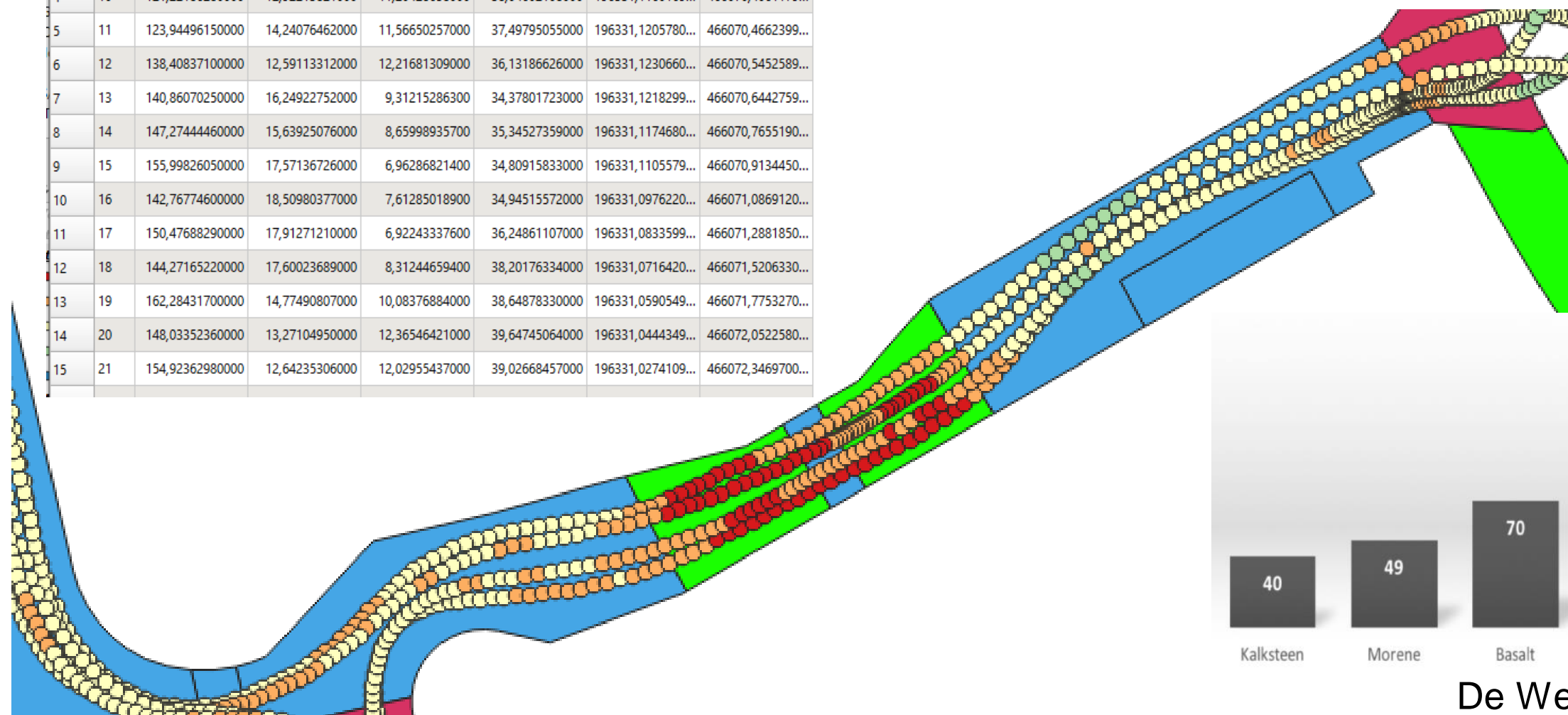
Verhardingsdikte :: Objecten Totaal: 8560, Gefilterd: 8560, Geselecteerd: 0



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3	6,2	196627,7106269...	466800,9411500...
4	6,2	196627,4867990...	466800,7393530...
5	6,2	196628,1699009...	466801,3532540...
6	6,2	196627,9338270...	466801,1434990...

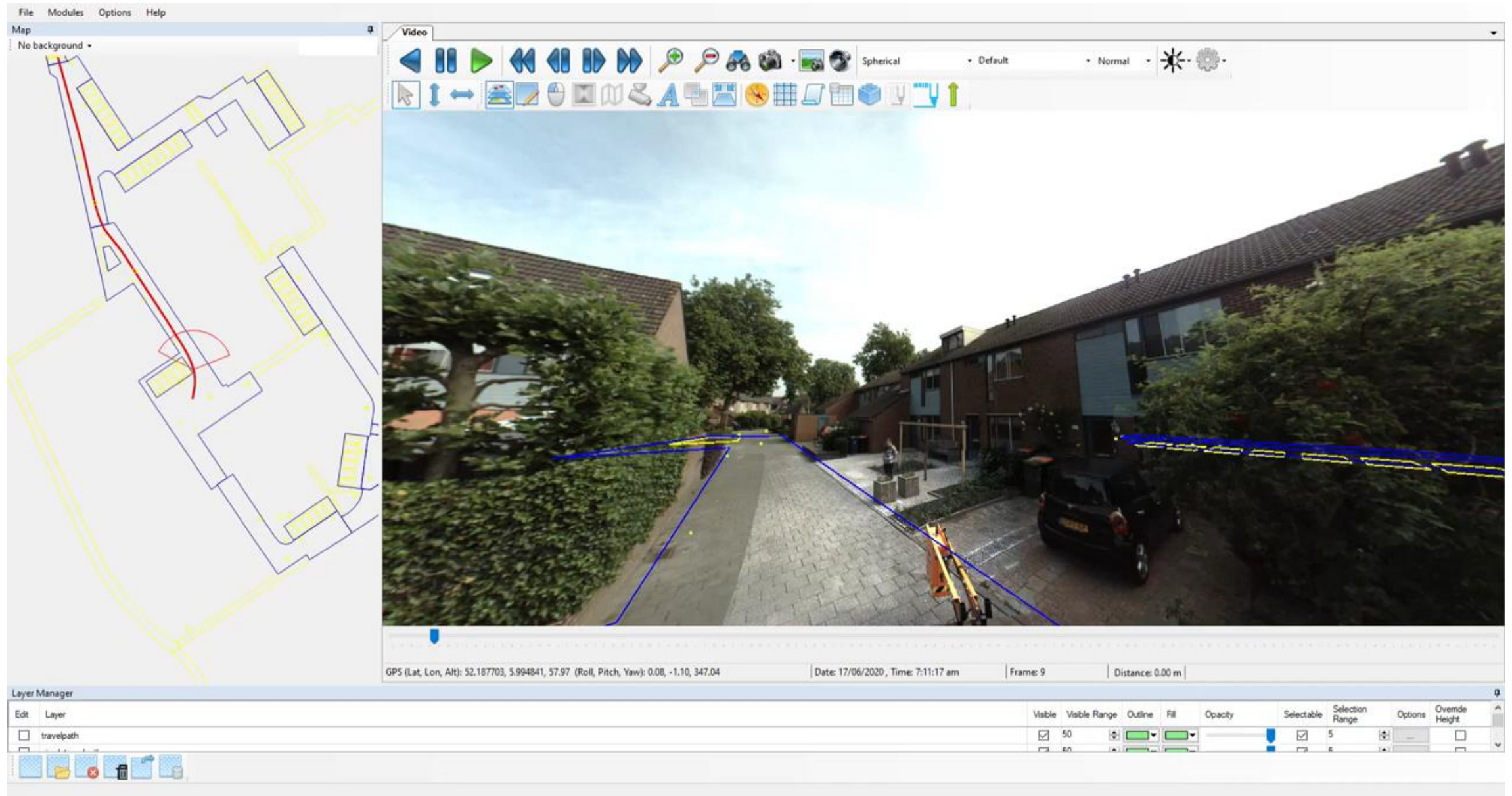
De Wegenscanners

	sectrui	40_K	238_U	232_Th	SSW_versch	RD_X	RD_Y
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2	8	120,38196560000	9,80786323500	12,96309853000	40,15852318000	196331,1045050...	466070,3348119...
3	9	117,13914490000	11,59746838000	11,63377285000	38,03551693000	196331,1098129...	466070,3626730...
4	10	121,22186280000	12,92213821000	11,20428658000	38,04602108000	196331,1160169...	466070,4061179...
5	11	123,94496150000	14,24076462000	11,56650257000	37,49795055000	196331,1205780...	466070,4662399...
6	12	138,40837100000	12,59113312000	12,21681309000	36,13186626000	196331,1230660...	466070,5452589...
7	13	140,86070250000	16,24922752000	9,31215286300	34,37801723000	196331,1218299...	466070,6442759...
8	14	147,27444460000	15,63925076000	8,65998935700	35,34527359000	196331,1174680...	466070,7655190...
9	15	155,99826050000	17,57136726000	6,96286821400	34,80915833000	196331,1105579...	466070,9134450...
10	16	142,76774600000	18,50980377000	7,61285018900	34,94515572000	196331,0976220...	466071,0869120...
11	17	150,47688290000	17,91271210000	6,92243337600	36,24861107000	196331,0833599...	466071,2881850...
12	18	144,27165220000	17,60023689000	8,31244659400	38,20176334000	196331,0716420...	466071,5206330...
13	19	162,28431700000	14,77490807000	10,08376884000	38,64878330000	196331,0590549...	466071,7753270...
14	20	148,03352360000	13,27104950000	12,36546421000	39,64745064000	196331,0444349...	466072,0522580...
15	21	154,92362980000	12,64235306000	12,02955437000	39,02668457000	196331,0274109...	466072,3469700...



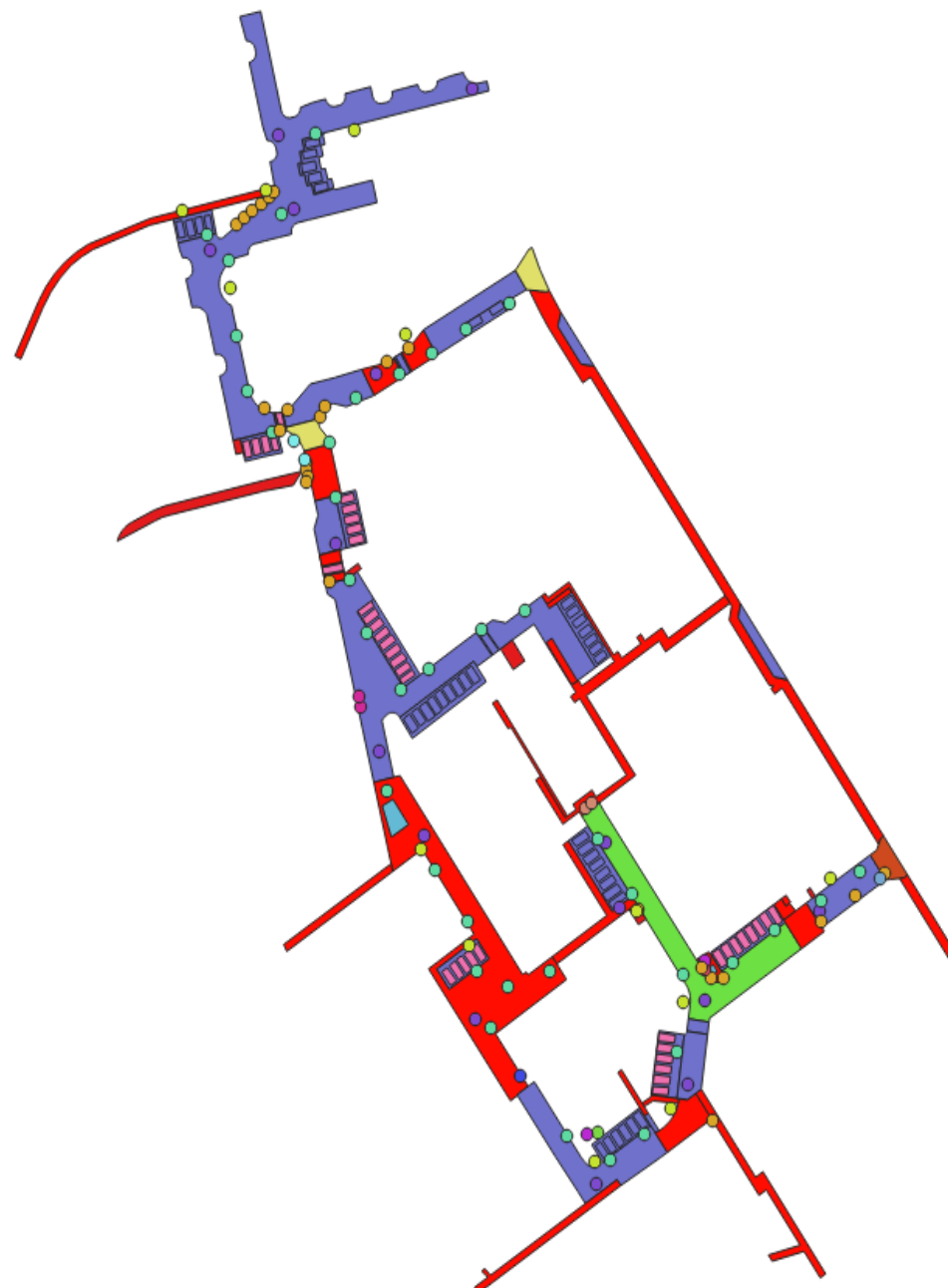
De Wegenscanners





### Apeldoorn punten

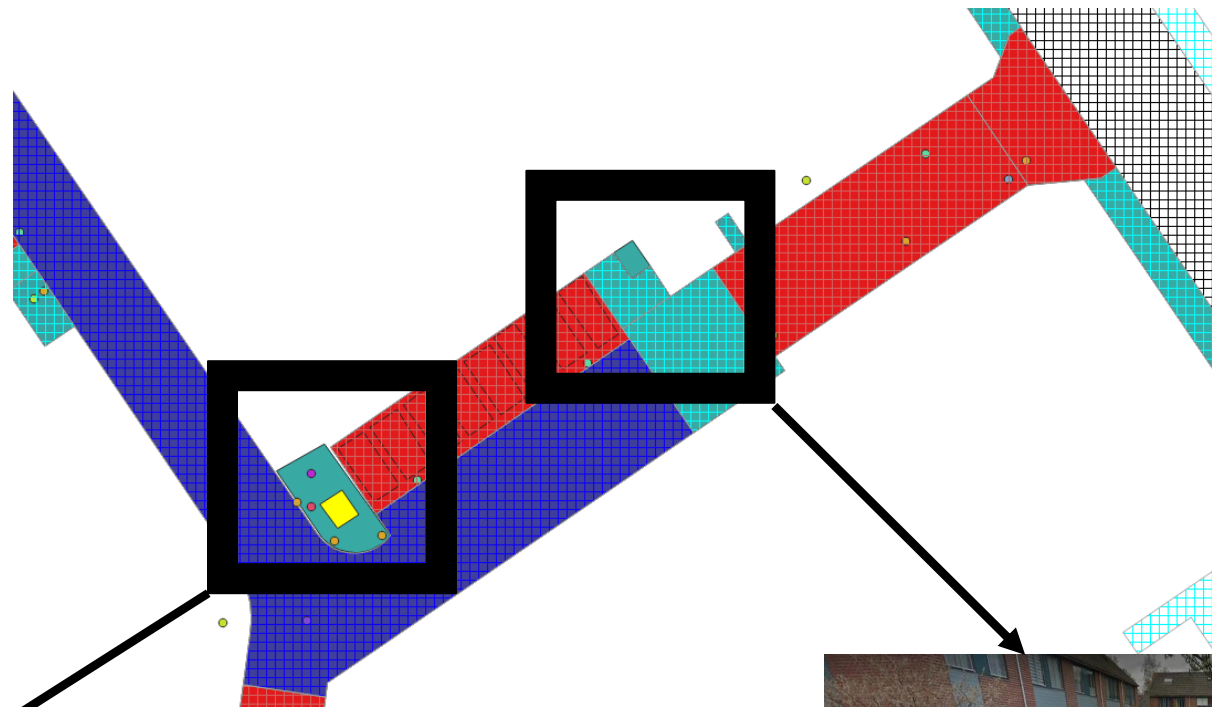
- Afvakbak
- Afvalbak
- Bank
- Betonblok
- Diamantkoppaal
- Inspectieput
- Lichtmast
- put overig
- Put overig
- Staatkolk
- Straatkolk
- Verkeersbord



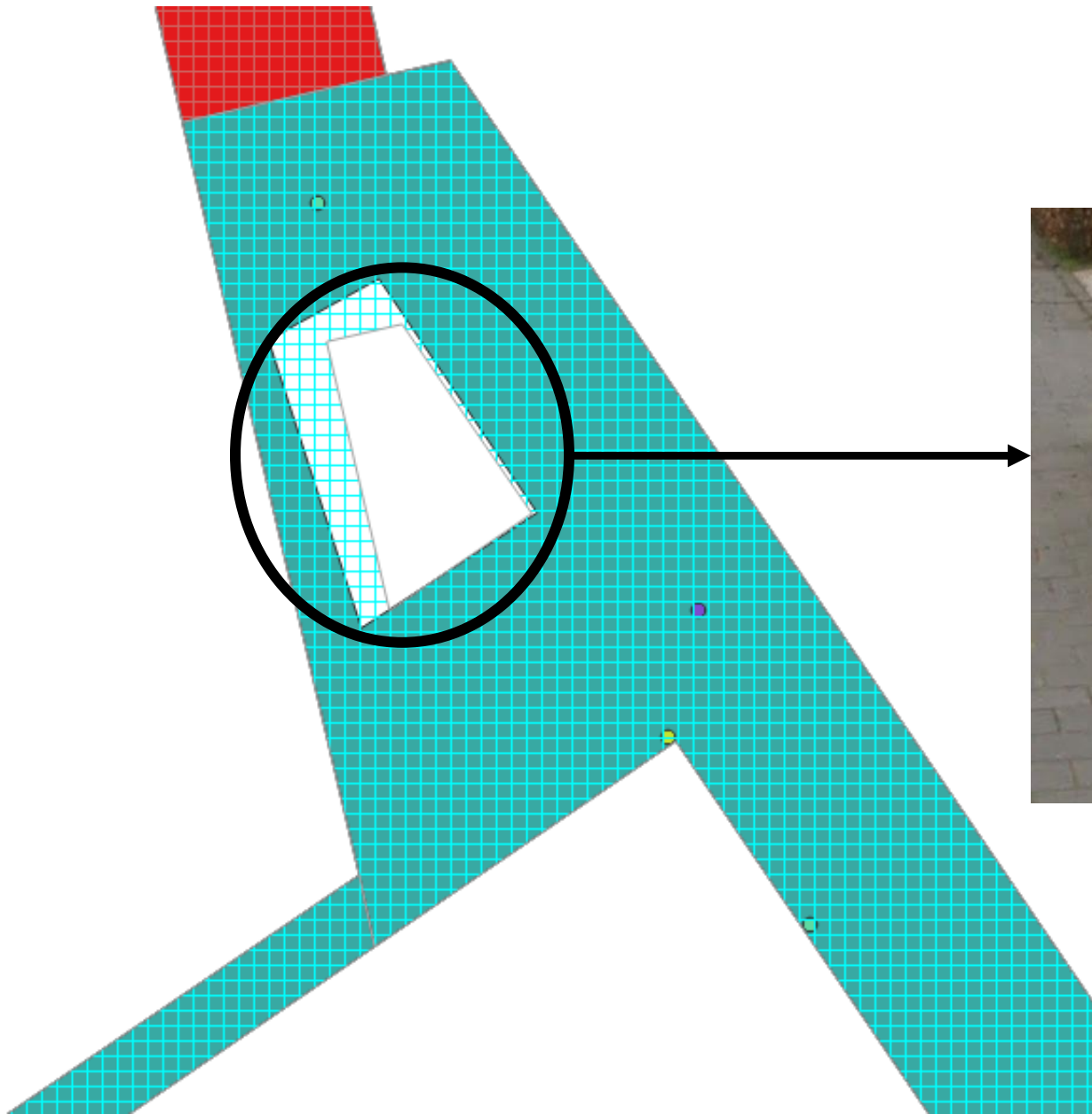
### Apeldoorn vlakken

- BSS
- BSS keiformaat
- BSS Keiformaat
- BSS overig
- Sierbestrating
- Tegels 30x30
- Tegels overig





InfraFocus





# Deriving a CO<sub>2</sub>-indicator

Based on Kellermann's CO<sub>2</sub>-indicator a Dutch version was developed. During the renovation of Griffiersveld the plan is to collect data.

AutoSave On v5\_Calculator\_LH - Last Modified: 29 June

File Home Insert Page Layout Formulas Data Review View Help

Clipboard Font Alignment Number Styles Cells Editing

K19

not completed Concrete tiles  
completed Concrete bricks  
completed Soil  
completed Asphalt

All cells that are marked blue need to be entered.  
Blue cells with text are drop down menus, here it is asked to make a choice

LCI (Concrete tiles)				
Loading capacity lorry	tons	Enter own capacity a		x
Weight empty lorry	tons	Enter weight empty lorry a	19,00	v
Total distance to waste depot/landfill	km		50,00	v
Highway distance to waste depot/landfill	km		5,00	v
Total distance to collection point/storage site	km		48,00	v
Highway distance to collection point/storage site	km		10,00	v
Amount of concrete tiles	~choose unit~		250,00	x
Reuse percentage	%		80,00	v
Concrete tile transport, kg CO <sub>2</sub> /(km*tons)			#DIV/0!	
Concrete tile transport, kg CO <sub>2</sub> /(km*tons)			#DIV/0!	

Comments

When choosing m2, a density of ... and a thickness of 6 mm are taken into account

The percentage of the material that is going to be reused

Transport emission of concrete tiles (waste depot/landfill)

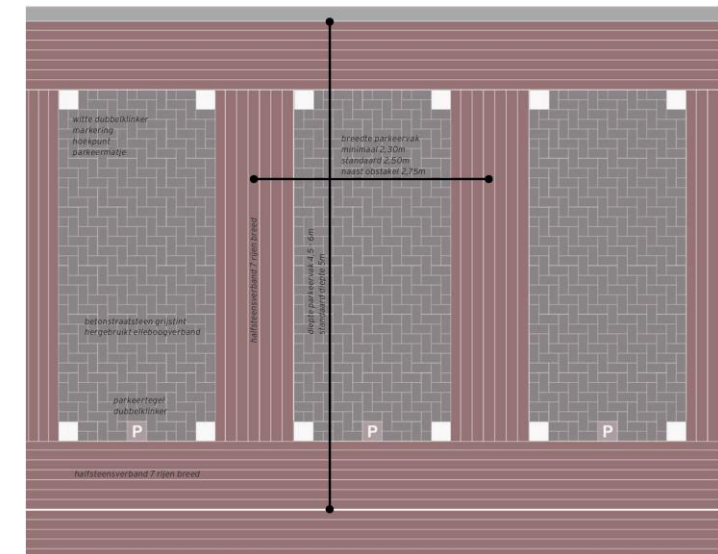
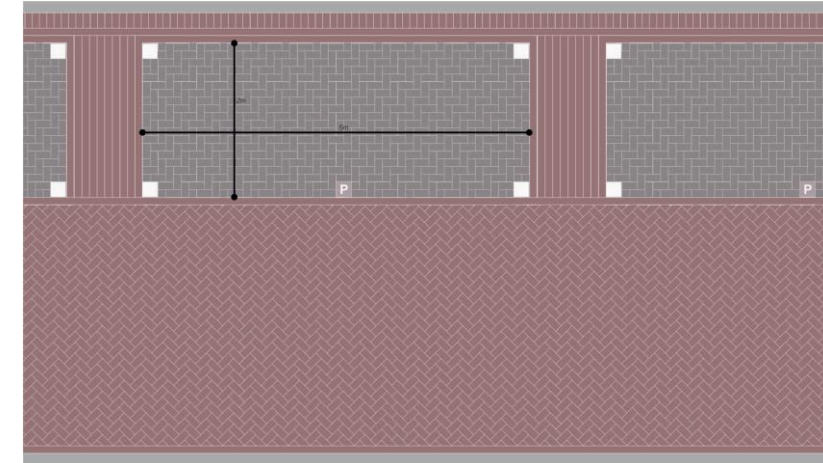
Total transport emission concrete tiles (collection point/storage site)

Input (calculator) Throughput (emission factors) Output (CO<sub>2</sub> saving potential)

# Parking space

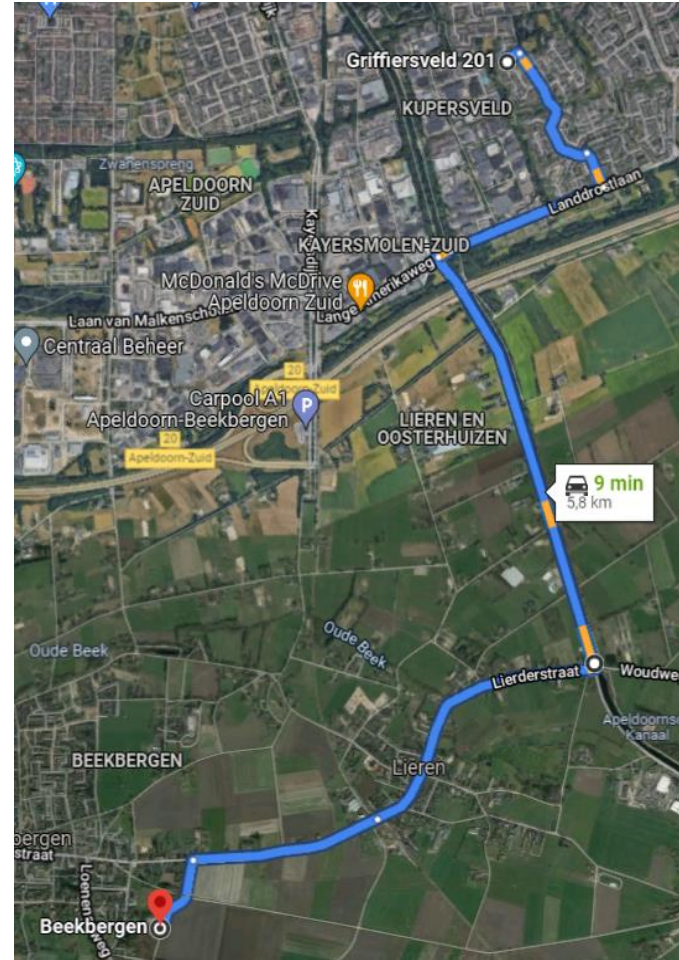
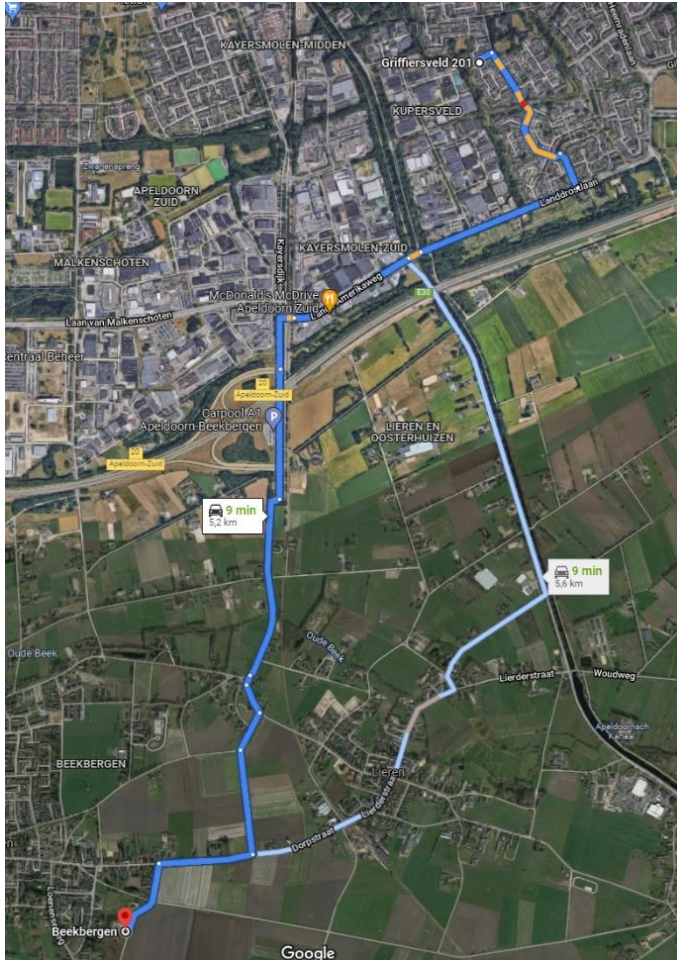


When 535 m<sup>2</sup> of the current concrete pavers are going to be reused in parking spots, this could save 9,51 kg CO<sub>2</sub>/m<sup>2</sup> (Biezemans, 2021) due to a lower virgin material demand and up to ±100 kg CO<sub>2</sub> (Hagen et al., 2021) by means of less transport.





# Transport



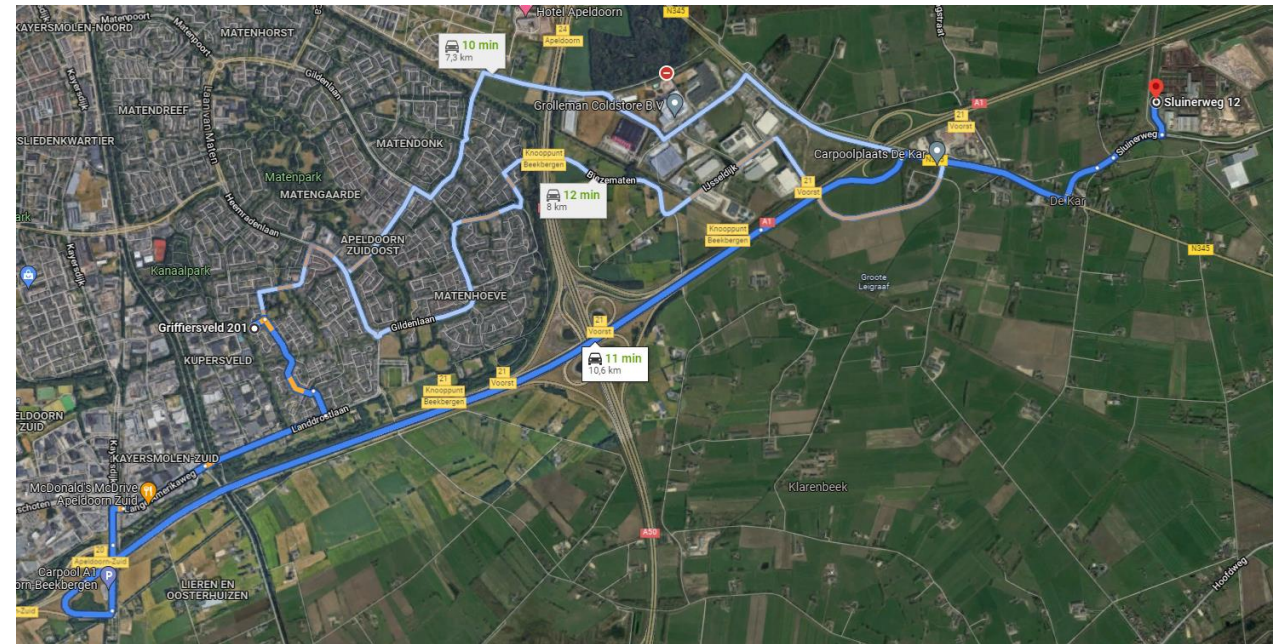
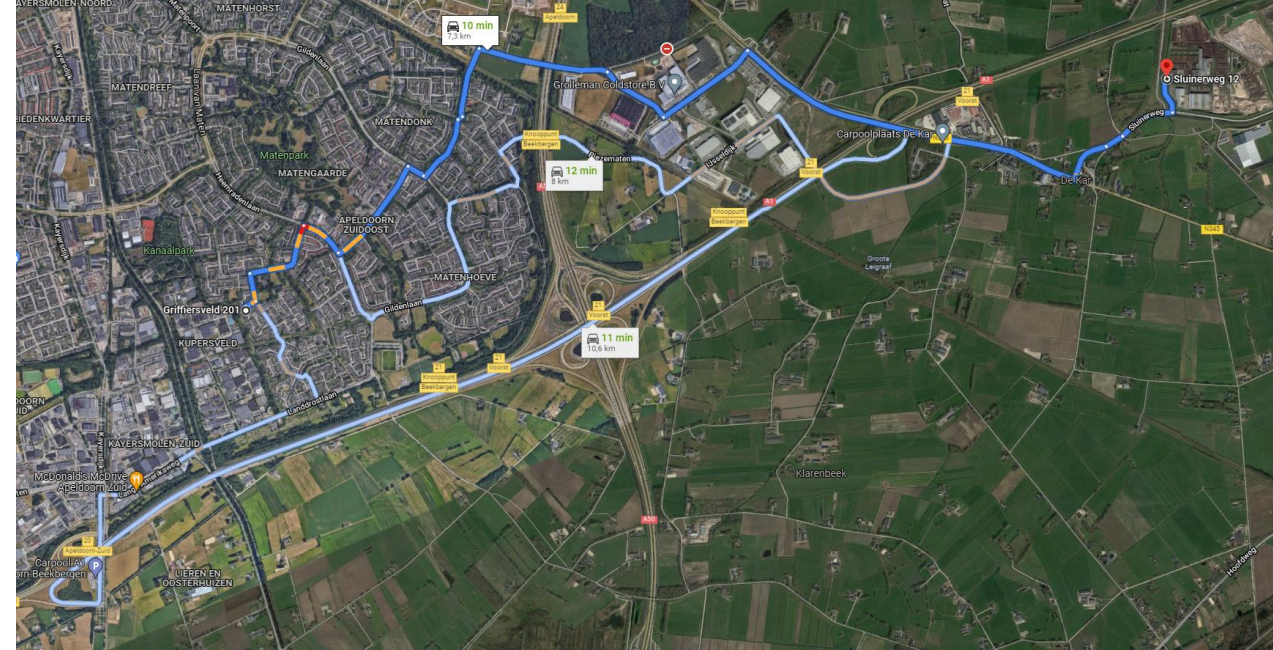
Transport routes to the material depot of the municipality of Apeldoorn.





# Transport

Transport routes to the waste processing plant of Attero.





# Closure



We still think very much in terms of quantities of materials, but it is a challenge to find out what exactly makes up their quality and the expected remaining life span of a particular road section.

The structure to store data is available, but it is expensive and time consuming to keep this system up to date, to collect all data necessary to close material loops and to provide input to a platform that enables us to offer these products at a(n) (online) market.

What will happen or will be decided when actual pavers, tiles and curb-stones are going to be taken out of the street by experienced pavers?

# Suggestions for further reading



Brinke, R.J. ten, et al., 2021. *Designing and realizing circular urban road renovation*

Entrop, A.G., 2021. *Developments to come to a circular construction economy; experiences in facilitating a local soil and sand depot.*

Entrop, A.G., 2021. *The road to circularity; a framework and experiences collecting road data in a circular renovation process (under review)*

Entrop, A.G., Hagen, L., Leeuwen J. van (Work in progress). *Aligning the actors in circular road renovation projects; a process journey in Apeldoorn*

Goselink, E.A., 2021. *Circular approach for neighbourhood renovation; construction material passports and databanks.*

Hagen, L., Entrop, A.G., (Work in progress). *Deriving and testing a CO<sub>2</sub>-indicator for Dutch infrastructure projects.*

Poutiainen, S., Willoughby, N., Otten, B., 2020. *Facultative educational exploration circular material usage Griffiersveld Apeldoorn*

Tartarin, T., 2021. *Developing a circular business model for the municipality of Apeldoorn.*





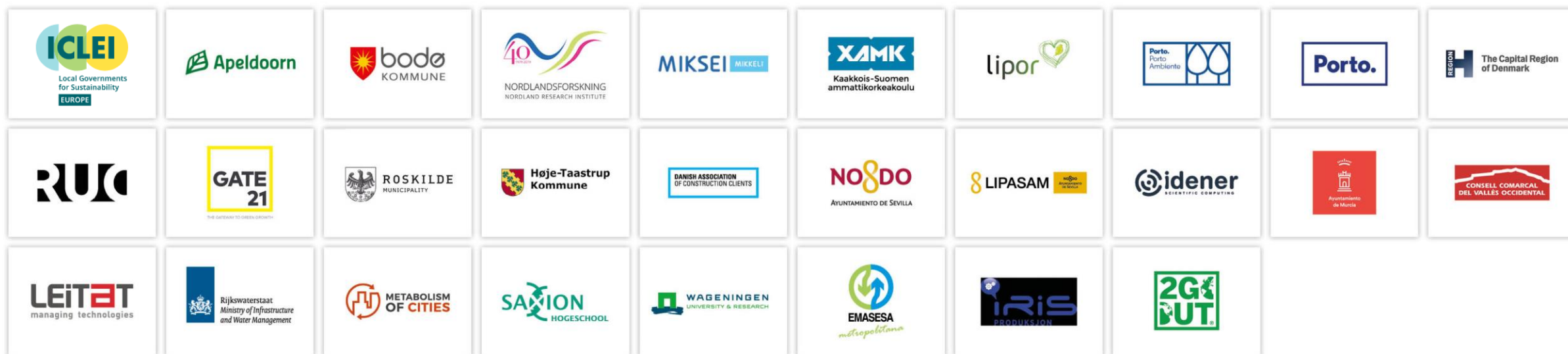
**THANK YOU  
VERY MUCH!**

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