A Spatio-Temporal Method for Impact Assessment

Organic Waste Collection in Amsterdam

Roos Teeuwen, June 2018

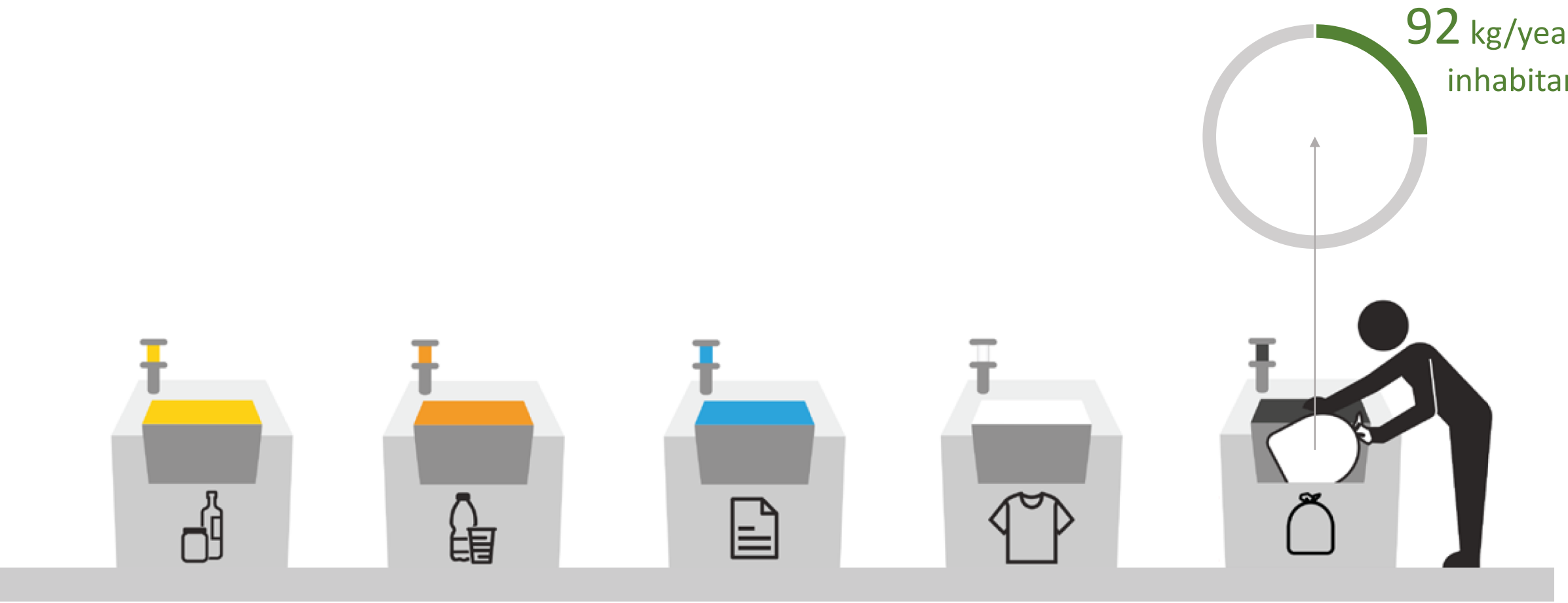
TU Delft

RE PAiR

1. Introduction
2. Theoretical Background
3. Tools and Data
4. The Method
5. Conclusions
6. Discussion

1. Introduction

Garden Waste, Fruit, Vegetables…?



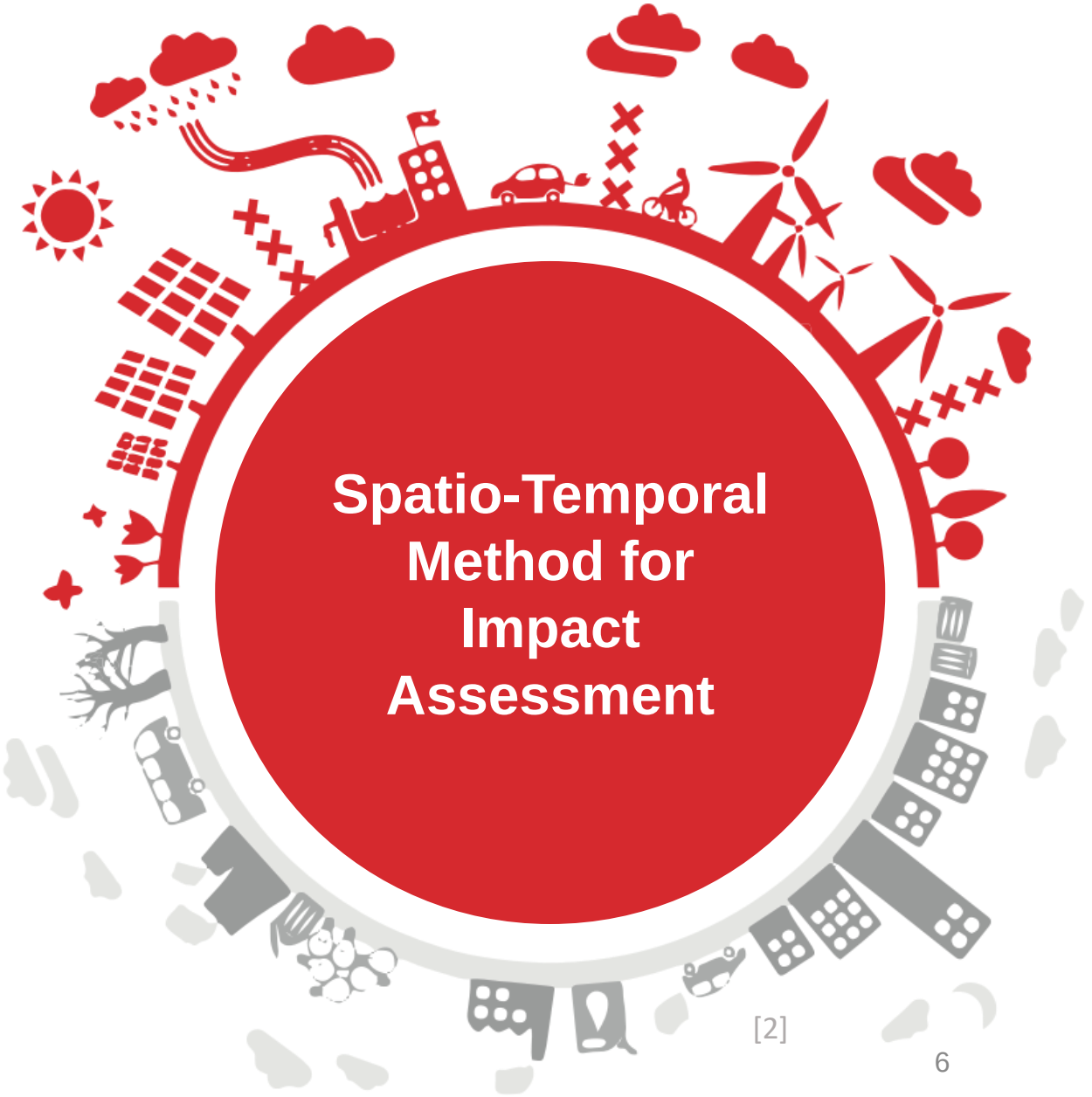
1. Introduction

Circular Economy:
Organic Waste

Collection System
Scenarios

Impact?
Complex Question…

1. Spatially varying
2. Time dependent
3. Multiple



[2]

1. Introduction

What **spatio-temporal method** is suitable to **assess the impacts** of organic waste collection system scenarios in Amsterdam?

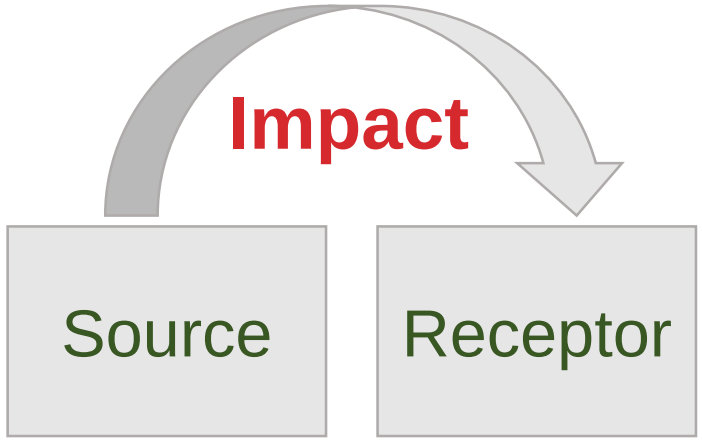
Three Technical Challenges

1. Assess Impact Spatially
2. Incorporate Temporal Factors
3. Aggregation

2. Theoretical Background

Definition – Impact

> **Impact is** the effect of a measure on a particular target group or situation affected [3]

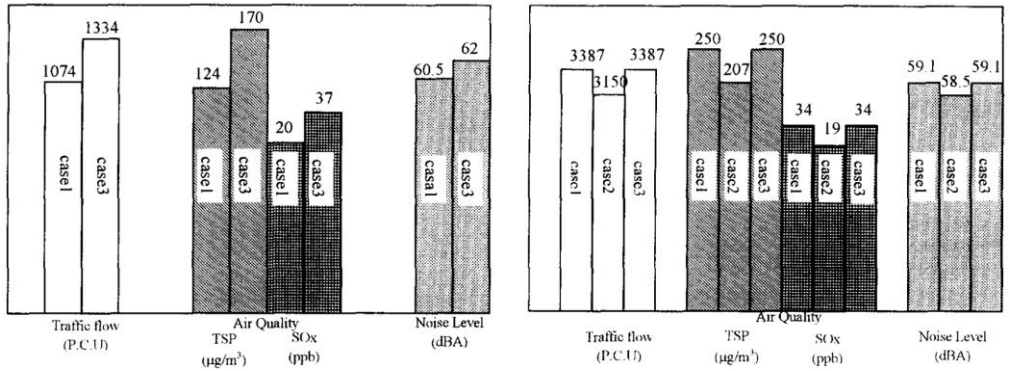


Coherence

Challenge 1 – Assess Impact Spatially

Challenge 1 – Assess Impact Spatially

- Calculations > Outcomes



[4]

- Lumped area > Individual Entities
- Phenomenon > Impact

Challenge 1 – Assess Impact Spatially

Source

- Livestock Areas
- Roads

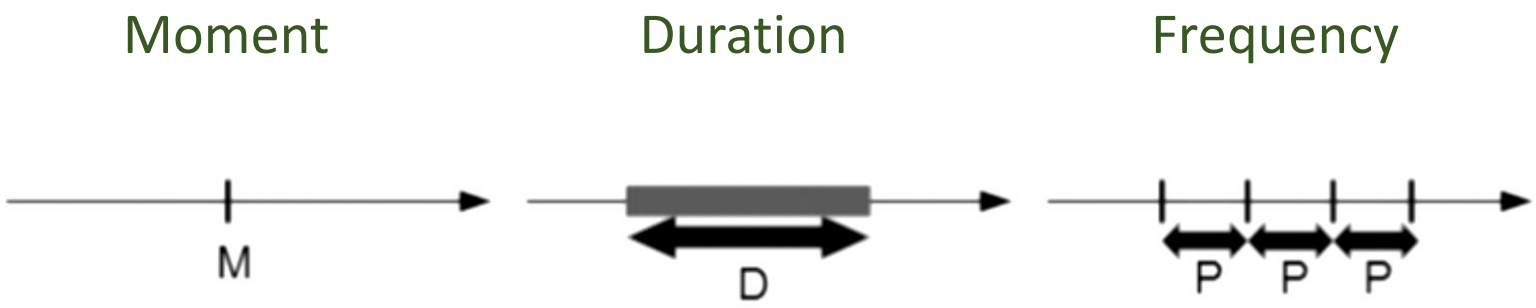
Receptor

- Population Points
- Buildings

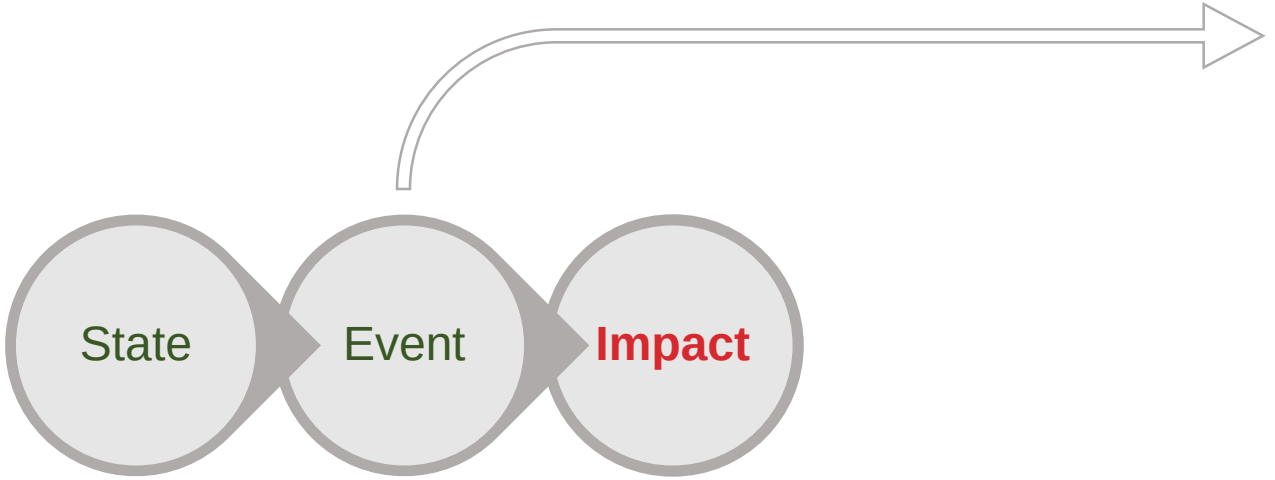
Challenge 2 – Incorporate Temporal Factors

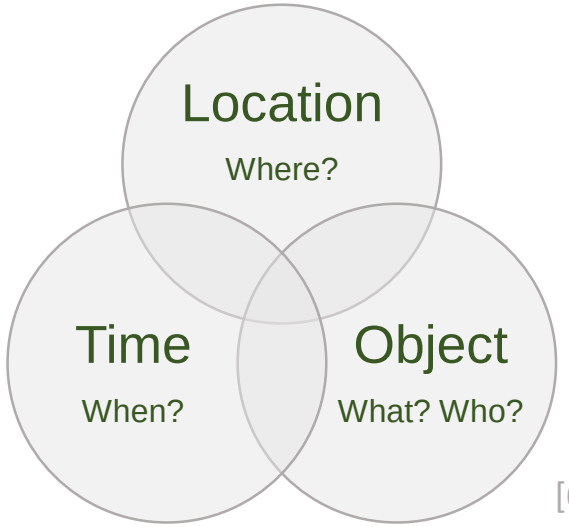
Challenge 2 – Incorporate Temporal Factors

Temporalities of Events [5]



Challenge 2 – Incorporate Temporal Factors





[6]

F requency
I ntensity
D uration
O ffensiveness
L ocation

[7]

Challenge 3 – Aggregation

Challenge 3 – Aggregation

Value Aggregation

- Compensation [8]
- *Andness* and *Orness* [9]
- Spatial Scales and Entities [10]

Challenge 3 – Aggregation

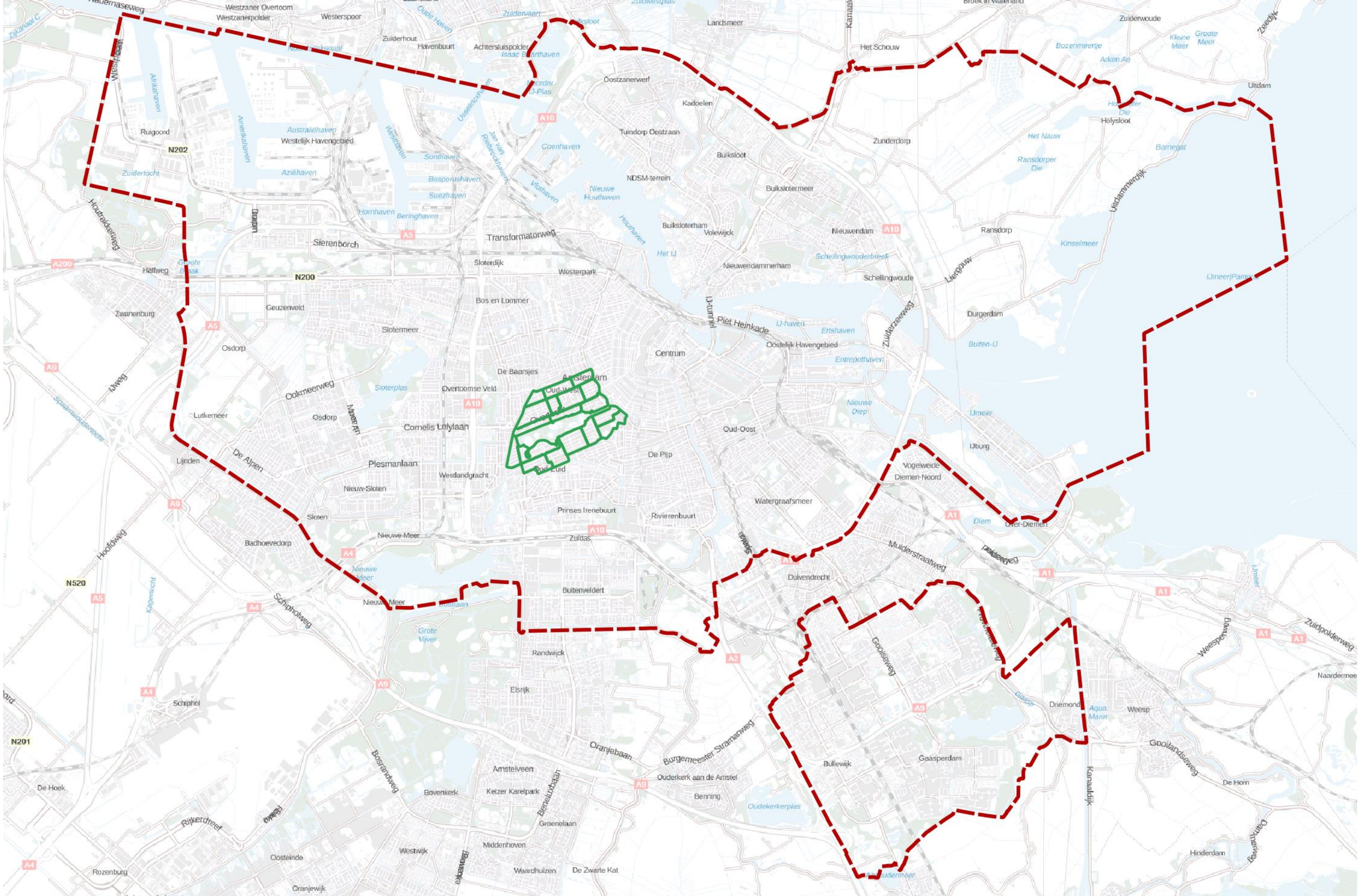
Spatial Aggregation

- Area
- Value

3. Tools and Data

Tools

Data


Westzaner Overtoom
Westzanerpolder
Westerspoor
Zuiderhout
Havenbuurt
Achtersluispolder
Oude Haven
Zuiderkade
Landsmeer
Het Schouw
Zuiderwoude
Bozenmeertje
Arken Ae
Uitdam
Westpoort
Afrikahaven
Ruigoord
N202
Zuidertocht
Australiehaven
Westelijk Havengebied
Amerikahaven
Aziëhaven
Westhaven
Sonthaven
Bosporushaven
Suezhaven
Hornhaven
Beringhaven
Coenhaven
Vlothaven
Nieuwe Houthaven
Houthaven
Oostzanerwerf
Kadoelen
Tuindorp Oostzaan
Buiksloot
NDSM-terrein
Buikslotermeer
Buiksloterham
Volewijck
Nieuwendam
Nieuwendammerham
Zunderdorp
Holysloot
Het Nauw
Ransdorper Die
Barnegat
Uitdammerdijk
Ransdorp
Kinselmeer
Schellingwouderbrug
Schellingwoude
Liergouw
Houtrakkerweg
Sierenborch
Transformatorweg
Sloterdijk
Westerpark
Het IJ
A200
Halfweg
N200
A10
A5
A9
A4
A2
A1
Zwanenburg
Geuzenveld
Bos en Lommer
Slotermeer
IJ-tunnel
Piet Heinkade
IJ-haven
Ertshaven
Oostelijk Havengebied
Zuiderzeeweg
Durgerdam
Buiten-IJ
IJmeer|Pampus
Osdorp
Centrum
Entrepothaven
De Baarsjes
Amsterdam
Oud-West
Sloterplas
Overtoomse Veld
IJweg
Ookmeerweg
Lutkemeer
Cornelis Lelylaan
Nieuwe Diep
IJmeer
IJburg
Oud-Oost
De Pijp
Oud-Zuid
Lijnden
De Alpen
Plesmanlaan
Westlandgracht
Vogelweide
Diemen-Noord
Nieuw-Sloten
Sloten
Prinses Irenebuurt
Rivierenbuurt
Watergraafsmeer
Diem
Over-Diemen
Badhoevedorp
Nieuwe Meer
Zuidas
Muiderstraatweg
Hoofdweg
N520
Kagertocht
Schipholweg
Buitenveldert
Duivendrecht
Gooiseweg
Bosbaan
Grote Vijver
Randwijck
Elsrijk
Zuidpolderweg
Weesperweg
Naardermeer
Schiphol
Driemond
Aqua Marin
Weesp
N201
Oranjebaan
Burgemeester Stramanweg
Bosrandweg
Amstelveen
Keizer Karelpark
Beneluxbaan
Bovenkerk
Ouderkerk aan de Amstel
Benning
Oudekerkerplas
Bullewijk
Gaasperdam
Gooilandseweg
De Hoek
De Horn
Kanaaldijk
Rijkerdreef
Groenelaan
Middenhoven
Westwijk
Oosteinde
Waardhuizen
De Zwarte Kat
Rozenburg
Oranjewijk
Hinderdam

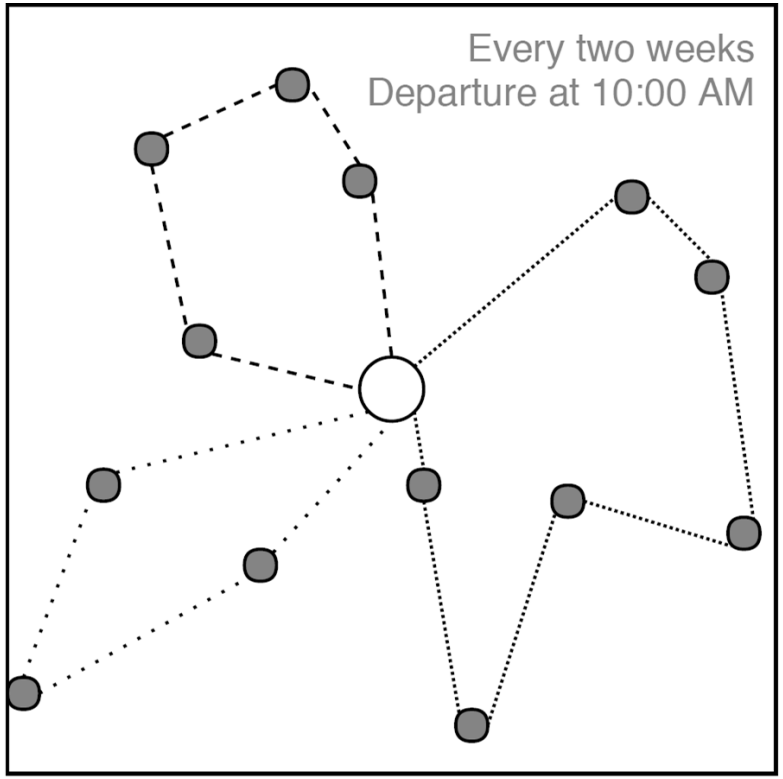
Neighbourhoods

Roads

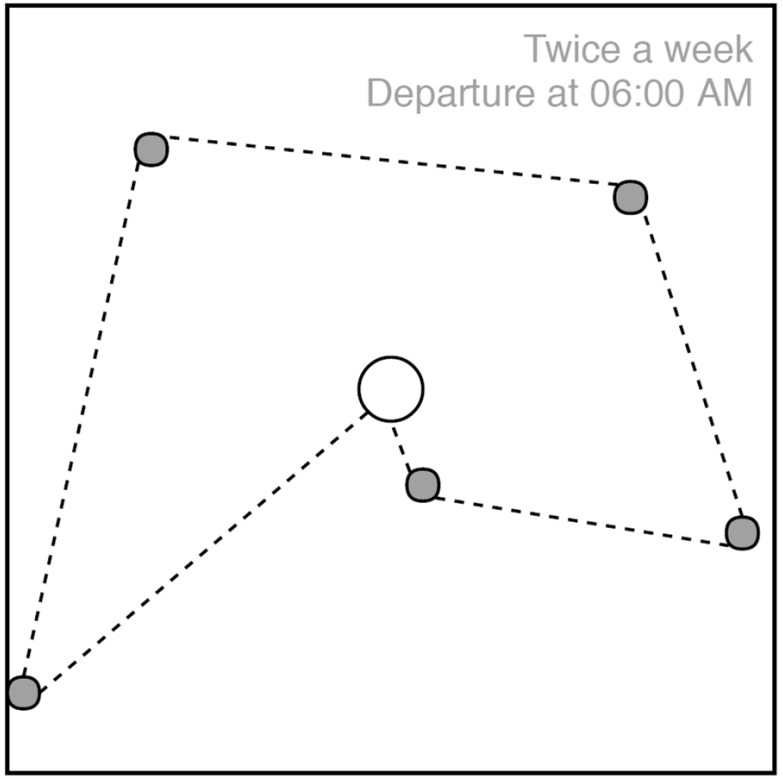
Houses

Scenarios

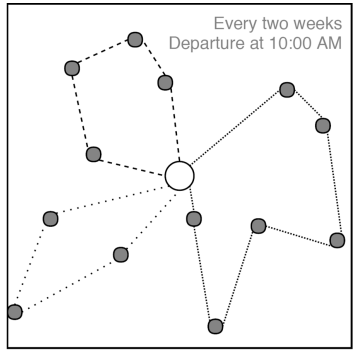
A



B



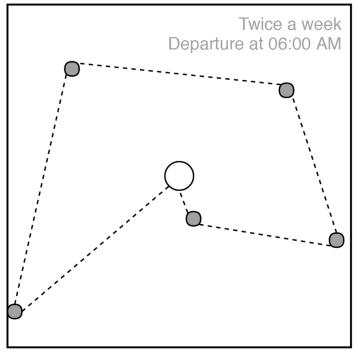
A



Attributes:

- Moment
- Duration
- Frequency
- Sequence

B



Attributes:

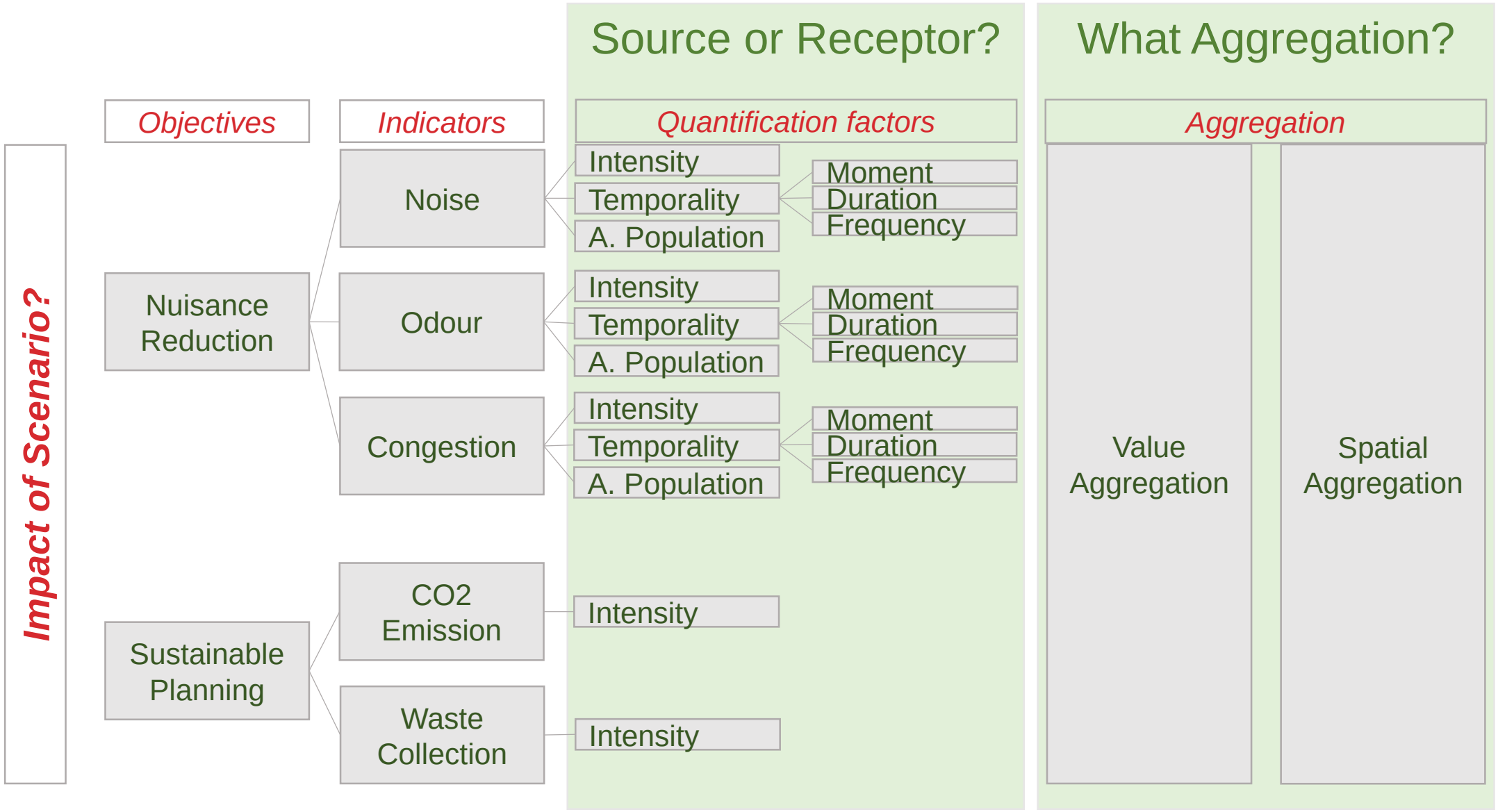
- Moment
- Duration
- Frequency
- Sequence

4. The Method

The Method Should

- Fit the Scenarios
  - Extent
  - Spatial Variance
  - Temporal Variance
- Be Transparent

4. The Method


Source or Receptor?
What Aggregation?
Impact of Scenario?
Objectives
Indicators
Quantification factors
Aggregation
Nuisance Reduction
Sustainable Planning
Noise
Odour
Congestion
CO2 Emission
Waste Collection
Intensity
Temporality
A. Population
Moment
Duration
Frequency
Value Aggregation
Spatial Aggregation

4.1. Quantification

Source or Receptor?

Impact of Scenario?

Objectives	Indicators	Quantification factors		Aggregation	
Nuisance Reduction	Noise	Intensity		Value Aggregation	Spatial Aggregation
		Temporality	Moment, Duration, Frequency		
		A. Population			
	Odour	Intensity			
		Temporality	Moment, Duration, Frequency		
		A. Population			
	Congestion	Intensity			
		Temporality	Moment, Duration, Frequency		
		A. Population			
Sustainable Planning	CO2 Emission	Intensity			
	Waste Collection	Intensity			

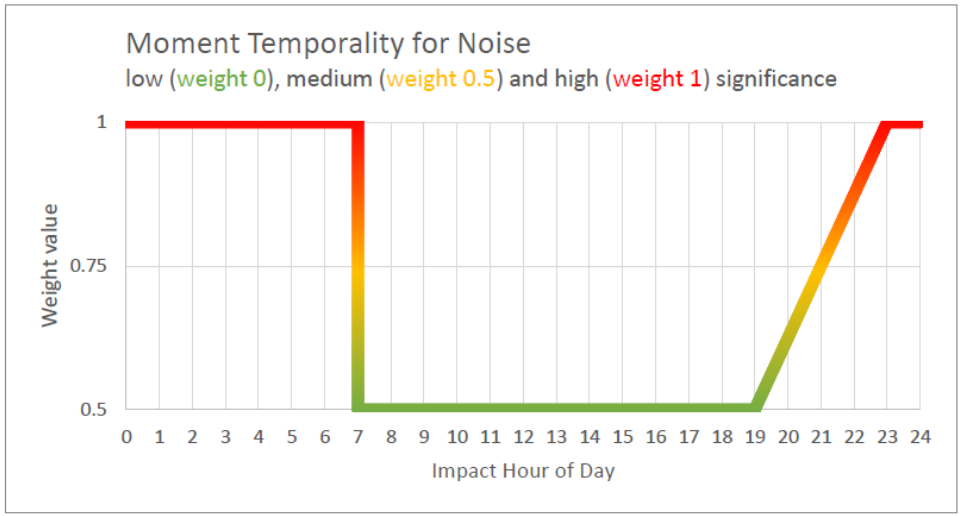
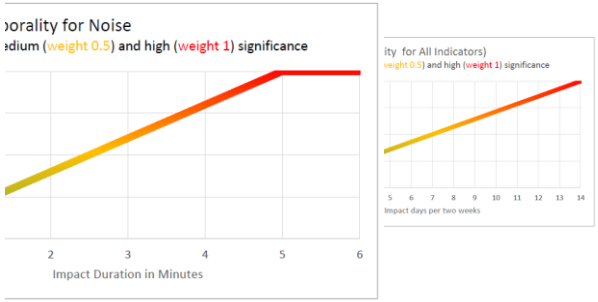
Spatial Approach

Impact

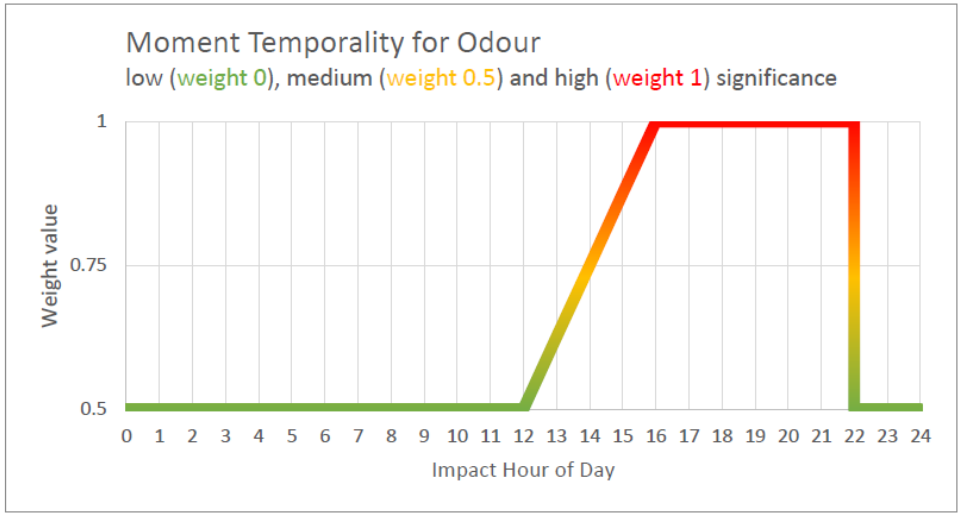
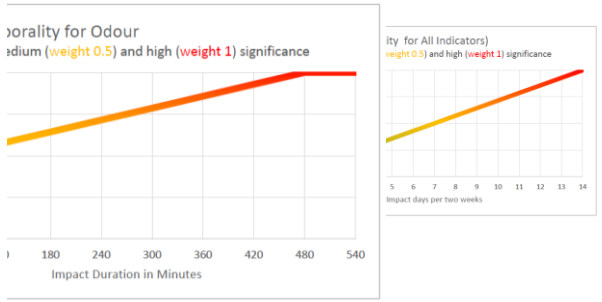
What is the impact **of** each container?

What is the impact **at** each house?

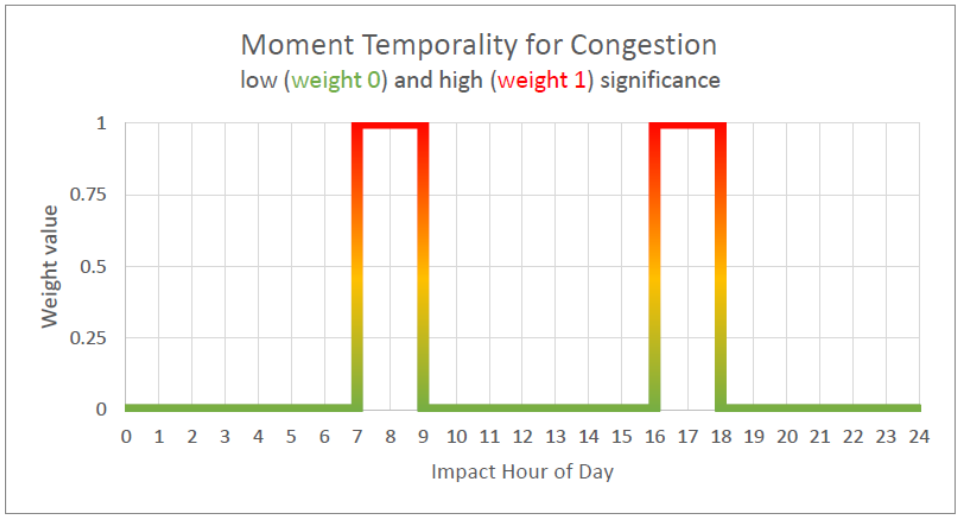
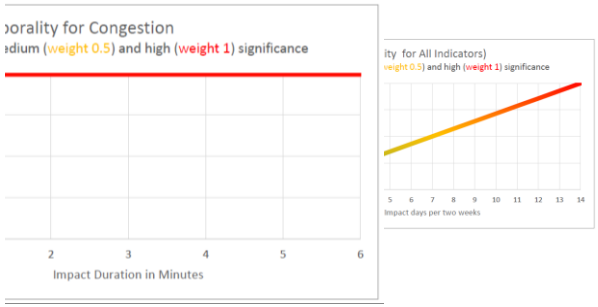
Quantification of Noise

	Source	Receptor
Intensity	$r = 10^{E - L - D_{building}}/10$	$L = E - D_{distance} - D_{building}$
Temporality		
Affected Population	# people within r	# people in house

Quantification of Odour

	Source	Receptor
Intensity	$r = (E/(C * \pi * u * 0.04))^{0.64}$	$C = E / (\pi * 0.04 * d^{1.56} * u)$
Temporality		
Affected Population	*# people within r*	*# people in house*

Quantification of Congestion

	Source	Receptor
Intensity	$maximum\ C\ in\ proximity$	$C = (L_{car} + 2\ L_{truck}) / c_{car}$
Temporality		
Affected Population	$maximum\ L\ in\ proximity$	$(L_{car} + L_{truck}) * 1.4 \frac{2}{60}$

Quantification of CO2 Emission

	Source
Intensity	$M = d * f_{load} * f_{speed} * 2.63 * \text{frequency}$

Quantification of Waste Collection

Intensity

Source

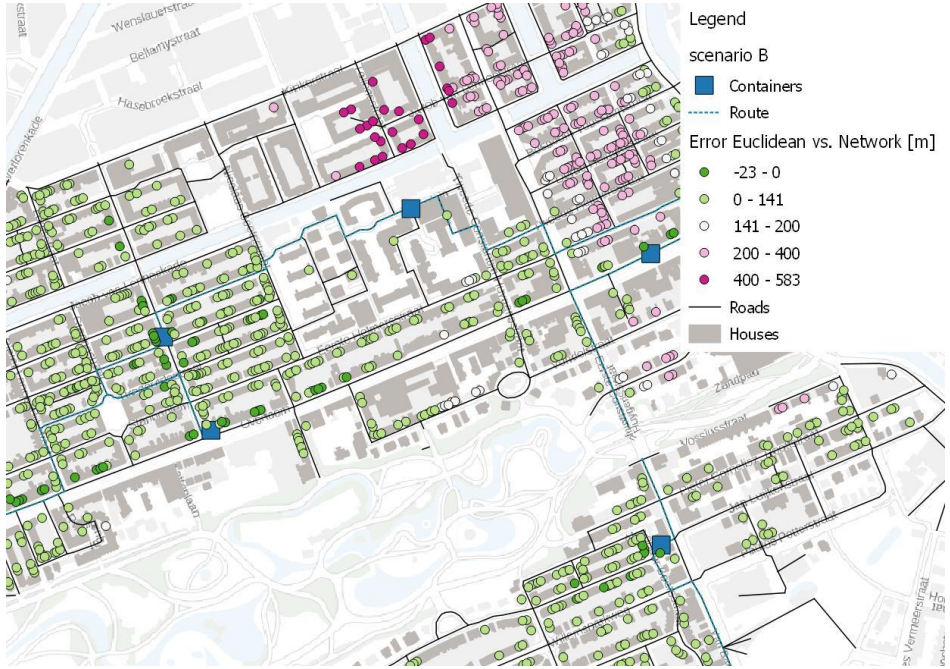
$$r = 140m$$

$$M = 92 * n_{people} * f_{willingness}$$

Receptor

$$A = (140 - d) / 140$$

$$M = A * 92 * n_{people} * f_{willingness}$$



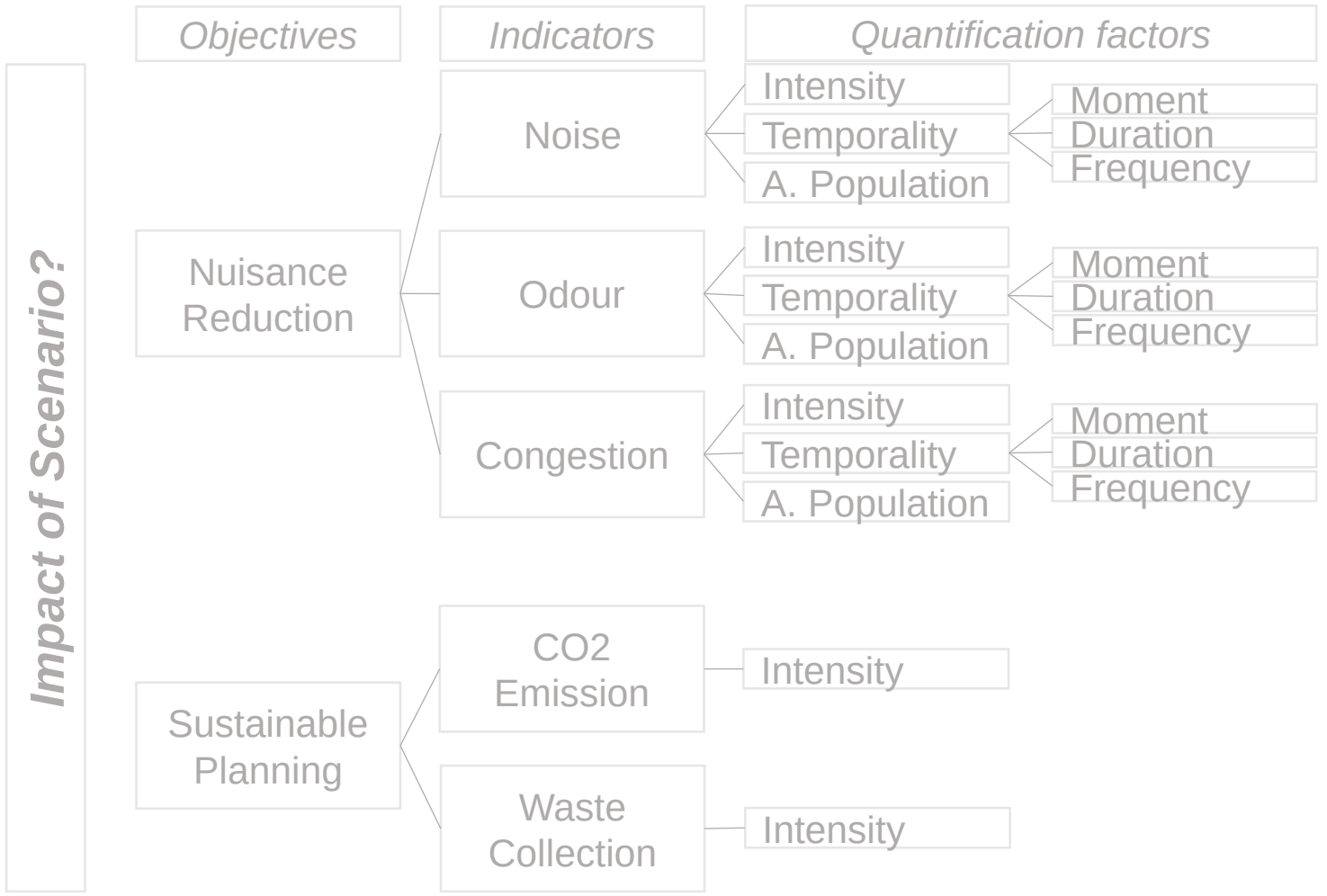
First Outcomes: Noise at Receptor

Intensity

Temporality

Affected Population

4.2 Aggregation



What Aggregation?

Aggregation

Value Aggregation

Spatial Aggregation

Value Aggregation

- Normalisation

- Aggregation: **andness**

  - Product
  - Boolean & Average
  - Boolean & Maximum

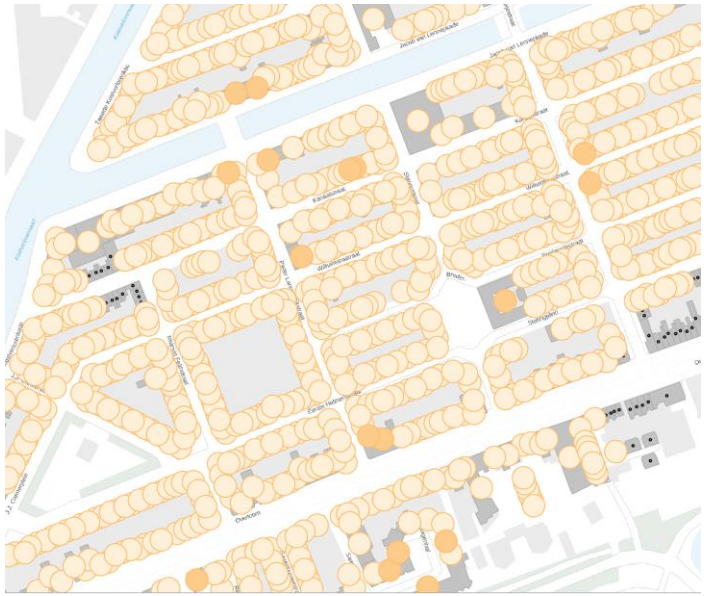
Value Aggregation

Intensity

Temporality

Affected Population

Product



Value Aggregation

Intensity

Temporality

Affected Population

Boolean & Average

Value Aggregation

Intensity

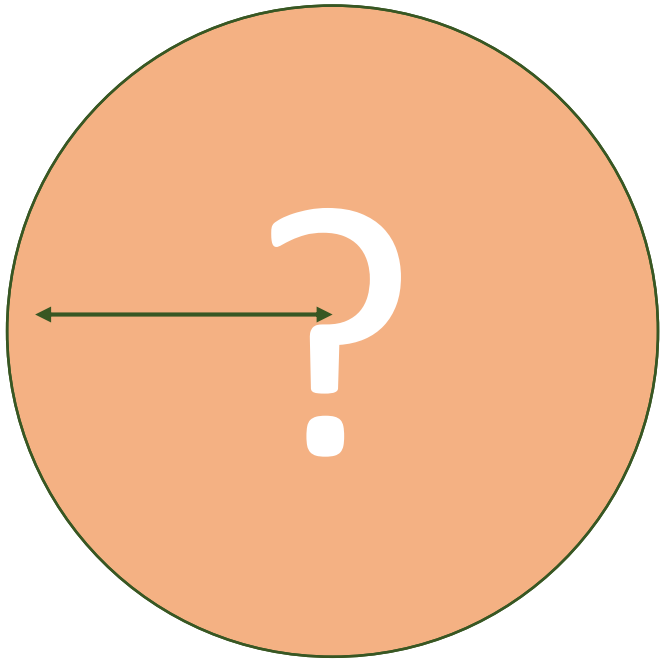
Temporality

Affected Population

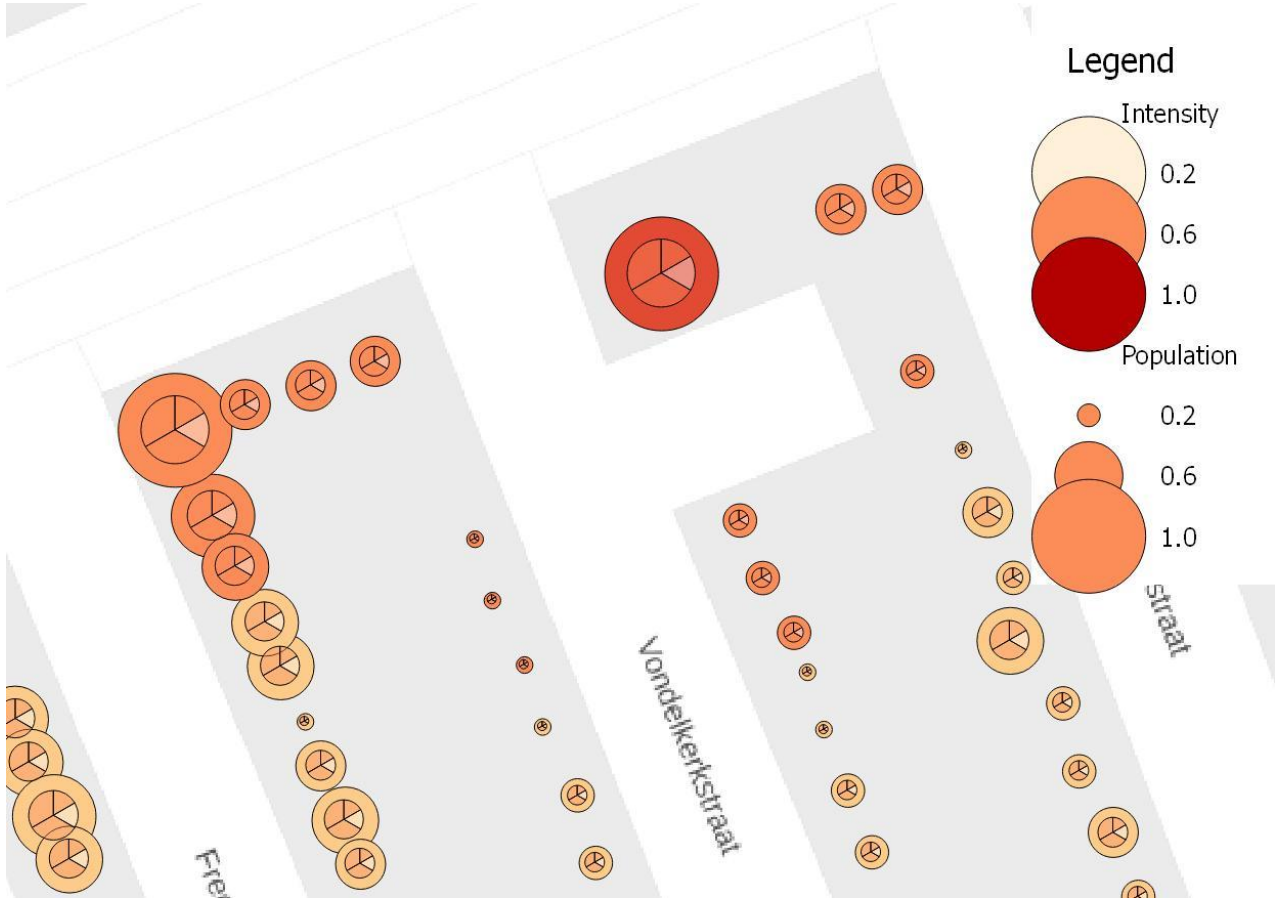
Boolean & Maximum

Visual Aggregation

- Affected Population
- Intensity
- 3 Temporalities
  - Diagram
  - Clock



Value Aggregation: Visual

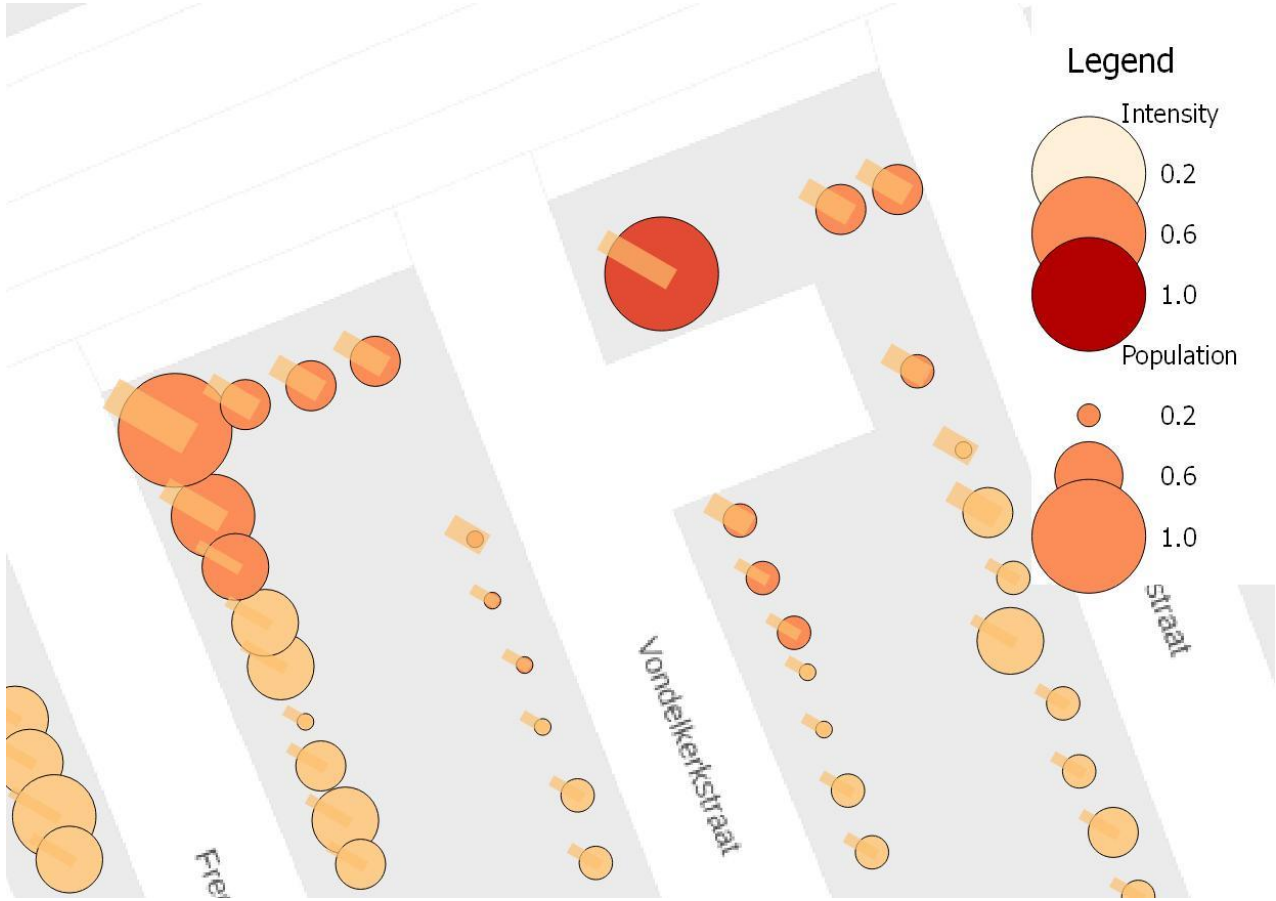


Moment factor 1.0
Duration factor 0
Frequency factor 0

Moment factor 0
Duration factor 1.0
Frequency factor 0

Moment factor 0
Duration factor 0
Frequency factor 1.0

Value Aggregation: Visual

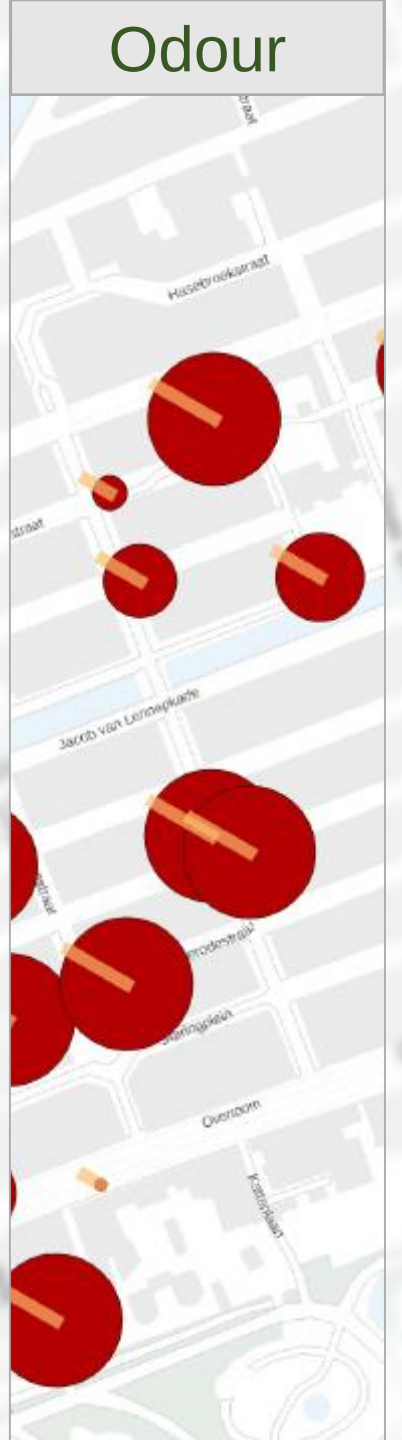


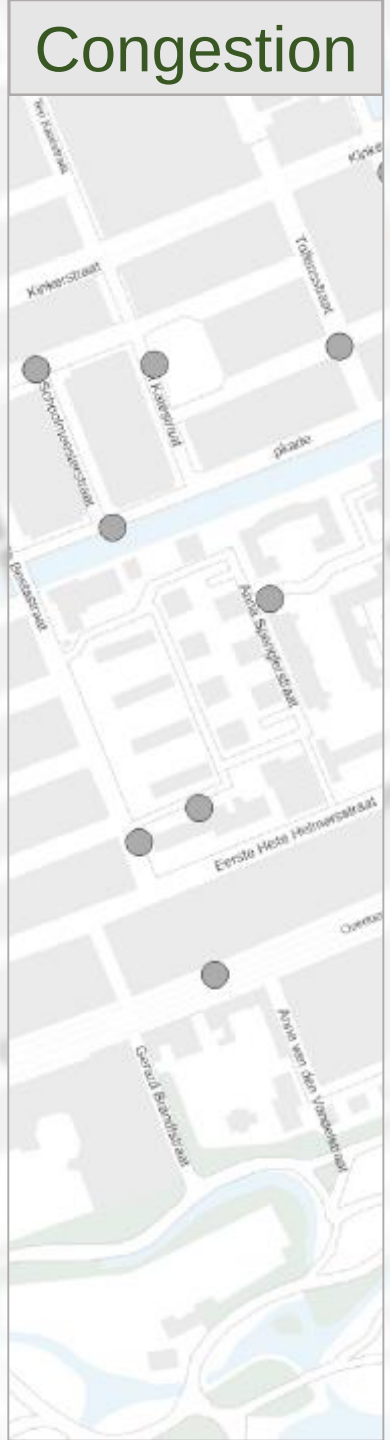
Outcomes: Individual Spatial Entities

Of Source

Scenario A


Noise


Odour


Congestion

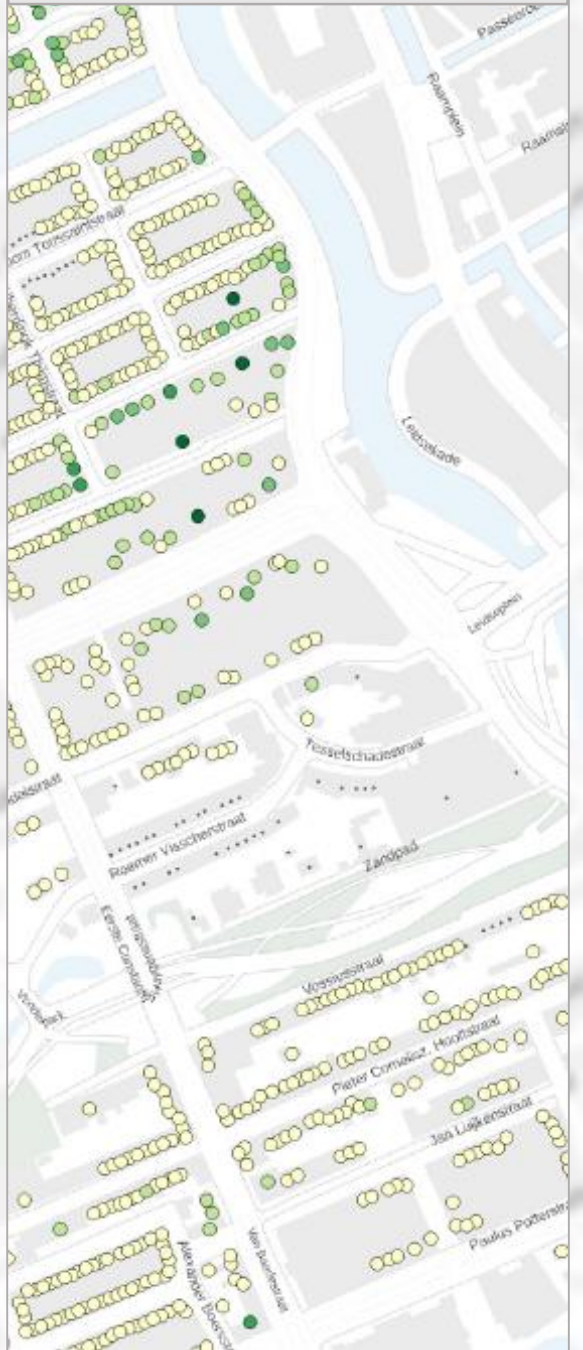

CO2


Waste

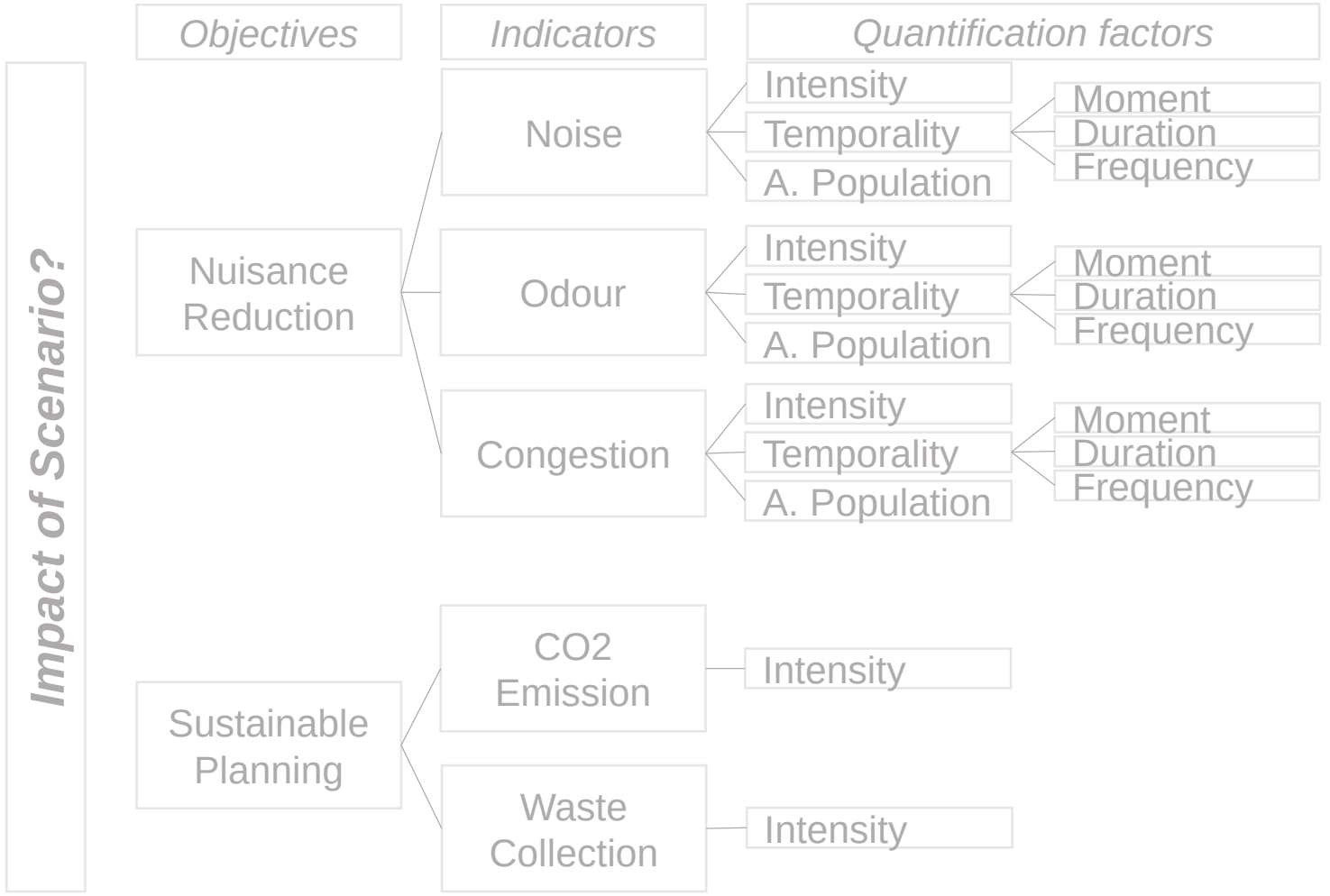
Outcomes: Individual Spatial Entities

At Receptor

Scenario A

Noise	Odour	Congestion	CO2	Waste
				

4.2 Aggregation



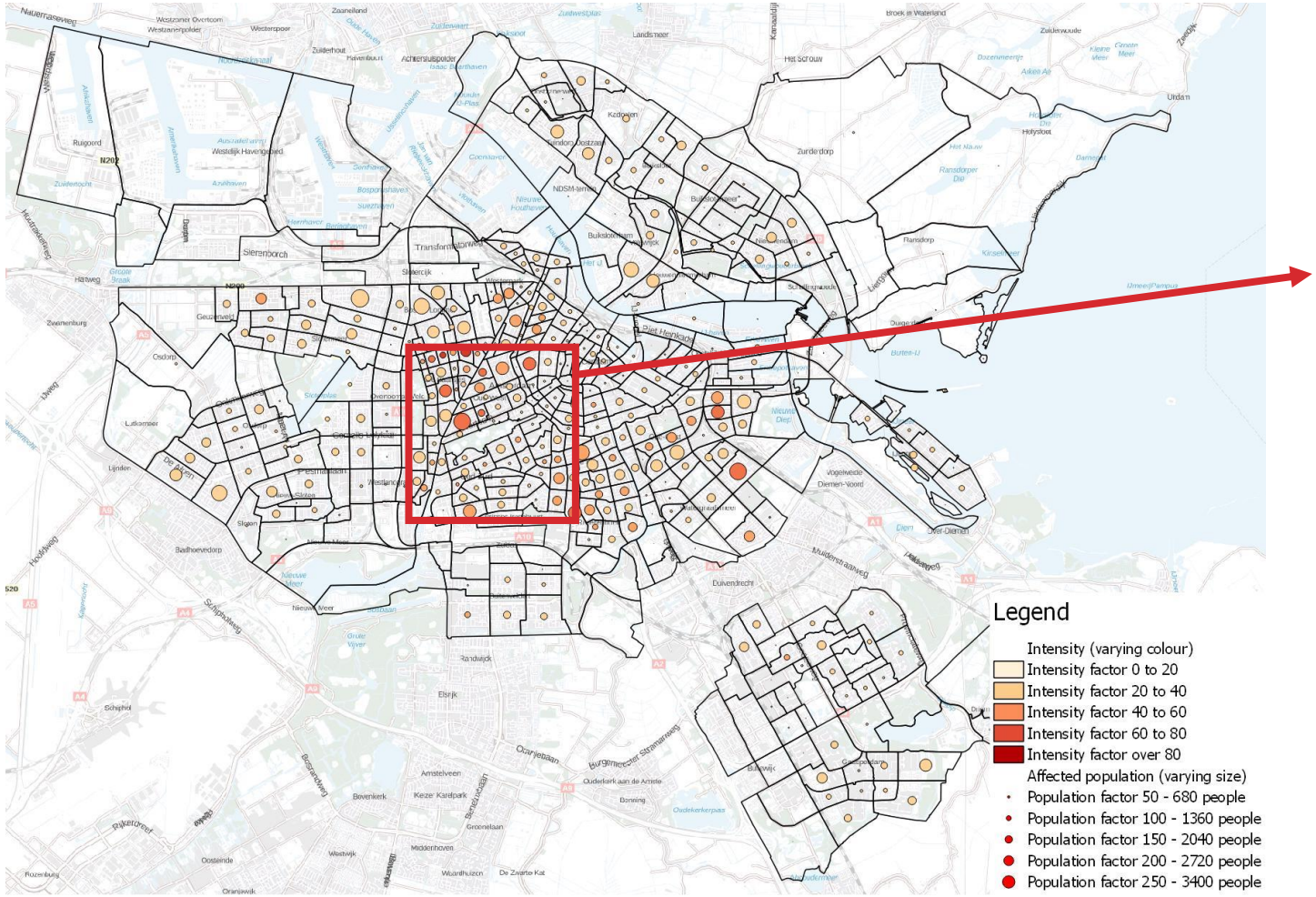
What Aggregation?

Aggregation

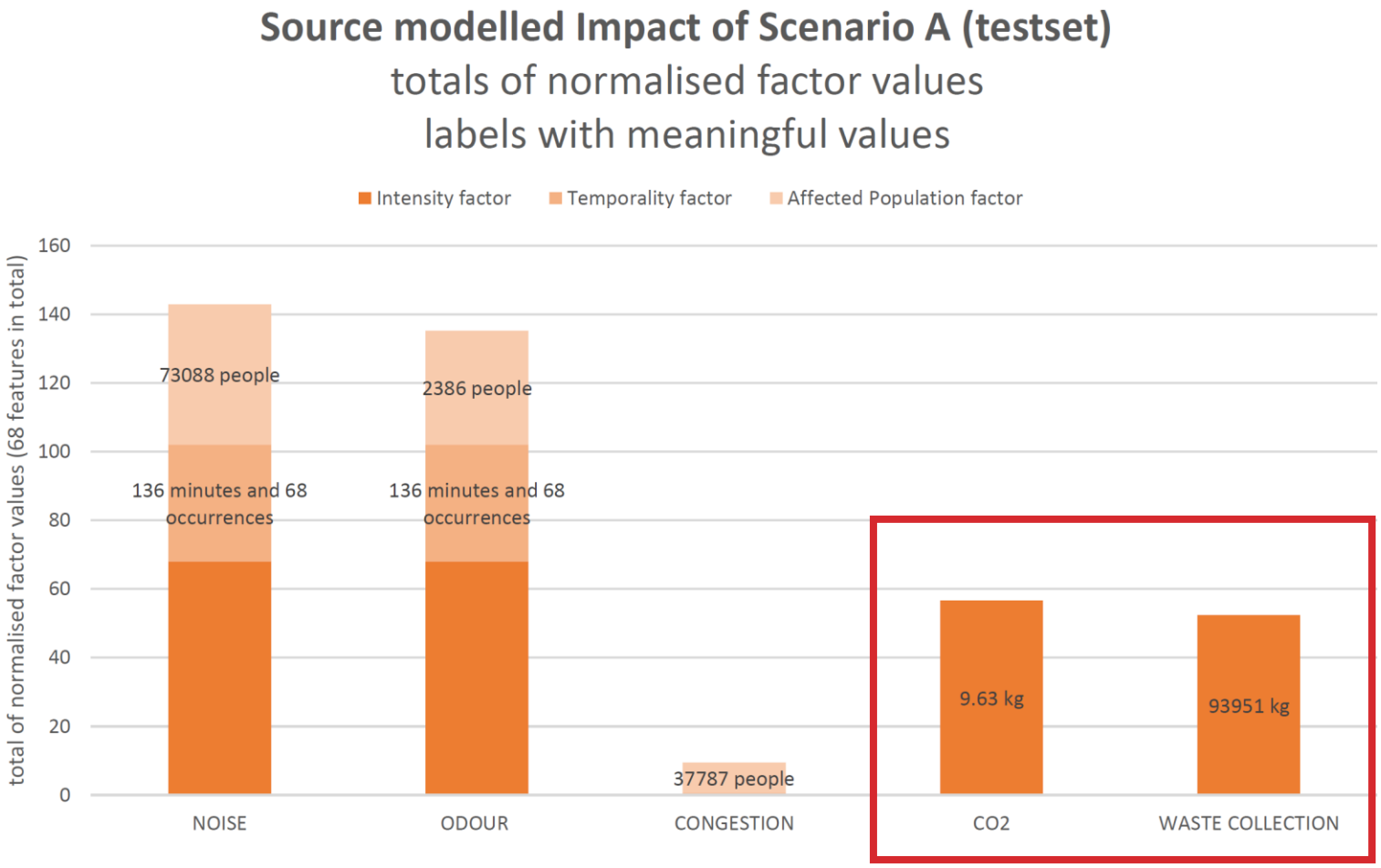
Value Aggregation

Spatial Aggregation

Spatial Aggregation



Validation: a Non-Spatial Chart



5. Conclusions

A Spatio-Temporal Impact Assessment Method…

Approaches Impact from **both**

- Source
- and Receptor

A Spatio-Temporal Impact Assessment Method…

Divides Impact into

- Objectives
  - Indicators
    - Factors

A Spatio-Temporal Impact Assessment Method…

Uses Nuisance Indicators

- Noise
- Odour
- Congestion

Quantified in **3 Factors**

- Intensity
- Temporality — Moment, Duration, Frequency
- Affected Population

A Spatio-Temporal Impact Assessment Method…

Uses Sustainability Indicators

- CO2
- Waste Collection

Quantified in **1 Factor**

- Intensity

A Spatio-Temporal Impact Assessment Method…

Presents Outcomes **Spatially** for

- Noise, Odour, Congestion and Waste

As Individual Entities

and Neighbourhood Totals

A Spatio-Temporal Impact Assessment Method…

Does not aggregate into values

But into **a marker**

A Spatio-Temporal Impact Assessment Method…

Presents Outcomes **also** Non-Spatially for

- CO2 & Waste Collection

6. Discussion

Critical Notes

- Assumptions
- Verification and Calibration
- Readability and Transparency

Recommendations

1. Verification and Calibration

2. Accuracy

3. User tests

What Else?

- Other Impacts
- Other Indicators
- Other Areas

Festivals, Markets?

Light Pollution?

Questions?

Roos Teeuwen, June 2018

References

Theme picture	Missouri Organic Recycling via https://www.missouriorganic.com/food-waste-recycling
[2]	Circular Amsterdam via https://amsterdamsmartcity.com/circularamsterdam
[3]	Rooijen & Nesterova (2013); Cambridge University Press (2017)
[4]	Chang & Wang (1997)
[5]	Arnaud & Davoine (2009); Gautier et al. (2017)
[6]	Peuquet (2005)
[7]	Freeman & Cudmore (2002)
[8]	Ferreti & Montibeller (2016); Antunes et al. (2001)
[9]	Yager (1988)
[10]	Antunes et al. (2001)