



**TRANSPORT
RESEARCH
ARENA
BUDAPEST**

18-21/05/26

Accelerating Public Charging Infrastructure

Micro-Level Approach
Enables Efficient Planning of
Charging Locations Based on
Suitability of Public Space

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Institute of Transport Research**



MOTIVATION

- EV fleet growing fast
 - **Charging infrastructure must expand proportionally**
- Private parking charging not always accessible, especially in dense cities
 - **Public charging infrastructure is therefore essential [a]**
- Public charging stations must satisfy site-specific constraining factors [b]
 - **Site selection is traditionally done on-site**
- Installation costs are high [c]
 - **Stations must be placed strategically to meet demand**

[a] Pardo-Bosch et al. 2021, [b] Wirges 2016, [c] Demiryürek et al. 2025

OBJECTIVE

ACCELERATE THE LOCATION SELECTION PROCESS

- **Automated tool:**
 - **High-resolution approach**
 - **Analysis of suitability in public space**
 - **Selection of locations depending on demand**
- **Adaptable to different urban settings**
 - **Use of broadly available data: open data, aerial imagery**

CASE STUDY

BERLIN, GERMANY

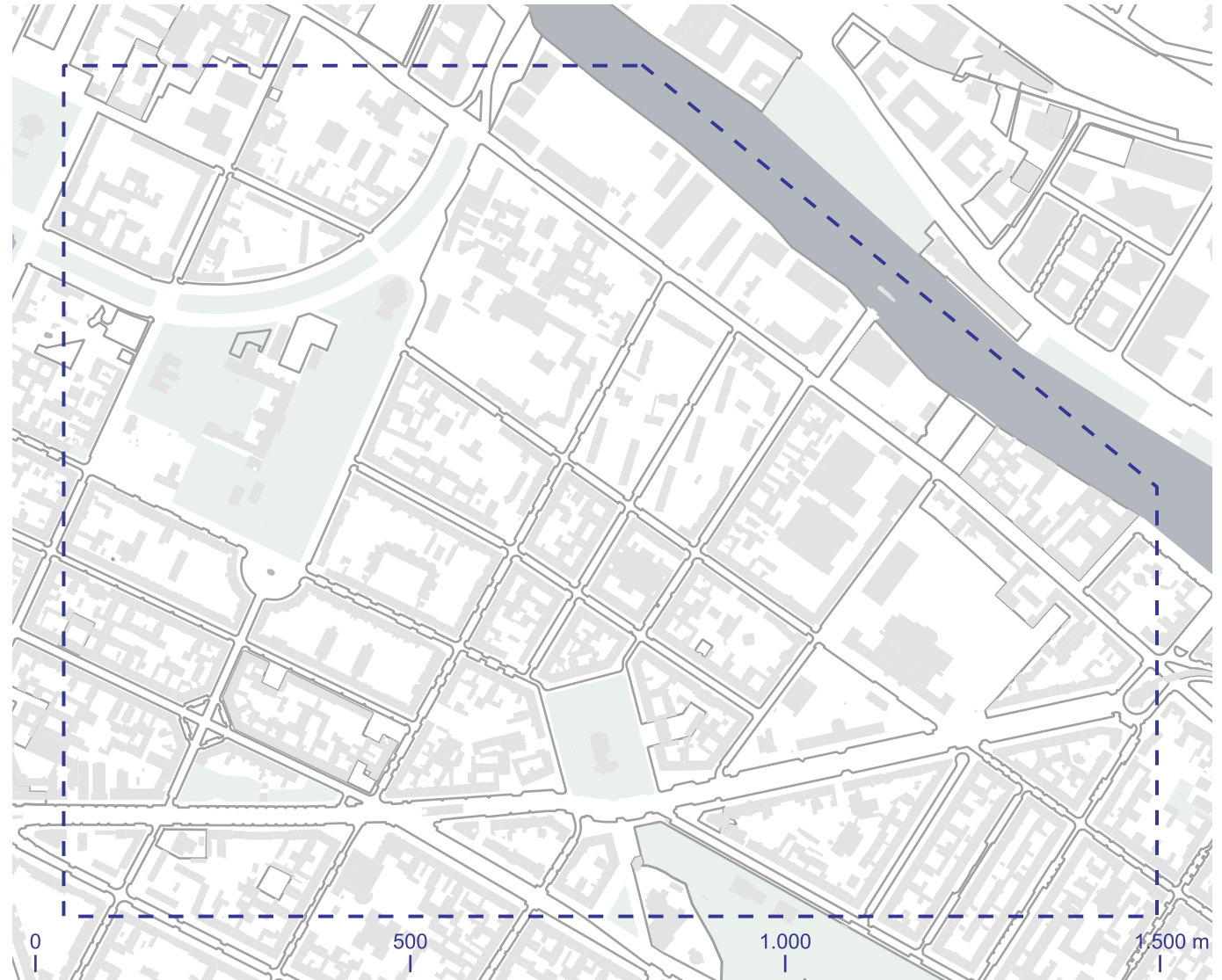


Case study area (Source: OpenStreetMap)

CASE STUDY

BERLIN, GERMANY

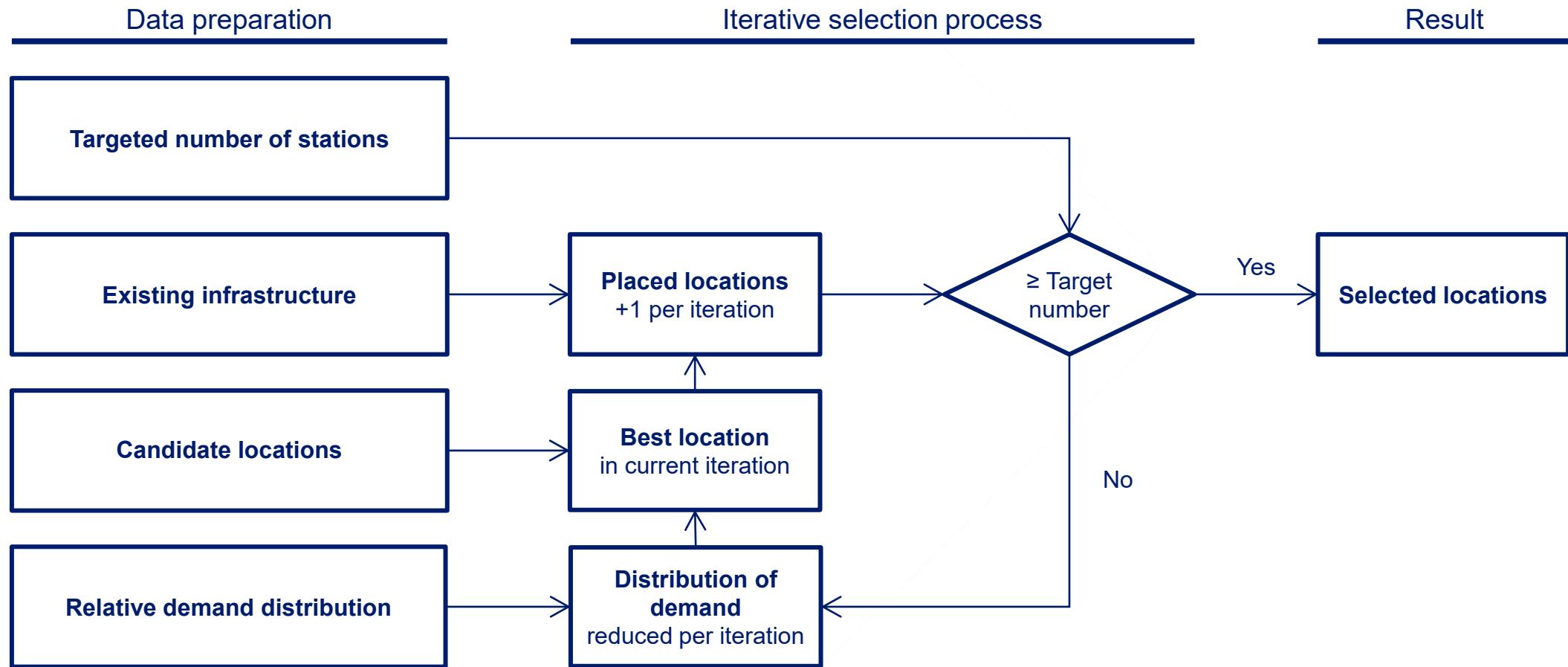
- Area $\approx 1.5\text{km}^2$
- Density $14.600/\text{km}^2$
- Mixed-use
- Lack of private parking
→ **Public charging infrastructure**



Case study area (Source: OpenStreetMap)

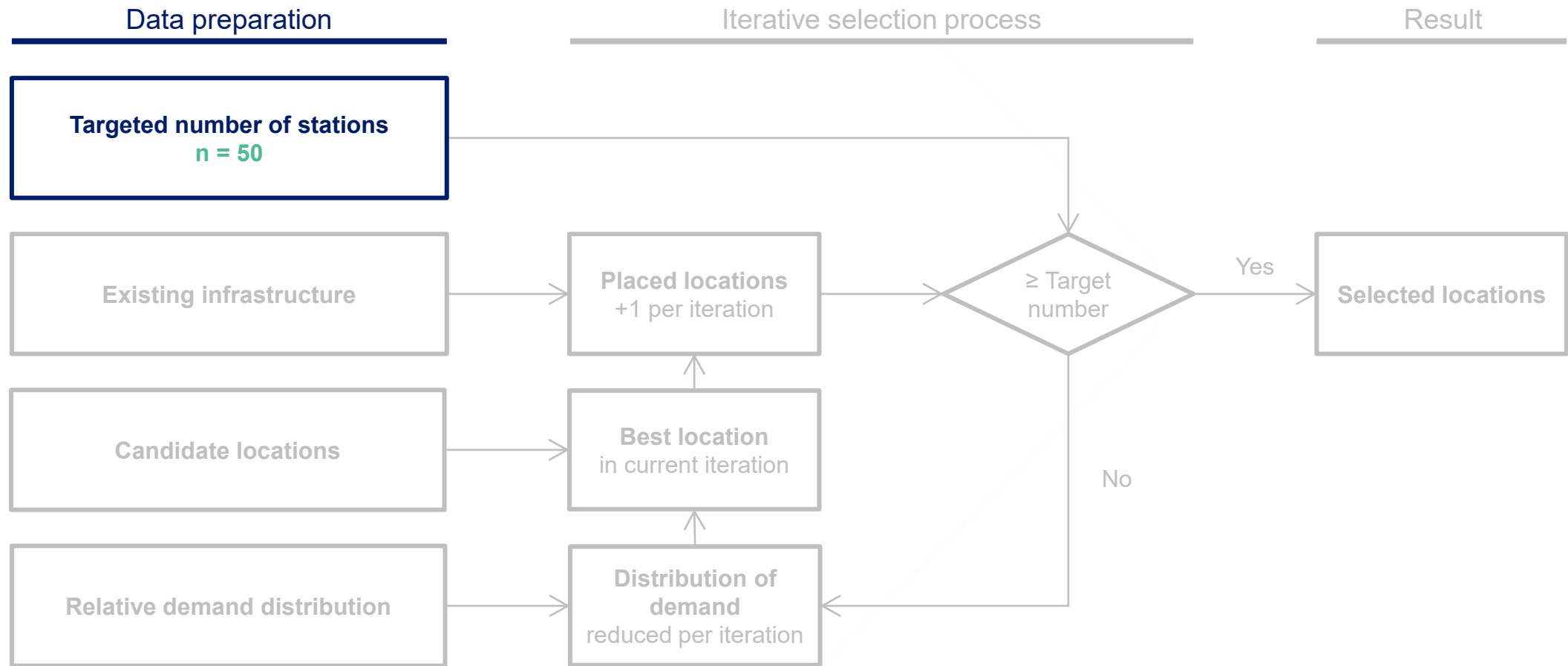
METHODOLOGY

OVERVIEW



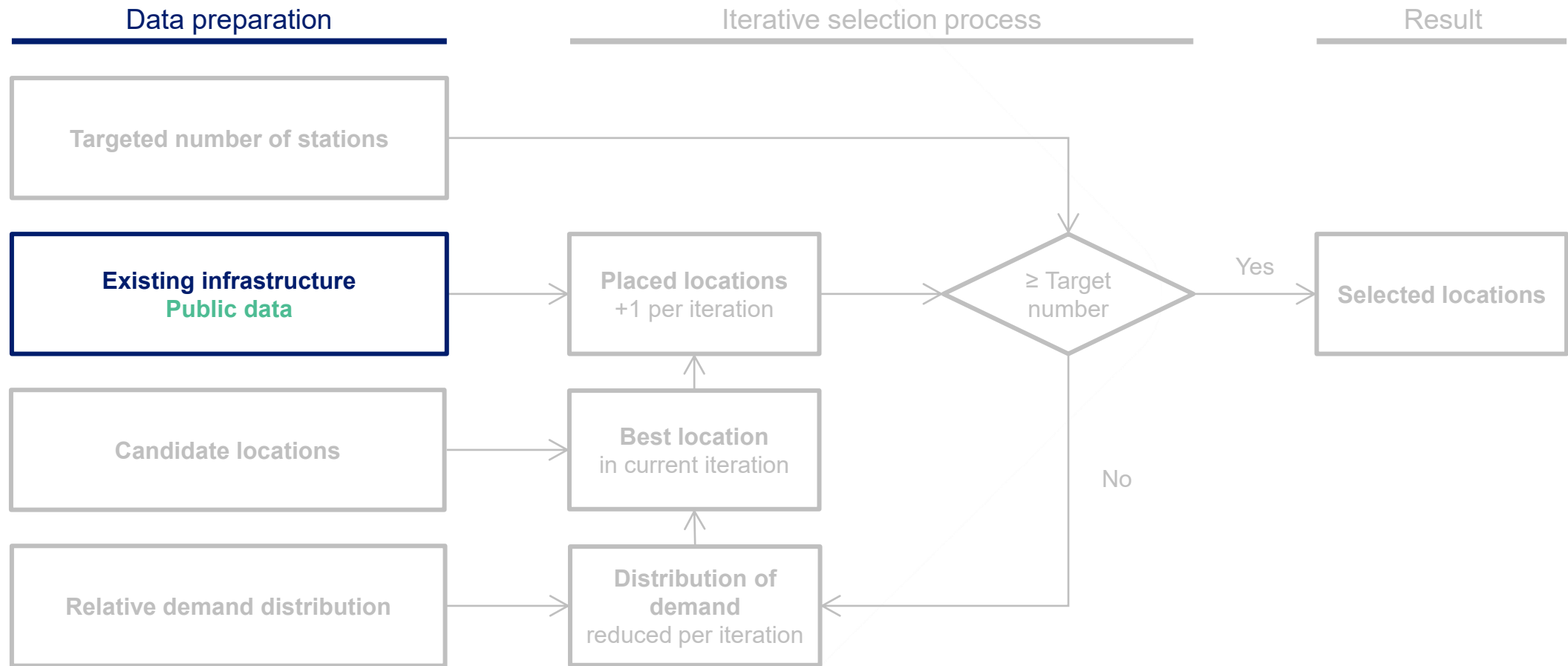
METHODOLOGY

INPUT DATA DEFINITION



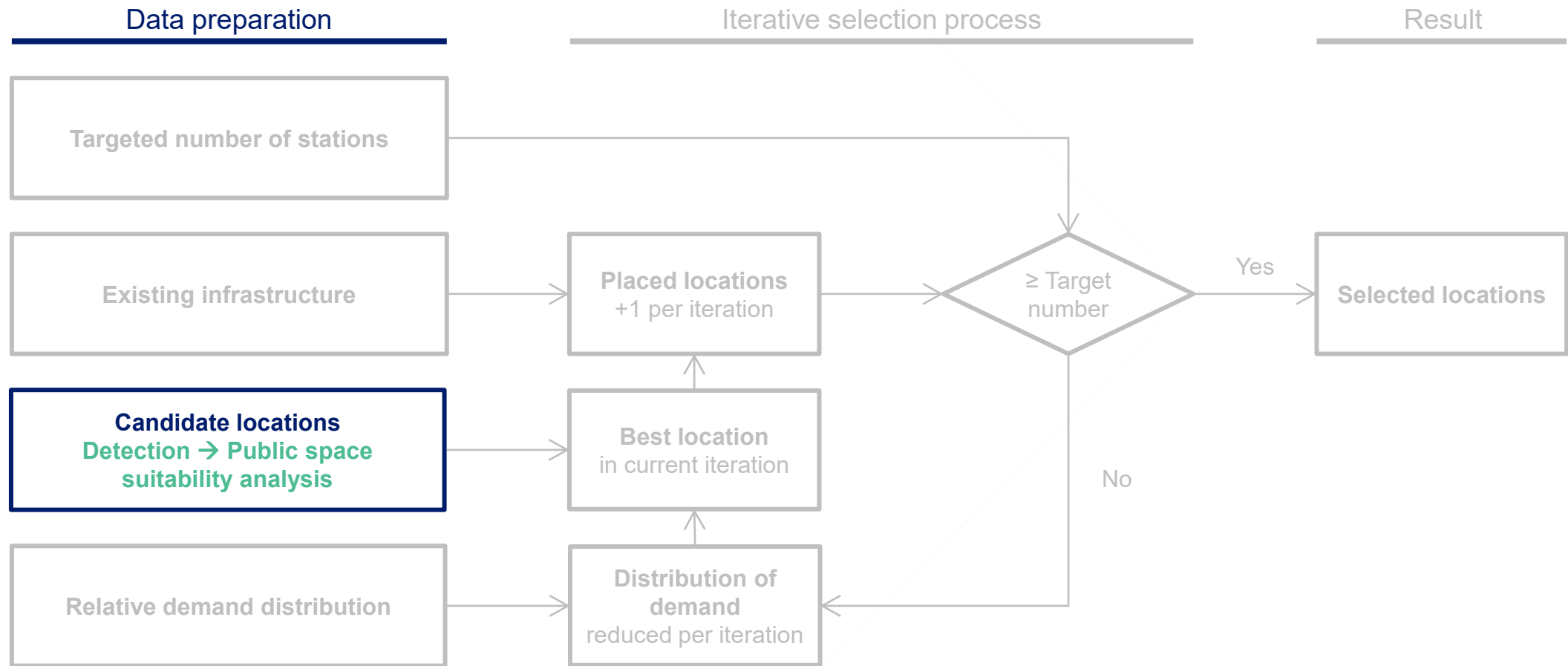
METHODOLOGY

INPUT DATA DEFINITION



METHODOLOGY

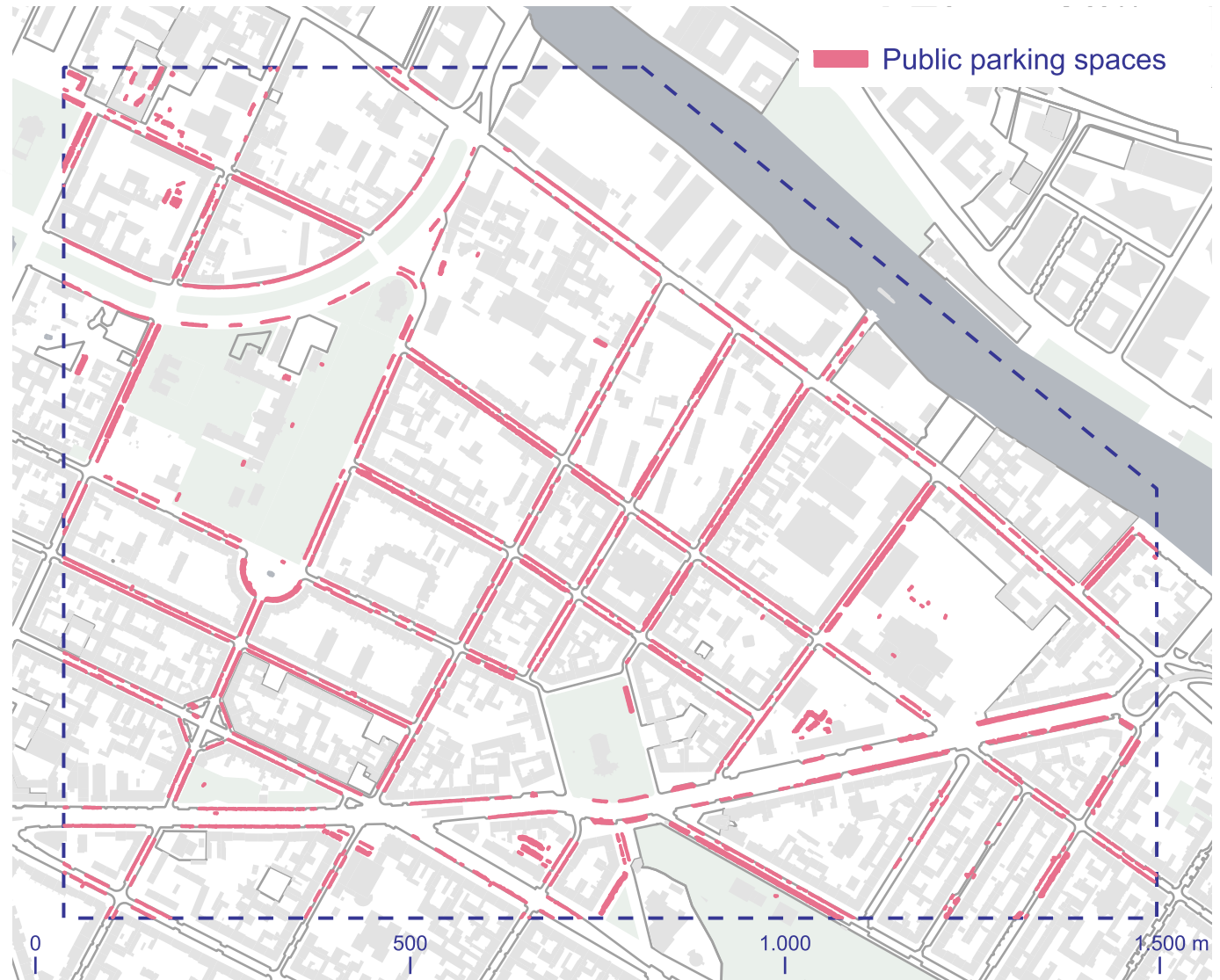
INPUT DATA DEFINITION



CANDIDATE LOCATIONS DETECTION

Public parking spaces: Detected from aerial imagery using a segmentation algorithm [a].

*DLR - Remote Sensing Technology
Institute*



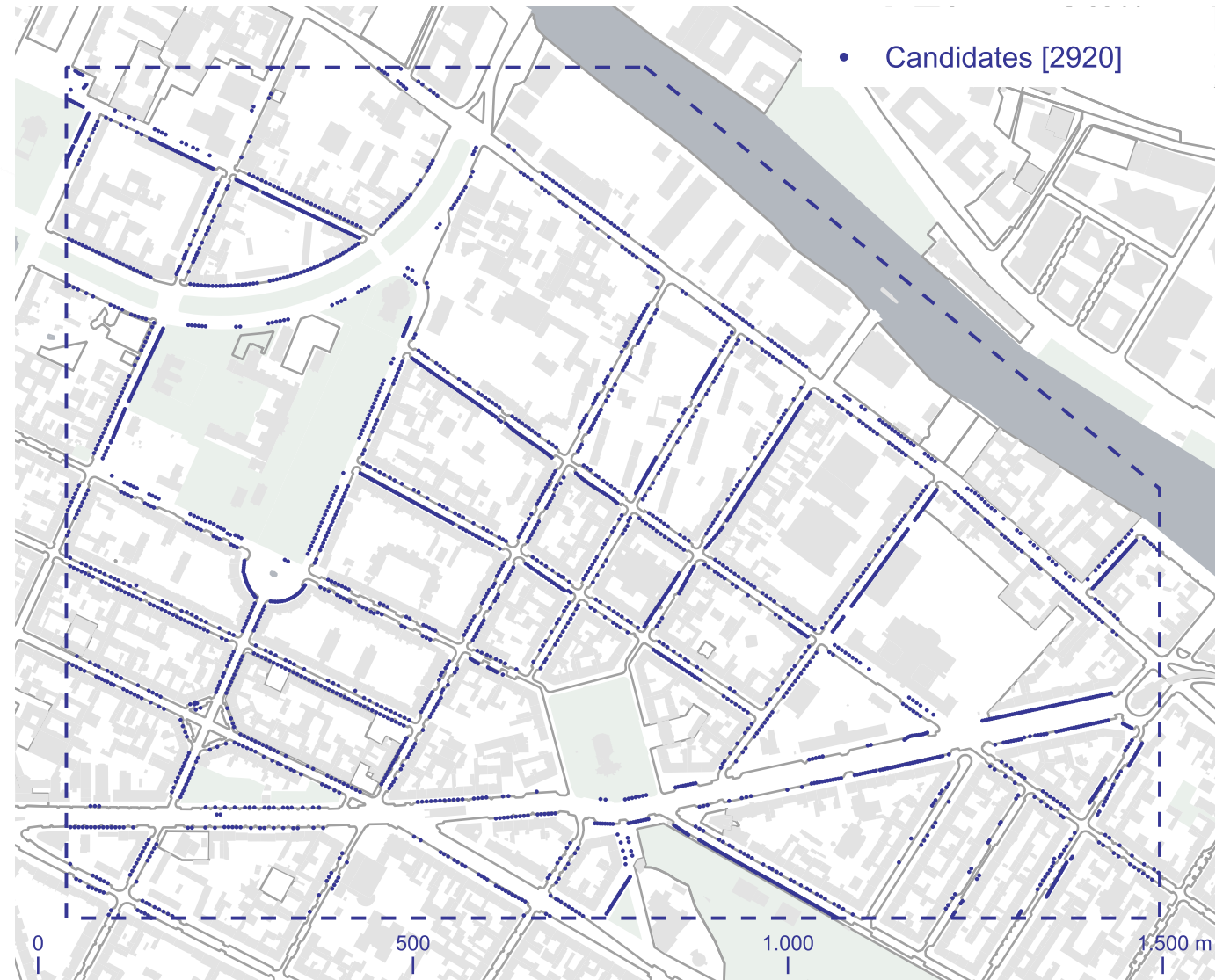
Parking space data (Source: OpenStreetMap, Remote Sensing Technology Institute)

[a] Hellekes et al. 2023

CANDIDATE LOCATIONS DETECTION

Generation of all possible sites as points every two parking spaces.

→ **2.920 candidate points**



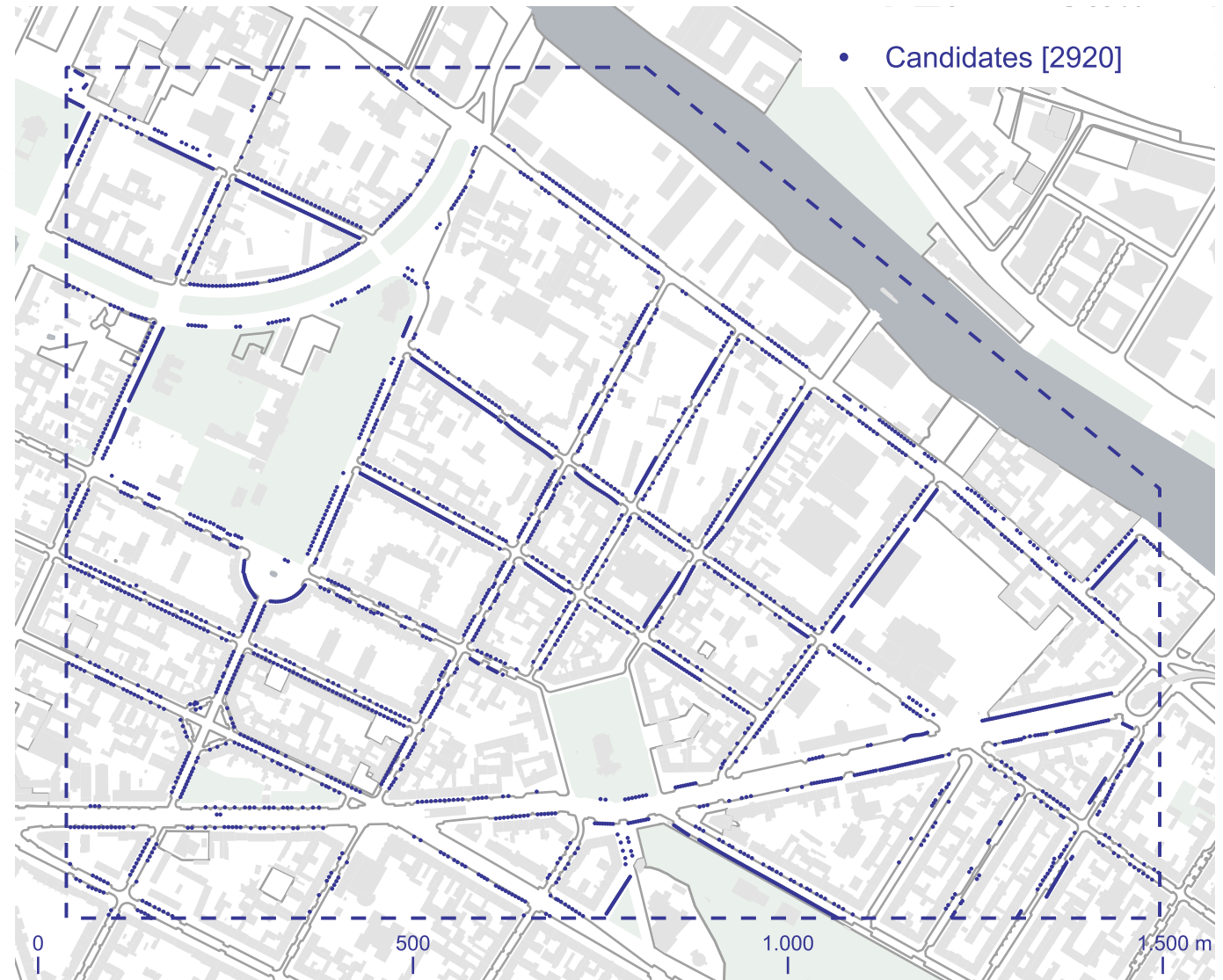
Detected Locations (Source: OpenStreetMap)

CANDIDATE LOCATIONS

SUITABILITY ANALYSIS

Constraining factors depending on city's regulations:

- Vegetation protection < 1,5m
- Heritage protection **True**
- Insufficient sidewalk width < 1,8m
- Conflict with road furniture < 2m
- Conflict with bike lanes < 1,9m
- Reserved parking spaces **True**
- (...)



Detected Locations (Source: OpenStreetMap)

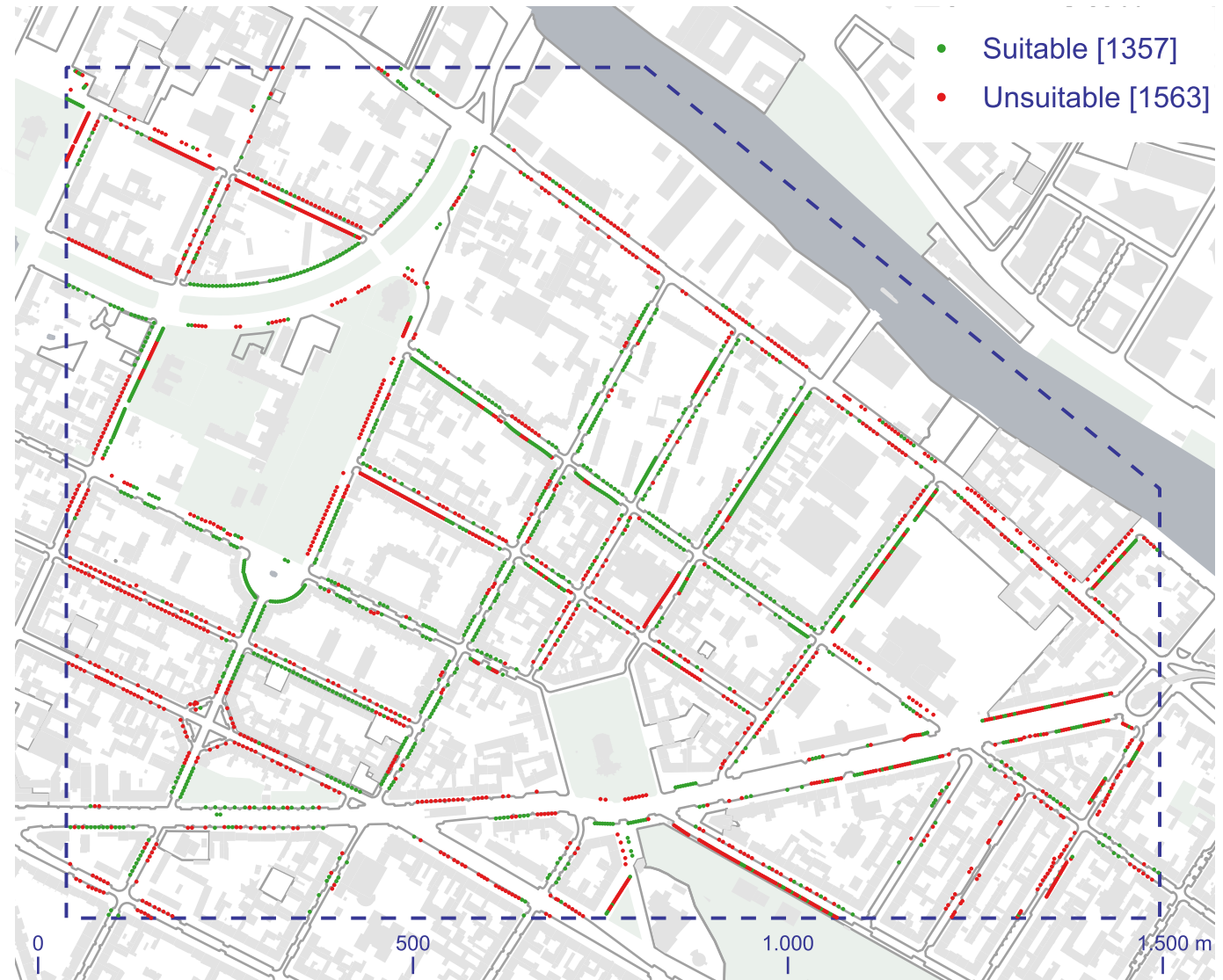
CANDIDATE LOCATIONS

SUITABILITY ANALYSIS

Overlay analysis with geospatial representation of constraints:

- 53.5% have at least one conflict
- 46.5% have no conflicts

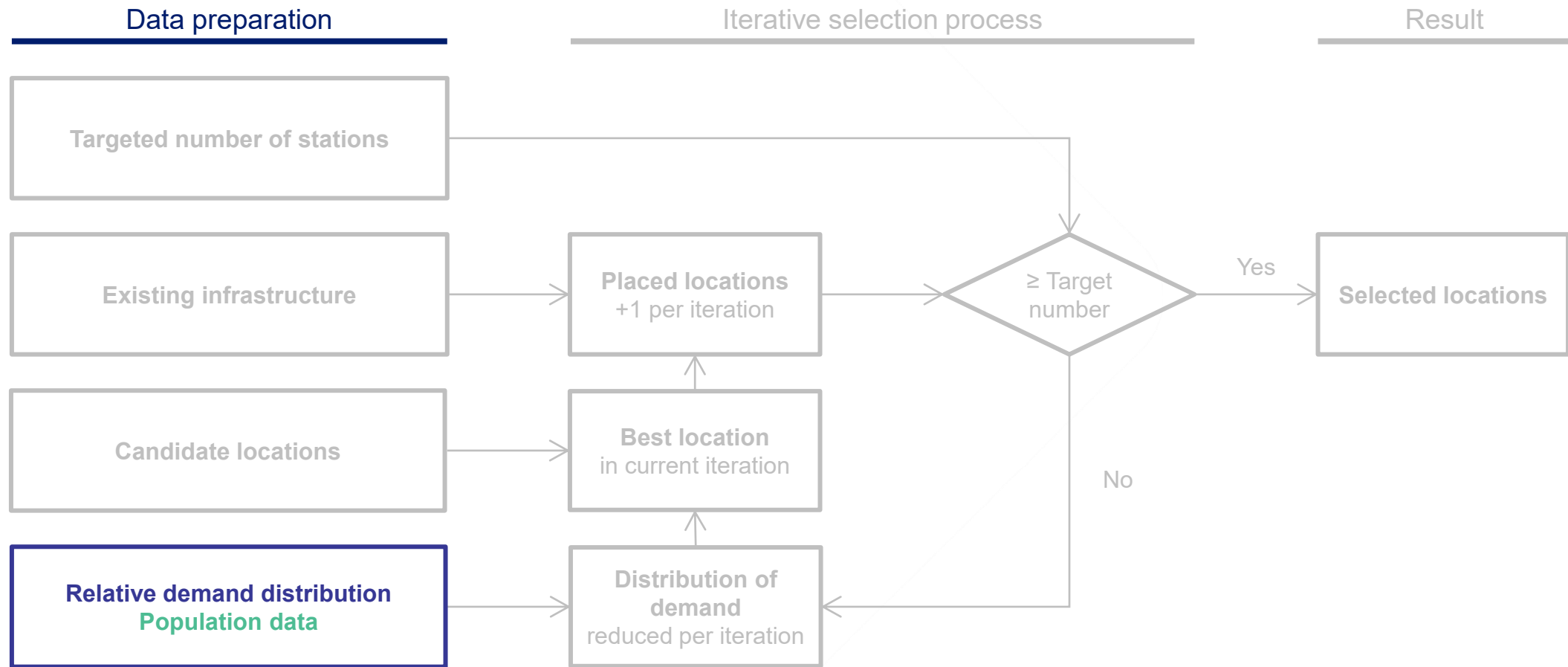
→ **1.357 suitable candidate locations**



Suitability analysis (Source: OpenStreetMap)

METHODOLOGY

INPUT DATA DEFINITION



RELATIVE DEMAND DISTRIBUTION

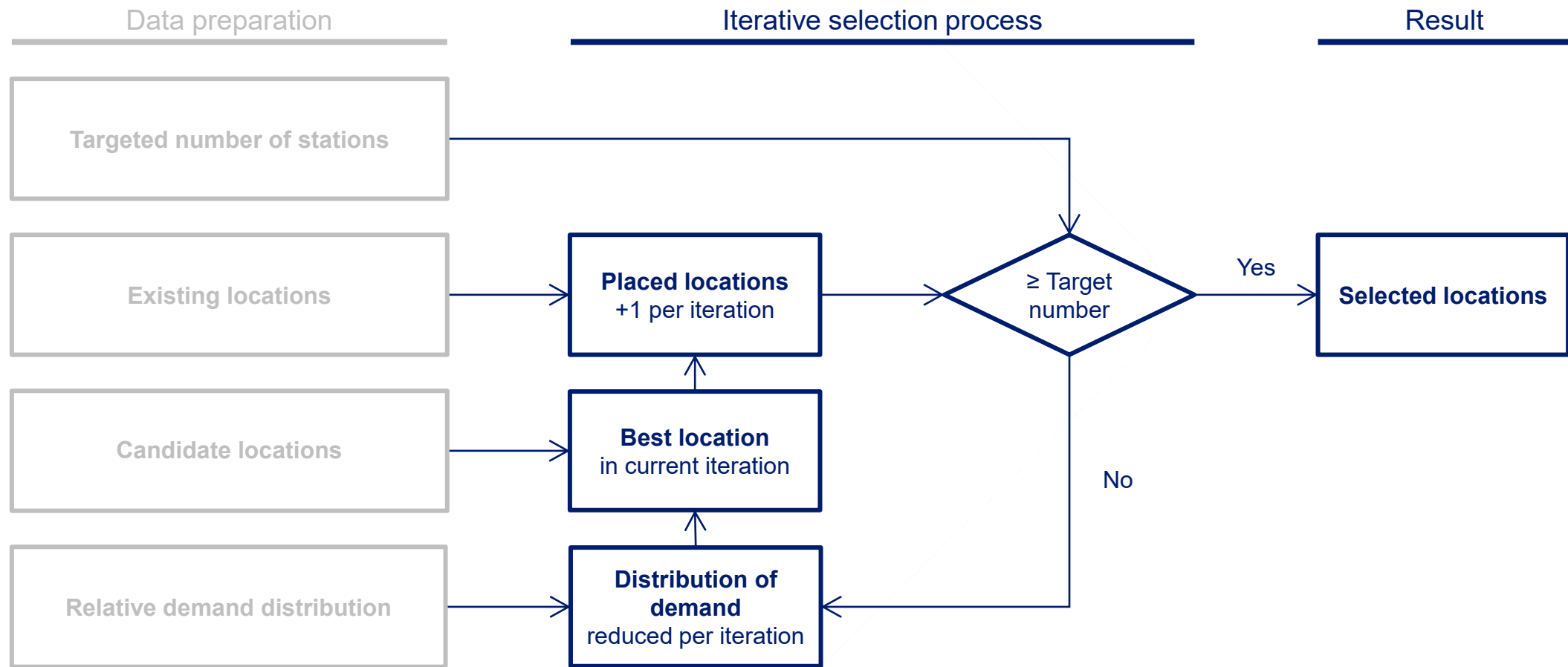
Address-level population data.



Relative demand (Source: OpenStreetMap, Bundesamt für Kartographie und Geodäsie)

ITERATIVE SELECTION PROCESS

OPTIMIZATION MODEL



ITERATIVE SELECTION PROCESS

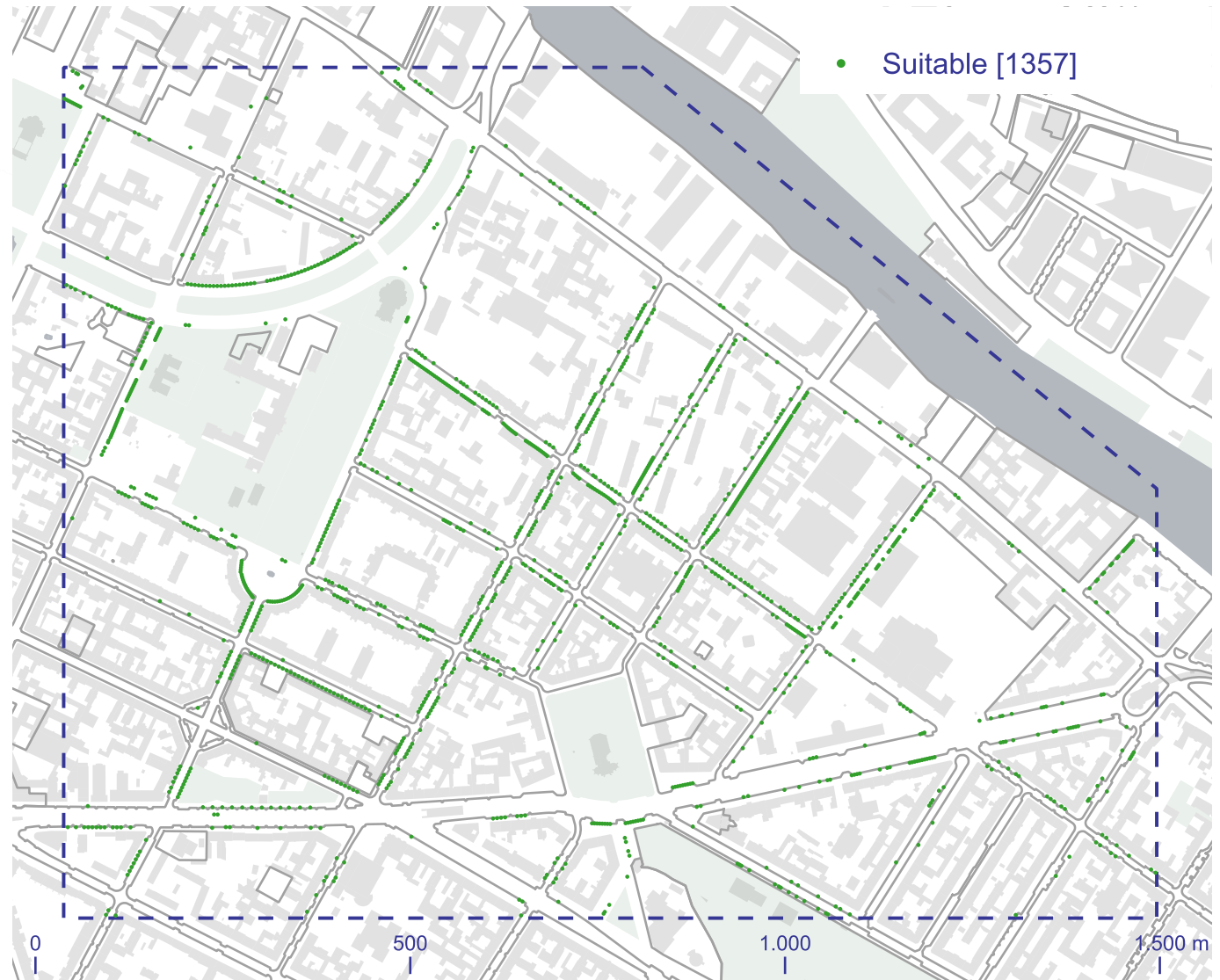
1. **Existing infrastructure:** subtraction of the demand already satisfied



Existing charging infrastructure (Source: OpenStreetMap, Bundesnetzagentur)

ITERATIVE SELECTION PROCESS

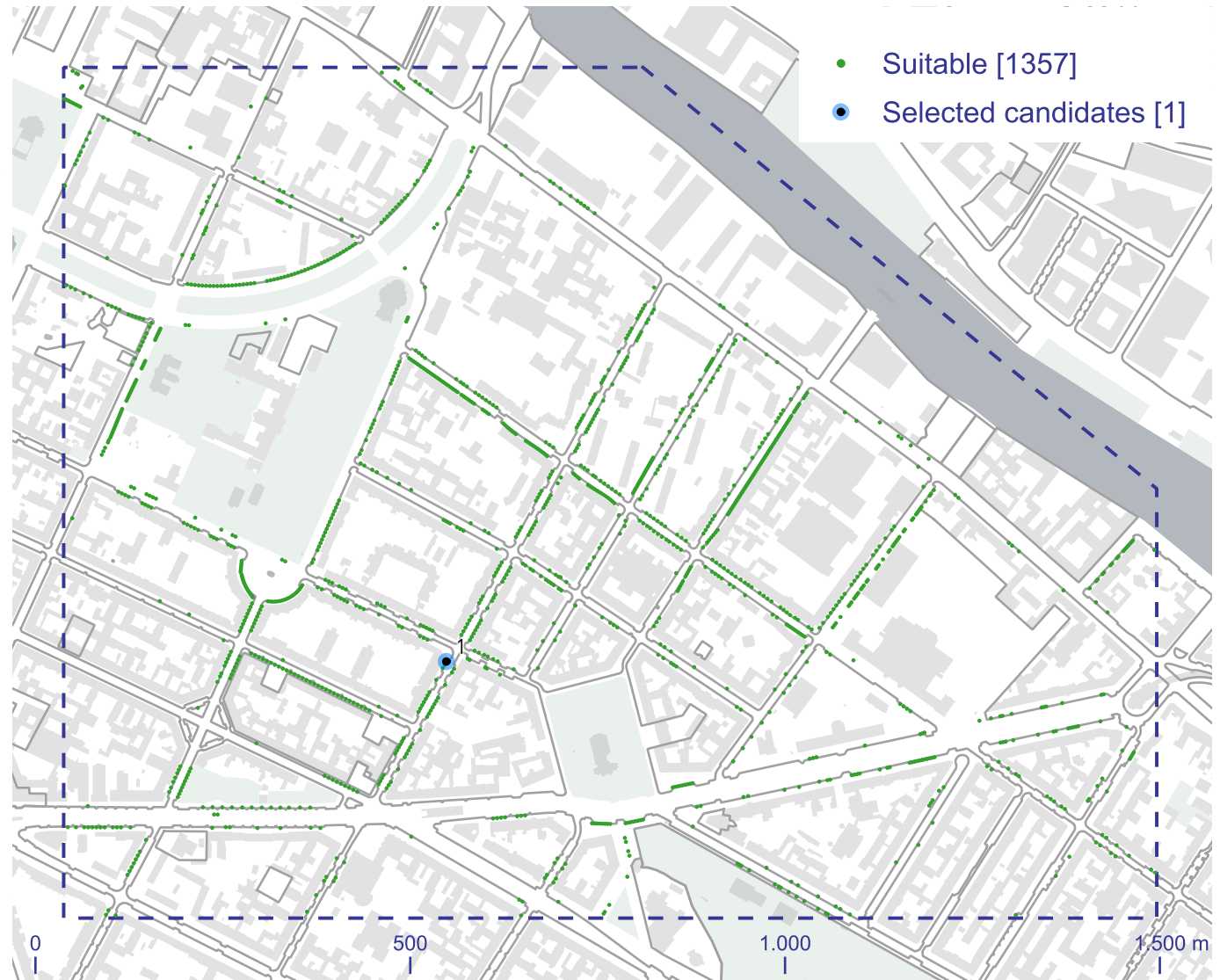
1. **Existing infrastructure:** subtraction of the demand already satisfied
2. **Candidate locations:** evaluation of the demand each candidate could satisfy



Potential locations (Source: OpenStreetMap)

ITERATIVE SELECTION PROCESS

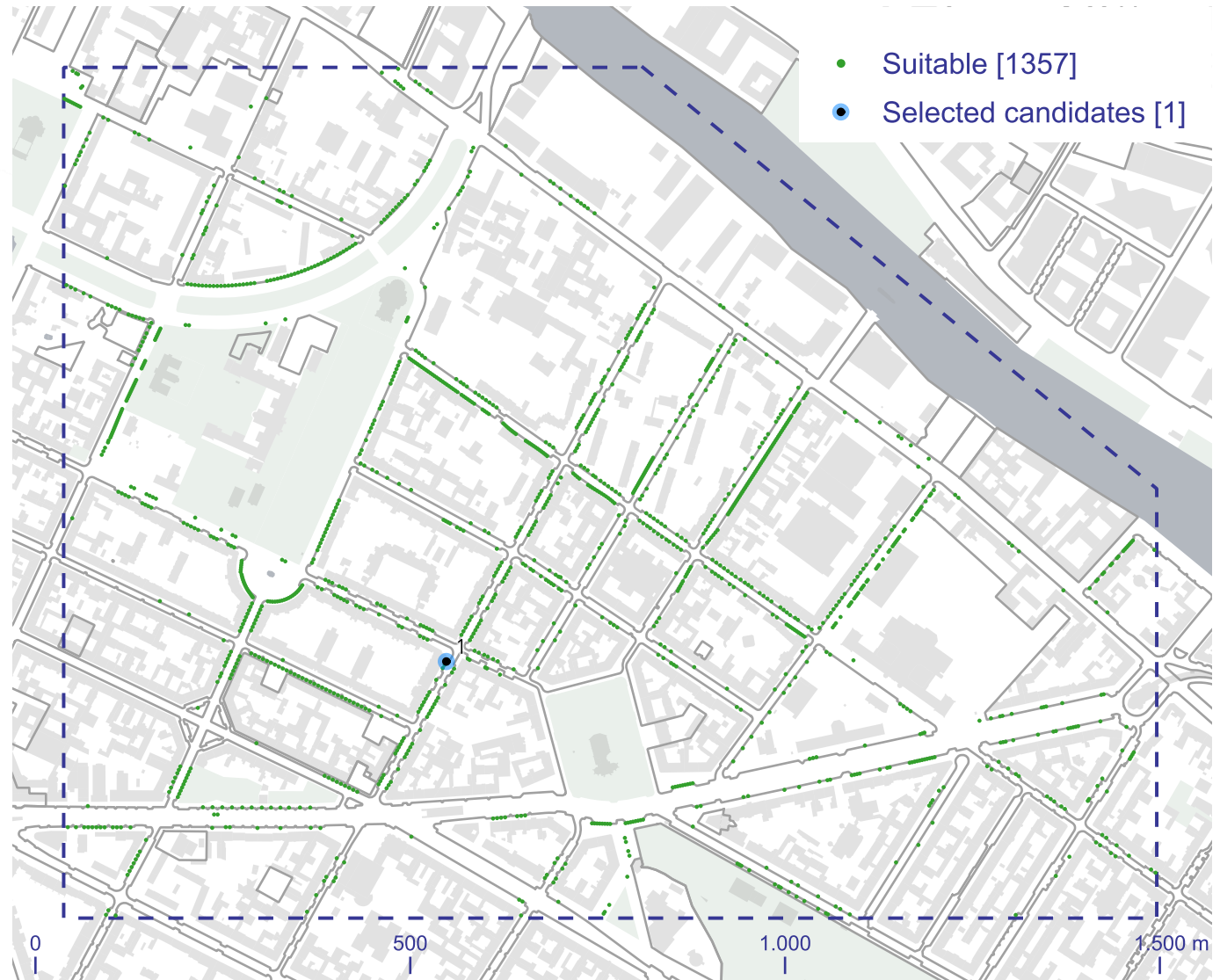
1. **Existing infrastructure:** subtraction of the demand already satisfied
2. **Candidate locations:** evaluation of the demand each candidate could satisfy
3. **Best scoring-location selection:** subtraction of the demand satisfied by the selected point



First selected location (Source: OpenStreetMap)

ITERATIVE SELECTION PROCESS

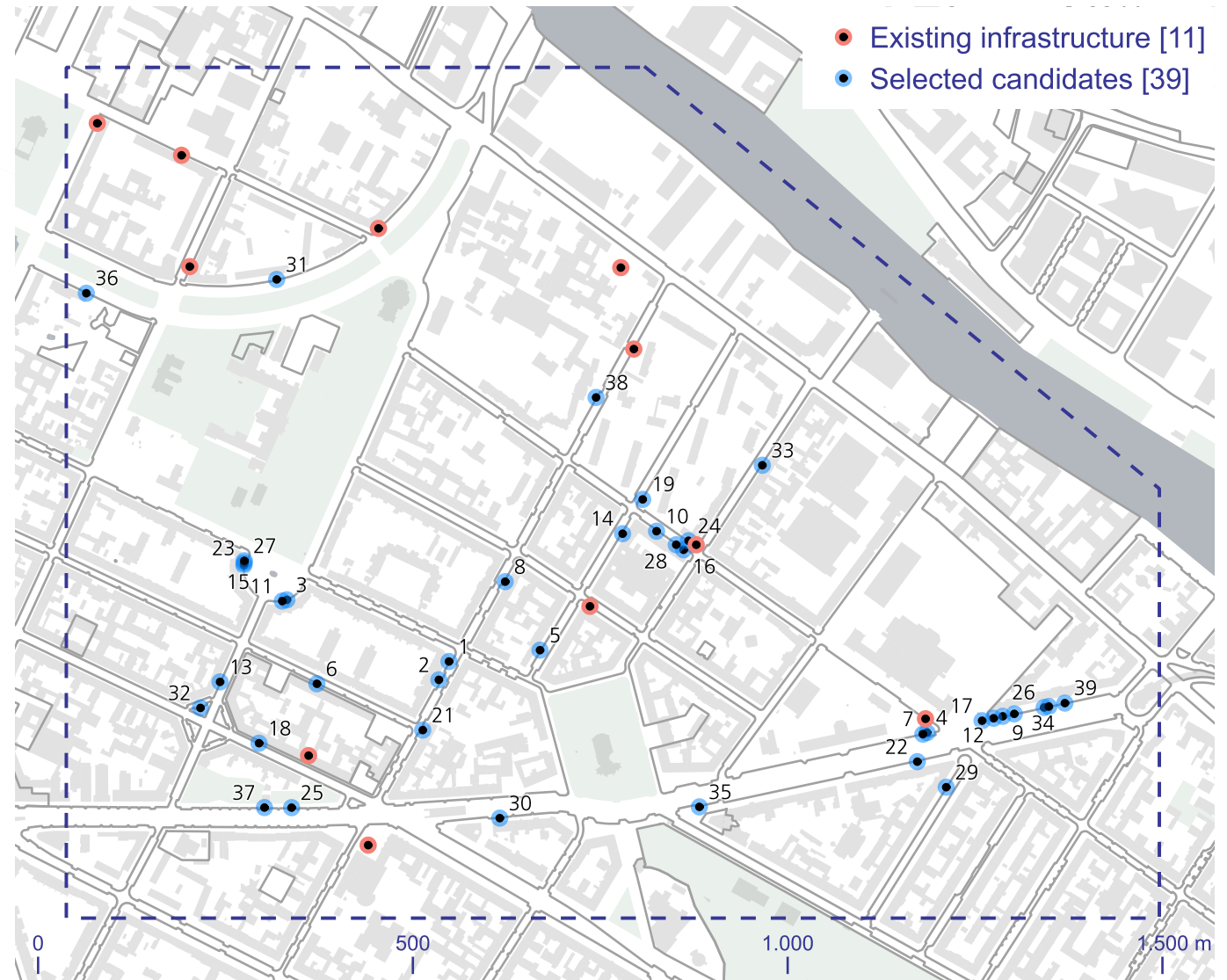
1. **Existing infrastructure:** subtraction of the demand already satisfied
2. **Candidate locations:** evaluation of the demand each candidate could satisfy
3. **Best scoring-location selection:** subtraction of the demand satisfied by the selected point
4. **Repeat** until targeted number of stations is reached



First selected location (Source: OpenStreetMap)

RESULT

- 39 best locations selected (from 1.357 suitable locations) aligning with the highest-demand areas
- The north-west corner received fewer placements because it is already well served by existing infrastructure



Result (Source: OpenStreetMap, Bundesnetzagentur)

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Result (Source: OpenStreetMap, Bundesnetzagentur)

CONCLUSION

- High-resolution output
- Reduction of on-site work
- Strategic placement of locations
- Transferable method for different urban settings
- Future work:
 - **More realistic demand representation**
 - **Application in private and publicly accessible parking**

Thank you!

Thanks to John E. Anderson, Jens Hellekes
and colleagues from project
PowerForecastMapper.



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Re-Generation
in transport



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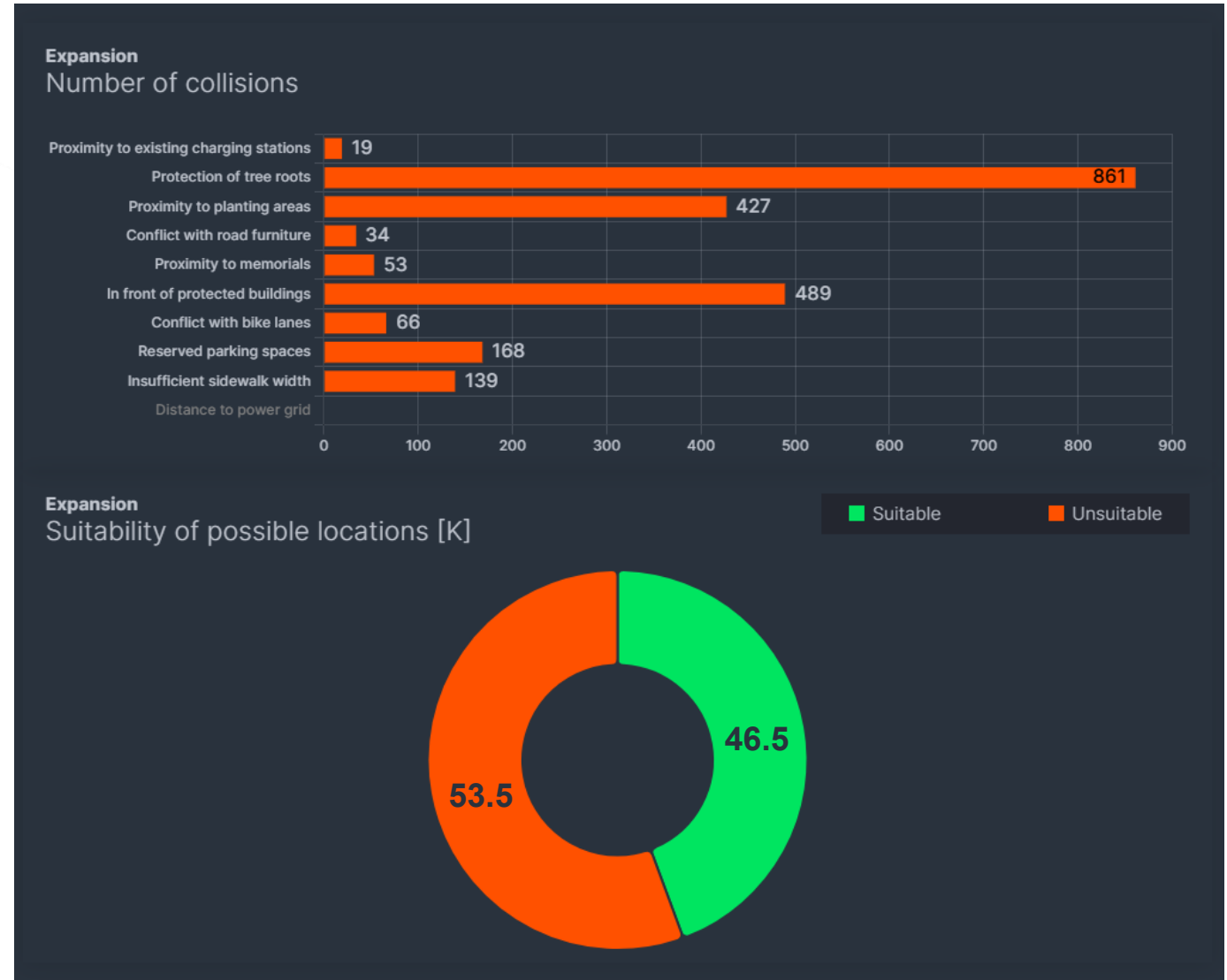
CANDIDATE LOCATIONS

SUITABILITY ANALYSIS

Overlay analysis with geospatial representation of constrains:

- 1.563 points (53.5%) have at least one conflict
- 1.357 points (46.5%) have no conflicts

→ **1.357 suitable candidate locations**



Collision analysis (Source: PowerForecastMapper)

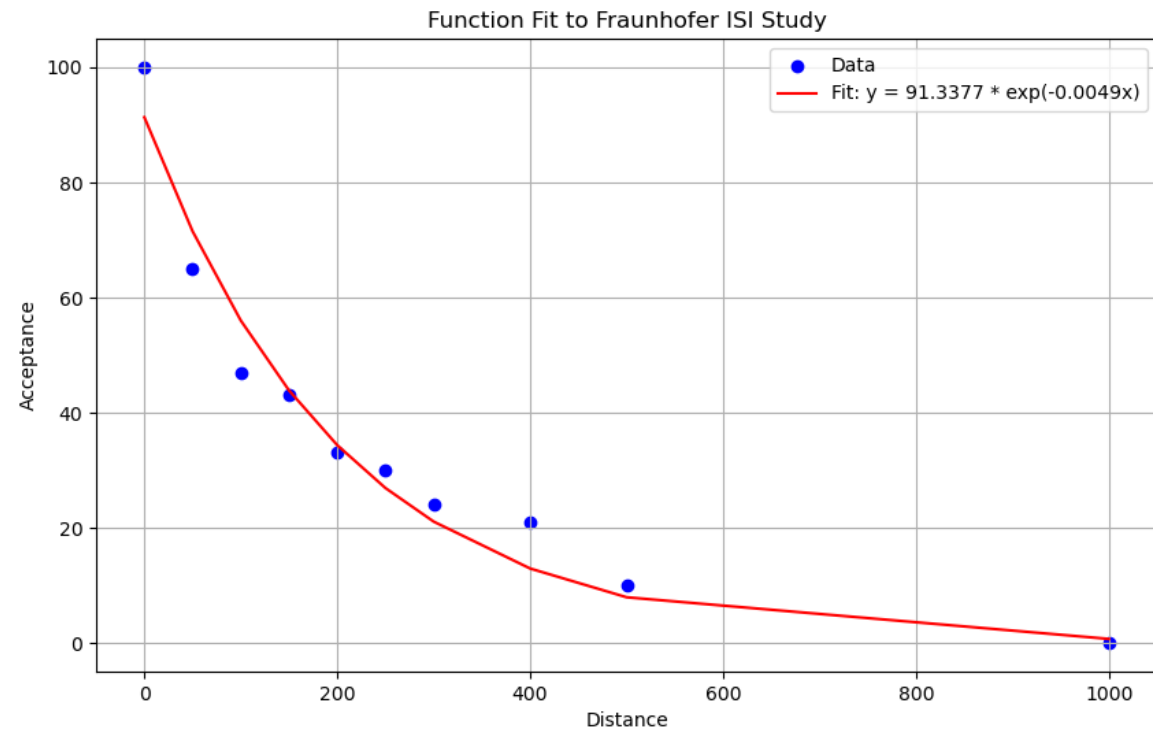
DEMAND SERVED PER CHARGER

Demand served per charger vs. walking distance.

Survey [a] shows relationship between acceptance and the walking distance between station and destination (distance-decay weight).

Relation used to:

- Estimate how much **demand each candidate can satisfy**
- **Reduce the demand** after each station (existing or new) is placed



[a] Fraunhofer ISI (Institute for Systems and Innovation Research) 2025