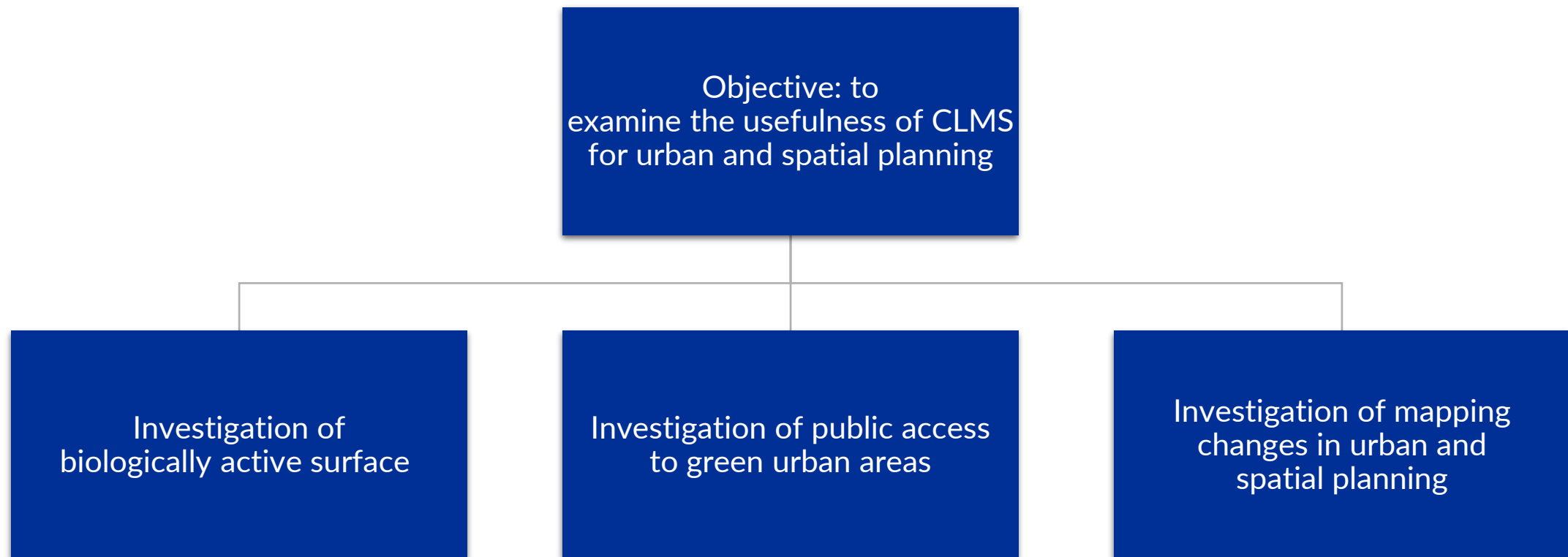


# The Benefits and Challenges of Using CLMS Products to Investigate Biologically Active Surfaces, Green Urban Areas, and LC Changes

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**Aim: to improve the user uptake of Land Cover / Land Use (LCLU) information derived from the integration of Copernicus Land Monitoring Service (CLMS) and national databases.**



# Investigation of biologically active surface

**biologically active surface ratio = soft landscaped area ratio** – defined as area with surface arranged in a way which ensures natural plant vegetation and rainfall retention as well as 50% of terraces and flat roofs with such surface and other surfaces ensuring natural plant vegetation of the surface of at least 10m<sup>2</sup> as well as surface water on this area

Regulation of the Minister of Infrastructure as of 12.04.2002  
on technical conditions which buildings and their location should comply with (Dz.U.15.1422 as amended)



## High Resolution Layers



Imperviousness



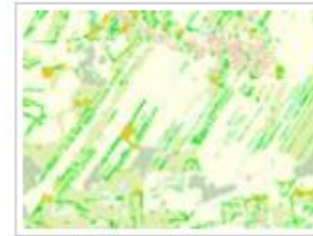
Forests



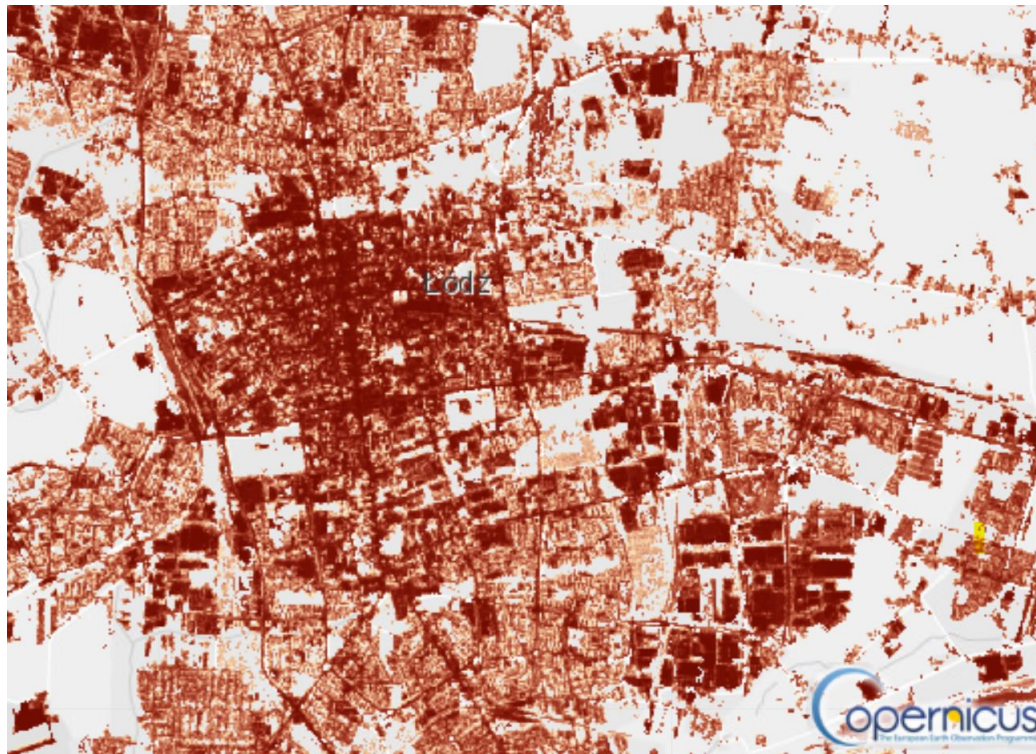
Grassland



Water & Wetness



Small Woody Features



Imperviousness Density 2018

### Available reference years:

2006, 2009, 2012, 2015, 2018

2021 – still unavailable

### Pixel size:

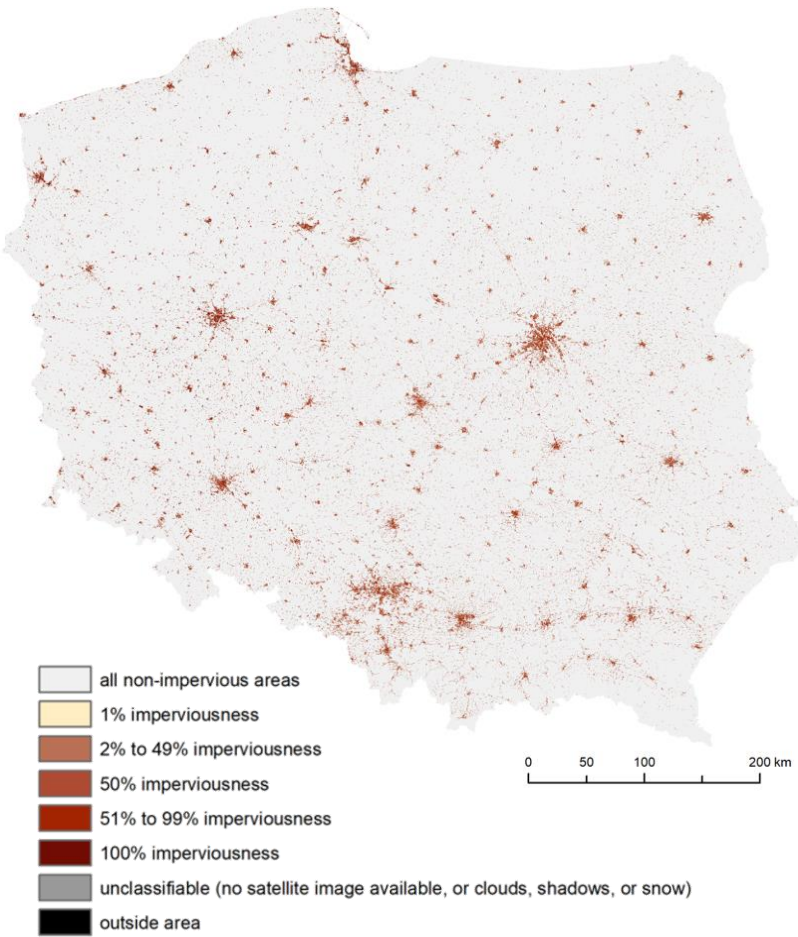
10m & 100m (2018)

20m & 100m (2006,2009,2012,2015)

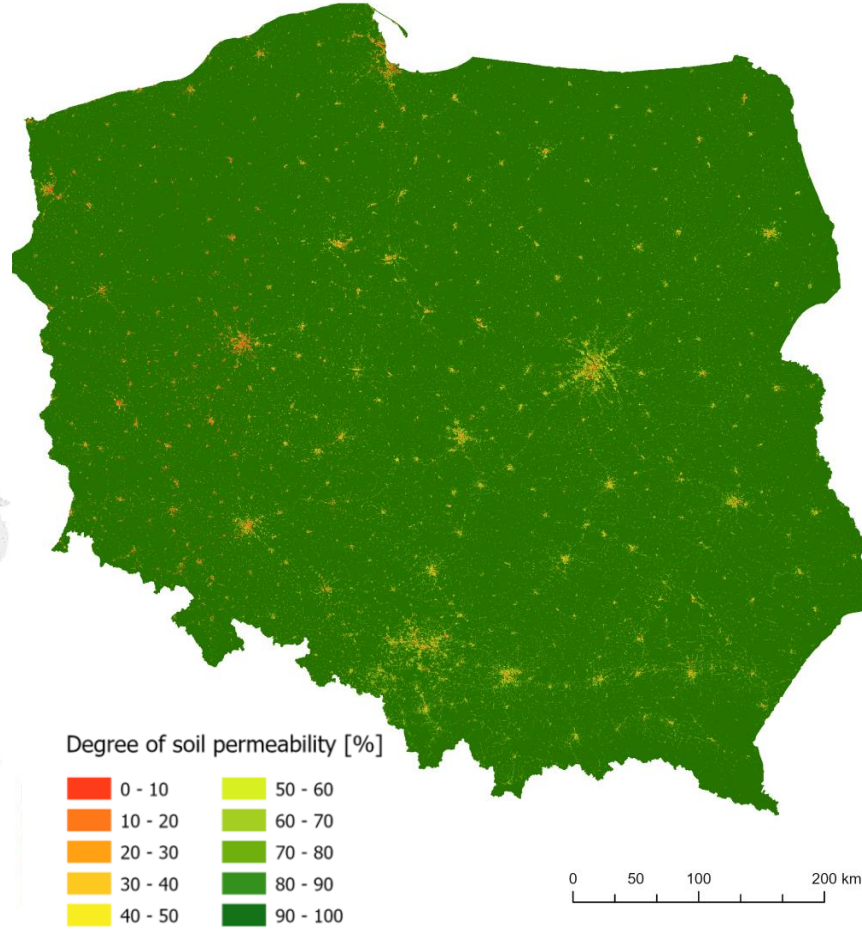
### Projection

National projections and LAEA (for pan-European mosaics)

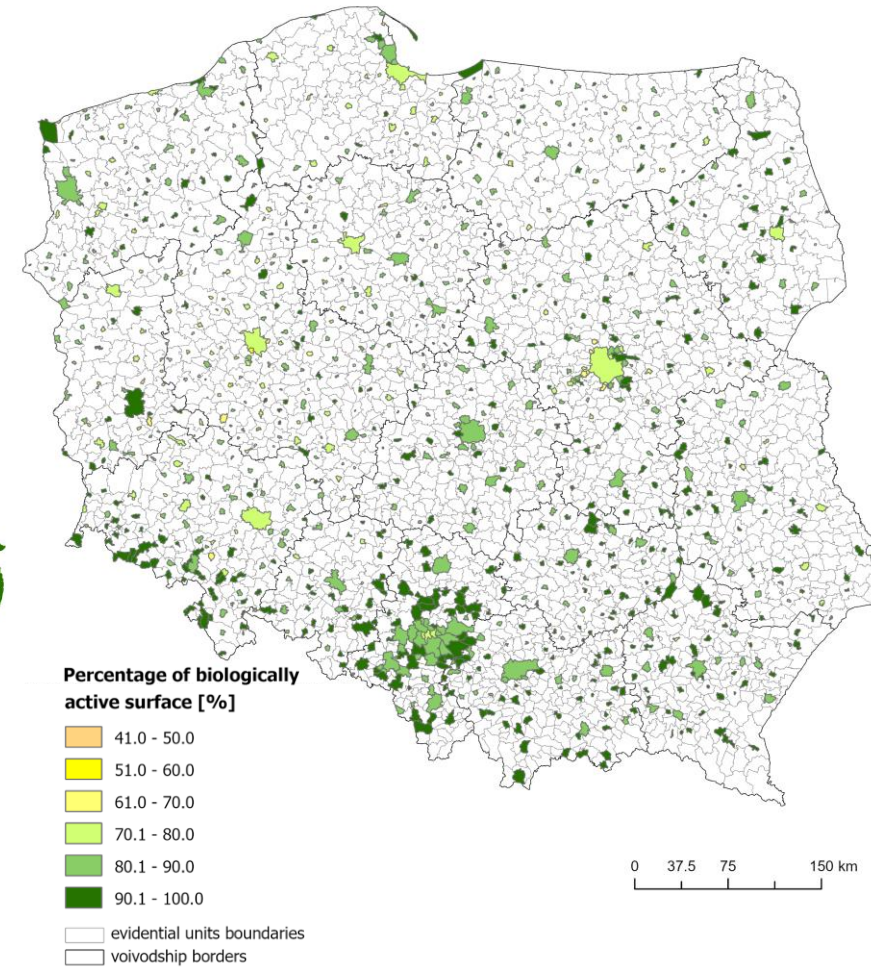




*HRL-Imperviousness 2018 data for Poland*



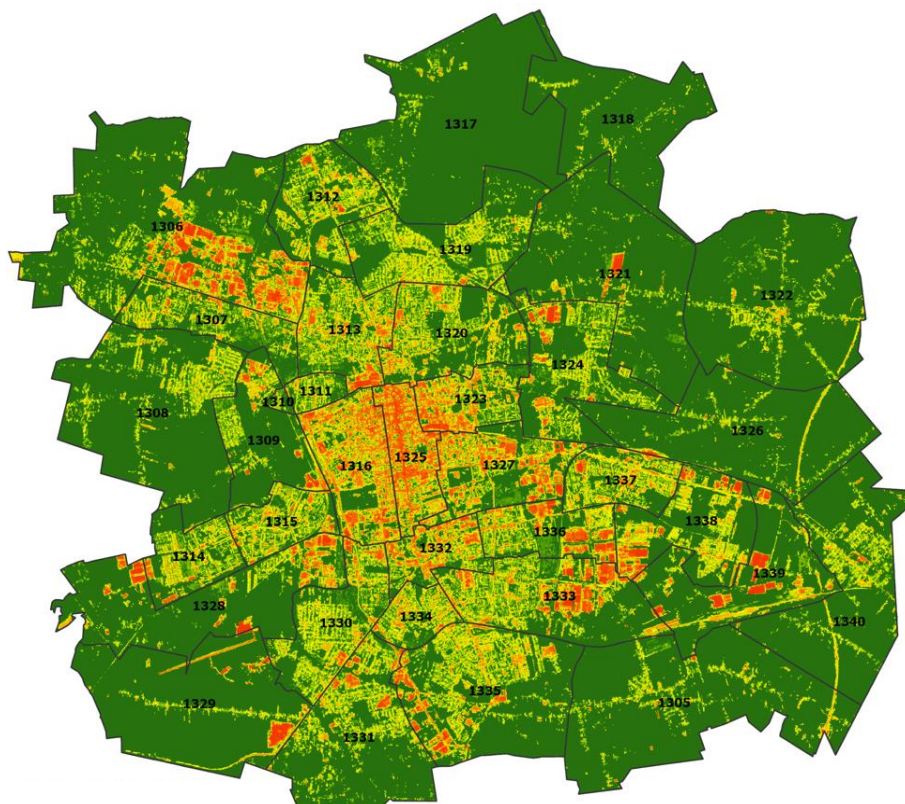
*Reversed HRL-Imperviousness data for Poland*



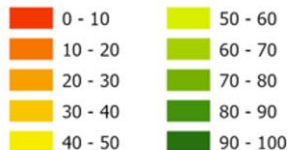
*Percentage of biologically active surface in urban municipalities and cities in urban-rural municipalities*



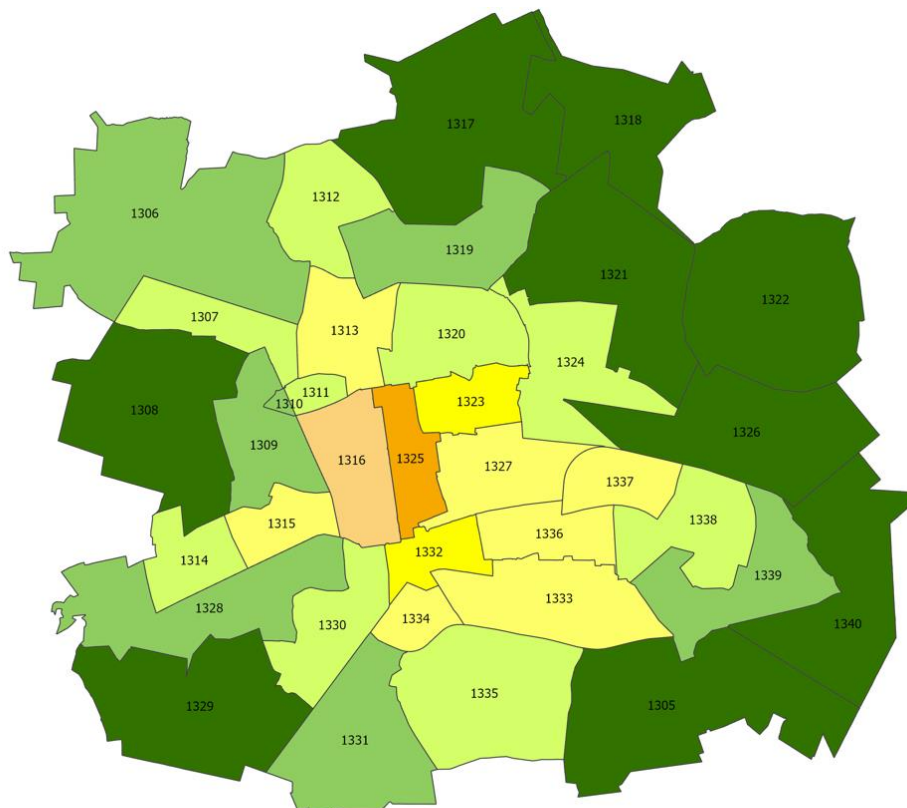
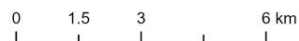
# Investigation of biologically active Surface within the Lodz auxiliary units



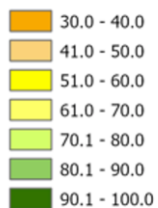
Degree of soil permeability [%]



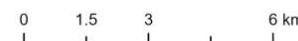
1329 auxiliary unit code  
 □ auxiliary unit boundary



Percentage of biologically active surface [%]



1329 auxiliary unit code  
 □ auxiliary unit boundary



Reversed HRL-Imperviousness data within the Lodz auxiliary units

Percentage of biologically active surface within the Lodz auxiliary units

Auxiliary unit	Auxiliary unit code	Percentage of biologically active area [%]
Łagiewniki	1317	98.3
Wzniesień Łódzkich	1318	98.0
Mileszki	1326	95.6
Dolina Łódki	1321	95.4
Wisłtino	1305	95.2
Nowosolna	1322	95.2
Nad Nerem	1329	93.6
Złotno	1308	92.4
Andrzejów	1340	92.1
Lublinek-Pienista	1328	86.4
Ruda	1331	84.4
Zdrowie-Mania	1309	84.1
<b>ŁÓDŹ</b>	-	<b>83.1</b>
nr 33	1339	82.9
im. Józefa Montwiła-Mireckiego	1310	82.4
Bałuty Zachodnie	1306	81.6
Julianów-Marysin-Rogi	1319	80.8
Stoki-Sikawa-Podgórze	1324	79.7
Chojny	1335	78.8
Teofilów Wielkopolska	1307	77.8
Radogoszcz	1312	77.5
Retkinia Zachód-Smulsko	1314	76.2
Bałuty Doły	1320	74.5
Olechów-Janów	1338	73.3
Koziny	1311	73.1
Rokicie	1330	72.2
Chojny Dąbrowa	1333	69.7
Karolew-Retkinia Wschód	1315	68.3
Widzew Wschód	1337	67.6
Piastów-Kurak	1334	66.0
Bałuty-Centrum	1313	64.3
Zarzew	1336	61.2
Stary Widzew	1327	61.1
Górniak	1332	56.3
Śródmieście Wschód	1323	56.0
Stare Polesie	1316	47.9
Katedralna	1325	34.2

## Classes selected from the BDOT10k database:

### From buildings, structures and facilities:

- buildings (code: BUBD)
- high technical buildings (code: BUWT)
- technical tanks (code: BUZT)
- covered swimming pools, open and covered tennis courts (code: BUSP)
- other structures (code: BUIB)

### From communication network:

- roadway (code: SKJZ)
- pedestrian and bicycle paths (code: SKRP)

### From other object:

- landmarks (code: OIOR)

### From land use complexes:

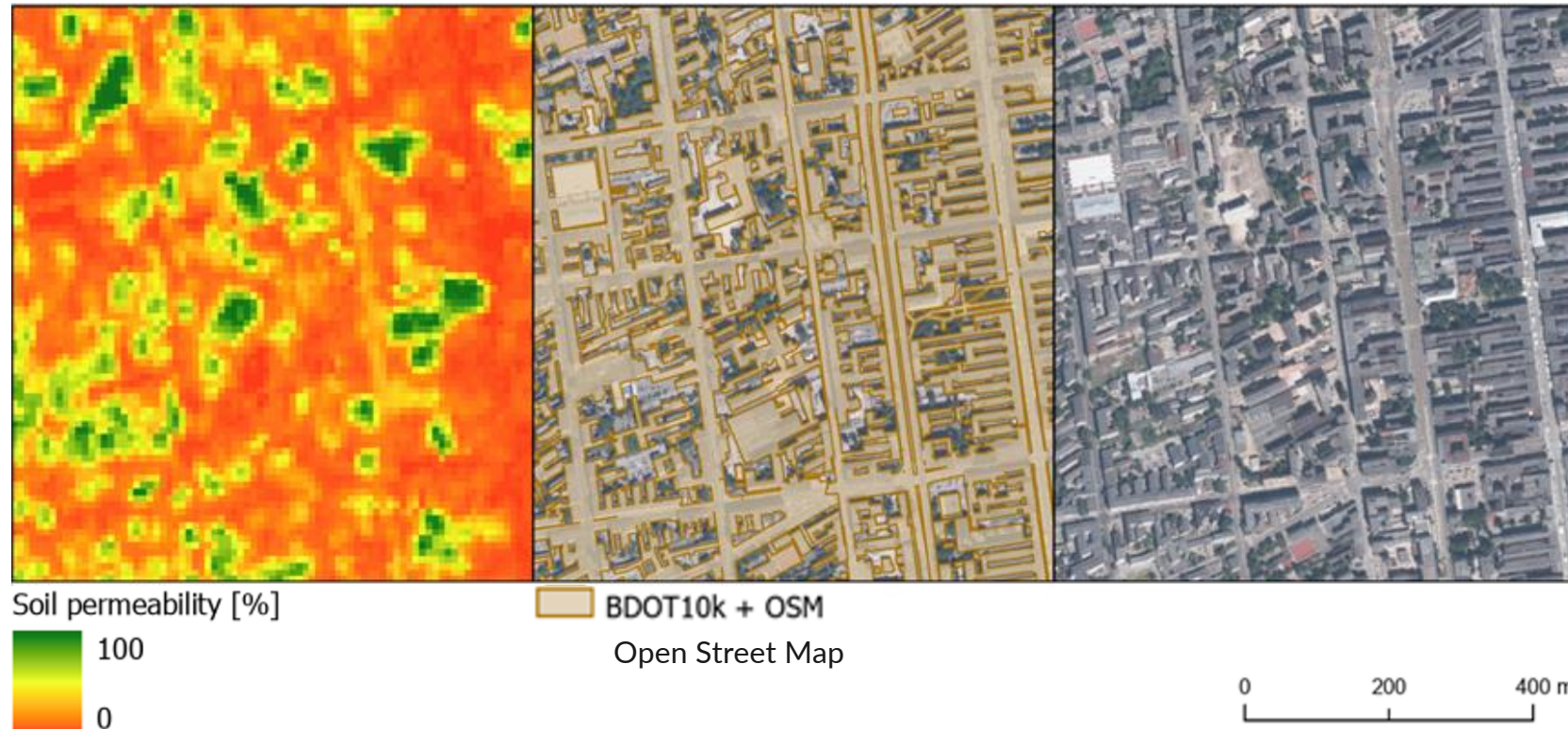
- petrol stations and depots (code: KUKO)

### From land cover:

- town squares (code: PTPL)
- area under the airport road (code: PTKM)
- dump sites (code: PTSO)
- other non-built-up areas (code: PTNZ)

## Selected layers from the OSM database:

- town squares and parking





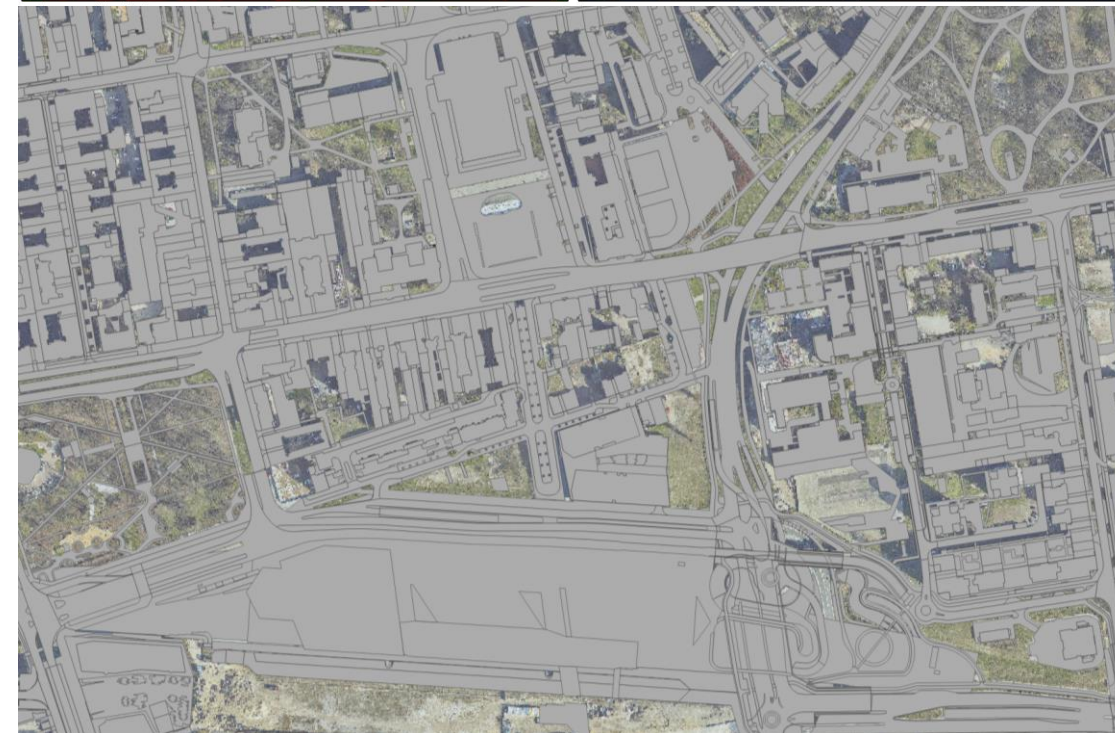
# Investigation of biologically active surface – national data [base map]

Geoinfo codes	Description of the object code - <u>Classes selected from the Lodz base map</u>
GESBZO	Building
GESBLO	Storeys above ground (building blocks)
GESBLI	Another block
GESBPD	Underground storeys
GESBNZ	Connector
GESBRP	Building related ramp
GESBTO	Terrace or porch
GESBWG	Veranda or porch
GESBWT	A shed or an open terrace on supports
GESIIB	another object related to the building
GESIWP	Entrance to the underground
GESSH	Stairs, overhead cranes, ramps for the disabled
GSSDSO	Retaining wall
GSSIIN	Dam
GSSISM	Dumpster
GSSKAL	Avenue (including: concrete, pavement, stone cubes, prefabricated cubes, bituminous mass, concrete slabs)
GSSKOA	Roadway
GSSKOD	Pavement
GSSKPL	Square or roundabout (including: concrete, pavement, clinker, stone cubes, prefabricated cubes, bituminous mass, concrete slabs)
GSSKSC	Lane
GSSSCH	Stairs
GSSSKT	Tennis Court
GSSSPS	Sports square
GSSUIN	Another engineering structure
GSSZES	Wharf
GSSZIN	Another earth structure
GSSZKL	Footbridge
GSSZSU	(strengthened) escarpment (including: Concrete cladding, other)

HRL + BDOT + OSM



Ortophoto



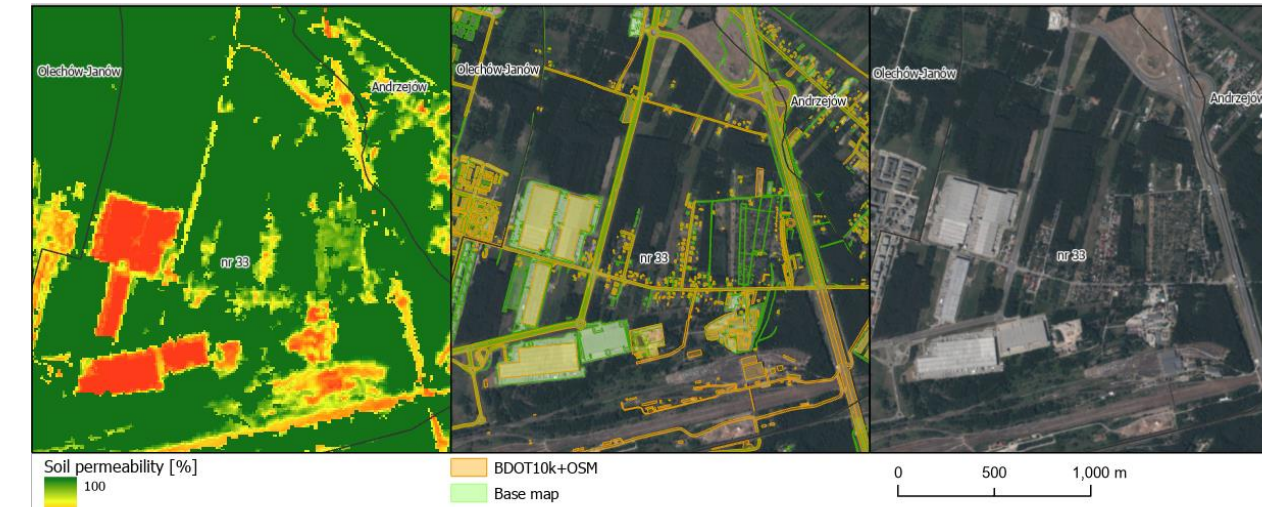
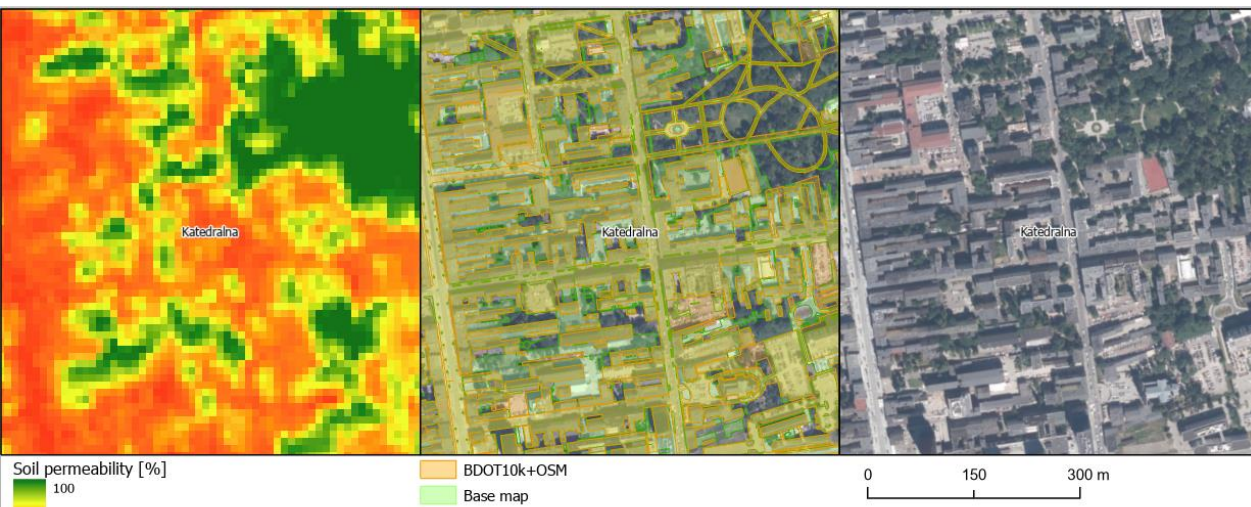
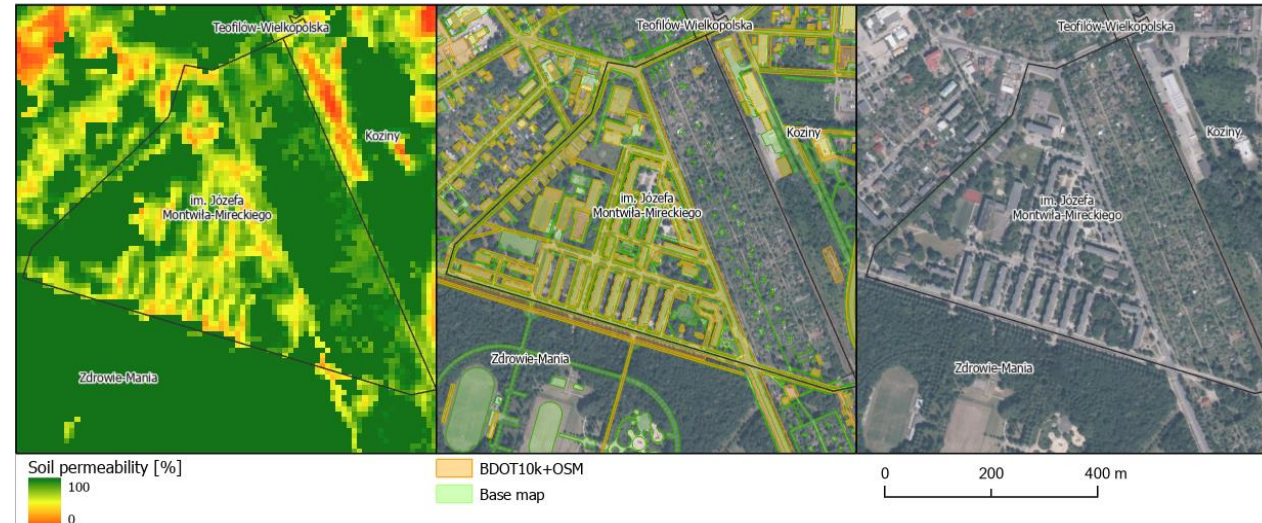
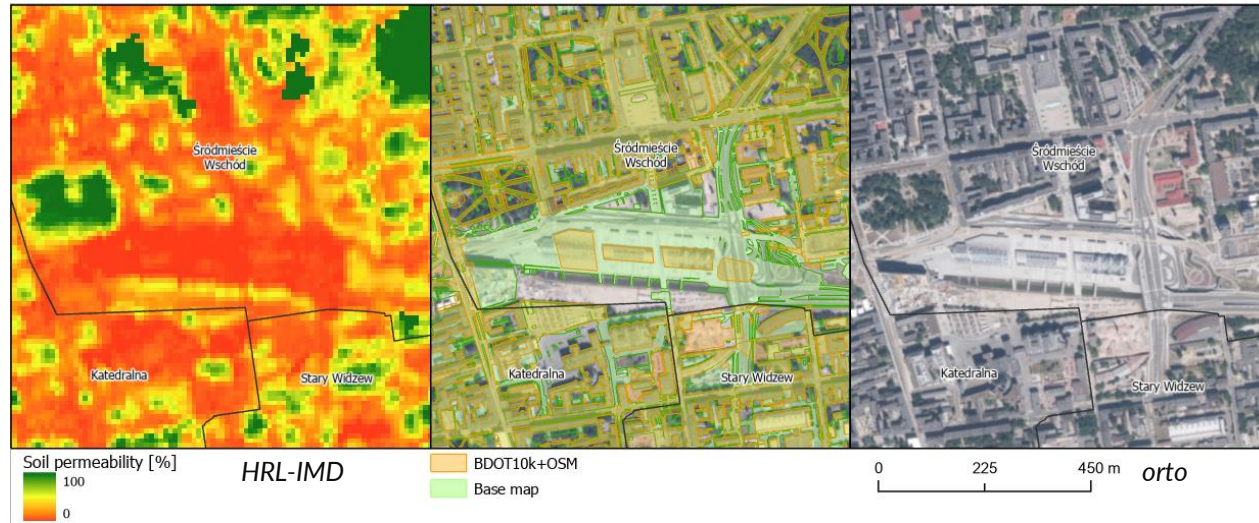
Impermeable surfaces derived from base-map



# Samples from different auxiliary units (housing estates)

BDOT is not updated on an ongoing basis and has lower accuracy compared to the data obtained from base maps

*the big difference between: BDOT + OSM – HRL and BASE MAP-HRL. Underestimated unsealed area in the space between blocks of multi-family housing (only 20-30%)*

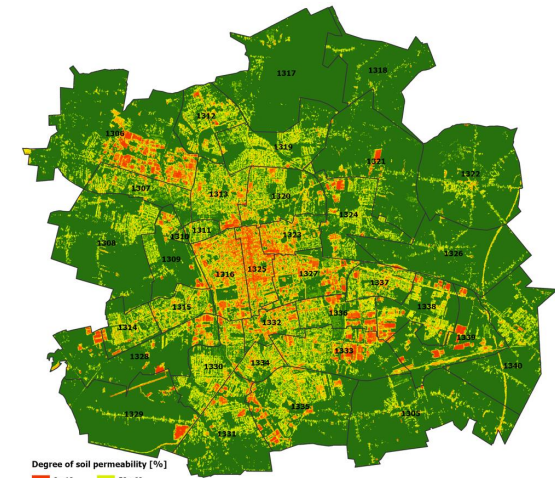


difference in the biologically active surface ratio between BDOT + OSM and the base map (11%)

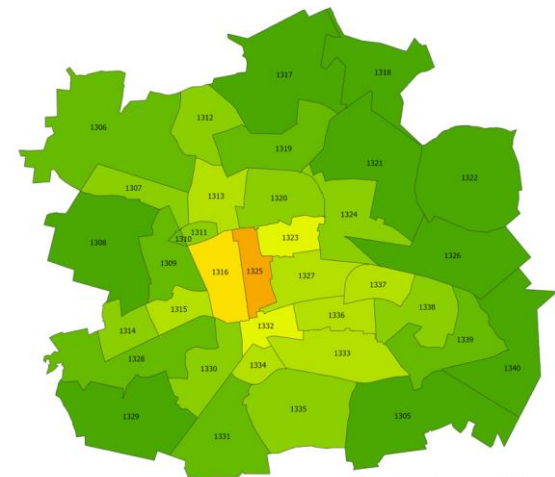
*example as a good result of BAS IMD (very little difference between each database)*



# Investigation of biologically active surface

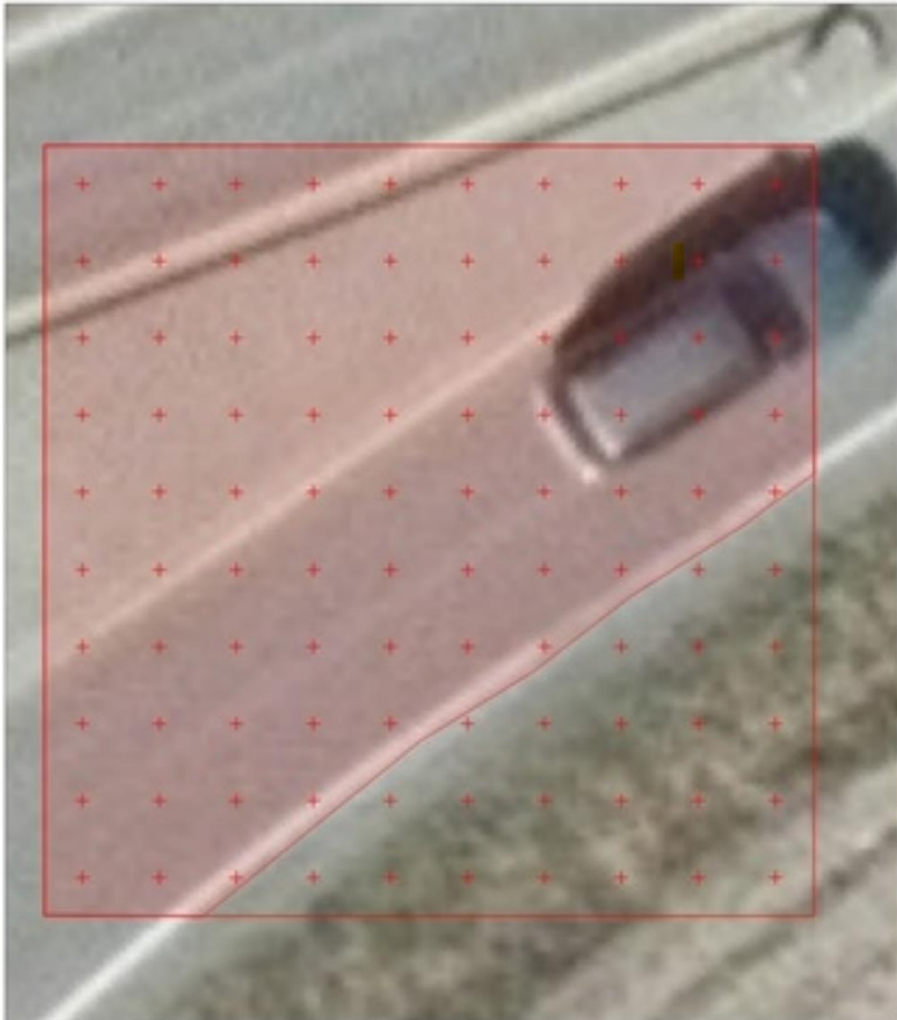


Overview of the reversed HRL-IMD data within the Lodz auxiliary units.



Map showing the percentage of biologically active surface within the Lodz auxiliary units.

Auxiliary unit code	Auxiliary unit	area [m2]	Percentage of biologically active surface HRL-IMD[%]	Percentage of biologically active surface BDOT10k [%]	Percentage of biologically active surface BDOT10k + OSM [%]	Percentage of biologically active surface Base Map [%]	difference BDOT+OSM - HRL	difference BASE MAP - HRL	difference BDOT+OSM - BASE MAP
Katedralna	1325	3633625,64	34,2	43,6	38,3	26,4	4	8	12
Stare Polesie	1316	5856396,53	47,9	50,1	47,0	42,9	1	5	4
Górnjak	1332	2952661,01	56,3	52,9	51,1	43,7	5	13	7
Śródmieście-Wschód	1323	3487801,25	56,0	55,0	52,1	47,4	4	9	5
Stary Widzew	1327	5901920,51	61,1	59,0	57,0	52,4	4	9	5
Bałuty Centrum	1313	5225670,20	64,3	56,1	54,2	53,3	10	11	1
Piastów-Kurak	1334	2179882,81	66,0	60,6	59,1	55,0	7	11	4
Karolew-Retkinia Wschód	1315	3217304,76	68,3	60,2	58,3	58,0	10	10	0
Zarzew	1336	4111283,16	61,2	60,9	59,4	59,5	2	2	0
Koziny	1311	1071469,06	73,0	67,8	67,0	63,3	6	10	4
Chojny-Dąbrowa	1333	8488666,92	69,7	67,5	66,5	63,9	3	6	3
Bałuty Doły	1320	6716376,55	74,4	64,9	63,8	64,6	11	10	1
Widzew Wschód	1337	3595976,86	67,6	58,5	57,3	65,1	10	3	8
Teofilów Wielkopolska	1307	4577614,62	77,8	68,9	66,9	65,6	11	12	1
im. Józefa Montwiła-Mireckiego	1310	256624,38	82,4	70,1	69,7	66,4	13	16	3
Rokicie	1330	5963931,13	72,3	72,1	71,6	67,6	1	5	4
Olechów-Janów	1338	6642083,34	73,3	69,6	68,5	70,5	5	3	2
Retkinia Zachód-Smulsko	1314	3775014,16	76,2	72,6	70,8	71,0	5	5	0
Chojny	1335	12020615,19	78,8	77,5	76,8	72,8	2	6	4
Radogoszcz	1312	5860225,66	77,5	72,0	71,0	72,8	6	5	2
Stoki-Sikawa-Podgórze	1324	8012139,71	79,7	78,5	78,2	76,4	2	3	2
Julianów-Marysin-Rogi	1319	8257451,22	80,7	80,5	80,4	77,4	0	3	3
Zdrowie-Mania	1309	5670685,50	84,1	81,5	80,8	79,8	3	4	1
Bałuty Zachodnie	1306	21513630,62	81,6	83,7	83,5	79,9	2	2	4
Ruda	1331	10060639,40	84,4	82,4	82,2	80,3	2	4	2
nr 33	1339	7977506,52	82,9	84,4	84,2	83,8	1	1	0
Lublinek-Pienista	1328	10797949,14	86,4	84,8	84,5	84,0	2	2	0
Złotno	1308	14664584,89	92,4	92,6	92,4	89,7	0	3	3
Wiskitno	1305	16682518,72	95,2	95,0	94,9	90,3	0	5	5
Nad Nerem	1329	13343008,55	93,6	89,6	89,5	92,7	4	1	3
Nowosolna	1322	15552144,13	95,2	94,5	94,4	92,9	1	2	1
Andrzejów	1340	11952023,02	92,1	93,1	93,1	93,1	1	1	0
Dolina Łódki	1321	14069553,64	95,4	95,5	95,5	93,5	0	2	2
Łągiewniki	1317	16817421,96	98,3	96,9	96,8	94,4	2	4	2
Mieszki	1326	12499886,77	95,6	95,3	95,3	96,6	0	1	1
Wzniesień Łódzkich	1318	9443847,43	98,0	96,4	96,4	96,7	2	1	0



### Dimensions

Pixelsize: 10 x 10 meter  
Pixelarea: 100 m<sup>2</sup>

### Sealed soil:

Human-produced surface that is essentially impenetrable by rainfall

### Imperviousness:

The proportion of a pixel that is sealed

### Estimated imperviousness

Remote sensing:  
72%


Digitizing the sealed part of the pixel:  
76%

Within pixel sampling:  
77%

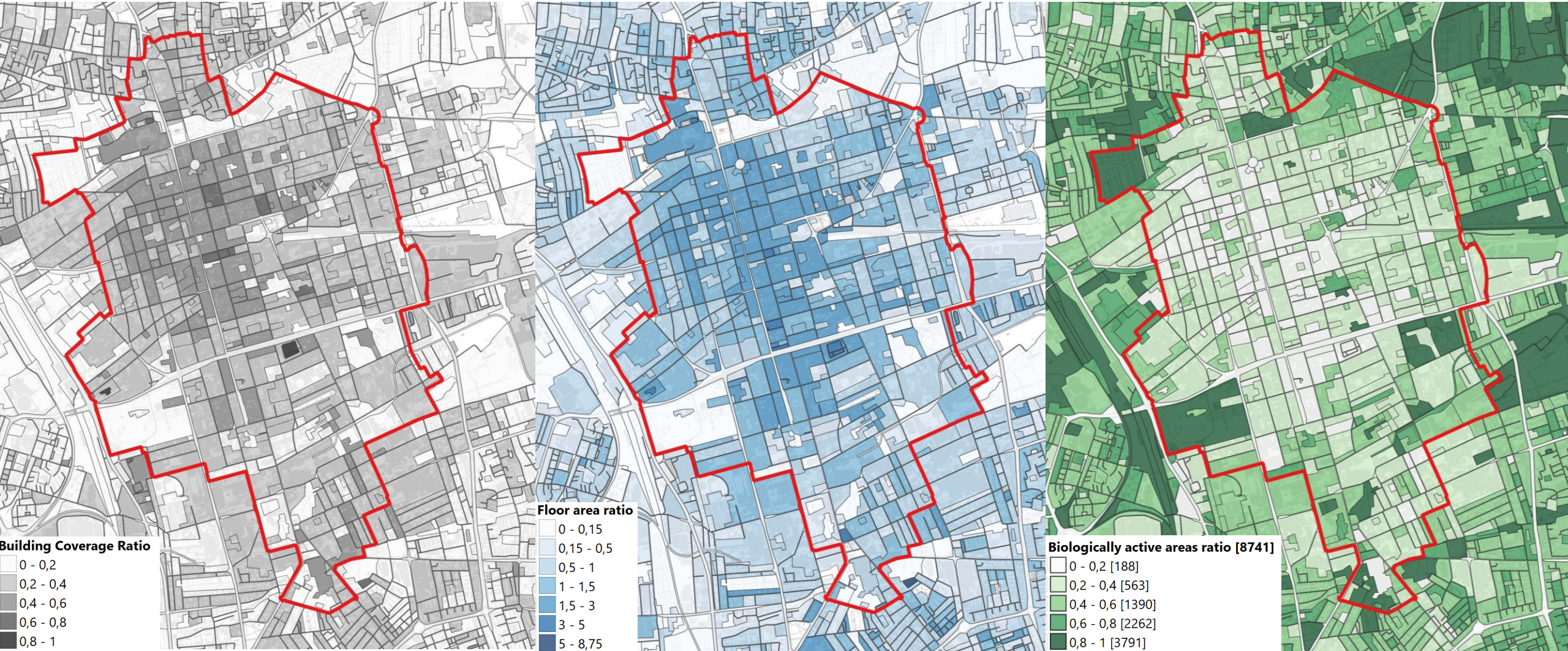


Article

## Accuracy of the Copernicus High-Resolution Layer Imperviousness Density (HRL IMD) Assessed by Point Sampling within Pixels

Geir-Harald Strand 





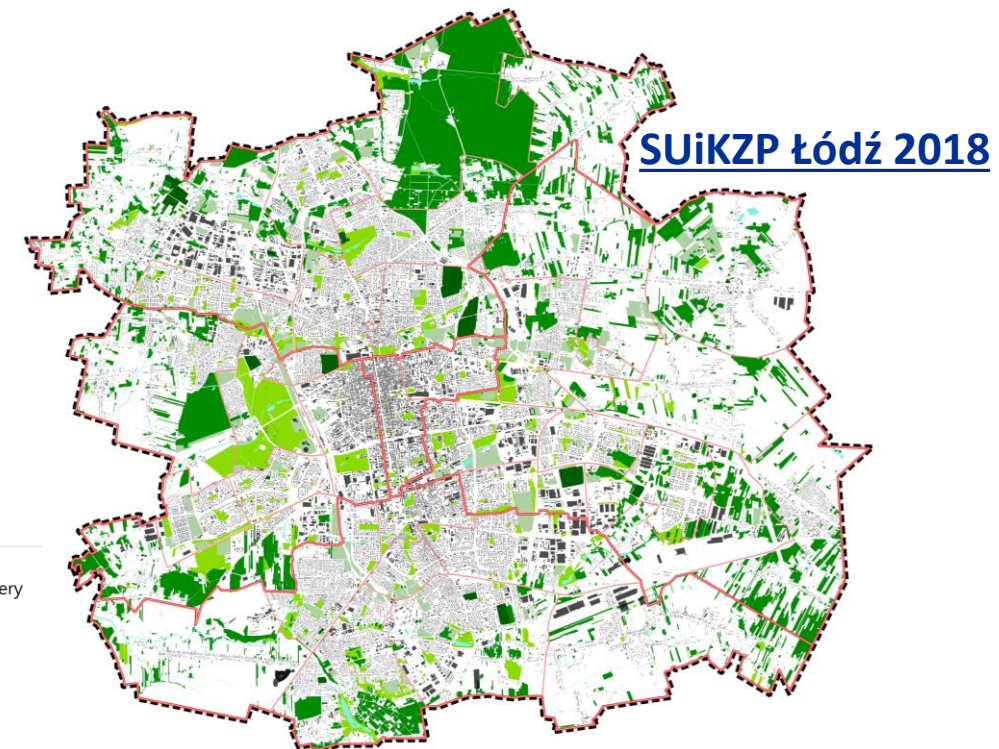
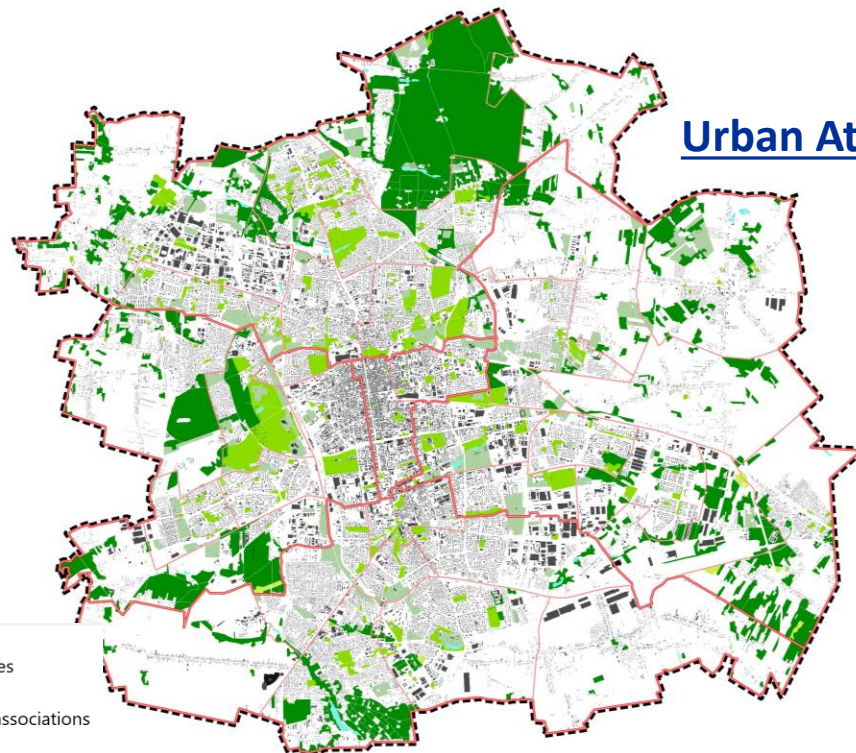


# Investigation of public access to green urban areas

## INDICATORS

1. Share of green urban areas and forests in total land area, by auxiliary unit
2. Green urban areas (m<sup>2</sup>) per capita (city/district/housing estate inhabitant)
3. Number of inhabitants per ha of green urban areas
4. Share of housing estate area within 300 metres linear distance to urban green areas (percentage)

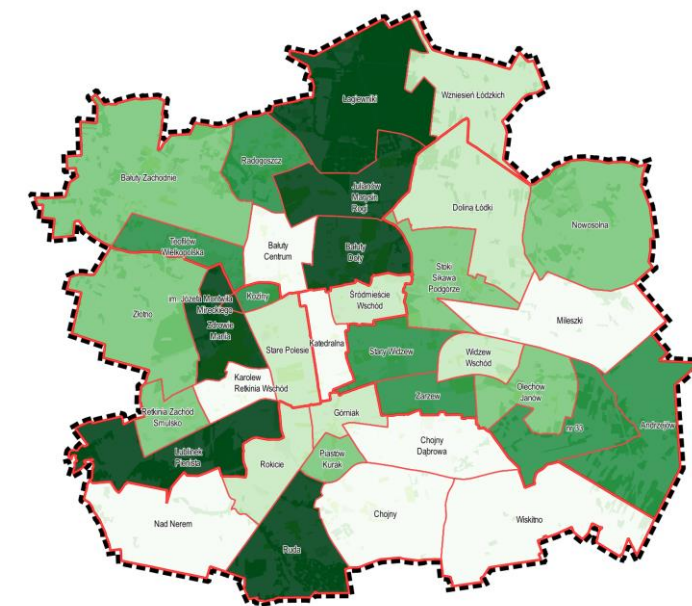
Urban Atlas LCLU 2018	SUIKZP/MPZP
14100: Green urban areas	ZP – Greenery areas, parks ZC – Cementries
14200: Sports and leisure facilities	ZD – Allotment gardens US – Sport and recreation services
31000: Forests	ZL – Forests LZ- Trees



# WP3 Milestone 2: Public access to green urban areas - quantitative research methods

## Share of green urban areas and forests in total land area

Auxiliary unit	Auxiliary unit code	Auxiliary unit area [ha]	Green urban areas	Sports and leisure facilities	Forests	Share of green areas in total land area [ UA ]	ZP+ZC (green urban areas)	ZD (sports and leisure facilities)	LS + LZ (Forests)	Share of green areas in total land area [MPU]	difference - share of green areas in total land area
Katedralna	1325	364	3,59%	0,09%	0,00%	3,68%	4,19%	0,37%	0,00%	5%	0,88%
Wiskitno	1305	1671	0,02%	0,00%	4,01%	4,03%	0,08%	0,00%	8,25%	8%	4,31%
Nad Nerem	1329	1336	0,00%	0,01%	4,80%	4,81%	0,72%	0,00%	7,92%	9%	3,83%
Mileszki	1326	1252	0,11%	0,07%	6,40%	6,58%	0,12%	0,00%	10,22%	10%	3,77%
Karolew-Retkinia Wschód	1315	322	4,62%	3,00%	0,00%	7,62%	5,40%	2,11%	0,03%	8%	0,07%
Chojny-Dąbrowa	1333	850	1,57%	3,73%	2,47%	7,77%	3,12%	2,72%	3,80%	10%	1,86%
Bałuty-Centrum	1313	523	4,99%	5,03%	0,00%	10,02%	4,26%	2,63%	0,52%	10%	-0,25%
Chojny	1335	1204	4,30%	3,17%	3,06%	10,53%	2,98%	1,36%	6,81%	12%	1,03%
Rokicie	1330	597	2,13%	7,43%	1,24%	10,79%	2,29%	5,61%	1,30%	9%	-1,38%
Stare Polesie	1316	586	8,98%	1,87%	0,00%	10,85%	7,94%	0,00%	0,01%	10%	-0,79%
Górniak	1332	296	8,27%	3,75%	0,00%	12,02%	5,75%	2,48%	0,00%	9%	-3,29%
Śródmieście-Wschód	1323	349	4,76%	6,60%	0,68%	12,04%	2,37%	3,35%	0,52%	8%	-3,99%
Wzniesień Łódzkich	1318	946	0,00%	0,46%	11,76%	12,22%	0,00%	0,25%	19,77%	20%	8,19%
Widzew-Wschód	1337	360	6,14%	2,47%	5,01%	13,62%	3,25%	1,70%	5,17%	12%	-1,79%
Dolina Łódki	1321	1409	0,04%	3,90%	10,20%	14,15%	0,00%	3,45%	20,40%	24%	9,85%
Nowosolna	1322	1557	0,31%	4,43%	12,36%	17,10%	0,07%	4,24%	13,69%	18%	1,03%
Retkinia Zachód-Smulsko	1314	378	4,51%	9,33%	3,64%	17,48%	6,89%	8,08%	2,49%	17%	-0,02%
Olechów-Janów	1338	665	2,49%	1,54%	13,52%	17,55%	3,96%	1,23%	14,40%	20%	2,32%
Piastów-Kurak	1334	218	5,13%	12,50%	0,00%	17,63%	4,91%	8,94%	0,18%	15%	-2,47%
Stoki-Sikawa-Podgórze	1324	802	4,83%	8,28%	5,01%	18,13%	5,75%	6,17%	8,35%	21%	2,79%
Bałuty Zachodnie	1306	2154	2,52%	2,88%	13,04%	18,44%	1,84%	2,53%	12,50%	17%	-1,45%
Złotno	1308	1468	0,27%	1,00%	17,38%	18,65%	2,73%	0,94%	18,98%	23%	4,05%
Andrzejów	1340	1197	0,77%	0,20%	18,71%	19,68%	0,07%	0,09%	21,78%	22%	2,37%
Zarzew nr 33	1336	412	11,71%	9,08%	0,00%	20,78%	10,73%	8,19%	0,00%	19%	-1,71%
	1339	799	0,00%	1,26%	21,31%	22,57%	0,80%	0,99%	19,04%	21%	-1,74%
Stary Widzew	1327	591	12,96%	11,45%	0,00%	24,41%	10,20%	5,45%	0,33%	20%	-4,28%
Teofilów-Wielkopolska	1307	458	7,46%	15,40%	1,58%	24,44%	5,03%	11,36%	1,12%	19%	-5,56%
Koziny	1311	107	22,99%	4,66%	0,00%	27,65%	20,04%	2,84%	0,00%	23%	-4,77%
Radogoszcz	1312	587	12,52%	4,72%	11,21%	28,44%	4,38%	3,56%	8,55%	17%	-11,86%
Julianów-Marysin-Rogi	1319	827	12,61%	2,23%	14,93%	29,77%	7,08%	1,59%	13,79%	23%	-7,21%
Ruda	1331	1007	3,26%	2,41%	25,58%	31,25%	3,59%	1,58%	19,06%	25%	-6,73%
Bałuty-Doły	1320	673	22,39%	8,41%	2,11%	32,91%	19,27%	5,48%	1,51%	27%	-5,53%
Lublinek-Pienista	1328	1081	0,12%	3,14%	29,94%	33,20%	4,38%	2,51%	27,74%	35%	1,59%
im. Józefa Montwiła-Mireckiego	1310	26	2,76%	39,67%	0,00%	42,43%	0,00%	33,05%	0,00%	33%	-9,38%
Zdrowie-Mania	1309	568	36,67%	15,12%	15,71%	67,50%	45,71%	6,29%	1,47%	59%	-8,45%
Łągiewniki	1317	1684	0,21%	3,54%	74,87%	78,62%	0,44%	2,93%	72,19%	76%	-2,88%



Share of green areas in total land area [36]

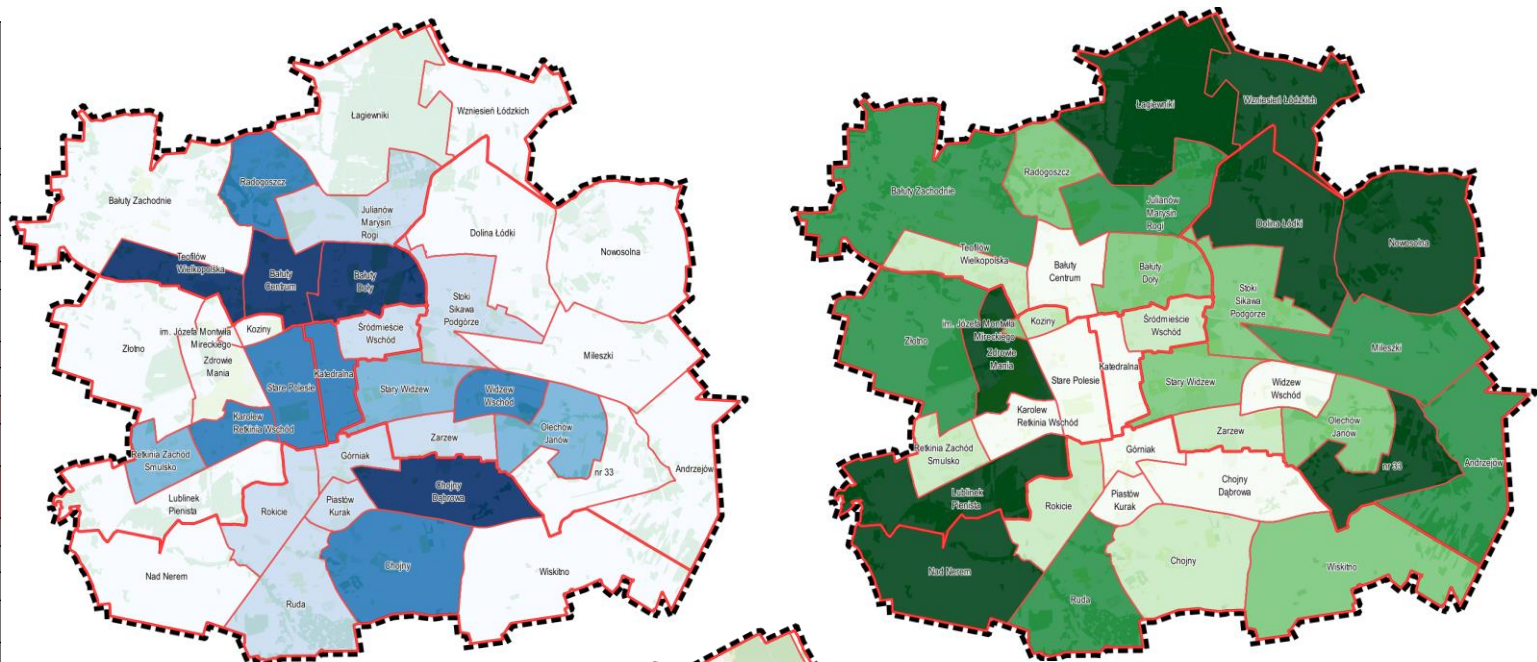
- 3,7 - 10,5 [8]
- 10,5 - 14,2 [7]
- 14,2 - 18,6 [7]
- 18,6 - 28,4 [7]
- 28,4 - 78,6 [7]



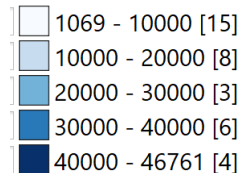
# WP3 Milestone 2: Public access to green urban areas - quantitative research methods

## Green urban areas (m2) per capita and Number of inhabitants per ha of green urban areas

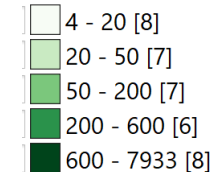
District	Auxiliary unit	Auxiliary unit area [ha]	number of inhabitants (2018)	Green areas (m2) per capita	Number of inhabitants per ha of green urban areas (ua)
GÓRNA	Wiskitno	1671	3445	195,31	51
BAŁUTY	Bałuty Zachodnie	2154	7002	567,35	18
BAŁUTY	Teofilów-Wielkopolska	458	42946	26,08	383
POLESIE	Złotno	1468	8431	324,90	31
POLESIE	Zdrowie-Mania	568	3011	1273,04	8
POLESIE	im. Józefa Montwiła-Mireckiego	26	1618	67,39	148
POLESIE	Koziny	107	9930	29,88	335
BAŁUTY	Radogoszcz	587	30790	54,21	184
BAŁUTY	Bałuty-Centrum	523	44680	11,74	852
POLESIE	Retkinia Zachód-Smulsko	378	25980	25,44	393
POLESIE	Karolew-Retkinia Wschód	322	35891	6,84	1463
POLESIE	Stare Polesie	586	32734	19,44	514
BAŁUTY	Łagiewniki	1684	1669	7933,27	1
BAŁUTY	Wzniesień Łódzkich	946	1314	879,22	11
BAŁUTY	Julianów-Marysin-Rogi	827	11462	214,76	47
BAŁUTY	Bałuty-Doty	673	40349	54,86	182
WIDZEW	Dolina Łódki	1409	2302	865,80	12
WIDZEW	Nowosolna	1557	4147	642,06	16
ŚRÓDMIEŚCIE	Śródmieście-Wschód	349	17451	24,10	415
WIDZEW	Stoki-Sikawa-Podgórze	802	10590	137,32	73
ŚRÓDMIEŚCIE	Katedralna	364	35699	3,75	2664
WIDZEW	Mieszki	1252	1961	419,79	24
WIDZEW	Stary Widzew	591	21095	68,39	146
POLESIE	Lublinek-Pienista	1081	5537	648,33	15
GÓRNA	Nad Nerem	1336	1069	601,63	17
GÓRNA	Rokicie	597	16647	38,72	258
GÓRNA	Ruda	1007	11325	278,01	36
GÓRNA	Górniak	296	17622	20,17	496
GÓRNA	Chojny-Dąbrowa	850	46761	14,13	708
GÓRNA	Piastów-Kurak	218	19307	19,93	502
GÓRNA	Chojny	1204	32059	39,53	253
WIDZEW	Zarzew	412	19811	43,19	232
WIDZEW	Widzew-Wschód	360	37254	13,16	760
WIDZEW	Olechów-Janów	665	21043	55,47	180
WIDZEW	nr 33	799	1079	1670,79	6
WIDZEW	Andrzejów	1197	5673	415,18	24
			629684	491,76	318



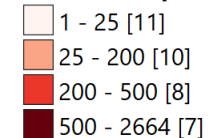
number of inhabitants (2018) [36]



Green areas (m2) per capita [36]



inhabitants per ha of green urban areas



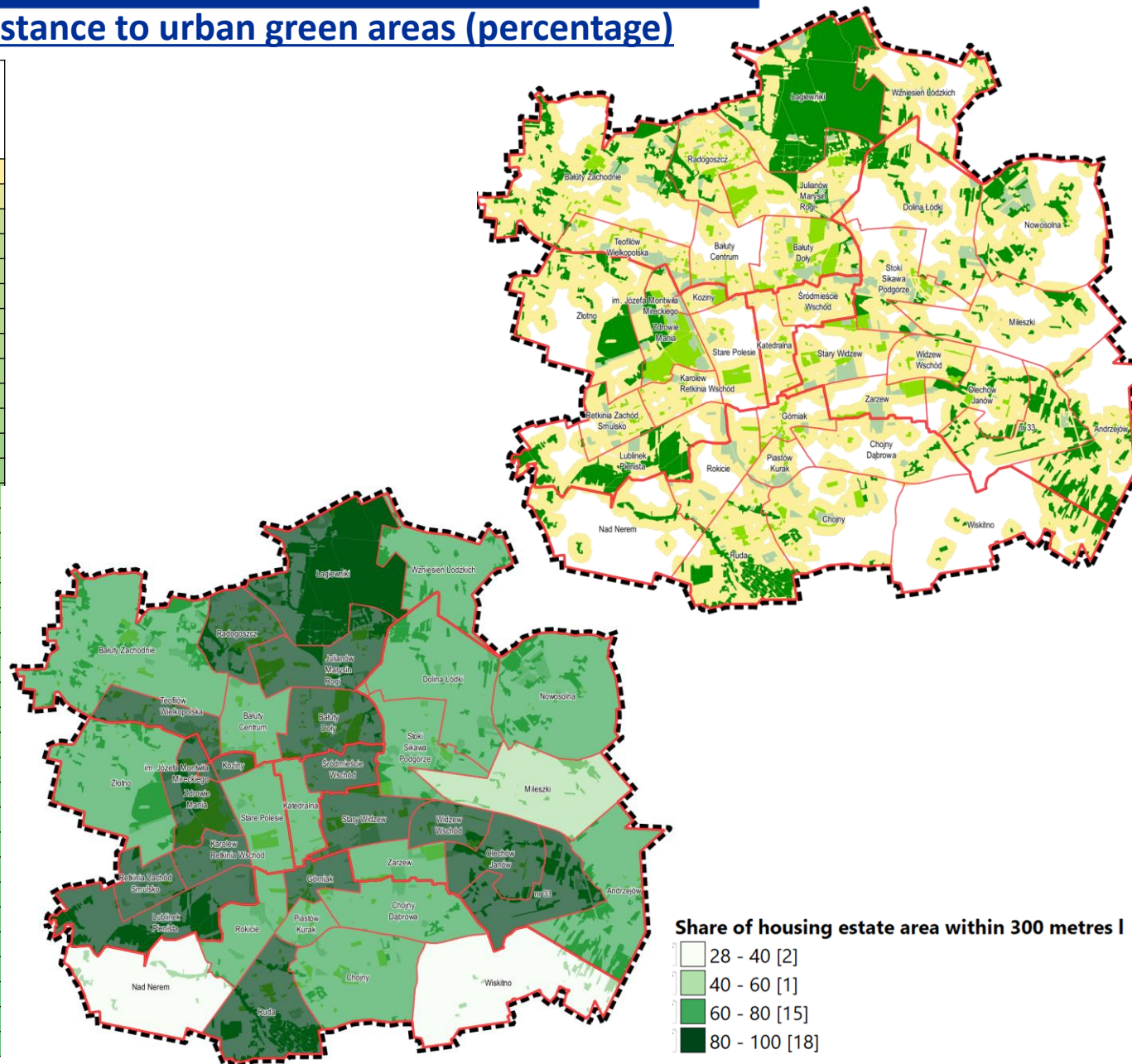


# WP3 Milestone 2: Public access to green urban areas - quantitative research methods

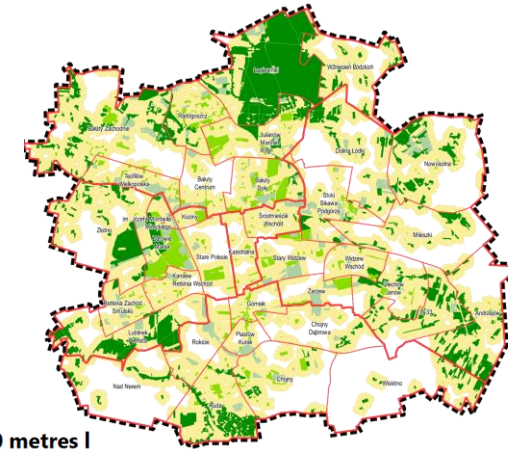
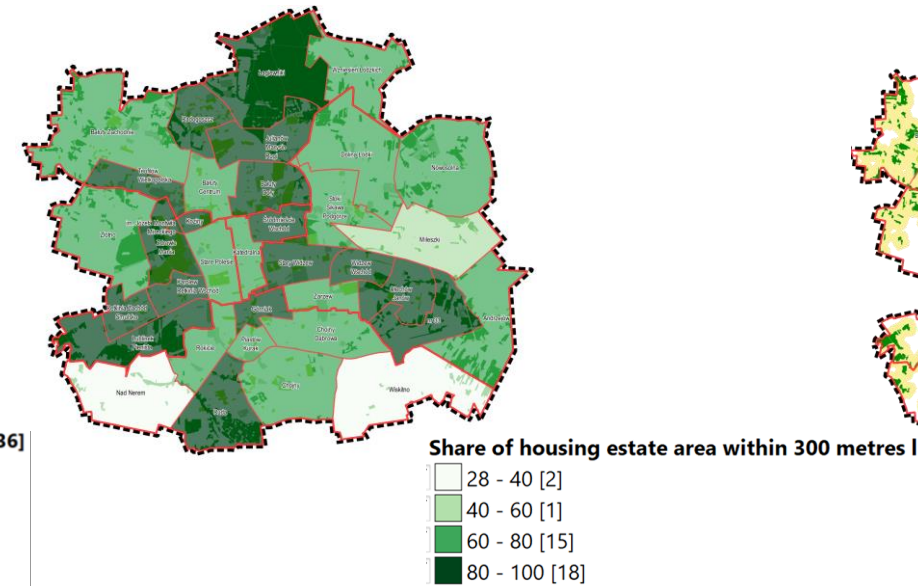
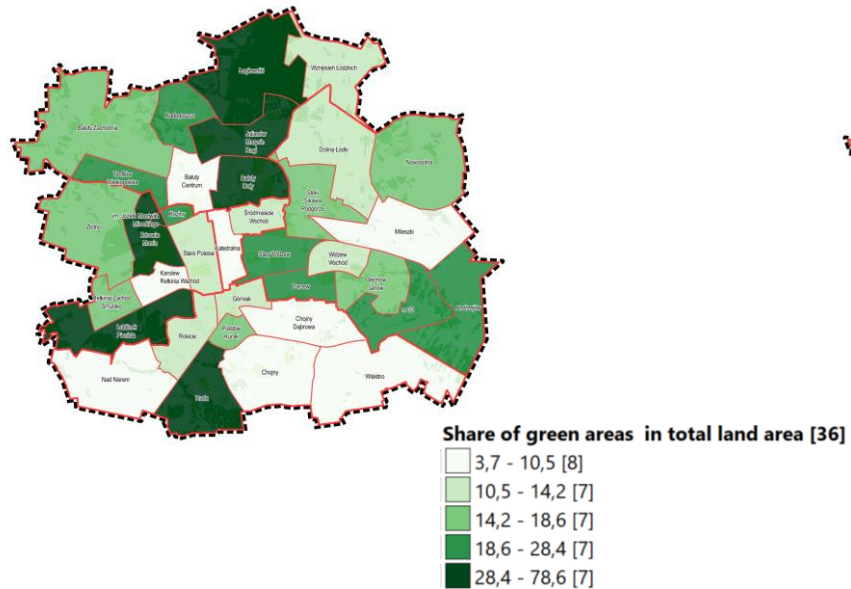
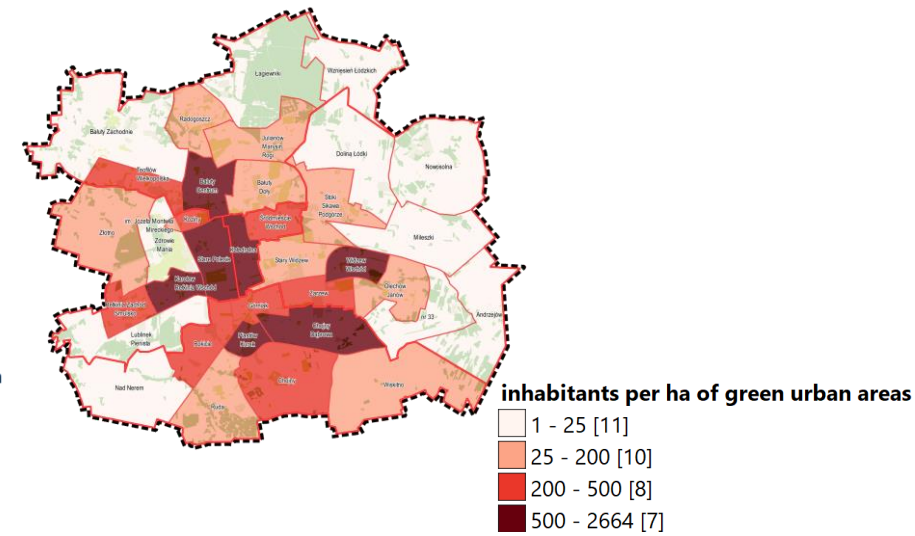
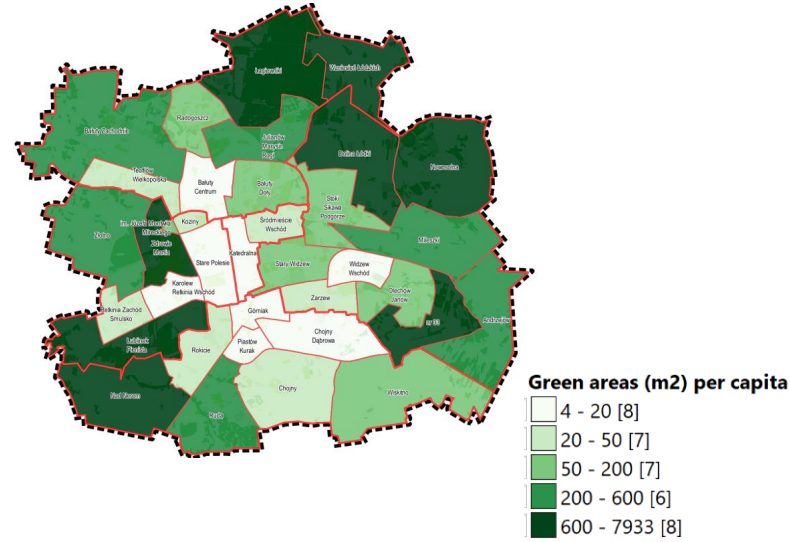
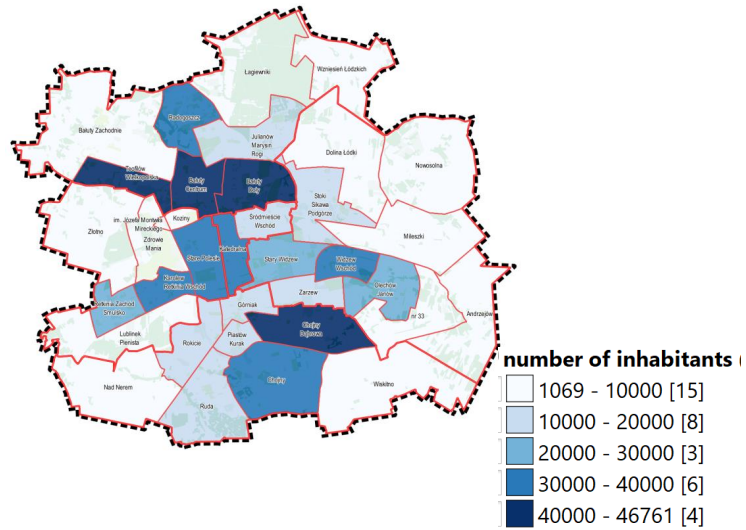
## Green areas (of at least 0,25 ha) within 300 metres linear distance (around 5 minutes' walk)

### Share of housing estate area within 300 metres linear distance to urban green areas (percentage)

District	Auxiliary unit	Auxiliary unit code	Auxiliary unit area [ha]	Share within 300 metres linear distance to urban green areas
GÓRNA	Wisłtino	1305	1671	28%
GÓRNA	Nad Nerem	1329	1336	40%
WIDZEW	Mileszki	1326	1252	55%
GÓRNA	Chojny	1335	1204	61%
BAŁUTY	Bałuty-Centrum	1313	523	61%
POLESIE	Stare Polesie	1316	586	62%
GÓRNA	Chojny-Dąbrowa	1333	850	62%
WIDZEW	Nowosolna	1322	1557	64%
WIDZEW	Dolina Łódki	1321	1409	67%
WIDZEW	Zarzew	1336	412	68%
WIDZEW	Andrzejów	1340	1197	68%
BAŁUTY	Wzniesień Łódzkich	1318	946	72%
WIDZEW	Stoki-Sikawa-Podgórze	1324	802	74%
GÓRNA	Rokicie	1330	597	75%
POLESIE	Złotno	1308	1468	75%
ŚRÓDMIEŚCIE	Katedralna	1325	364	75%
BAŁUTY	Bałuty Zachodnie	1306	2154	77%
GÓRNA	Piastów-Kurak	1334	218	79%
WIDZEW	Olechów-Janów	1338	665	81%
WIDZEW	Stary Widzew	1327	591	83%
GÓRNA	Górniak	1332	296	84%
POLESIE	Lublinek-Pienista	1328	1081	85%
WIDZEW	nr 33	1339	799	87%
POLESIE	Karolew-Retkinia Wschód	1315	322	87%
ŚRÓDMIEŚCIE	Śródmieście-Wschód	1323	349	91%
BAŁUTY	Julianów-Marysin-Rogi	1319	827	92%
WIDZEW	Widzew-Wschód	1337	360	92%
BAŁUTY	Teofilów-Wielkopolska	1307	458	92%
BAŁUTY	Bałuty-Doty	1320	673	94%
POLESIE	Retkinia Zachód-Smulsko	1314	378	95%
GÓRNA	Ruda	1331	1007	97%
POLESIE	Koziny	1311	107	97%
BAŁUTY	Łagiewniki	1317	1684	99%
BAŁUTY	Radogoszcz	1312	587	99%
POLESIE	Zdrowie-Mania	1309	568	100%
POLESIE	im. Józefa Montwiła-Mireckiego	1310	26	100%



## Green urban areas (m2) per capita and Number of inhabitants per ha of green urban areas



HRL-IMD  
BDOT10k+OSM  
Base map  
Urban atlas

Errors, deficiencies and discrepancies

Research on national and local scale  
(country, auxiliary units/districts, urban  
atlas units)

Open, user-friendly  
InCoNaDa's data platform



# Investigation of mapping changes in urban and spatial planning

## WP3 Milestone 3.3

### Title: Investigation of mapping changes in urban and spatial planning

Database	YEARS	SOURCE	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
IMD Change Layer (20m + 100m resolution)	2015/2018	CLMS																			
Urban Atlas Change	2006 – 2012, 2012 – 2018	CLMS																			
LC changes	2018/2019, 2019/2020, 2020/2021	IGIK InCoNaDa																			
SUIKZP (2018)	2018	MPU														SPATIAL PLANNING POLICY - RECOMMENDATIONS AND DIRECTIONS					
Detection of the orthophotomap of Łódź	(2013-2015, 2015-2017, 2017-2019, 2019-2021)	MGGP AERO																			

Study of conditions and directions of spatial development



## UA\_change\_2006

- 11100: Continuous Urban fabric (S.L. > 80%)
- 11210: Discontinuous Dense Urban Fabric (S.L.: 50% - 80%)
- 11220: Discontinuous Medium Density Urban Fabric (S.L.: 30% - 50%)
- 11230: Discontinuous Low Density Urban Fabric (S.L.: 10% - 30%)
- 11240: Discontinuous very low density urban fabric (S.L. < 10%)
- 11300: Isolated Structures
- 12100: Industrial, commercial, public, military and private units
- 12210: Fast transit roads and associated land
- 12220: Other roads and associated land
- 12230: Railways and associated land
- 12300: Port areas
- 12400: Airports
- 13100: Mineral extraction and dump sites
- 13300: Construction sites
- 13400: Land without current use
- 14100: Green urban areas
- 14200: Sports and leisure facilities
- 20000: Agricultural Areas
- 30000: Forests and semi-natural areas
- 40000: Wetlands
- 50000: Water



UA\_change\_2012

- 11100: Continuous Urban fabric (S.L. > 80%)
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- 22000: Permanent crops
- 23000: Pastures
- 24000: Complex and mixed cultivation patterns
- 25000: Orchards
- 31000: Forests
- 32000: Herbaceous vegetation associations
- 33000: Open spaces with little or no vegetations
- 40000: Wetlands
- 50000: Water

ITEM2012		
Nazwa	HA	%
Nad Nerem	82,9	18,2
nr 33	32,0	7,0
Nowosolna	31,3	6,9
Dolina Łódki	31,3	6,9
Olechów-Janów	25,4	5,6
Bałuty Zachodnie	24,5	5,4
Wiskitno	22,9	5,0
Lublińek-Pienista	18,9	4,2
Ruda	18,6	4,1
Mieszki	17,8	3,9
Złotno	16,2	3,6
Chojny	15,9	3,5
Andrzejów	11,9	2,6
Zarzew	10,4	2,3
Chojny-Dąbrowa	9,9	2,2
Stare Polesie	9,8	2,2
Radogoszcz	9,4	2,1
Stoki-Sikawa-Podgórze	7,3	1,6
Wzniesień Łódzkich	6,7	1,5
Julianów-Marysin-Rogi	6,3	1,4
Retkinia Zachód-Smulsko	6,2	1,4
Rokicie	5,9	1,3
Widzew-Wschód	4,7	1,0
Stary Widzew	4,7	1,0
Katedralna	4,6	1,0
Śródmieście-Wschód	4,5	1,0
Zdrowie-Mania	4,3	0,9
Bałuty-Centrum	4,1	0,9
Łagiewniki	2,4	0,5
Karolew-Retkinia Wschód	1,6	0,3
Bałuty-Doły	1,6	0,3
Górniak	1,2	0,3
Teofilów-Wielkopolska	0,4	0,1
	455,6	100,0



# Urban Atlas Change 2006 - 2012



ITEM2012	Constructi on sites	fabric (S,L, : < 10%)	Water	Land without current use	Isolated structures	Discontinuos medium density urban fabric (S,L, : 30% - 50%)	Pastures	Discontinuos dense urban fabric (S,L, : > 80%)	Industrial, commercial, public, military and private units	Discontinuos dense urban fabric (S,L, : 50% - 80%)	Mineral extraction sites	Other associated land	Green areas	Discontinuos low density urban fabric (S,L, and : 10% - 30%)	Sports and leisure facilities	
ITEM2006																0
Agricultural, semi-natural areas, wetlands	79,3	61,9	1,1	13,3	10,4	6,3	0,0	0,9	42,0	2,2	21,8	5,2	0,0	13,3	0,7	258,4
Construction sites	0,0	11,5	0,0	0,0	1,2	4,6	5,4	16,5	30,8	6,3	0,0	1,8	0,9	3,7	0,0	82,7
Continuous urban fabric (S,L, : > 80%)																
Continuous urban fabric (S,L, : > 80%)	0,0	0,0	0,0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,6
Discontinuous dense urban fabric (S,L, : 50% - 80%)																
Discontinuous dense urban fabric (S,L, : 50% - 80%)	0,0	0,0	0,0	0,4	0,0	0,0	0,0	6,2	1,2	0,0	0,0	1,6	0,0	0,0	0,0	9,3
Discontinuous medium density urban fabric (S,L, : 30% - 50%)																
Discontinuous medium density urban fabric (S,L, : 30% - 50%)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,0	0,3
Forests	0,4	1,3	0,0	0,0	0,0	0,0	0,0	0,0	2,9	0,0	0,0	3,1	0,0	0,0	0,0	7,8
Green urban areas																
Green urban areas	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,5	0,0	0,0	0,0	0,0	0,3	1,3	3,2
Industrial, commercial, public, military and private units																
Industrial, commercial, public, military and private units	2,6	3,6	0,0	18,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,7	0,0	0,0	0,0	26,3
Isolated structures																
Isolated structures	0,0	5,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0	0,0	6,3
Land without current use																
Land without current use	2,5	3,6	0,0	0,0	0,0	1,0	0,0	0,7	10,7	2,1	0,0	0,5	0,0	0,6	0,0	21,7
Mineral extraction and dump sites																
Mineral extraction and dump sites	0,0	0,0	0,0	0,0	0,0	0,0	1,2	0,0	32,9	0,0	0,0	2,3	0,0	0,0	0,0	36,4
Sports and leisure facilities																
Sports and leisure facilities	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,6	0,0	0,0	2,6
	84,86	87,37	1,09	32,64	11,63	11,91	6,52	24,17	122,06	11,82	21,80	16,28	3,54	17,92	2,02	

CODE	ITEM2006		
20000	Agricultural, semi-natural areas, wetlands		56,7%
13300	Construction sites		18,2%
13100	Mineral extraction and dump sites		8,0%
12100	Industrial, commercial, public, military and private units		5,8%
13400	Land without current use		4,8%
11210	Discontinuous dense urban fabric (S,L, : 50% - 80%)		2,1%
30000	Forests		1,7%
11300	Isolated structures		1,4%
14100	Green urban areas		0,7%
14200	Sports and leisure facilities		0,6%
11100	Continuous urban fabric (S,L, : > 80%)		0,1%
11220	Discontinuous medium density urban fabric (S,L, : 30% - 50%)		0,1%
		455,6 HA	100%



CODE	ITEM2012		
12100	Industrial, commercial, public, military and private units		27%
11240	Discontinuous very low density urban fabric (S,L, : < 10%)		19%
13300	Construction sites		19%
13400	Land without current use		7%
11100	Continuous urban fabric (S,L, : > 80%)		5%
13100	Mineral extraction and dump sites		5%
11230	Discontinuous low density urban fabric (S,L, : 10% - 30%)		4%
12220	Other roads and associated land		4%
11220	Discontinuous medium density urban fabric (S,L, : 30% - 50%)		3%
11210	Discontinuous dense urban fabric (S,L, : 50% - 80%)		3%
11300	Isolated structures		3%
23000	Pastures		1%
14100	Green urban areas		1%
14200	Sports and leisure facilities		0%
50000	Water		0%
		455,6 HA	100%

# Urban Atlas Change 2012 - 2018



UA\_change\_2012

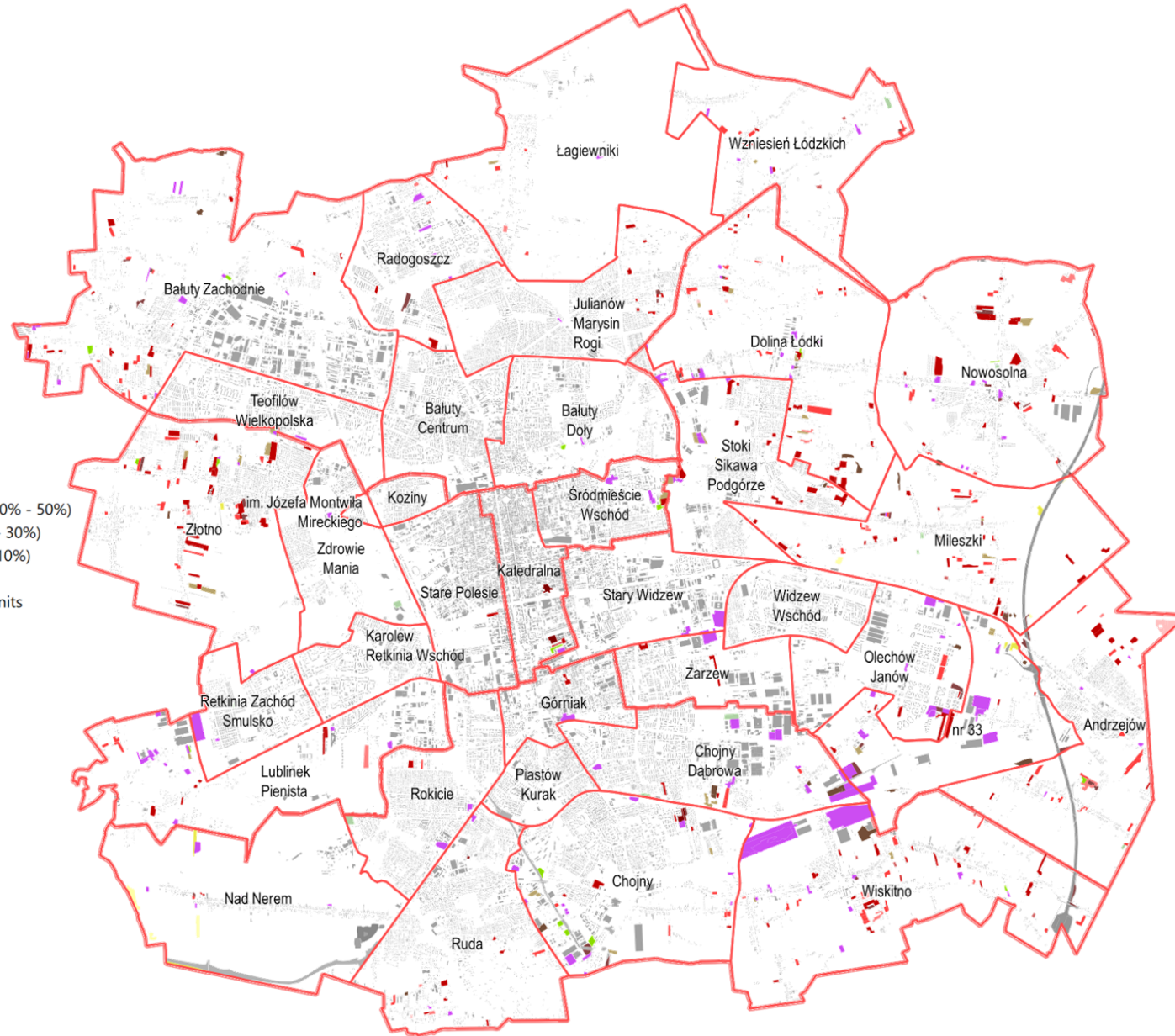
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code	class_2012	ha	%
23000	<b>Pastures</b>	432749,5	40,8%
21000	<b>Arable land (annual crops)</b>	339798,5	32,0%
31000	<b>Forests</b>	120641,1	11,4%
13300	Construction sites	68396,48	6,4%
13400	Land without current use	29351,85	2,8%
14100	Green urban areas	15217	1,4%
12100	Industrial, commercial, public, military and private units	14017,23	1,3%
13100	Mineral extraction and dump sites	13292,97	1,3%
11210	Discontinuous dense urban fabric (S,L : 50% - 80%)	9196,337	0,9%
12220	Other roads and associated land	7651,192	0,7%
12230	Railways and associated land	5640,196	0,5%
50000	Water	2407,426	0,2%
14200	Sports and leisure facilities	1444,019	0,1%
32000	Herbaceous vegetation associations (natural grassland, moors,,)	798,8386	0,1%
11100	Continuous urban fabric (S,L : > 80%)	798,8386	0,1%
11220	Discontinuous medium density urban fabric (S,L : 30% - 50%)	436,5739	0,0%
	sum	1061838	100,0%

code	class_2018	ha	%
11210	<b>Discontinuous dense urban fabric (S,L : 50% - 80%)</b>	256766,6	24,2%
11220	<b>Discontinuous medium density urban fabric (S,L : 30% - 50%)</b>	187125,6	17,6%
12100	<b>Industrial, commercial, public, military and private units</b>	183107,5	17,2%
12210	Fast transit roads and associated land	89119,47	8,4%
12220	Other roads and associated land	86971,76	8,2%
13400	Land without current use	72949,11	6,9%
13300	Construction sites	46443,76	4,4%
13100	Mineral extraction and dump sites	36174,64	3,4%
11230	Discontinuous low density urban fabric (S,L : 10% - 30%)	22789,79	2,1%
14100	Green urban areas	20361,07	1,9%
11300	Isolated structures	19452,52	1,8%
14200	Sports and leisure facilities	10782,53	1,0%
23000	Pastures	10519,96	1,0%
11240	Discontinuous very low density urban fabric (S,L : < 10%)	7415,679	0,7%
21000	Arable land (annual crops)	6511,832	0,6%
11100	Continuous urban fabric (S,L : > 80%)	5346,309	0,5%
	sum	1061838	100,0%



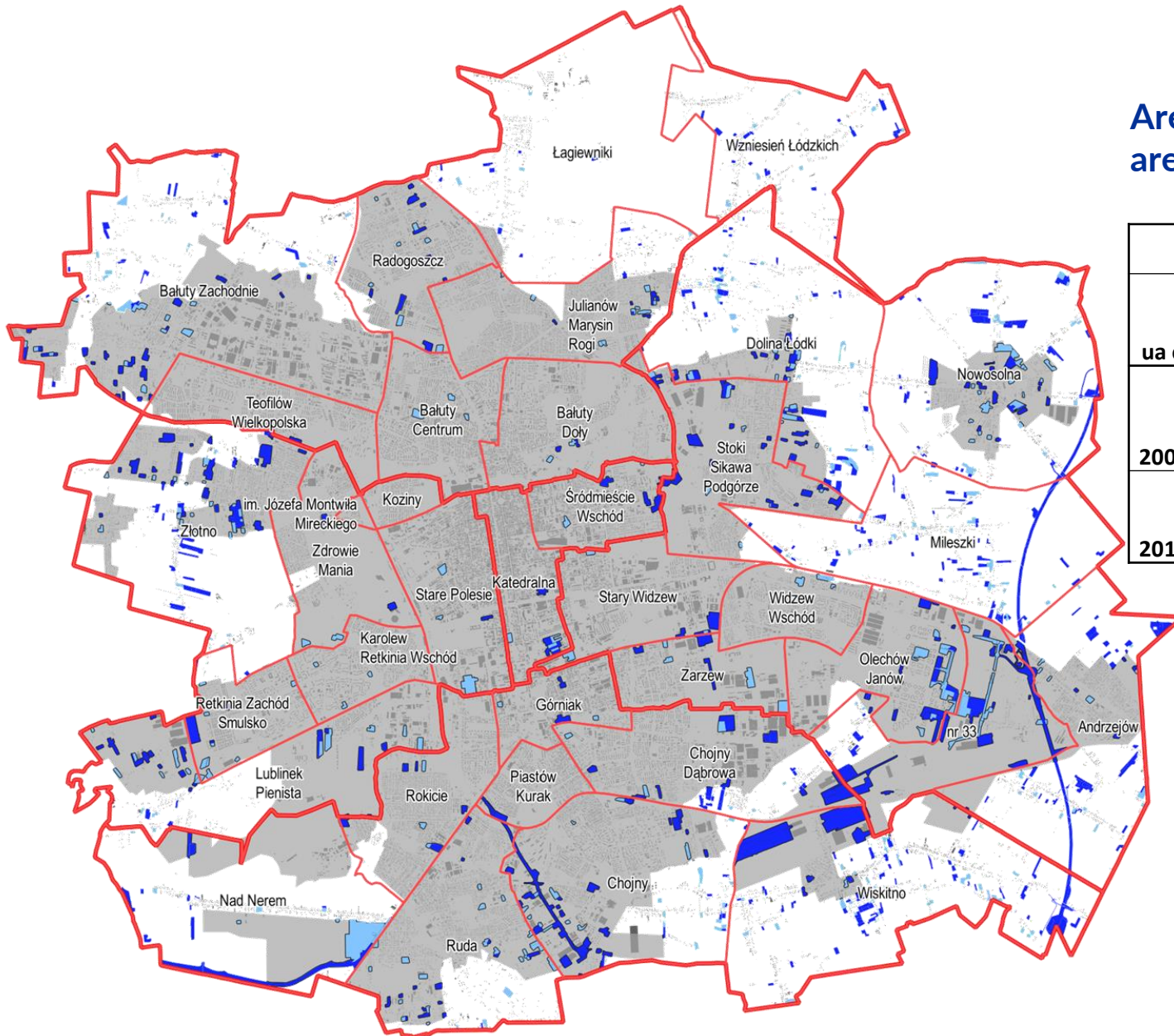
# Urban Atlas Change 2012 - 2018



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- 31000: Forests
- 32000: Herbaceous vegetation associations
- 33000: Open spaces with little or no vegetations
- 40000: Wetlands
- 50000: Water

code_2018		
Nazwa	HA	%
Wiskitno	141994,9	13,4%
Nowosolna	112127,8	10,6%
Bałuty Zachodnie	109871,9	10,3%
Mieszki	103890,5	9,8%
Andrzejów	98139,6	9,2%
Złotno	91046,4	8,6%
Dolina Łódki	81715,0	7,7%
Chojny	80648,8	7,6%
nr 33	40740,8	3,8%
Lublinek-Pienista	29194,7	2,7%
Nad Nerem	24050,7	2,3%
Chojny-Dąbrowa	21250,8	2,0%
Stoki-Sikawa-Podgórze	20860,1	2,0%
Wzniesień Łódzkich	20804,9	2,0%
Ruda	20148,9	1,9%
Łagiewniki	15156,5	1,4%
Olechów-Janów	12637,2	1,2%
Julianów-Marysin-Rogi	9922,6	0,9%
Radogoszcz	5868,3	0,6%
Rokicie	4180,5	0,4%
Śródmieście-Wschód	3841,9	0,4%
Bałuty-Doły	2017,7	0,2%
Katedralna	1819,3	0,2%
Stary Widzew	1773,0	0,2%
Piastów-Kurak	1746,3	0,2%
Zarzew	1646,8	0,2%
Retkinia Zachód-Smulsko	1512,1	0,1%
Zdrowie-Mania	1135,7	0,1%
Teofilów-Wielkopolska	916,8	0,1%
Górniak	591,3	0,1%
Stare Polesie	586,4	0,1%
	1061838,1	100,0%

# "Returning to the Center" policy expressed in SUIKZP of Lodz (2018+)



Are the investments located in the zone of urbanized areas/urban core/areas excluded from future development?

ua change	area (ha)	urbanized zone (SUIKZP)						areas excluded from future development	
		urban		urban-rural		sum			
2006-2012	455,64	274,58	60%	24,92	5%	300,09	66%	155,55	34%
2012-2018	836,66	448,88	54%	33,39	4%	482,80	58%	353,86	42%

period	Urban Core Zone	% of changes	% of Urban Core Zone
	ha		
2006-2012	14,2	1,7%	1,02%
2012-2018	14,3	3,1%	1,03%

What's the dynamics of land-use changes? - 150% increase 2006-2012/2012-2018

ua changes  
 ■ 2012 - 2018  
 ■ 2006 - 2012  
 ■ strefa\_zurbanizowana



# MONITORING CHANGES IN THE BUILDING IN ŁÓDŹ IN THE YEARS 2013-2021

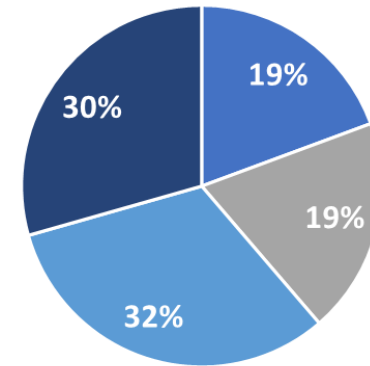
- based on Municipal Planning Office of Lodz, Poland

## CHANGES OF BUILDINGS [12484]

- 2013-2015 [2912]
- 2015-2017 [2645]
- 2017-2019 [3206]
- 2019-2021 [3721]

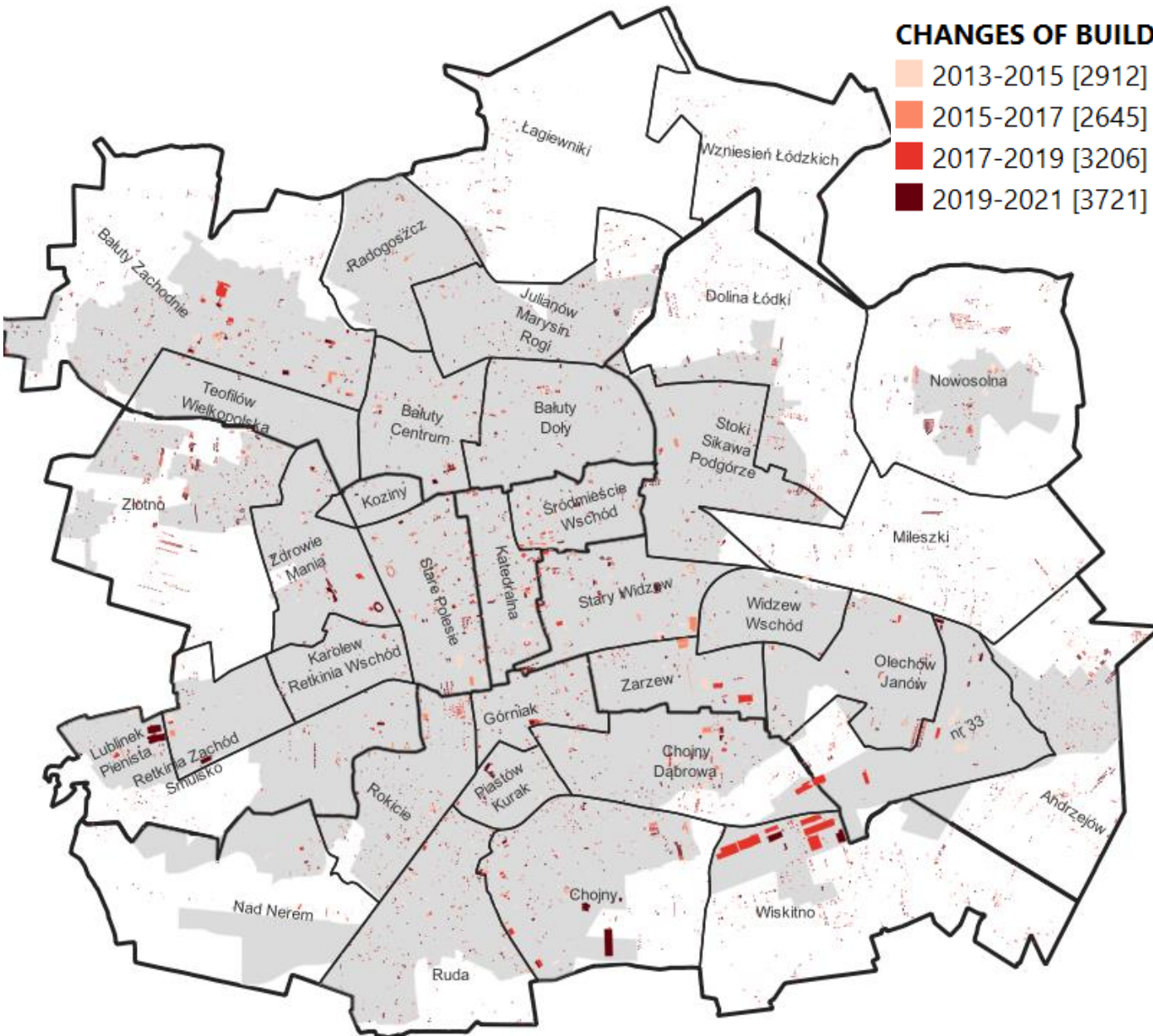
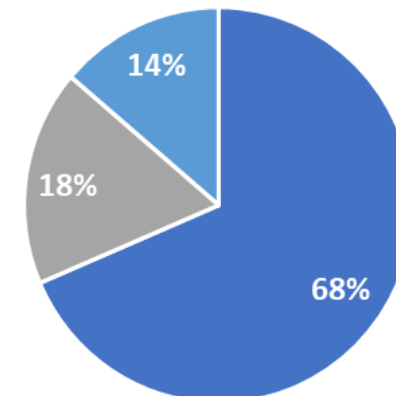
## MONITORING OF CHANGES IN YEARS

- 2013-15
- 2015-17
- 2017-19
- 2019-21

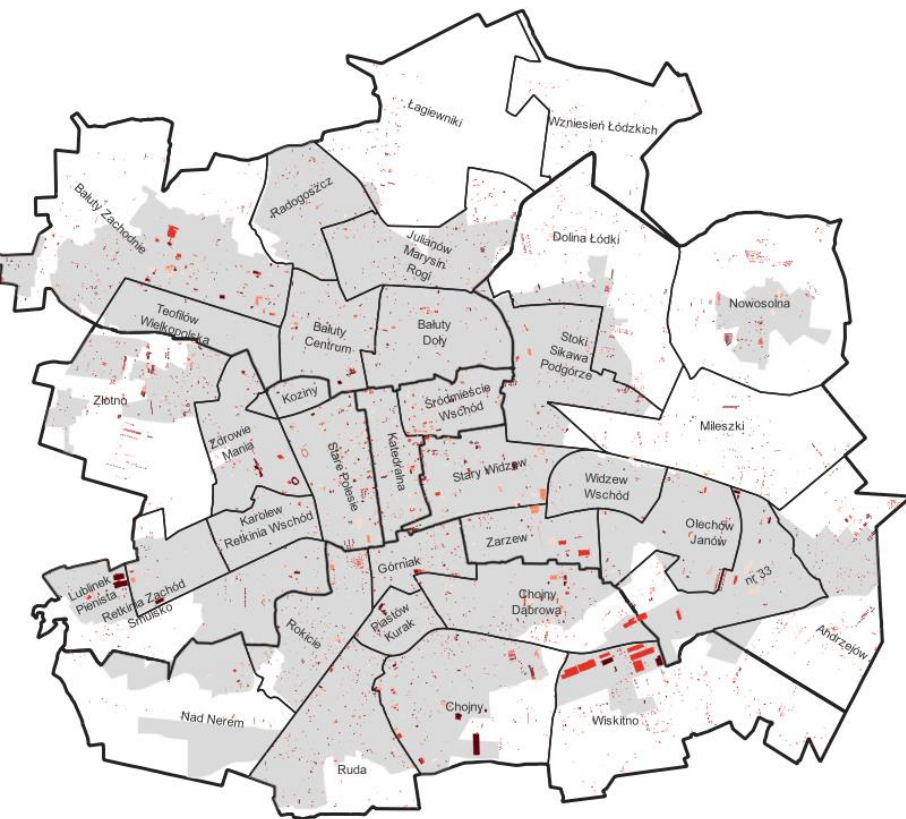


## TYOLOGY OF CHANGES

- New building
- Demolishment
- Reconstruction



# MONITORING CHANGES IN BUILDINGS IN ŁÓDŹ IN THE YEARS 2013-2021



## CHANGES OF BUILDINGS [12484]

- 13-15 [2912]
- 15-17 [2645]
- 17-19 [3206]
- 19-21 [3721]

Auxiliary Units	13-15	15-17	17-19	19-21	SUM (HA)	%	AVERAGE	New building	Demolishment	Reconstruction
Andrzejów	1,55	1,47	1,97	2,82	7,8	2%	1,95	6,5	0,7	0,6
Bałuty Doły	1,60	1,22	2,28	1,75	6,8	2%	1,71	4,6	1,7	0,5
Bałuty Zachodnie	6,54	8,11	11,55	8,08	34,3	8%	8,57	15,8	6,9	11,6
Bałuty-Centrum	1,99	2,77	1,83	3,04	9,6	2%	2,41	5,7	3,5	0,4
Chojny	2,72	3,98	6,72	14,25	27,7	6%	6,92	22,1	2,6	3,0
Chojny-Dąrowa	5,19	3,90	11,33	3,28	23,7	5%	5,92	18,4	2,0	3,3
Dolina Łódki	2,46	1,63	2,24	3,26	9,6	2%	2,40	8,4	0,7	0,5
Górniak	1,83	1,26	2,86	1,62	7,6	2%	1,90	4,1	2,2	1,3
Julianów-Marysin-Rogi	1,50	1,67	1,44	3,07	7,7	2%	1,92	5,5	1,5	0,6
Karolew-Retkinia Wschód	0,54	0,64	0,90	0,54	2,6	1%	0,66	1,6	0,6	0,4
Katedralna	2,85	2,08	3,49	1,99	10,4	2%	2,60	5,7	4,1	0,6
Koziny	0,05	0,14	0,08	0,33	0,6	0%	0,15	0,3	0,3	0,1
Lublinek-Pienista	2,73	1,84	3,05	10,10	17,7	4%	4,43	6,7	0,9	10,1
Mileszki	1,52	1,41	1,00	2,37	6,3	1%	1,57	5,2	0,9	0,3
Nad Nerem	1,45	0,76	1,37	0,52	4,1	1%	1,02	3,4	0,6	0,1
Nowosolna	2,27	1,87	2,19	3,58	9,9	2%	2,48	8,6	1,1	0,2
Olechów-Janów	3,39	1,09	2,39	2,46	9,3	2%	2,33	7,4	1,2	0,8
Piastów-Kurak	0,73	0,43	0,38	2,59	4,1	1%	1,03	0,9	0,8	2,5
Radogoszcz	0,72	2,00	0,43	1,00	4,1	1%	1,04	3,5	0,5	0,2
Retkinia Zachód-Smulsko	1,57	1,20	0,75	2,14	5,7	1%	1,41	5,3	0,2	0,2
Rokicie	1,62	2,89	3,15	1,57	9,2	2%	2,31	3,9	4,4	1,0
Ruda	2,45	2,51	2,90	2,69	10,5	2%	2,64	7,9	1,8	0,8
Stare Polesie	4,72	4,13	4,41	4,72	18,0	4%	4,50	10,7	5,4	1,9
Stary Widzew	3,84	7,14	3,48	7,00	21,5	5%	5,37	8,7	8,6	4,2
Stoki-Sikawa-Podgórze	1,62	2,78	2,29	2,24	8,9	2%	2,23	7,0	1,5	0,5
Teofilów-Wielkopolska	0,53	0,34	0,16	0,29	1,3	0%	0,33	1,2	0,1	0,1
Widzew-Wschód	1,43	0,59	0,51	0,33	2,9	1%	0,72	1,9	0,3	0,6
Wiskitno	1,57	1,85	35,77	9,77	49,0	11%	12,24	47,1	1,3	0,6
Wzniesień Łódzkich	0,40	0,60	0,40	0,74	2,1	0%	0,53	1,5	0,5	0,1
Zarzew	2,97	3,91	6,53	1,15	14,6	3%	3,64	8,8	0,9	4,8
Zdrowie-Mania	1,47	0,61	3,24	4,63	9,9	2%	2,49	6,6	1,8	1,5
Złotno	2,87	2,96	3,89	6,66	16,4	4%	4,10	14,8	1,2	0,4
nr 33	6,44	0,36	4,49	3,99	15,3	4%	3,82	13,9	1,2	0,2
Łągiewniki	0,42	0,50	0,69	1,22	2,8	1%	0,71	2,2	0,6	0,1
Śródmieście-Wschód	2,65	2,78	1,91	1,84	9,2	2%	2,30	4,7	3,4	1,1
<b>SUM (HA)</b>	<b>83,66</b>	<b>83,35</b>	<b>137,81</b>	<b>126,87</b>	<b>431,70</b>	<b>100%</b>	<b>2,77</b>	<b>69%</b>	<b>18%</b>	<b>14%</b>
	<b>19%</b>	<b>19%</b>	<b>32%</b>	<b>29%</b>	<b>100%</b>					

# Transformations of housing development as an element shaping the direction of urban changes in Lodz.

**GOAL:**

Transformations of housing development as an element shaping the direction of urban changes in Lodz.



**METHODOLOGY:**

GIS ANALYSIS  
CLMS data (urban atlas changes) and orthophoto monitoring by MGGP Aero



CLMS - general LC/LU changes  
orthophoto – detailed changes in building typology



**RESULTS**

the actual changes that have taken place in recent years (2013-2021)



residential development transformation trends within the administrative boundaries vs. spatial policy



new single-family housing on suburbs (Złotno, Nowosolna)  
new multi-family housing in city centre (Stare Polesie, Widzew)



# Transformations of housing development as an element shaping the direction of urban changes in Lodz.

## • Methodology

### • GIS Analysis:

- Employed ArcGIS software for the processing, analysis, and interpretation of spatial data.

### • Spatial Policy Assessment:

- Analyzed the implementation of the 2018 Study of Conditions and Directions for Spatial Development of the City of Łódź (SUIKZP), focusing on land cover change analyses

### • Scale of Analysis:

- the level of ancillary units within Łódź in context of housing development.

### • Policy Impact Observation:

- Investigated the effects of the "Return to the Centre" policy and housing development trends

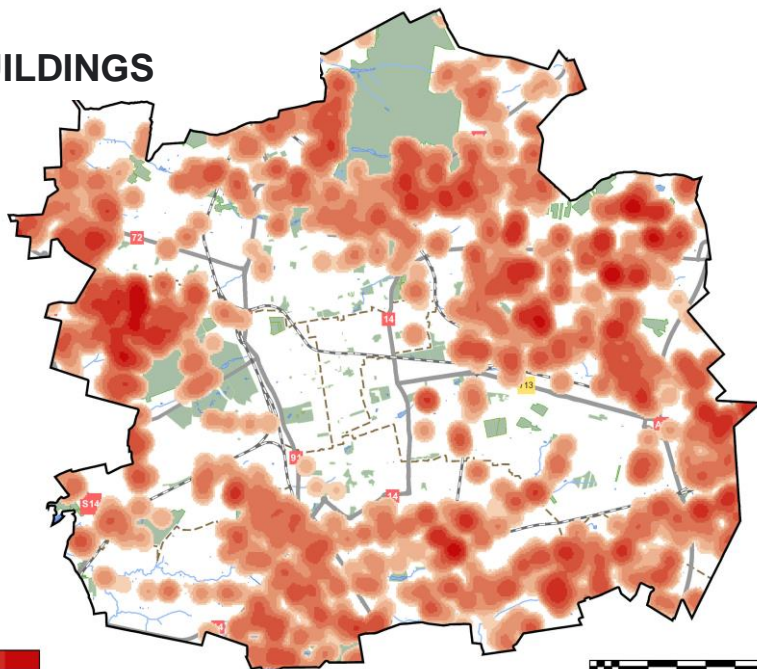
- This methodology provided a comprehensive understanding of residential development transformations in Łódź, reflecting on urban planning trends and spatial policy impacts.

### SINGLE-FAMILY BUILDINGS

#### Legenda

- Kolej
  - Drogi krajowe i wojewódzkie
  - Zbiorniki wodne
  - Ciek
- Zieleń
- Cmentarze
  - Lasy miejskie
  - Parki, zieleńce, skwery

Budynki mieszkalne powierzchnia całkowita

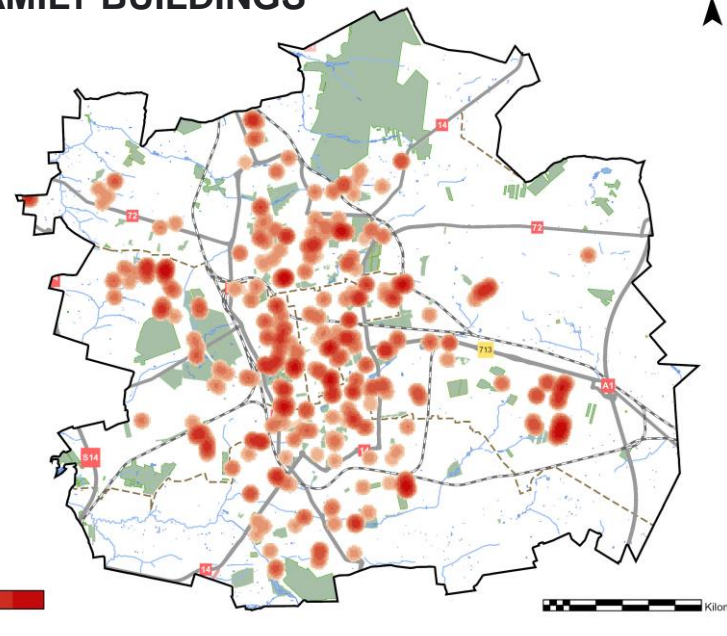


### MULTI-FAMILY BUILDINGS

#### Legenda

- Kolej
  - Drogi krajowe i wojewódzkie
  - Zbiorniki wodne
  - Ciek
- Zieleń
- Cmentarze
  - Lasy miejskie
  - Parki, zieleńce, skwery

Budynki mieszkalne wielorodzinne

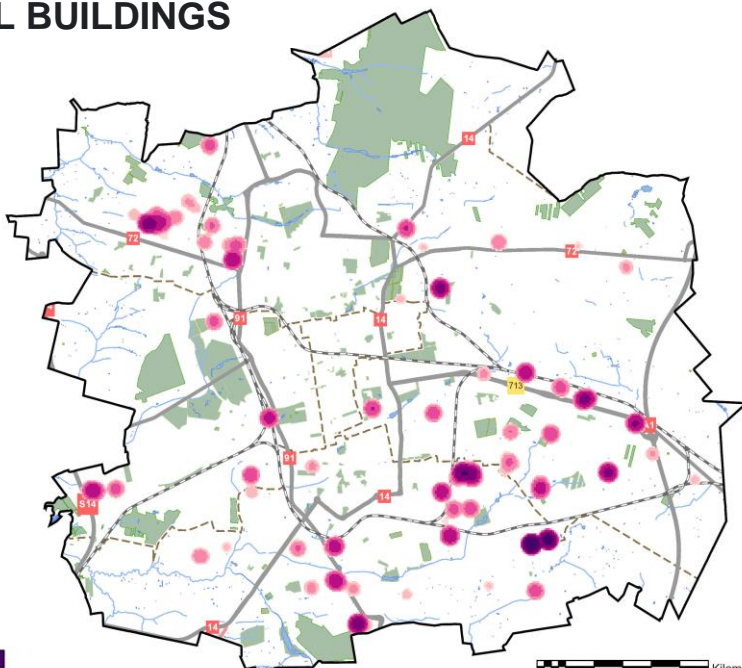


### INDUSTRIAL BUILDINGS

#### Legenda

- Kolej
  - Drogi krajowe i wojewódzkie
  - Zbiorniki wodne
  - Ciek
- Zieleń
- Cmentarze
  - Lasy miejskie
  - Parki, zieleńce, skwery

Budynki mieszkalne wielorodzinne

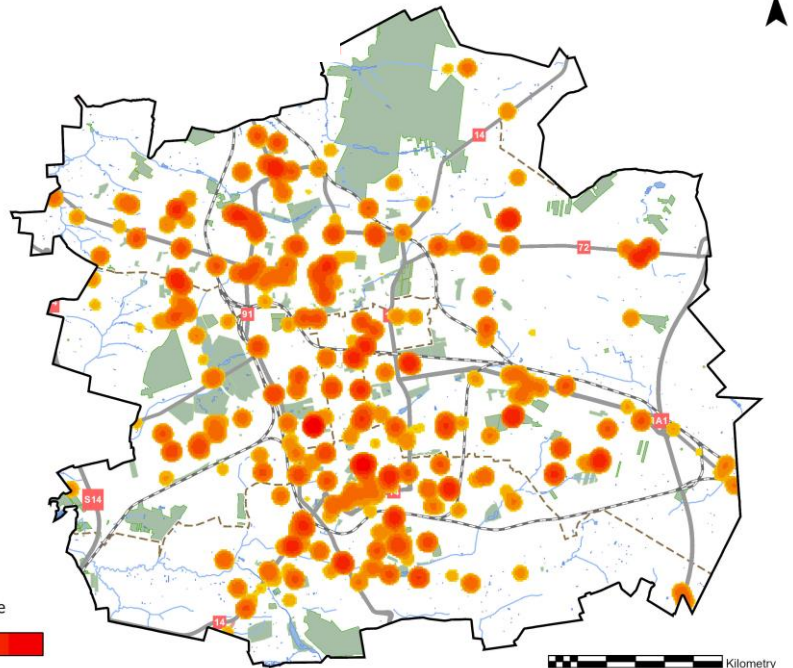


### COMMERCIAL AND SERVICE BUILDINGS

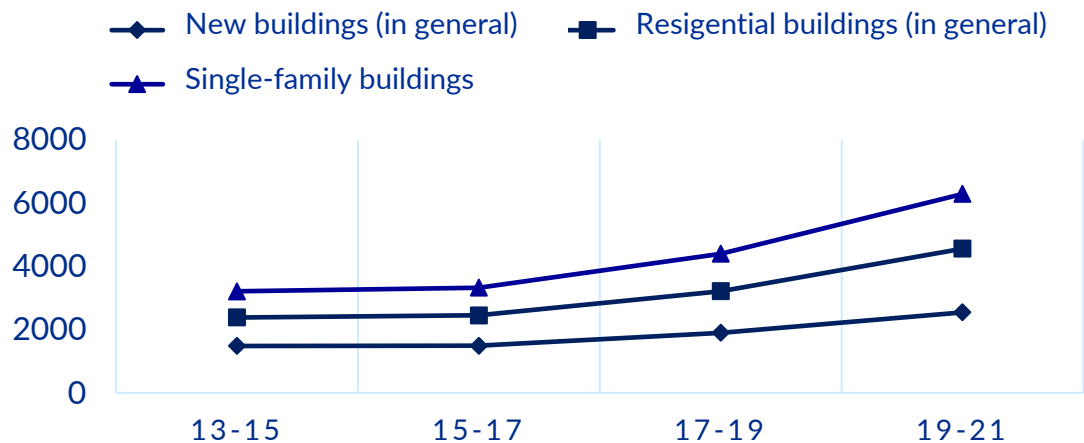
#### Legenda

- Kolej
  - Drogi krajowe i wojewódzkie
  - Zbiorniki wodne
  - Ciek
- Zieleń
- Cmentarze
  - Lasy miejskie
  - Parki, zieleńce, skwery

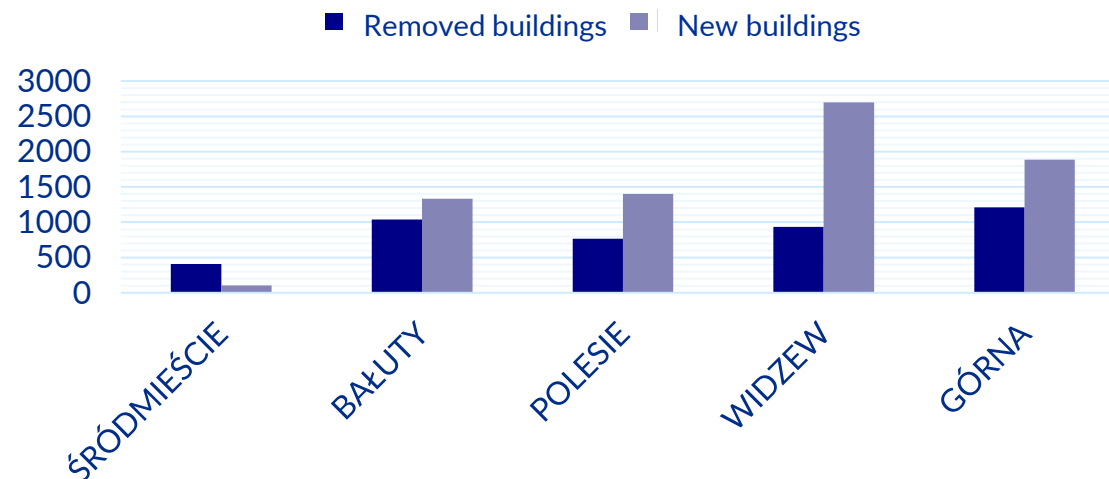
Budynki handlowo usługowe



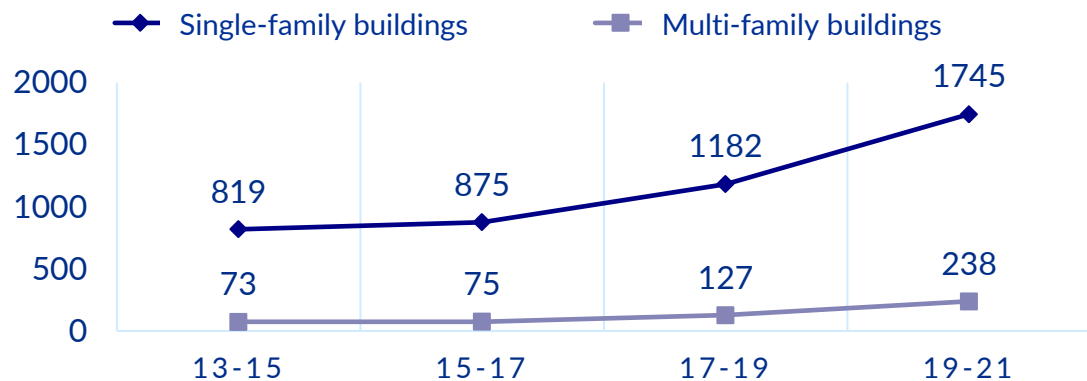
## NEW BUILDINGS IN THE YEARS 2013-2021



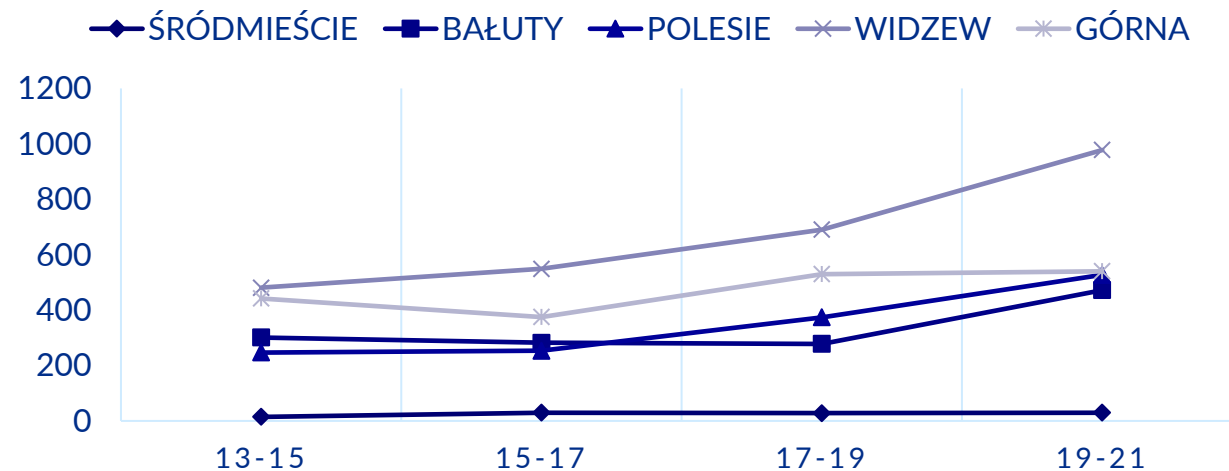
## DEVELOPMENT CHANGES IN THE YEARS 2013-2021



## NEW SINGLE-FAMILY AND MULTI-FAMILY BUILDINGS

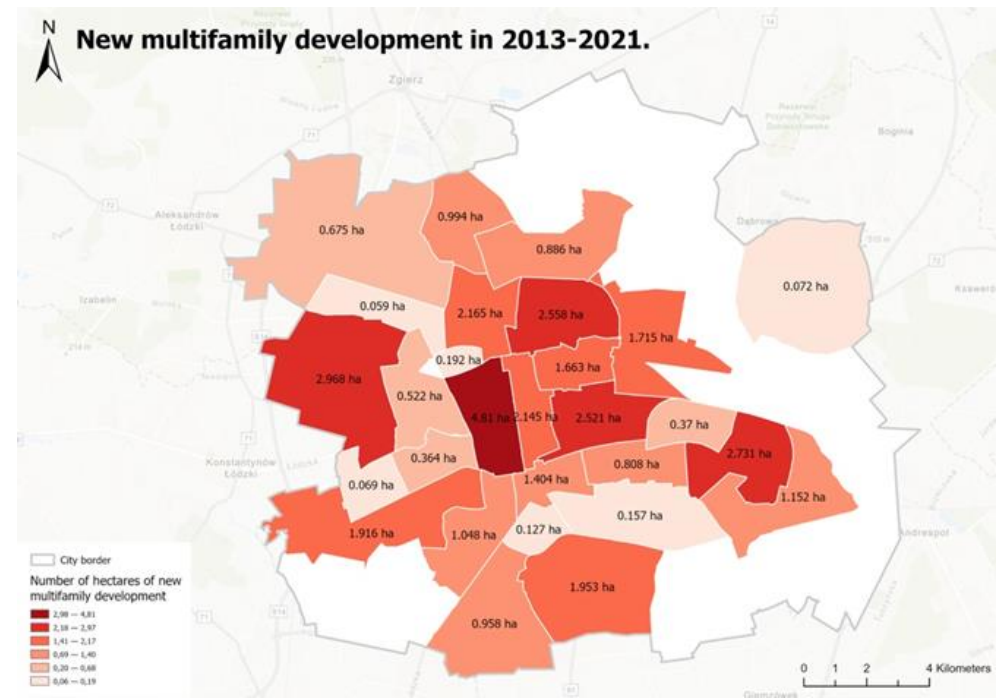
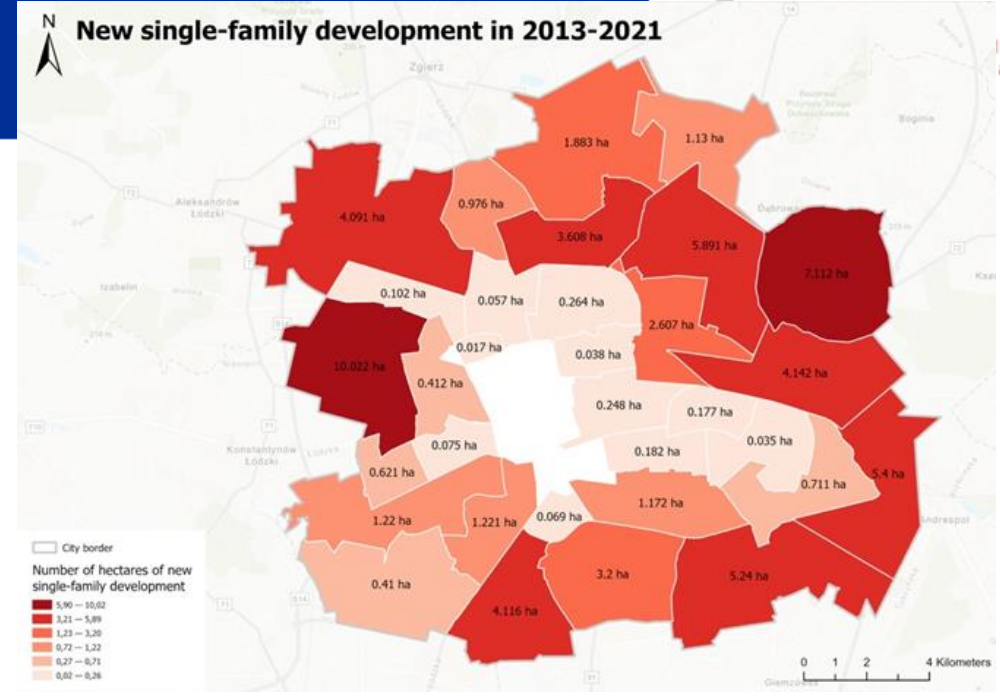
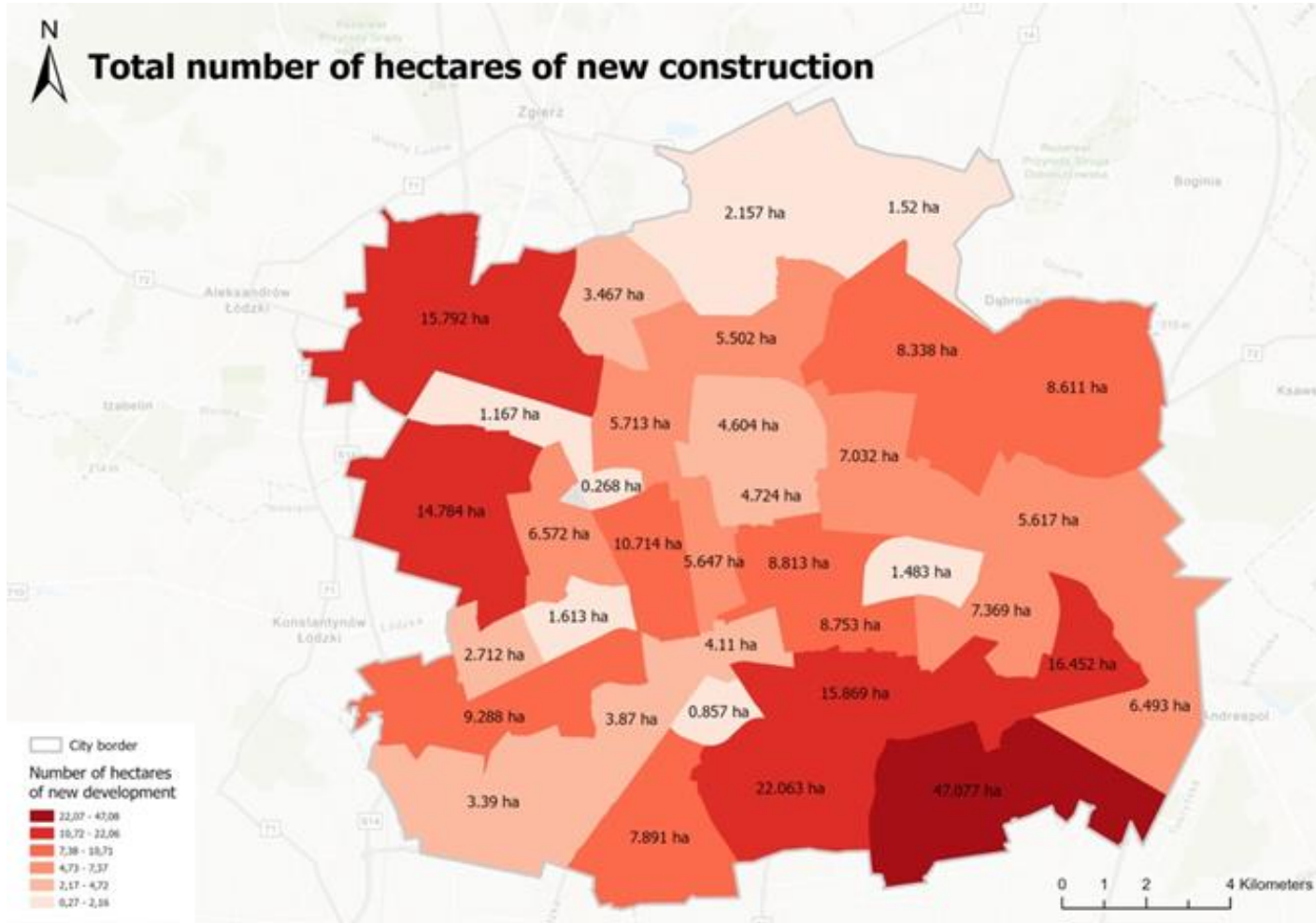


## NEW BUILDINGS BY YEARS



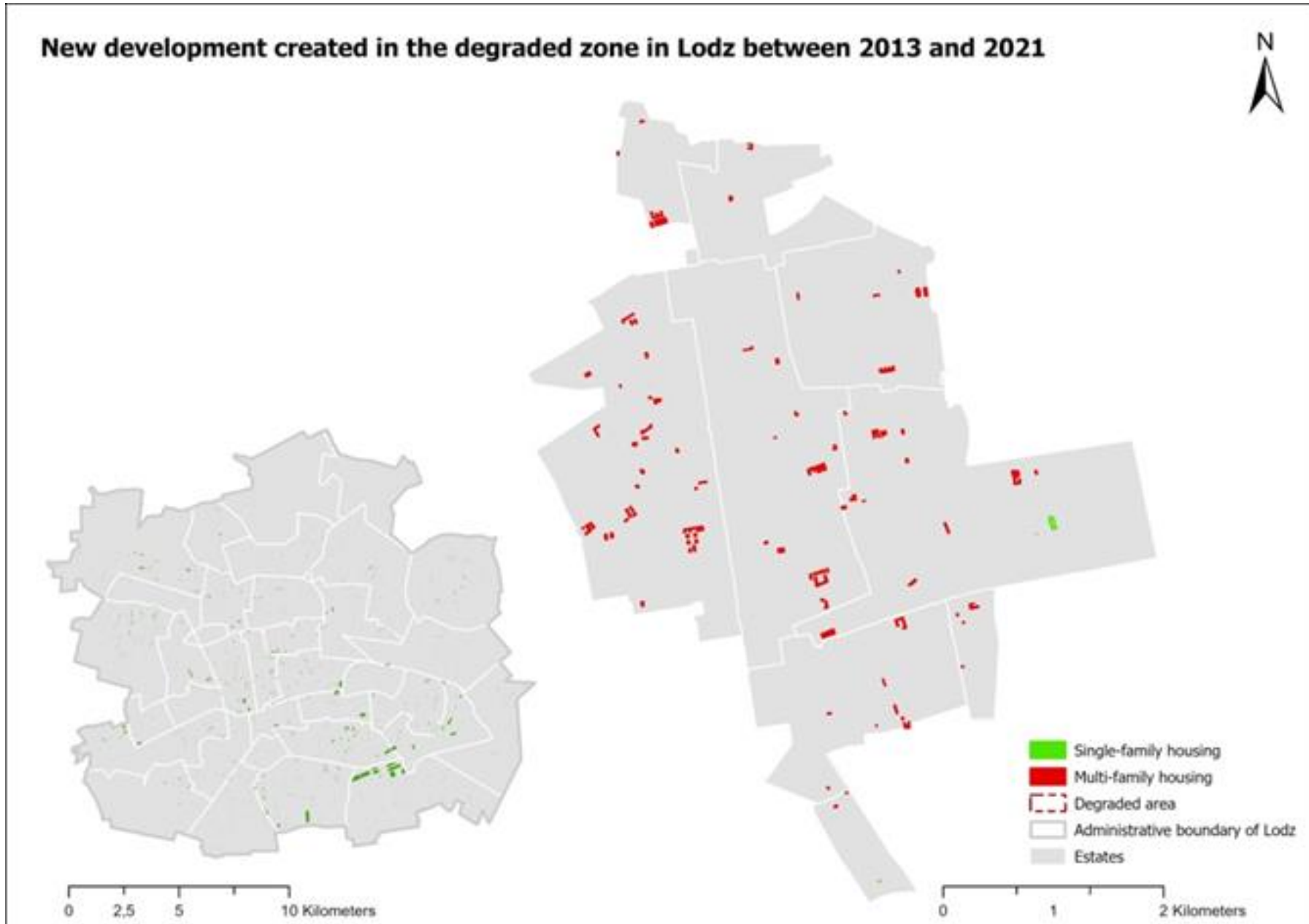


# Transformations of housing development as an element shaping the direction of urban changes in Lodz.





# Transformations of housing development as an element shaping the direction of urban changes in Lodz.



## CONCLUSION

**Geospatial technologies play a critical role** in identifying urban planning trends and facilitating spatial planning in Łódź.

**The analysis of CLMS data** offers valuable insights for comparative urban studies, from local to international levels, underscoring the significance of standardized and consistent datasets (but the quality of data is too low to make spatial decisions based on this source)

**Orthophotomap monitoring data, verified by students,** provided a detailed understanding of the city's development structure and dynamics, highlighting the increasing demand for multi-family housing.

**GIS technology enabled the analysis** of the impact of housing investments on Łódź's urban landscape and supports the prediction of future development trends and spatial planning needs.

**The study underlines the necessity** for continuous data monitoring and collaboration with academic institutions to ensure effective spatial planning and sustainable urban development in Łódź.

# Thank you for your attention!

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