Analysis of changes in Land Zoned for Urban Development in Perth and Peel Subregions from 2011 to 2016

Background

Urban sprawl is a complex phenomenon that can lead to pollution, traffic congestion, greenhouse gas emissions, and shortage of affordable housing (OECD, 2018). Perth and Peel region increasingly recognized sprawl as an immediate issue as the demand for housing development grew due to rapid economic growth driven by the mining industries and shifting demographics to independent house-owners, such as single-parent families (Hiller et al., 2013). According to the Urban Growth Monitor (UGM), "land supply" refers to undeveloped land that is reserved for urban development in a regional scheme. In Perth and Peel region, the UGM is responsible for monitoring land supply, which is crucial to managing and minimizing urban sprawl.

The purpose of this report is to provide an overview of land supply in Perth and Peel region based on the principles of the UGM-13, thereby informing sustainable land-use planning. The report aims to numerically and geographically identify land zoned for urban development (LZUD) in 2011 and 2016; and compare the area of LZUD that was urbanized between 2011 and 2016. Consequently, we can calculate the annual rate at which LZUD has been urbanized from 2011 to 2016 and estimate how long the non-urbanized LZUD will last assuming similar land consumption rates persist.

Data and methods

Datasets

The study's data were sourced from Australian Bureau of Statistics (ABS) and Western Australian Planning Commission (WAPC). *Table 1* describes the datasets in detail. The study area is defined by LGA_2016_PerthPeel, which covers Perth Metropolitan Region and Peel Region. The dataset was made more suitable for analysis by excluding islands, which are not relevant to LZUD. The whole analyses were carried out for each subregion.

Table 1: Information of the datasets used in the study

Dataset Name	Format	Description	Source
LGA_2016_PerthPeel	Geopackage – Layer	Local Government Areas for Perth Metropolitan Region and Peel Region (2016)	Extracted from LGA_2016_WA - Western Australia Local Government Area ASGS Edition 2016 (cat no. 1270.0.55.003) - ABS
RegionSchemes2010	Geopackage – Layer	Metropolitan Region Scheme and Peel Region Scheme dated 31/12/2010	Extracted from Metropolitan Region Scheme and Peel Region Scheme - WAPC (2010)
RegionSchemes2016	Geopackage – Layer	Metropolitan Region Scheme and Peel Region Scheme dated 31/12/2016	Extracted from Metropolitan Region Scheme and Peel Region Scheme - WAPC (2016)
Lu_SubRegion_LGA	Geopackage – Table	Attribute table for Subregion to Local Government Areas (2016)	Compiled by the University of Western Australia, sourced from WAPC (2022)
1270055004_ucl_2011 _aust_shape.zip	Shapefile	Urban Centres and Localities (2011)	Australian Statistical Geography Standard (ASGS) Volume 4 – Significant Urban Areas, Urban Centres and Localities, Section Of State (cat no. 1270.0.55.004) – ABS (2011)
1270055004_ucl_2016 _aust_shape.zip	Shapefile	Urban Centres and Localities (2016)	Australian Statistical Geography Standard (ASGS) Volume 4 – Significant Urban Areas, Urban Centres and Localities, Section of State (cat no. 1270.0.55.004) – ABS (2017)

Pre-processing

First, we removed Rottnest Island, Garden Island, and other islands from LGA_2016_PerthPeel by converting the data to single parts and excluding the islands by “Saving Selected Features”. Then, we added subregion attributes of the Lu_SubRegion_LGA dataset to the former dataset using “Join Attributes by Field Value”.

Identifying and quantifying LZUD

We extracted the urban and urban deferred zones, which represent LZUD, from RegionSchemes2010 and RegionSchemes2016 using “Select Features by Expression” and merged them with the new LGA dataset using “Intersection” tool to form LZUD datasets. The RegionSchemes2010 dated 31/12/2010; therefore, it was used to approximate 2011 data. This approximation is a limitation of the study as the dataset may not truly represent urbanization in 2011. The area of the urban and urban deferred zones was identified and calculated in hectares for both 2011 and 2016.

Identifying and quantifying LZUD that was urbanized

We obtained spatial context of urbanized area by "clipping" UCL_2011_AUST and UCL_2016_AUST with the pre-processed LGA dataset to convert them from to Geopackage files, then removed 'Rural Balance' by "Select Features by Expression" because it is irrelevant to the study. We then combined the LZUD datasets with the clipped UCL datasets using "Intersection" tool to identify LZUD that was urbanized and calculated that area in hectare. The non-urbanized area was calculated by subtracting urbanized area from the total LZUD area. The whole process was executed for both 2011 and 2016. We then calculated the annual urbanization rate by dividing the difference in urbanized area by the study period length. Lastly, we determined how long the remaining non-urbanized land will last in year by dividing the non-urbanized area in 2016 by the annual rate.

Results

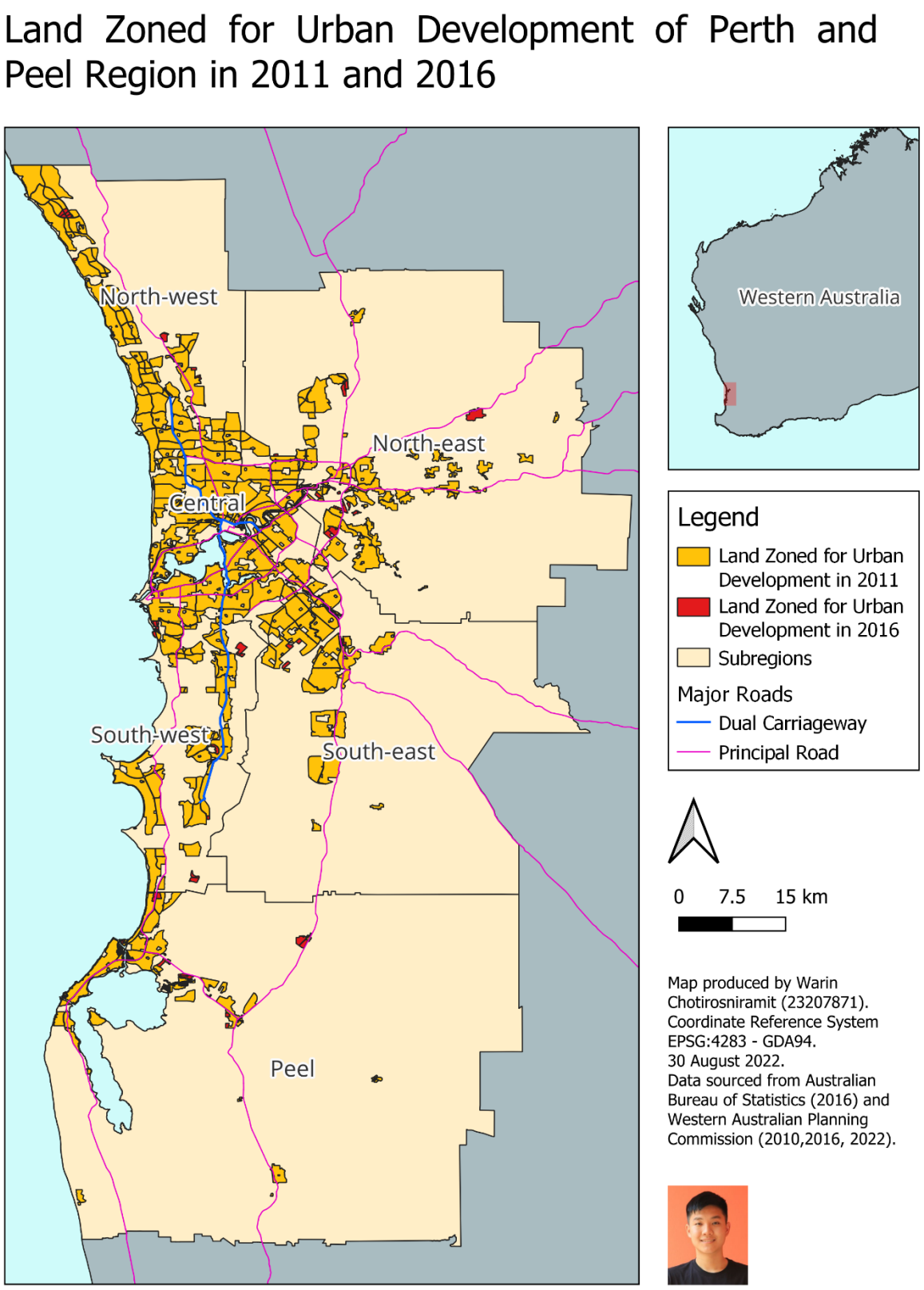
LZUD of Perth Metropolitan region and Peel region in 2011 and 2016

Table 2 shows that North-east subregion underwent the greatest increase in supply of LZUD between 2011 and 2016, followed by Peel, South-west, North-west, and South-east in descending order. *Map 1* shows a significantly larger portion of LZUD in 2016 than in 2011 in North-east subregion. Central subregion experienced the least change in LZUD supply with only an increase of 16 hectares (*Table 2*).

Table 2: Change in stock of LZUD between 2011 and 2016 in Perth and Peel subregions

Perth and Peel Subregion scheme	Description	Stock (ha) 2011	Stock (ha) 2016	Change (ha) 2011 to 2016
Central	Urban zoned land	29,507	29,539	32
	Urban deferred zoned land	32	17	-16
	Subtotal	**29,540**	**29,556**	**16**
North-east	Urban zoned land	13,137	14,296	1,159
	Urban deferred zoned land	641	438	-203
	Subtotal	**13,778**	**14,734**	**956**
North-west	Urban zoned land	18,593	18,864	271
	Urban deferred zoned land	1,898	1,854	-43
	Subtotal	**20,490**	**20,718**	**227**
Peel	Urban zoned land	8,548	9,129	581
	Urban deferred zoned land	165	126	-39
	Subtotal	**8,712**	**9,254**	**542**
South-east	Urban zoned land	12,744	12,849	106
	Urban deferred zoned land	1,327	1,349	22
	Subtotal	**14,071**	**14,198**	**128**
South-west	Urban zoned land	12,770	14,193	1,423
	Urban deferred zoned land	1,949	833	-1,116
	Subtotal	**14,719**	**15,025**	**307**
Total regional schemes	Urban zoned land	95,299	98,870	3,572
	Urban deferred zoned land	**6,012**	**4,617**	**-1,395**
	Total	**101,310**	**103,486**	**2,176**

Map 1: Change in stock of LZUD in Perth metropolitan region and Peel region between 2011 and 2016



Area of urbanized and non-urbanized LZUD in 2011 and 2016

The relationship between urbanized area, non-urbanized area and total LZUD is indicated in *Table 3* and *Table 4.* The increase in total LZUD is proportionally smaller than the increase in urbanized area, which leads to a decreasing temporal trend in the available non-urbanized LZUD area. There had been an increase in urbanized LZUD area in all subregions from 2011 to 2016, except for Central subregion, which was already fully urbanized in both 2011 and 2016 (*Table 3* and *Table 4*). *Map 2* illustrates the changes in urbanized and non-urbanized LZUD between the two years.

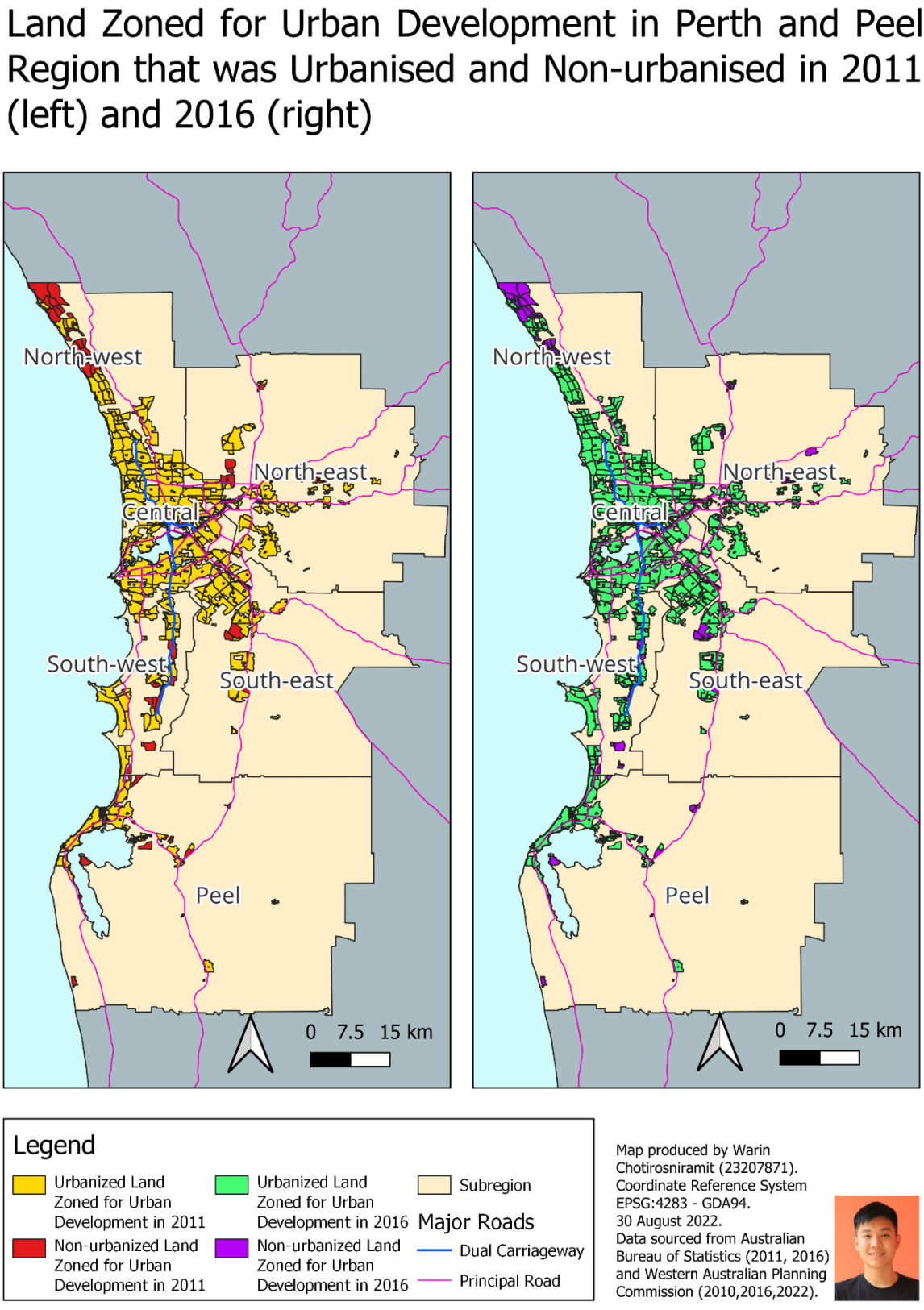
Table 3: Urbanized and non-urbanized LZUD of Perth and Peel subregions in 2011

Subregion	Urbanized area (ha)	Non-urbanized (greenfield area) (ha)	Total LZUD (ha)	Urbanized (%)
Central	29,540	0	29,540	100
North-east	12,247	1,531	13,778	89
North-west	14,828	5,663	20,490	72
Peel	7,269	1,444	8,712	83
South-east	12,703	1,368	14,071	90
South-west	12,554	2,165	14,719	85
Total	89,140	12,170	101,310	88

Table 4: Urbanized and non-urbanized LZUD of Perth and Peel subregions in 2016

Subregion	Urbanized area (ha)	Non-urbanized (greenfield area) (ha)	Total LZUD (ha)	Urbanized (%)
Central	29,556	0	29,556	100
North-east	13,678	1,056	14,734	93
North-west	16,204	4,513	20,718	78
Peel	8,195	1,060	9,254	89
South-east	12,932	1,267	14,198	91
South-west	13,844	1,181	15,025	92
Total	94,409	9,077	103,486	91

Map 2: Urbanized and non-urbanized LZUD in Perth and Peel subregions in 2011 and 2016



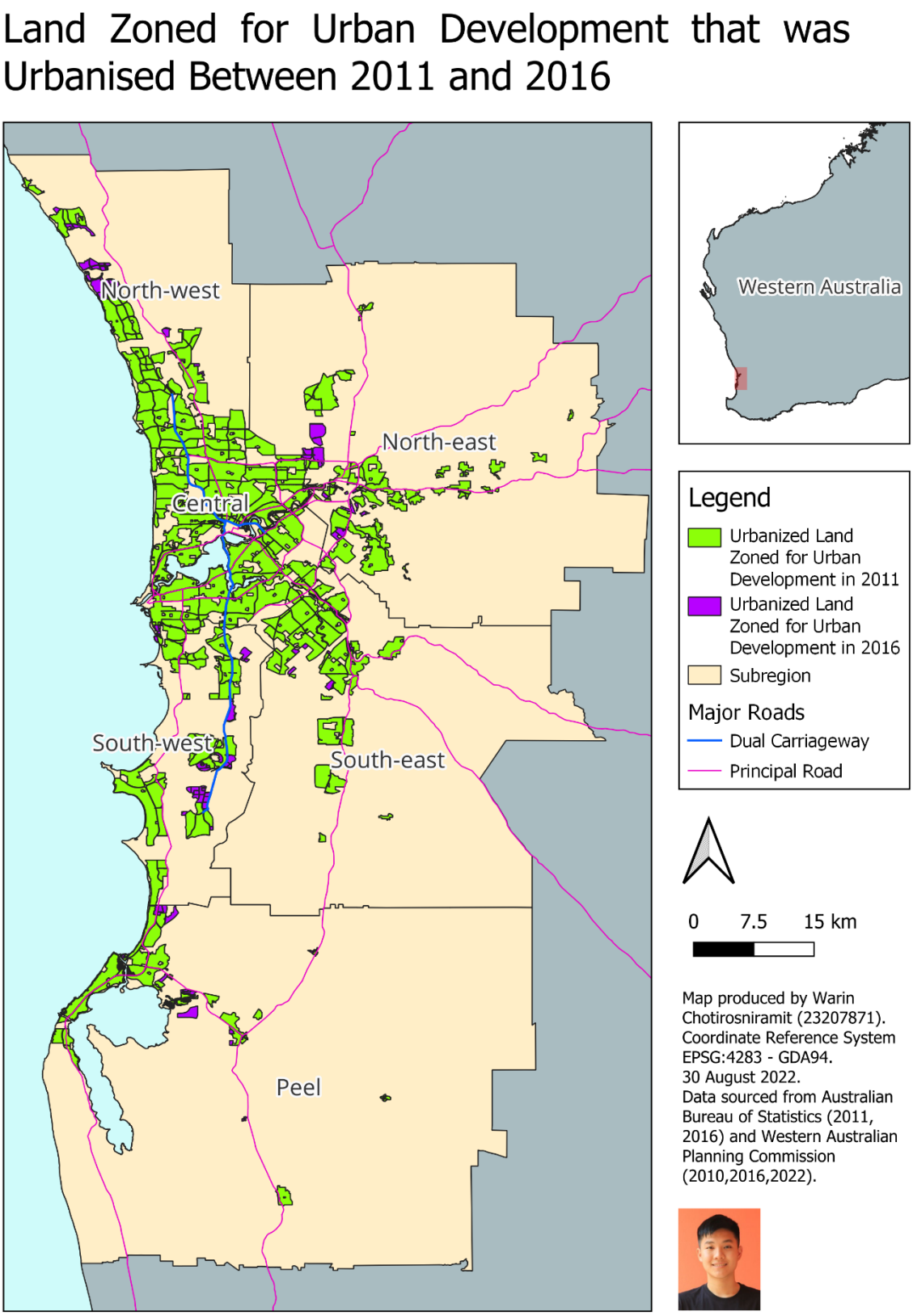
Urbanization of Perth and Peel subregions' LZUD between 2011 and 2016

Table 5 shows that North-east subregion has the highest annual rate of urbanization and the least temporal supply of LZUD (not accounting for Central subregion). This causal pattern, however, is not observed in all subregions because the temporal supply of LZUD depends on the available non-urbanized LZUD. For instance, North-west subregion has a higher annual rate of urbanization than Peel, but because the North-west subregion has 4.5 times greater non-urbanized LZUD area than Peel (*Table 4)*, it has a much a longer temporal supply than Peel (*Table 5*). *Map 3* illustrates how urbanized LZUD area had increased in Perth and Peel subregions from 2011 to 2016.

Table 5: Urbanization rate and temporal supply of non-urbanized land-supply in Perth and Peel subregions

Subregion	Urbanized area in 2011 (ha)	Urbanized area in 2016(ha)	Change in urbanized area from 2011 to 2016	Annual rate of urbanisation (hectare per annum)	Time until non-urbanized land-supply runs out (year)
Central	29,540	29556	16	3.2	0.0
North-east	12,247	13678	1,431	286.2	3.7
North-west	14,828	16204	1,376	275.2	16.4
Peel	7,269	8195	926	185.2	5.7
South-east	12,703	12932	229	45.8	27.7
South-west	12,554	13844	1,290	258	4.6
Total	89,140	94409	5,269	1053.8	8.6

Map 3: Urbanized LZUD of Perth and Peel subregions in 2011 and 2016



Discussion

Our results have highlighted that several subregions, particularly North-east and South-west, have undergone intensive urbanization as shown by the high annual urbanization rate and low temporal land supply. This finding aligns with the data from UGM-13, which stated that North-east and South-west subregions underwent 72% and 74% urbanization, respectively, compared to 61% for North-west and South-east and 65% for Peel (Western Australian Planning Commission & Department of Planning Lands and Heritage, 2022).

However, the UGM-13 also indicated that the available non-urbanized LZUD would last around 30 years (Western Australian Planning Commission & Department of Planning Lands and Heritage, 2022), which contradicts with our findings that suggest that the whole region had only 8.6 years of land supply consumption left (*Table 5*). The UGM-13 used gross consumption rates in their calculation, which accounted for residential and non-residential requirements, such as educational facilities, transport infrastructure, and natural reserves. A limitation of our study is that we did not account for such factors in our calculation for temporal land supply and assumed continuing similar urbanisation rates.

Conclusion

LZUD, urbanized land supply, and non-urbanized land supply vary between each year and have complex relationship. Our findings have shown a positive trend in urbanized areas and a negative trend in non-urbanized areas in Perth and Peel subregions throughout the study period. This is indicative of the urban sprawl phenomenon, an issue that must be addressed to prevent socio-economic and environmental damages. Constant monitoring of land supply is essential for informed, sustainable land-use planning.

Reference

Hiller, B. T., Melotte, B. J., & Hiller, S. M. (2013). Uncontrolled Sprawl or Managed Growth? An Australian Case Study. *Leadership and Management in Engineering, 13*(3), 144-170. https://doi.org/doi:10.1061/(ASCE)LM.1943-5630.0000238

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