

Urban development growth strategies and societal well-being

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Article

Keywords: Societal well-being, city sustainability, urban planning strategy, beyond economic growth, causal maps

Posted Date: June 25th, 2024

DOI: <https://doi.org/10.21203/rs.3.rs-4378969/v1>

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Additional Declarations: There is **NO** Competing Interest.

Abstract

Cities have advanced in terms of economic and social status over the last five decades, improving the living conditions of hundreds of millions of people. However, population growth and urban expansion have put pressure on social and environmental conditions. This study examines the relationship between urban development and societal well-being over time. We analyze 500 pages from published urban plans of Greater Sydney between 1968 and 2018 and code the text into causal maps. The findings show that policymakers adopted a dominant urban development strategy over the last fifty years to pursue economic and public infrastructure growth. This growth strategy resulted in unintended, negative consequences for social and environmental dimensions of societal well-being. Although policymakers eventually recognized the seriousness of these social and environmental consequences, they never attempted to fundamentally change the dominant growth strategy. Instead, policymakers sought to address the consequences (i.e., symptoms) by responding to each issue piecemeal.

INTRODUCTION

Australian cities and many cities worldwide have grown rapidly in the last five decades, increasing the pressure on environmental and social conditions. While there have been numerous improvements including in education, life expectancy, poverty levels, personal income and access to water, degradations in other social and environmental indicators present challenges and risks for societies^{1,2}. For example, population growth in urban areas has increased energy consumption³, waste generation^{4,5}, loss of green spaces⁵, housing price⁶, and time spent commuting^{7,8}.

Previous research highlights the need to shift strategies from primarily focusing on economic growth to strategies focusing on sustainable development with a broader conceptualization of societal well-being^{9,10}. Societal well-being depends not only on economic prosperity but also on the quality of the environment and social capital in our communities¹¹. Policymakers and scientists increasingly recognize the need to adopt a broader perspective of well-being when developing and evaluating public policies and strategies to advance society^{12,13}. For example, the well-being framework *How's life?* proposed by the OECD aims to balance current well-being and sustainable well-being over time through a multidimensional approach that includes the natural, human, economic, and social capital stocks. Similarly, Brundtland's definition of sustainable development and the Wellbeing Economy Alliance (<https://weall.org/>) definition of societal well-being¹¹ embrace broader perspectives of societal progress that include environmental and social aspects.

The social and environmental challenges facing urban policymakers require understanding the interdependencies among social, economic, and environmental dimensions of well-being and how urban planning strategies impact these dimensions¹⁴⁻¹⁶. Rather than focusing on the individual parts of the urban system in isolation, continued improvement of societal well-being requires analyzing how the different parts of an urban system interact^{16,17} and how policy action can be coordinated. Previous

research also calls for understanding the “*implications of governing for rapid population growth*”¹⁸ and proposals to adopt systems thinking in urban planning to operationalize sustainability¹⁹⁻²².

This study identifies the urban planning strategies of policymakers in Greater Sydney over time and the consequences of those strategies for the economic, social, and environmental conditions that determine societal well-being. Greater Sydney is selected as a case study because it is recognized for having a high quality of life (www.eiu.com/n/campaigns/global-liveability-index-2023/), participates in multiple sustainability networks of global cities (www.c40.org/cities/sydney), develops many sustainability initiatives (www.arcadis.com/en-au/knowledge-hub/perspectives/global/sustainable-cities-index), and leads in introducing numerous urban development innovations (innovation-cities.com/worlds-most-innovative-cities-2022-2023-city-rankings/26453/). However, similar to many other cities around the world, rapid urban growth in Greater Sydney over the last five decades has negatively impacted food production²³, urban heat stress²⁴, cost of living (ipsos.com/en-au/lifeinsydney), housing affordability²⁵, traffic congestion (<https://www.bitre.gov.au>) and other social and environmental indicators.

We elicited policymakers’ urban planning strategies from three published governmental urban plans in Greater Sydney between 1968 and 2018 comprising 500 written pages²⁶⁻²⁸. We coded the text from these reports into causal maps showing policymakers’ beliefs about the complex web of causal relationships involved in urban planning development strategies. Causal maps are a well-established research method for representing decision makers’ perceived causal relationships, and have been used extensively in urban planning to integrate health and urban planning policies²⁹, understand urban green spaces³⁰, and urban agriculture³¹. Although the urban reports do not explicitly use the phrase “societal well-being”, policymakers emphasize a number of indicators that directly relate to societal well-being, including: travel time, housing affordability, green areas, pollution, job opportunities, economic prosperity, water availability, and heat island effects. Throughout this paper, we discuss the impacts of Greater Sydney’s urban planning strategy on “Attractiveness of the City to Residents” as a proxy for societal well-being. The analysis reveals numerous unintended social and environmental consequences of the dominant urban planning strategy of prioritizing and pursuing growth in the economy and public infrastructure.

EMPHASIS ON ECONOMIC AND PUBLIC INFRASTRUCTURE GROWTH

Our analysis of the 1968, 2005 and 2018 urban plans shows that policymakers adopted a dominant urban planning strategy for the last 50 years in Greater Sydney to grow economic prosperity and public infrastructure. In the 1968 urban plan policymakers’ emphasized the importance of “*strong industrial growth fundamental to Sydney's expansion*”²⁶ to guarantee full employment. The 2005 plan established an urban development strategy over 25 years, between 2005 and 2030, “*to secure Sydney's place in the global economy by promoting and managing growth*”²⁷. The 2018 plan outlined initiatives “*to maximize economic growth and cater for population growth*”²⁸. Prioritizing and pursuing economic and public infrastructure growth defined the dominant urban development strategy for Greater Sydney since 1968.

Figure 1 shows this dominant growth strategy underpinning the 1968, 2005 and 2018 urban development plans. The causal relationships highlight the principal mechanisms policymakers adopted to promote growth in the economy and public infrastructure to make Greater Sydney more attractive to business firms and residents over time. The *Economic Opportunities* loop (labelled R1) in the center of the causal map shows policymakers' beliefs about the benefits of economic growth. As the city becomes more attractive to firms, more new business firms startup or move into the city, increasing the number of business firms in Greater Sydney, and leading to greater economic opportunities and prosperity. Increasing economic opportunities and prosperity create more jobs, which in turn increases the attractiveness of the city to (current and potential future) residents, and results in a higher population growth rate. As the Greater Sydney population increases, the demand for commercial goods and services also increases, making the city even more attractive to firms. These causal relationships form a reinforcing feedback loop, whereby an initial change compounds in the same direction with each cycle around the loop.

An increase in economic opportunities and prosperity also improves the attractiveness of the city to even more business firms, and leads to even further growth in the number of business firms locating and operating in the city. On the right-hand side of Figure 1, these causal relationships close the *Attracting Business Firms* reinforcing loop (R2).

The left side of Figure 1 shows policymakers' beliefs about the benefits of public infrastructure growth. As the population of Greater Sydney grows, the demand for more public city services and facilities increases. In response, the Government increases public investment to expand the infrastructure for city services and facilities, including expansion and improvements in the transport network, health facilities, the education system, and the utilities network. The intent is for increasing public investment to provide city services and facilities that the growing population needs in close proximity to where residents live, making the city more attractive to residents and leading to even further population growth. These causal relationships close the *Public Services and Infrastructure* reinforcing loop (R3). Importantly, few city governments invest to keep ahead of population growth and there can be very long-time delays in perceiving the need to invest, allocating resources to fund such investments, getting approvals to expand infrastructure in specific locations, and constructing buildings, roads, subway lines, or light rail once construction begins. In a growing city, these time delays often result in demand for infrastructure growing much more rapidly than supply. We will return to this point shortly.

These three reinforcing loops capture policymakers' dominant strategy to pursue economic and public infrastructure growth for Greater Sydney over the last five decades. In the absence of other feedback effects and without considering other indicators of progress, this boundedly rational strategy would lead to a growing, vibrant city. However, there have been numerous unintended social and environmental consequences of this urban growth strategy that have partially diminished Greater Sydney's progress in terms of overall societal well-being. The success of the dominant growth strategy has led directly to these unintended consequences. At different points in time, policymakers highlighted these

consequences as challenges to overcome as part of the urban development planning process. We discuss these consequences next.

SOCIAL AND ENVIRONMENTAL CONSEQUENCES OF URBAN GROWTH STRATEGY

Figures 2–4 show the social and environmental consequences of the strategy to pursue economic and public infrastructure growth over a long time period. We identified these consequences directly from each of the 1968, 2005 and 2018 urban development reports. The reports show that policymakers understood that pursuing growth resulted in unintended consequences, but that awareness did not motivate rethinking of the dominant strategy.

Two unintended consequences of “success” with the dominant growth strategy emerged from analyzing the 1968 urban plan. Figure 2 illustrates the social consequence of the *Congestion* loop (B1) and the environmental consequence of the *Urban Sprawl* loop (B2). We start by explaining the *Congestion* loop. As the attractiveness of the city to residents increases (because of growing economic opportunities and prosperity and increasing city services and facilities), the population growth rate increases, the Greater Sydney population increases, and the Demand for Transport rises. This leads to an increase in the Number of Motor Vehicles on the Road and the average Travel Time within the city. Increasing average Travel Time reduces the Attractiveness of the City to Residents relative to what it would have been if all conditions had remained the same. These causal relationships close the *Congestion* balancing loop (B1).

The *Urban Sprawl* loop (B2) shows that as the attractiveness of the city to residents increases, the population growth rate increases, the Greater Sydney population increases, and the Demand for Dwellings and Land increases, which increases the Land Released for Urban Development. As more land is designated for housing development, fewer Green Areas (i.e., undeveloped bush or forest areas) reduce the Attractiveness of the City to Residents relative to what it would have been if all conditions had remained the same. These causal relationships close the *Urban Sprawl* balancing loop (B2).

Analysis of the 2005 plan identifies four additional unintended social and environmental consequences that emerged by adhering to the dominant growth strategy. Figure 3 shows these consequences, starting with the *Pollution* loop. As attractiveness of the city to residents increases (because of growing economic opportunities and prosperity and increasing city services and facilities), the population growth rate increases, the Greater Sydney Population increases, the Demand for Transport rises, and the Number of Motor Vehicles on the Road rises. The increasing Number of Motor Vehicles on the Road increases Pollution and Waste, decreasing Attractiveness of the City to Residents relative to what it would have been if all conditions had remained the same. These causal relationships close the *Air Pollution* balancing loop (B3).

The *Too Expensive to Live* balancing loop (B4) shows that increasing the Attractiveness of the City to Residents, increases the Population Growth Rate, and therefore increases the Greater Sydney Population. The growing population increases the Demand for Dwellings, which erodes Housing Affordability due to increasing housing prices and rents. Declining Housing Affordability reduces the Attractiveness of the City to Residents relative to what it would have been if all conditions had remained the same. These relationships close the *Too Expensive to Live* balancing loop (B4).

Decreasing Housing Affordability, in and close to the Central Business District (CBD) in the city center, also pushes some residents to move to housing further from the city center thereby increasing the average Distance from the CBD to Access Affordable Housing. Greater distance increases the average Travel Time to and from work and reduces the Attractiveness of the City to Residents relative to what it would have been if all conditions had remained the same. These causal relationships close the *Far from Work* balancing loop (B5). The 2005 urban plan highlighted declining housing affordability as an important problem for Greater Sydney and suggested boosting public investment to increase the number of dwellings. However, as shown in loop B2 of Figure 2, building additional housing to supply the demand for dwellings requires developing additional land, resulting “*in continual clearing and fragmentation of native vegetation and habitats in Sydney*”²⁷, increasing “*the demand on infrastructure and services across the region*”²⁸, and increasing the urban footprint of the city.

Analysis of the 2018 plan identifies a further four unintended social and environmental consequences that emerged by continuing to follow the dominant urban growth strategy. Figure 4 shows these trade-offs, starting with the *Waste* balancing loop (B6). As attractiveness of the city to residents increases, the population growth rate increases, the Greater Sydney population increases, leading to more waste generation in the city. As shown in Figure 3 and Figure 4, an increase in the Number of Business Firms also increases the waste generation and pollution level. As the waste generation in Greater Sydney increases, the pollution level increases, reducing Attractiveness of the City to Residents relative to what it would have been if all conditions had remained the same. Policymakers recognized that “*Greater Sydney currently consumes energy and water resources and creates waste well beyond what can be managed within its boundaries*”²⁸ and that “*Greater Sydney faces challenges providing and managing waste services as the population grows*”²⁸.

The *Heating the City* loop (B7) shows that as attractiveness of the city to residents increases, the population growth rate increases, the Greater Sydney population increases, and the Demand for Dwellings increases. As a result, the Demand for Land rises, the Land Released for Urban Development increases, and using more land for urban development reduces the Green Spaces (i.e., undeveloped green space, open spaces and bushland) throughout the city and surrounding areas. Less green space leads to intensifying the Heat Island Effects throughout the city and decreases the Attractiveness of the City to Residents relative to what it would have been if all conditions had remained the same. These relationships close the *Heating the City* balancing loop (B7) shown in Figure 4.

In addition, as attractiveness of the city to residents increases, the population growth rate increases, the Greater Sydney population increases, and leads to increasing Consumption of Energy and increasing Consumption of Fossil Fuels (e.g., electricity generation to power homes and office buildings). As shown in Figure 4, an increase in the Number of Business Firms also increases the consumption of energy and the consumption of fossil fuels. Increasing the Consumption of Fossil Fuels increases the Pollution Level, reducing the Attractiveness of the City to Residents relative to what it would have been if all conditions had remained the same. These relationships close the *Pollution from Energy Use* balancing loop (B8).

Higher levels of Pollution also increase the probability and frequency of climate events, such as Heat Island Effects (and also other climate events not displayed in Figure 4, such as floods), reducing the Attractiveness of the City to Residents relative to what it would have been if all conditions had remained the same. These relationships close the *Climate Hazard* balancing loop (B9).

Finally, as the *Attractiveness of the City to Residents* increases, the population growth rate increases, the *Greater Sydney Population* increases, and leads to increasing Consumption of Water. Higher water demand and usage reduces the Amount of Reliable and Affordable Water supply in dams and reservoirs for the city. When water supply levels fall enough, water usage restrictions become active and reduce the Attractiveness of the City to Residents relative to what it would have been if all conditions had remained the same. Policymakers highlighted in the 2005 plan that “*the population has doubled since 1950, water consumption has tripled, placing significant demands on supply*”²⁷ and in the 2018 plan projected that the “*population growth, drought, climate change and changing community expectations present challenges and can increase demand for water*”²⁸. These relationships close the *Water Supply* balancing loop (B10).

Table 1 lists the feedback loops identified in Figures 1–4 categorized as part of (1) the dominant urban growth strategy, (2) a social consequence of the urban growth strategy, or (3) an environmental consequence of the urban growth strategy. Notably, at different times, policymakers highlighted the social and environmental consequences as challenges to overcome in the urban planning process. The dominant urban growth strategy consists of three reinforcing loops. Three balancing feedback loops represent the social consequences, and seven balancing feedback loops represent the environmental consequences. Figure 5 shows the full set of causal relationships combined from Figures 1–4.

Table 1. Feedback loops in policymakers’ economic and population growth strategy

Growth Strategy	Loop	Social Consequences	Loop	Environmental Consequences	Loop
Economic Opportunities	R1	Congestion	B1	Urban Sprawl	B2
Attracting Firms	R2	Too Expensive to Live	B4	Pollution	B3
Public Services and Infrastructure	R3	Far from Work	B5	Waste	B6
				Heating the City	B7
				Pollution from Energy Use	B8
		-	-	Climate Hazard	B9
				Water Supply	B10

DISCUSSION

The growth of cities has improved the living conditions of hundreds of millions of people around the globe, but has also increased pressure on social and environmental conditions and negatively affected societal well-being. This research finds that policymakers in Greater Sydney adopted a dominant urban development strategy promoting economic, population, and public infrastructure growth that has successfully achieved the growth aspirations. However, this urban growth strategy has compromised the sustainability of societal well-being by leading to numerous negative social and environmental consequences over the last 50 years. These consequences were unintentional outcomes, and urban policymakers – once they recognized these problems – sought ways to address and mitigate these challenges. However, we find no evidence that policymakers questioned or attempted to fundamentally change the dominant urban growth strategy. Instead, policymakers’ foundational urban growth strategy has changed little during the last fifty years. The mental models about the virtues of continuously pursuing growth are strongly held in many modern societies, including among urban policymakers.

The feedback loops identified in this study show the complexity of urban dynamics and the potential unintended social and environmental consequences stemming from urban policies and strategies. Explicitly mapping the causal relationships of policymakers’ growth mental models addresses the call for adopting systems and transdisciplinary approaches for transitioning toward a sustainable pathway^{16,17}. These causal maps also reveal the interconnections among the pillars of sustainability – economic, social and environmental dimensions – that address the calls for a transition from primarily pursuing economic growth to strategies emphasizing sustainable development with a broader conceptualization of societal well-being⁹. Lastly, the causal maps contribute to understanding the implications of economic growth and growth strategies in a city.

Unintended impacts on social and environmental dimensions of societal well-being

Our results reveal several social and environmental consequences arising from the success of the dominant urban growth strategy that negatively affect societal well-being. The social consequences of urban growth include rising traffic congestion, declining housing affordability, and increasing travel time (and the commensurate loss of leisure time) that impacts societal well-being. Identifying the causal mechanisms that generate unintended social consequences contributes to our understanding about the impact of population growth on housing affordability³³, the impact of urban area size on housing affordability because of the concentration of high-income and high housing costs³⁴, the socio-economic implications of congestion based on the area of a city, population size and planning³⁵, urban transport challenges facing transportation network companies³⁶, and urban planning and commuting time^{21,33,37,38}. The findings also highlight the interconnections among these social aspects of societal well-being and the interdependencies between economic, population, and public infrastructure growth and societal well-being. Policymakers did not intend to create negative social consequences, but misperceptions about the feedback structure of the system³⁹ have enabled these urban challenges to become larger and more pressing over time.

The environmental consequences of urban growth include declining undeveloped green spaces and bushlands, rising pollution and waste levels, increasing energy consumption, more frequent and intense climate events (e.g., heat island events, bush fires and floods), and decreasing water storage and supply⁴⁰. Our analysis shows the interconnections among economic growth, environmental degradation and societal well-being⁴¹, the loss of natural areas in the city due to urban expansion⁴², the loss of food production near the city as a consequence of urban growth²³, water stress⁴⁰, the impact of vehicle emissions on pollution levels in urban areas⁴³, and climate policies and urban planning²¹. Importantly, the results highlight that continuing to pursue the dominant urban growth strategy negatively impacts the livability and sustainability of Greater Sydney for future generations.

Evolution of policymakers' beliefs

The causal maps underpinning policymakers' strategies in the 1968, 2005 and 2018 urban development plans show similarities in aims, variables and causal relationships. In all three reports, the focus on growth aims to make the city attractive to current and prospective residents and business firms and to prosper economically. In all three reports, policymakers were aware of social and environmental challenges. However, there were some differences between the reports in terms of the social and environmental consequences that were discussed. Therefore, these differences also appear in the causal maps as different unintended environmental and social consequences emerge over time.

The sequential appearance of unintended social and environmental consequences from the causal maps bears attention. In the 1968 plan, policymakers' primary social concern was the concentration of

activities and population and how to reduce congestion in the center of Sydney. Policymakers' main concerns in 2005 and 2018 included decreasing housing affordability, increasing commuting time, and the distribution of jobs and services throughout Greater Sydney to reduce traffic congestion. The results show a similar pattern for environmental challenges. In the 1968 plan, policymakers were concerned primarily with land use and local spaces to grow. In the 2005 plan, the key concern was air and noise pollution levels from traffic congestion. In the 2018 urban plan, the key concern was the consumption of natural resources (i.e., energy and water), increasing waste generation, loss of green areas, the need for more renewable energy, increasing pollution (i.e., water, air, and noise), and climate hazards such as heat island effects and floods. These findings align with the recent concerns about social and environmental impacts on societal well-being^{21,33,37,38}. The results also highlight that environmental challenges arise after policymakers focus on economic and infrastructure growth strategies as solutions to social challenges. In addition, the transition from an economic-based urban development strategy to a broader sustainability-based strategy aligns with research examining the evolution of the urban planning literature⁴⁴. This may open the discussion about how scientific knowledge can inform future policy and decision-making⁴⁵.

METHOD

Text Coding and Causal Mapping. We use a systematic and iterative coding process to convert text data into causal map diagrams to analyze each urban development plan by capturing the policymakers' beliefs about causal relationships. Causal maps focus researchers' attention on eliciting the causal structure of the information feedback system of interest⁴⁶. Agents operating in a system have a great deal of knowledge about the system, and eliciting their beliefs about causal relationships, delays, nonlinearities, strategies and policies helps explain how the system operates^{32,46-48}.

To capture policymakers' urban development strategies, we use a coding process adapted from Kim and Andersen⁴⁹, Eker and Zimmermann⁵⁰ and Tomoia-Cotisel et al.⁵¹. This iterative coding process increases reliability by constantly reviewing the raw data as the analysis advances. Checking the raw data at each step reduces the likelihood of omitting important information and allows evaluation of the relevance of each quotation extracted from the text of the urban planning reports. The iterative process also helps define the system boundary by selecting relevant causal arguments⁴⁹. The coding process identifies variables and causal relationships between variables⁵² and enables mapping the relationships using causal maps⁵³.

Each causal relationship is recorded following the procedure proposed by Eker and Zimmermann⁵⁰ and using computer-aided qualitative data analysis software (CAQDAS). Each causal relationship is supported by at least one quotation extracted from the urban reports^{49,51}. The causal relationships are used to develop the causal map^{52,54}, revealing the causal beliefs of policymakers' embedded in each urban report⁵⁵. Sentences and paragraphs in each report are analyzed to identify the causal relationships between variables^{49,56,57}. We use sentences as the minimum unit of analysis to identify variables and

causal beliefs. To identify the unintended social and environmental consequences, we focused on the deleterious causal relationships between variables identified in the text.

Data collection. We elicited policymakers urban planning strategies from 500 pages from three published governmental urban plans in Greater Sydney between 1968 and 2018: (1) *Sydney Region. Outline Plan*²⁶; (2) *City of Cities. A plan for Sydney's Future*²⁷; and (3) *A Metropolis of Three Cities – connecting people*²⁸. Each urban development plan offers rich information about how policymakers understand and think about urban areas. We chose Greater Sydney as a case study due to its worldwide status and well-known quality of life and the challenges faced because of the rapid urban growth³⁷.

Limitations. Our study has several limitations. Due to the length of the urban reports, only three reports were analyzed. Across all three urban planning reports, over 500 pages of written text were examined to capture policymakers' beliefs about causal relationships. However, the analysis of more data from additional urban planning reports could be useful to understand more subtle changes in strategies over time. Another limitation involves the coding procedure and analysis being conducted by a single coder because of the labor-intensive and time-consuming process. However, the results were discussed among several researchers multiple times to reduce this potential bias. In addition, the procedure implemented to analyze the urban plans opens the code for explicit review.

Another limitation is that this study includes only urban development plans by the Greater Cities Commission. Although the urban development plans were discussed with different stakeholders, this study did not include other urban area stakeholders such as businesses, inhabitants, non-governmental organizations, or other public institutions. Including the beliefs about causal relationships of other stakeholders would potentially increase the understanding of how urban planning strategies shape societal well-being over time, and represents a potential path for future research.

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Figures

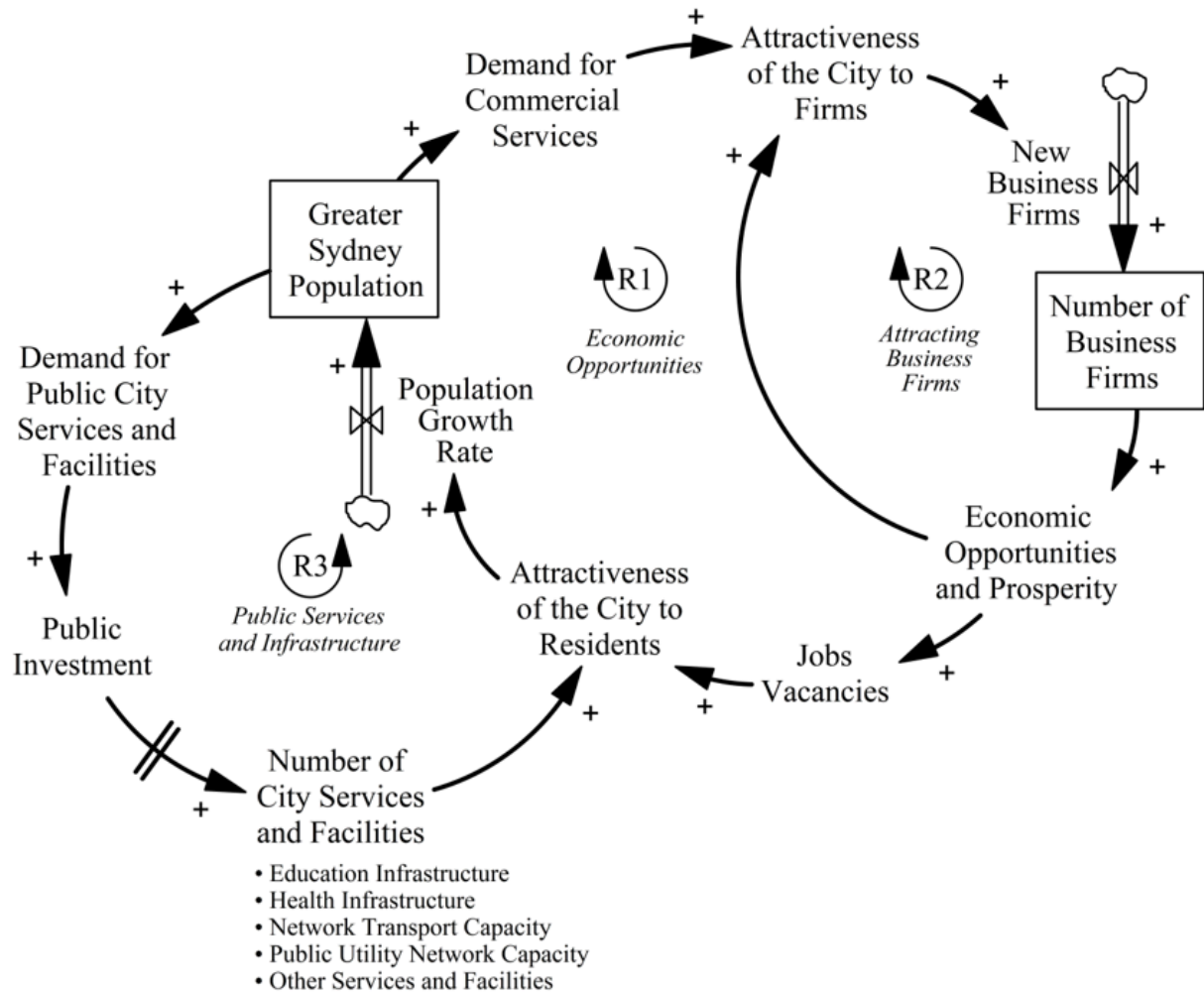


Figure 1. Causal map of economic and infrastructure growth strategy of urban policymakers. Arrows indicate the direction of causality. Signs at arrowheads ('+' or '-') indicate the polarity of the relationship. A '+' sign denotes that an increase in the independent variable causes the dependent variable to rise above what it would have been, *ceteris paribus* (and a decrease causes a decrease). A '-' denotes that an increase in the independent variable causes the dependent variable to decrease beyond what it would have been. Formally, "+" is defined as $X \rightarrow + Y \Leftrightarrow \partial Y / \partial X > 0$ and "-" is defined as $X \rightarrow - Y \Leftrightarrow \partial Y / \partial X < 0$. The loop label "R" indicates reinforcing (positive) feedback³². Rectangles represent stocks; arrows with valves represent flows. Formally, Greater Sydney Population (GSP) = $GSP_{(t)} = GSP_{(t_0)} + \int_{t_0}^t [Population\ Growth\ Rate] dt$

Figure 1

See image above for figure legend.

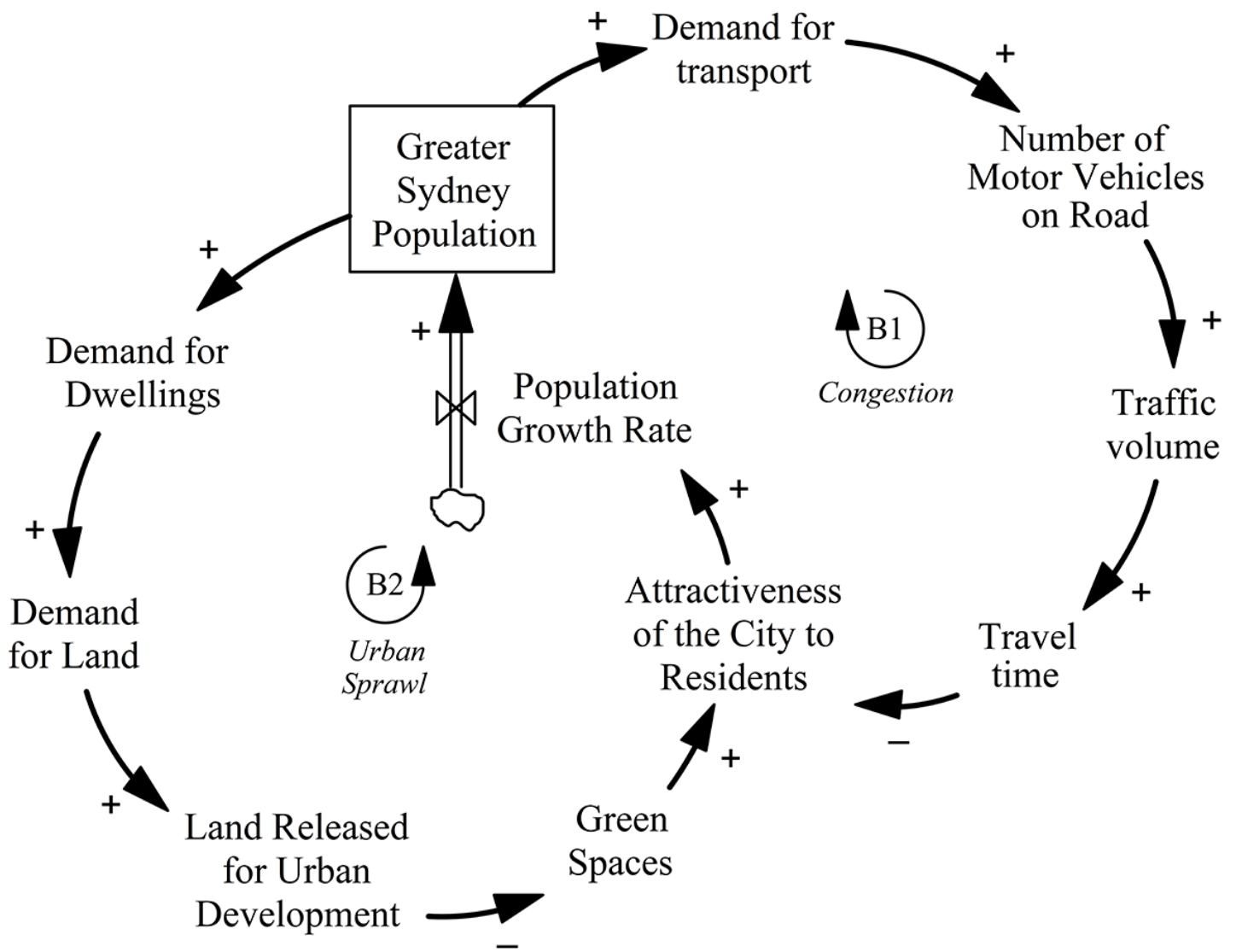


Figure 2

Causal map of social and environmental consequences identified in 1968 urban plan. The label "B" indicates negative (balancing) feedback³².

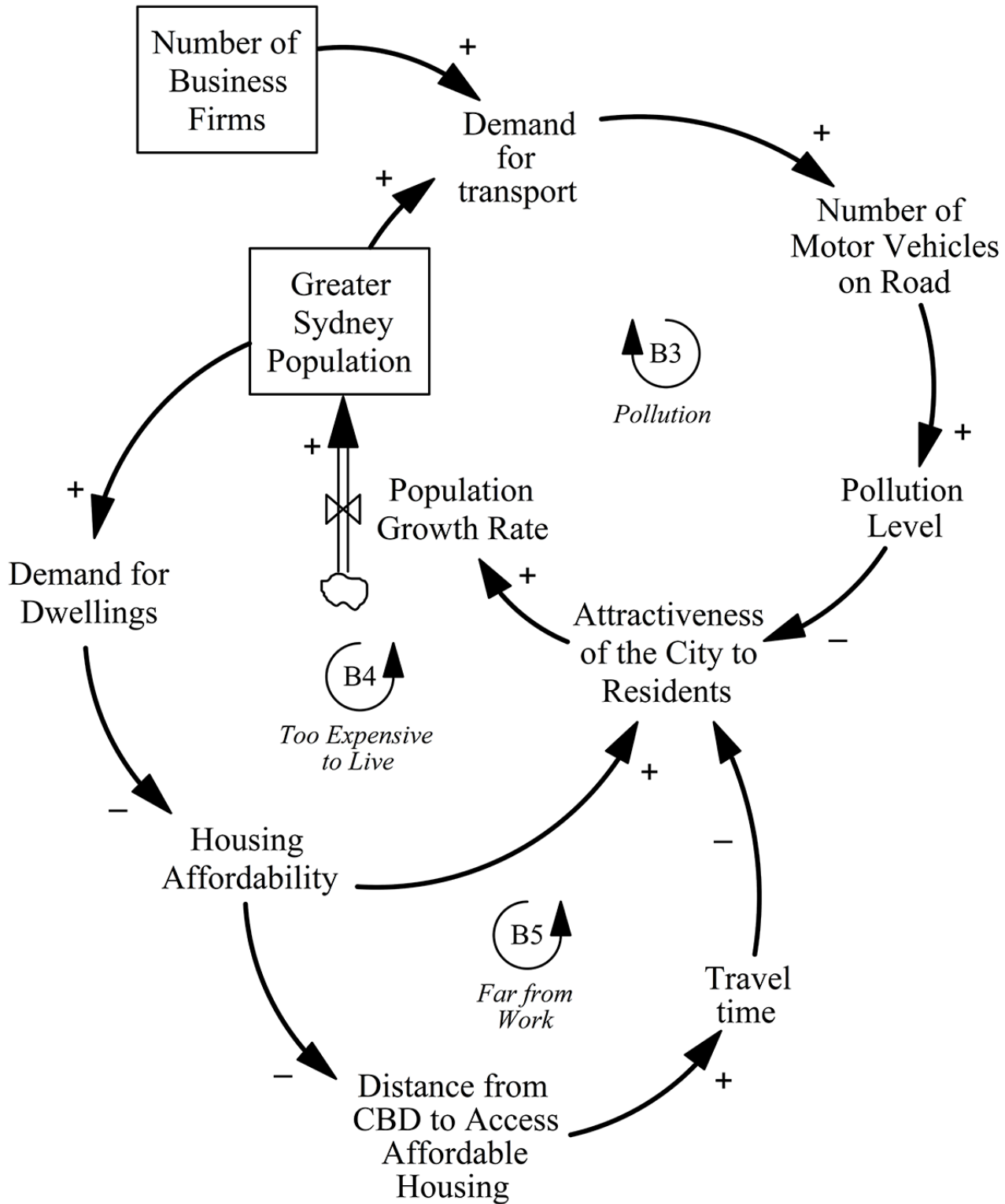


Figure 3

Causal map of social and environmental consequences identified in 2005 urban plan.

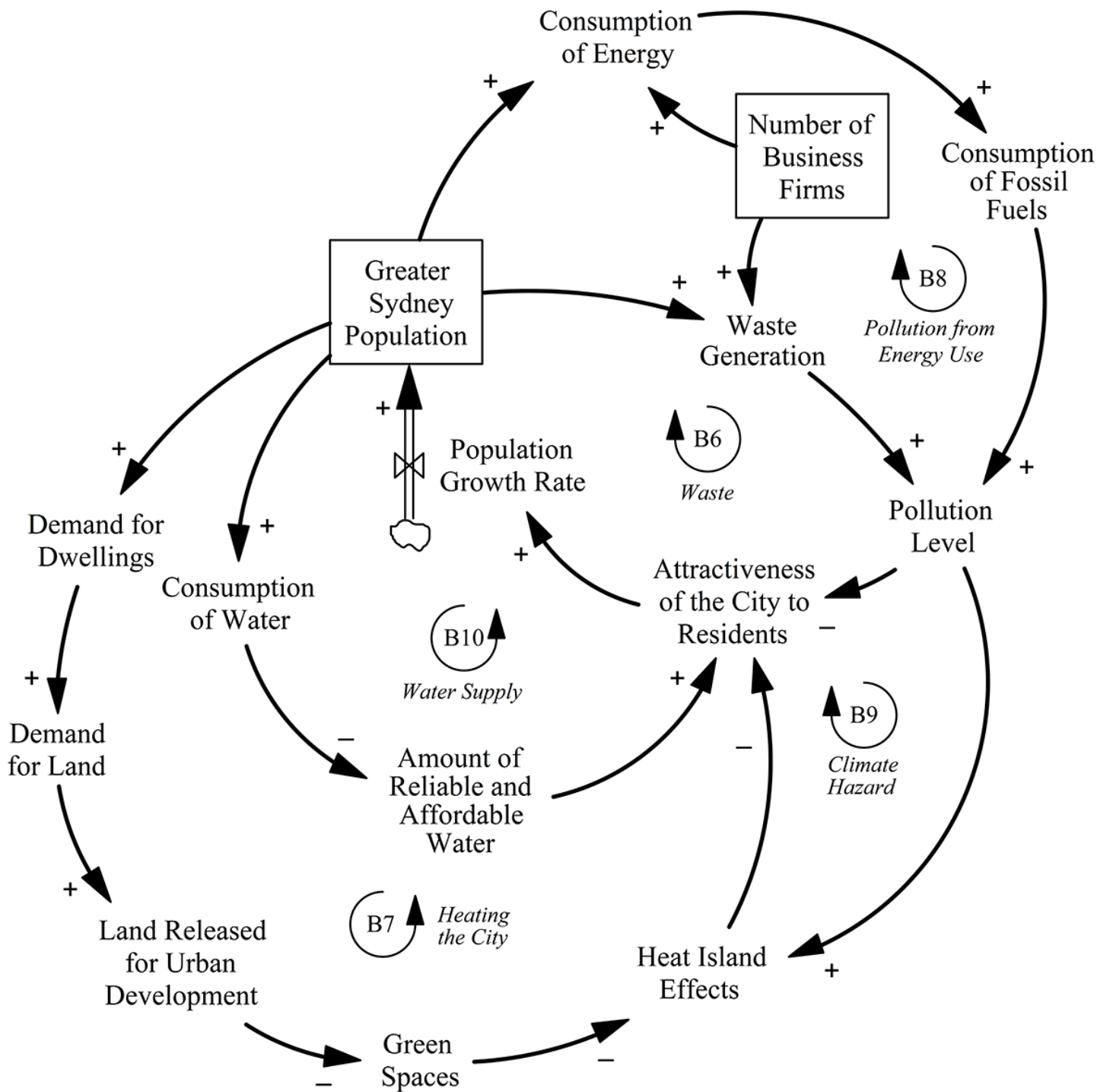


Figure 4

Causal map of social and environmental consequences identified in 2018 urban plan.

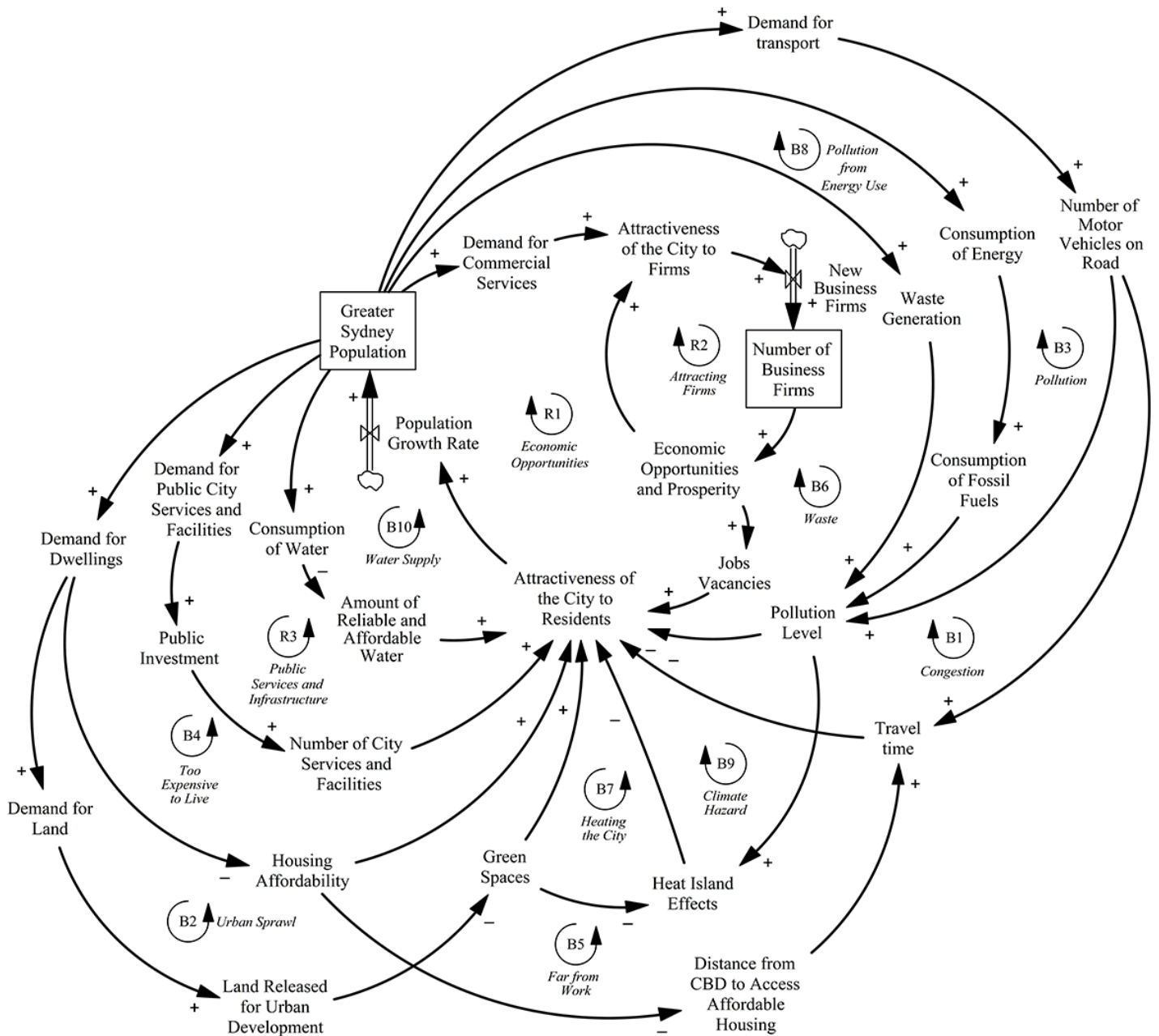


Figure 5

Combined causal map of relationships in Greater Sydney Urban Plans 1968, 2005, and 2018

Supplementary Files

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