Universidad Austral de Chile
Facultad de Ciencias Económicas y Administrativas

technische universität dortmund

SPRING

ASSESSING NODALITY IN NEIGHBOURHOODS IN TRANSFORMATION: A CONCEPT OF SUSTAINABLE URBAN FORM. THE CASE STUDY OF RAHUE BAJO, OSORNO, CHILE

Master Thesis

Master of Science in

Regional Development Planning and Management

This thesis is part of the research project of FONDECYT No. 11160096: "Sostenibilidad y Modularidad Urbana: Aplicación de una Metodología para la Medición y Evaluación de los Niveles de Sostenibilidad de Áreas Urbanas en Ciudades Intermedias", funded by CONICYT – Chile.

HOSNI, Jilan Abdelaziz Mohamed Hosni Abdelaziz

VALDIVIA, Chile

June 2017

AUTORIZACIÓN

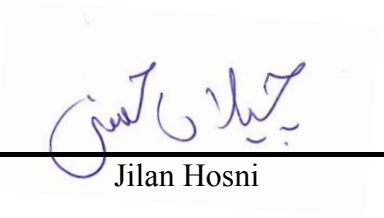
Por la presente declaración, yo Jilan Abdelaziz Mohamed Hosni, cédula nacional de identidad número 25.494.105.-0, domiciliado en Calle Viel S/N Isla Teja Valdivia, vengo en declarar lo siguiente:

PRIMERO: Que en el marco de mis estudios de postgrado adscrito al Msc. Regional Development Planning and Management realicé la tesis denominada "Assessing Nodality in Neighbourhoods in Transformation: A Concept of Sustainable Urban Form. The Case Study of Rahue Bajo in Chile".

SEGUNDO: Que el académico responsable de mi trabajo es el Profesor Antonio Zumelzu.

TERCERO: Que en cumplimiento con lo dispuesto en la Política y Reglamento de Fomento de Propiedad Intelectual de la Universidad Austral de Chile, aprobados por Decretos número 022 y 023 de 2015, por este instrumento autorizo a la Universidad a mantener la tesis resultante del trabajo realizado durante mis estudios de postgrado, en biblioteca para consulta académica, y a publicarla en formato digital, a partir de un año de su defensa pública que será efectuada en Valdivia el 10 de julio de 2017, a fin de que ésta cumpla con su misión de tener disponible a la sociedad el conocimiento que se genera en ella.

En este mismo acto, autorizo a la Universidad, en caso de ser necesario, a mantener confidencial la tesis, memoria, seminario de título o equivalente realizado durante mis estudios de postgrado, y que contengan información confidencial o secretos industriales relacionados con la investigación sobre las que estas versen.



Jilan Hosni

Antonio Zumelzu

Valdivia, 11 de Mayo de 2018.

Declaration of the Author

ASSESSING NODALITY IN NEIGHBOURHOODS IN TRANSFORMATION: A CONCEPT OF SUSTAINABLE URBAN FORM. THE CASE STUDY OF RAHUE BAJO, OSORNO, CHILE

By

HOSNI, Jilan Abdelaziz Mohamed Hosni Abdelaziz

This thesis was submitted to the Faculty of Economic and Administrative Sciences in partial fullfillment of the requirements to obtain the academic degree "Master of Science in Regional Development Planning and Management", the 2-year postgraduate study programme "Spatial Planning for Regions in Growing Economies" (SPRING), jointly offered by the Faculty of Economic and Administrative Sciences, Universidad Austral de Chile in Valdivia and the Faculty of Spatial Planning, Technische Universität Dortmund in Germany.

The author declares to have elaborated the present research solely by her own efforts and means. All information taken from external sources is marked accordingly.

HOSNI, Jilan Abdelaziz Mohamed Hosni Abdelaziz

Valdivia, Chile

07 June 2017

MASTER THESIS APPROVAL REPORT

The Thesis Assesment Committee communicates to the Graduate School Director of the Faculty of Economic and Administrative Sciences that the Master Thesis presented by the candidate

HOSNI, Jilan Abdelaziz Mohamed Hosni Abdelaziz

has been approved in the Thesis defence examination taken on July 2017, as a requirement to opt for the Master of Science in Regional Development Planning and Management Degree.

Thesis Advisor:	Co- Thesis Advis0r
Antonio Zumelzu	Roberto Burgos Mann

Assessment Committee

External Examiner	Panel Member

Acknowledgements

First, I would like to express my gratitude to the DAAD that fully funded my two years of study abroad. I also acknowledge the FONDCYT project (11160096), having able to fund the project “Sostenibilidad y modularidad urbana: aplicación de una metodología para la medición y evaluación de los niveles de sostenibilidad de áreas urbanas en ciudades intermedias”, that have given me the opportunity to study such an interesting subject.

Like every Master thesis student, we have good and bad days. I feel thankful to my professor Antonio Zumelzu who had always been trying to facilitate my thesis process, and his continuous and immediate response to my doubts. I appreciate his understanding of how hard it is to start studying in a foreign country. My appreciation would also be for my co-supervisor Roberto Burgos Mann who had taught me how to structure my thesis.

I have always wished to be part of something bigger than myself and here I am participating in a wider research platform. To my project team who helped me achieve this goal, thanks to Camila Sepulveda, Melissa Barrientos and Daniel Espinoza who helped me on data collection and fieldwork. Also thanks to the junior team members Andrew Curi and Valentina Paz for giving their best to assist.

I would like to express my tremendous gratefulness towards all who had always been behind my success. For my family, I hope I made you proud by now. Special thanks to my mother who had dedicated her life for her daughter’s happiness. To the one that had taught me to stand up for myself. Thanks to my father who had always taken my education as a priority and has been supportive for in all round matters. I am also thankful to have a supportive brother Youssef.

Thanks to my best friend Aya Adel who had always been on call for my technical and emotional support. I appreciate the support of my loyal friend Shadwa Negm for backing me up as always and Konrad Voges that had been always offering his help. My acknowledgment would also go for the Poblete family and Maria Fernanda Romero whom my Chilean experience wouldn’t have been enjoyable without them.

I dedicate my study to my grandma and Auntie Mona who had passed away during my study in Chile.

Resumen

Las transformaciones de las ciudades en Chile han seguido un patrón de cambio similar a lo observado en contextos europeos y norteamericanos, relacionado a dos aspectos base de la ciudad: forma y función. La mayor demanda en la posesión de viviendas unifamiliares y automóviles han sido un tema en urbanismo en la última década. Desde las personas a comunidades, las relaciones sociales en los espacios públicos han estado en una tendencia decreciente siguiendo un enfoque de estilo de vida individualista. Consecuentemente, este modo de vida ha reflejado sus rasgos en la función morfológica de la ciudad; formando nuevas estructuras residenciales, cambiando la escala de la ciudad y provocando así numerosos debates ambientales sobre sostenibilidad. En el reconocimiento de patrones de ciudad en diferentes escalas, el concepto de barrio es identificado como la unidad sostenible básica de la forma urbana (SUF) en la cual conceptos socio-urbanísticos son más bien tangibles. Al mirar críticamente el despliegue de los procesos de urbanización y el cambio de las relaciones sociales en la ciudad, los barrios están bajo amenaza de perder su vitalidad e identidad. La vitalidad de barrios es un concepto que fue calificado tanto por investigadores como por algunos urbanistas; como Jane Jacobs, Bosselmann, Gehl y Talen; sobre urbanidades vibrantes que expresan la presencia de comunidades en los espacios públicos. A su vez, los espacios públicos en barrios representan el eje de control social sobre el territorio. La noción actual se observa en las áreas públicas exteriores desiertos de personas, aunque algunos otros se observan congestionados. En consecuencia, esto evidencia la brecha que existe en la práctica del diseño urbano que ha ido en espiral fuera de control. A pesar del debate engañoso sobre los conceptos de ciudad sostenible, los profesionales y expertos han acordado en la necesidad de actuar localmente, ya que las declaraciones generalizadoras han incorporado más dificultades para aplicar las teorías en la práctica. Para analizar la sostenibilidad de la forma urbana, cinco dimensiones han sido establecidas por investigadores: accesibilidad, conectividad, densidad, diversidad y nodalidad. Estos criterios han sido aplicados con éxito en varias ciudades para la exploración de la sostenibilidad en el entorno construido y la construcción de programas de regeneración

urbana. Mediante la aplicación del concepto de nodalidad en barrios como una estrategia para abordar la transformación actual, la escala de la ciudad podría ser redefinida. Como muchas ciudades en el sur de Chile, Osorno está pasando por una dramática fase de transformación. La investigación tiene como objetivo evaluar la calidad de los espacios públicos en el barrio de Rahue Bajo, a través de la aplicación de la nodalidad como dimensión de forma urbana sostenible. También, explorar los potenciales morfológicos del barrio que promuevan actividades humanas. La investigación sigue un enfoque de estudio de caso empírico junto a un análisis cualitativo del espacio urbano. El marco metodológico se considera como tres fases secuenciales de re-mapear, re-escalar y de reorganización. Los métodos adaptados están dedicados a evaluar la nodalidad del espacio público en las ciudades chilenas medias. Los resultados demuestran un nuevo tipo de herramienta analítica, basada en la investigación morfológica urbana y las técnicas de sintaxis espacial para observar el movimiento de las personas en los espacios públicos. A través de la cartografía, el barrio es re-organizado con un nuevo mapa de jerarquías espaciales definidos por nodos de interacción social. A pesar de la profundidad técnica de la investigación, ésta entrega una nueva perspectiva de colaboración entre la academia y los municipios para ayudar a los funcionarios en avanzar con nuevos métodos para lograr mejores resultados de diseño. Esto puede ser visto como un paso adelante hacia un desarrollo más inclusivo de la ciudad y puede exponer en discusión nuevos sistemas de organización de ciudad, ya que los resultados se basan en un diseño orientado al usuario que ilustra el comportamiento de las personas en el espacio.

Palabras clave*: Nodalidad, espacios públicos, morfología urbana, interacción social, sostenibilidad, forma urbana, barrios, escala, patrones, ciudades intermedias, post-carbono, transformación urbana, vitalidad, estructuras modulares*.

Abstract

The transformation of Chilean cities has followed the same pattern change as observed in European and North American contexts, related with two based aspects of the city: form and function. More demand on the possession of individual housing units and automobiles has been a subject in urbanism during the last decade. From individuals to communities, social relations in public spaces have been in a declining observed manner following an individualistic lifestyle approach. Consequently, this way of living has reflected its features on the morphological function of the city; forming new residential structures, changing the scale of the city and hence provoking numerous environmental debates on sustainability. In recognition of city patterns at different scales, the concept of neighbourhood is identified as the basic sustainable unit of urban form (SUF) in which socio-urbanistic concepts are rather tangible. By looking critically at the unfolding of the urbanisation process and the change of social relations, neighbourhoods are under threat to lose their vitality and identity. Vitality of neighbourhoods is a concept that was termed both by researchers and some urbanists; like Jacobs, Bosselmann, Gehl, and Talen; on vibrant urbanities expressing the presence of communities in public areas. In turn, public spaces in neighbourhoods represent the hub of social control over territories. The current notion is observed in public outdoor areas deserted of people, although some others are seen to be congested. Accordingly, this shows the gap that appears in the urban design practice that has gone spiralled out of control. Despite the misleading debate about sustainable city concepts, professionals have agreed upon the necessity of acting locally since generalizing statements added up more difficulties for applying theories into practice. In order to analyse the sustainability of urban form, five dimensions were set by researchers as: accessibility, connectivity, density, diversity and nodality. These criteria have been applied successfully in a number of cities for exploring sustainability in built environment and the construction of urban regeneration programs. By applying nodality in neighbourhoods as a strategy to afford with the current transformation, the city scale could be redefined. Like many cities in the southern Chile, Osorno is passing through a dramatic transformation phase. The research aims to evaluate the quality of public spaces in the

neighbourhood of Rahue Bajo, through applying nodality as a dimension of SUF. It also explores the morphological potentials of the neighbourhood that promotes human activities. Furthermore, the research follows an empirical case study approach with a qualitative analysis of urban space. The methodological framework is regarded as three sequential phases of Re-mapping, Re-scaling and Re-organizing. The adapted methods are dedicated to assess nodality of public space in intermediate Chilean cities. The results demonstrate a new type of analytical tool, based on urban morphological investigation and Space Syntax techniques to observe people's movement in public areas. Through cartography, the neighbourhood is re-organized with a new hierarchical map that is defined by nodes of social interaction. Despite the technical depth of the research, it gives a new perspective of the collaboration between academia and municipalities to help officials advance with new methods to achieve better design results. This can be seen as a step forward towards more inclusive city development and can expose the discussion of new systems of organizing cities, since the results are based on user-oriented design, illustrating people's behaviour in space.

Keywords: *Nodality, public spaces, urban morphology, social interaction, sustainability, urban form, neighbourhoods, scale, patterns, intermediate cities, post-carbon, urban transformation, vitality, modular structures.*

Contents

List of Tables

List of Figures

List of Abbreviations and Acronyms

AutoCAD	Auto Computer-Aided Design
BREEAM	Building Research Establishment Environmental Assessment Method
e.g.	*Exampli gratia* – For example
etc.	*et cetera* - And so on
et al.	*et alia* - And others
GIS	Geographic information system program
HHI	Harvard Humanitarian Initiative
i.e	*id est* - That is to say
IMO	Ilustre Municipalidad de Osorno – Municipality of Osorno
IRC	International Rescue Committee
Km	Kilometre
Km^2	Kilometre Square
LEED	Leadership in Energy and Environmental Design certificate
m	Meters
m^2	Meter square
MAMSL	Metres above mean sea level
MINVU	Ministerio de Vivienda y Urbanismo - Ministry of housing and Urbanism
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
ped./day	Pedestrian per day
RB	Rahue Bajo
SS	Snapshot
St	Street
SUF	Sustainable Urban Form
UN	United Nations
UN HABITAT	United Nations of Human Settlements
veh./ day	Vehicle per day

INTRODUCTION

Through the emphasis on the cities as homes for humanity; as stated by the UN Secretary General; HABITAT III (HIII), urbanization has become one of the most significant modern trends of our century (HABITAT, 2016). Cities are currently the most evident expression of human influence on earth, founded to intensify economy and save energy systems; accepting huge agglomerations (Zumelzu, 2015). Additionally, cities today consume more than two thirds of the world's energy and produce more than 70% of their greenhouse gas emissions (UN HABITAT, 2016). Modern industrialisation has forced cities to be fossil-dependant energy systems in order to achieve a better economic status despite its threat to collapse eventually (Atkinson A. , 2007). The rise of *carbon cities* has undoubtedly affected not only the continuous energy demands, but also the trend of urban growth through constant land consumption of its footprint. The world is currently witnessing rapid urban expansion patterns much faster than its population growth to the extent that has raised concerns about the essentiality of continuing urbanization (Batty M. , 2015). This unfamiliar morphological trend of growth can be explained by the fact that cities are under transformation pressure where compactness is going unrestrained resulting in city dispersion. (Zumelzu A. , 2015; Salinas & Pérez, 2011). Specifically, cities in Latin America have proven to occupy land more than necessary compared to their population and urban growth (UN HABITAT, 2012). In that sense, planners have to admit that urbanization has spiralled *out of control* and a new wave of design innovation has yet to appear (Atkinson A. , 2007). With the purpose of preparing for the post carbon era, the main task of urbanism should not be dedicated to new city plans, but rather to re-planning and re-designing the existing cities. In fact, sustainable future cities are closely endowed by the success of the current city function which its focus is on the transformation process (Doevendans & Zumelzu, 2017).

The transformation patterns of built-up environment are tangibly apparent in the growth of suburban areas, gated communities (Vaughan L. , 2015; UN HABITAT, 2012). Likewise, the transformation of Chilean cities has followed the same pattern change as observed in European and North American contexts (Salinas & Pérez, 2011).The models are repeatedly based on roads construction, shopping centres and separated residential communities (UN HABITAT, 2012). Nevertheless, the environmental crisis that the globe has to face is expressed as falling victim to continuous demand of land consumption and the depletion of fossil fuels to produce energy. Another intangible effect is associated to the significant decrease in social interaction (Atkinson A. , 2007).

In relation to the transformation of cities to what researchers name as carbon cities, the occidental culture has always accompanied the modern life of inhabitants, changing incrementally the social relations towards more individualistic and independent approach (Escobar, 2005; Atkinson A. , 2007). More demand on the possession of individual housing units and automobiles was a feature subject of the decade (Atkinson A. , 2014). The change of the individualistic lifestyle was not a matter of necessity, but an instrument of self-expression and pride of wealth. From individuals to communities, social relations have been in a decrescent observed manner following the *individualistic family model* (Van de Kaa, 2004). As a result, this way of living has reflected its hallmarks on the urban morphological function in Latin America; specifically in Chile; through forming new residential structures changing the scale of the city and consequently provoking numerous environmental debates on sustainability (Atkinson A. , 2007; Bridge, 2010; Popper & Popper, 2010; Gringonis, 2013; Blanco J. , 2015; Guevara, 2015; Truffello & Hidalgo, 2015; Zumelzu, 2015).

In awareness of the complexity, the city scale is explained by Wilson (2000), Canniggia & Maffei (2001), Howitt (2002), Kärrholm (2011) and others, as hierarchical structural units of space, place and environment (Zumelzu A. , 2015). In that sense, the multi-scalar system of a typical city has declined through the transformation process by the separation of functions and distance dependant areas. Critics of regenerating cities have looked scathingly at unfolding urbanisation processes and change of social relations and in certain respects of coherences (Atkinson A. , 2007). In recognition of city patterns at

different spatial scales, neighbourhoods can be identified as the basic units of sustainable urban form (SUF) in which socio-urbanistic concepts are tangible (Hillier B. , 1999; Zumelzu, 2015). In other words, the association between spatial urbanisation processes with social organization identifies the neighbourhood as the basic sustainable unit of the city (Zumelzu, 2016; 2015). In addition, it also represents the micro-structure of the city where its component is inevitable. Since city creation, neighbourhoods has been a fundamental element where urban form and social interactions define its territory. In one way or another, urban inhabitants have always lived in a neighbourhood where it represents the elementary link between the city and individuals (Frey & Yaneske, 2007; Hillier B. , 1996; Blanco J. , 2015). The concept behind neighbourhoods is more than a physical determinism as mentioned by Lawhon, however the definition of neighbourhood has a lot of meanings according to how people perceive their own space (Demiddel & Bustamante, Más que una suma de casas. La unidad vecinal Villa Pedro de Coronel , 2009).

In the latter discussion, through looking critically at the unfolding urbanisation process and the change of social relations, neighbourhoods are losing their vitality and identity (Atkinson A. , 2007). Vitality of neighbourhoods is a concept that was termed by some urbanists; like Jacobs, Bosselmann, Gehl, and Talen; on vibrant urbanities expressing the presence of communities on public areas. In turn, public spaces in neighbourhoods is an interesting subject to be analysed since they represent the hub of social control over territories (Jacobs, 1961). As explained years later by (Hillier B. , 1996), space consists of two elements form and society, the constant decrease of the social element confronts the concept of vitality of neighbourhood under a persistent threat. This can be observed currently in public outdoor life in a number of specific Chilean neighbourhoods to be deserted of people, although some others are seen to be congested. Accordingly, this shows the gap that appears in the urban design practice that has gone out of control (Hillier B. , 1996; Evan, 2005; Frey & Yaneske, 2007; Hillier 2007; Oliveira, 2013). Looking with the same lens, the identity of neighbourhoods is a dynamic process identified by its communities. However, neighbourhoods under transformation are suffering a blue-print wave of private investment housing units disfiguring its main concept. (Vaughan L. ,

Suburban Urbanities: Suburbs and the Life of the High Streets, 2015). The lack of planning is placing cities of Chile in the centre of the development agenda of the twenty-first century (UN HABITAT, 2012).

In addition, the general idea of implementation failure of sustainable urban models is due to the weak technical analytic discourse. Architectural theories have been too easy to use them to generate designs, but they are too fragile in predicting what these designs will be like when built (Hillier B. , 1996). Contrariwise, the power of design lies in the appreciation for a possible way to generate more sustainable urban environmental conditions, if research would take a turn in the development of methods, instruments and tools for practical application of sustainability (Kärrholm , 2011; Leon, 2013; Doust, 2014; Zumelzu *et al.*, 2015). As a way forward towards new methodologies, setting SUF as an operational concept can be seen from the perspective of assessing the current trajectories in order to re-design existing neighbourhoods (Frey, 1999; UN-Habitat, 2009; Barton *et al.*, 2010; Talen, 2011; Zumelzu & Doevendans 2015; Zumelzu & Doevendans, 2017).

Despite the misleading global debate about sustainable city concepts producing perfect models for application, professionals have agreed upon the necessity of acting local since generalizing statements added up more difficulties for applying theories to practical contexts (Hillier & Hanson, 1984; Hillier, 1996; Frey & Yaneske, 2007; Frey *et al.*, 2010; Andersen, MØller-Jensen, & Engelstoft, 2011; UN HABITAT, 2015). The Chilean cities, especially Intermediate-sized cities, require a detailed diagnosis to improve the effectiveness of local management and is urgent to re-organize in order to adapt with the current urban structures towards sustainable urban development. Although the sustainability concept has appeared recently on the urban platform borrowing models from different disciplines, a group of researchers; such as Frey, Hillier, Batty and Talen; took the lead long before in defining technically the dimensions of SUF (Hillier B. , 1996). In order to analyse the sustainability of built-up environment, five dimensions were set, viz. accessibility, connectivity, density, diversity and nodality (Frey, 1999; Batty M. , 2005; Talen, 2011). These criteria have been applied successfully in cities such as Glasgow and Freiburg (Frey H. , 1999) and recently in Dutch cities of Eindhoven and Amstelveen (Doevendans *et al..,* 2014; Zumelzu, 2014; 2015) for the construction of urban

regeneration programs areas. By focusing on applying nodality in neighbourhoods as a strategy to adapt with the current transformation, the city scale can be redefined. Therefore, the research defines nodality as the centres of human interaction in public areas which vary in sizes. Nodes promote the sustainability of the urban form through providing public spaces where all the shops, local services and social interaction occur. In addition, they can afford a physical articulation of the community, by providing a common destination for residents of the surrounding area. Such spaces support other aspects of sustainable urbanism, such as increased density in the surroundings, mixed types of housing anchored by a space centralized, or the viability of commerce at the neighbourhood scale (Ellin, 2006; Frey H. , 2010; Talen, 2011).This endorses the idea of polycentric or Multi-nuclei city that can be organized around different nodes of levels and sizes. (Frey, 1999; Wilson, 2000; Batty M. , 2005; Kärrholm, 2011).

Focusing on the Chilean context, the high primacy of the capital city has not given the chance for intermediate cities; specifically in the South; to be observed by researchers as a potential for a sustainable morphological change (UN HABITAT, 2012; Inzulza, 2014; Maturana & Rojas, 2015). In fact, intermediate cities in the southern of Chile are facing a constant transformation process and spatial expansion. On one hand, these cities are fragile to accept the significant impacts from urbanization despite the current pressure subjected for their transition. On the other hand, evidences from individual city systems has stressed out on the importance of medium and small sized cities, owing to their opportunity to absorb growing possibilities of urban settlers that can be advanced to relate the spatial dimensions (Dix, 1986; UN HABITAT, 2012; IOM, 2014; UN HABITAT, 2014; Batty M. , 2015). While the expansion tends to segregate the territory, the SUF tends towards apparent hierarchy: from regional growth nodes to neighbourhood centres or even public spaces. However, the research emphases on the nodes of neighbourhoods.

Like many cities in the Patagonian Southern region, the city of Osorno; in Chile; is passing through a current transformation phase. An intermediate city of a population of 130,000 which had been under pressure of industrial growth, feeding its surrounding rural sector. During the 1990s, a plan was designed for the city's extension, resulting in the formal construction of Rauhe Bajo which was occupied by informal settlements. The

neighbourhood was then designed to absorb the working class population that immigrated to support the industrial extension. Due to the constant migration pattern in Rahue Bajo, the neighbourhood has transformed its urban form of land use, densities and Etc. to adapt with the current situation. Consequently, the neighbourhood concept has drifted to lose its significance to sustain the continuous change. Through assessing the potentiality of sustainability dimensions of its urban form, specifically nodality of space, it would contribute to determine the current state of the neighbourhood and its scale according to the city. For the first time, in the Southern Chilean cities, this research would take place to reduce the gap between actualization of neighbourhoods and how people perceive their city.

1.1 Research Hypothesis

The main hypothesis of the research is to quantify sustainability of urban form in order to assess the intermediate cities through re-development. The second set assumption is that Latin American cities; specifically Chilean cities; can be seen as a system of modular units and hence the neighbourhood unit is its main component. This statement continues to prove that neighbourhood units help to understand the hierarchical structures of settlements and improve the physical conditions of residents.

1.2 Research questions:

Following from the above, the research is dedicated to evaluate the public spaces through applying nodality as a dimension of SUF. The questions are derived from the research hypothesis and objectives to hold one main question and two specific ones. The main research question is therefor: *How does the urban form; in Southern Chile; affect the social sustainability of neighbourhoods?*

1.2.1 Specific questions:

Successively, the specific questions are addressed to ask firstly: How can nodality contribute to re-define scaling of neighbourhoods in order to steer a sustainable built-up environment in Southern cities? And secondly: How do people perceive and use urban space in Rahue Bajo?

1.3 Research Objectives

In order to answer the above questions, the research mainly aims to prepare the existing city of Osorno for the post-carbon era through enhancing their sustainability potentials. In the line of the latter discussion, the research utilizes the methodology of Frey for assessing the sustainability of urban form to assist decision makers (Zumelzu, Doevendans, & De Meulder, 2015), for re-scaling and re-designing cities (Frey & Yaneske, 2007) in Latin America.

The research objectives focuses on one main objective and specifies two others in order to achieve the results. The main objective is showed as follows:

- Restructure the spatial organization through understanding residents' perception about space in order to compulse a new urban unit to put in value social sustainability.

While the specific objectives are explained to:

- Evaluate the quality of public spaces in Rauhe Bajo through applying nodality as a dimension of Sustainable Urban Form (SUF).
- Explore the potentials of neighbourhood as a basic unit for local urban development.

CHAPTER 1

CONCEPTUAL FRAMEWORK: SUSTAINABILITY IN ACTION

2.1 Introduction

At the beginning of the research study, this chapter sets the cornerstone of the empirical study through providing a common ground for assessing nodality in neighbourhoods of transformation. The chapter's objective is to establish a theoretical background for the whole study in order to determine a common framework. It also reflects the illustration in a historical narrative style with the purpose of giving a fair overview of the recent debates. The following chapter sections are based on the different definitions and explanations of specific terms that are discussed along the research.

2.2 Carbon Cities in Transformation: Towards the Necessity of Post-Carbon Urbanism

The city is a core of manifestation of civilisations where it was and still is an expression and exercise of power (Núñez, 2010; Atkinson A. , 2014). No doubt that cities create wealth, generate employment and drive human progress by harnessing the forces of agglomeration (UN HABITAT, 2016). Such glorious idea about the city has obviously attracted more desire for populations to seek the luxurious lifestyle. Cities liberated peasants from the rigours of rural slavery, offering them the opportunities of civilization (Rodríguez-Álvarez, 2014). For this sake, nowadays more than half of the world's population are living in cities and even higher percentages are recorded in Latin American

cities. Stimulated by recent projections that world population was to settle, at around nine billion this century, in urban areas with urbanisation continuing unavoidably (Batty, 2015). Apart from the concern of population growth, the phenomenon which had drawn the attention is the spatial occupation of urban land that is expanding much faster than the population growth (UN HABITAT, 2012; Batty M., 2015; Vaughan *et al.*, 2015). Remarkably, the rapid trend of urbanization have been experienced as a traumatic transformation, resulting in environmental deterioration and social inequality (UN HABITAT, 2012). Cities are responsible for more than 70% of the global carbon dioxide emissions. Numerous concerns from international organisations as well as researchers are raised about the future of the cities, due to their unsustainable manner of growth (UN HABITAT, 2016).

Focusing on the Chilean context, the high primacy of the capital city has not given the chance for intermediate cities; specifically in the South; to be observed by researchers as a potential for a sustainable morphological change (UN HABITAT, 2012; Inzulza, 2014; Maturana & Rojas, 2015). Most of these studies have been carried out in the Northern metropolitan cities (Zumelzu, 2016). However, intermediate cities in the southern of Chile are facing a constant transformation process and spatial expansion. On one hand, these cities are fragile to accept the significant impacts from urbanization despite the current pressure subjected for their transition. In addition, few evidence for research on intermediate cities - especially in southern Chile – have been witnessed, despite the range of greater potentiality and interest to promote SUF (UN Habitat, 2012; Inzulza, 2014; Maturana & Rojas, 2015).

Like many cities in the Patagonian Southern region, the city of Osorno - in Chile - is passing through a current transformation phase. An intermediate city of a population of 130,000 which had been under pressure of industrial growth, feeding its surrounding rural sector. During the 1990s, a plan was designed for the city's extension, resulting in the formal construction of Rauhe Bajo which was occupied by informal settlements. The neighbourhood was then designed to absorb the working class population that immigrated to support the industrial extension. Due to the constant migration pattern in Rahue Bajo, the neighbourhood has transformed its urban form of land use, densities and etc. to adapt with the current situation. Consequently, the neighbourhood concept has drifted to lose its significance to sustain the continuous change. Through assessing the potentiality of sustainability dimensions of its urban form, specifically nodality of space, it would contribute to determine the current state of the neighbourhood and its scale according to the city. For the first time, in the Southern Chilean cities, this research would take place to reduce the gap between actualization of neighbourhoods and how people perceive their city.

2.3 Sustainability as an Operational Concept in Urban Form

The topic of sustainable development was initially founded by the United Nations in the late 80s to endorse member countries to follow suite. Ten years later, the concept was spread worldwide although of its rather vague principles. Despite the exhortation of using

the term sustainable neighbourhoods as a catchphrase for development, the definition is still a subject to be discussed and argued. It is of quite importance to set a common ground for the research to define sustainable cities and how can it facilitate the process of assessing its urban form. Without getting into details in specific definitions - since it's not the main focus of the study- there are three main lens to understand sustainability of cities. The first lens can be explained as the classic definition that was initially mentioned in the Brudtland report in the World Commission on the Environment and Development in 1987. The definition mentions sustainability as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Burnett, 2007). Later in the Rio summit (1992), the definition of sustainability repeated itself agreeing on a concept around three main drivers of social, economic and environmental disciplines. More concepts later have been embraced to include the institutional framework as a fourth driver. Also, other models have included sustainability as a precondition for all aspects. Such main stream approach has been criticized to be limited in some cases, like for example if we include themes such as: neighbourhoods (Frey & Yaneske, 2007; Zumelzu, 2015).

The second lens is mainly concerned about equity as a dominant aspect still with the emphasis on the three pillars of sustainability (Dawodu *et al*., 2016). The equitable development has mainly focused on the concept of equal life for all through economic development and social justice. It was more recognized in spite of the discussion of homogenous communities, living together, but the cultural aspect was barely mentioned on such a platform. In the recognition of the new strategy of sustainable neighbourhood development that the UN HABITAT (2015) has published, five principles were recognized to lead the forthcoming planning. The five principles are mainly targeted to tackle the efficiency of street networks, high density, mixed land-use, social mix and limited land use specialization per block. The third lens of sustainability can be reviewed to circulate around rationality and efficiency. Each of the principles has been defined by a range that should be adopted by each neighbourhood to establish a sustainable form. This hypothesis is set to predict if these principles are applied to adjust the urban system, social inclusion, economies of scale and vibrancy would be fostered in a harmonic sense. Nevertheless, the rigidity in some of the features; e.g. suggesting the grid block form with 9x9 km length; gets a number of neighbourhoods outside the sustainable scale. Cities like Venice,

Florence, and Valparaiso have proven their long history of effective neighbourhood life, which contradicts the new principles. On the other hand, the sustainability analysis of the neighbourhood are established through certain percentages which reflects that it can be a flexible matter. Despite the confusion, this can be a model for applying principles on the urban form and cannot be generalized as a sustainable neighbourhood, since sustainability also is context specific. However, it is worth mentioning that this was one of the pioneer definitions to courageously include the morphological modern models with sustainability.

Referring to the different lenses of sustainability, action plans have taken different approaches. As Zumelzu (2015) mentioned in framing the debate of sustainability, five main approaches can be summed up to show the transdisciplinary of such term. The first approach was adopted by Szerszynski and Urry (2010) introduced the scepticism, gradualism and catastrophism typology from migration to adaptation. This approach expects the environmental change as the leading pillar which would lead to normative change of economy and society. Accordingly, economic adjustments, individuals and societies should adapt with what they called the *catastrophism*. This approach can be related to urbanism; as explained by Zumelzu (2015); through translating the different approaches to adapt with the ecological enclaves that resulted from industrial cities. However, the problem that our cities are collapsing with the high fossil fuel and oil consumption which can be related as our current catastrophe (Frey H. , 1999; UN-HABITAT, 2009; Hodson & Marvin, 2010). This concept appears in the design concepts for a sustainable city, aiming to embrace nature as an integral part of the city construction through introducing landscape.

Whereas, the second approach was introduced by Middleton who classified of techniques, values and design solutions. It has mainly amplified the integration between engineering solutions, lifestyle approaches and creativity (Middleton, 2005). The complexity of this approach has to be recognized and cannot be simplified easily. Moreover, he classified the human activity into two main categories of natural science and science of artificial. The natural science can be explained as *the way things are*, and the other as *how things might be*. The latter approach, can be related to passive design techniques that is currently central in achieving sustainability (Zumelzu A. , 2015).

Meanwhile, the third approach is related to policy on both the global and national levels. Many strategies and policies have been made but little have been implemented and operated. In the last decade, policies had focused more on energy and applying technologies for energy reductions and water management. Through that, various programmes have appeared to serve this purpose; such as: LEED and BREEAM.

By comparison, the fourth approach is affiliated more to terms of fairness and efficiency. Sustainability concepts has revolved around fairness in the sense of the fair distribution of resources and access to basic needs and services, as well as participation. The efficiency is highly linked to reduction of energy consumption by buildings and means of transportation. This approach can easily affect urban structures and human behaviour through changing the mobility strategies and infrastructure as well as densities (Zumelzu, 2015; Madlener & Sunak, 2011).

Finally, the fifth approach is dominantly emphasised on mobility and compactness of urban form. Undoubtedly, various urban models have been introduced to direct urbanization towards a better development (Valderrama & Jorgensen, 2008). Furthermore, as favoured by Holden four models were described, namely urban sprawl, the green city, large compact city, and decentralized concentration (Holden, 2004). Another opinion was suggested by Jabreen (2006) who proposed the compact city, eco-city, urban containment, and neo-traditional development. As observed, the compact city is a repetitive term that has been caraterized to be a concept that achieves social and economic diversity and vitality (Jenks *et al.,* 1996; Jenks & Dempsey, 2005; Jenks & Jones, 2010). The hypothesis was made that compact cities reduce urban sprawl, protect agricutural land, in addition to maximizing effeciently the exisiting land use. UK and US initiatives have worked to advocate such higher densities with mixed-use in order to reduce travel distances and lead to social diversity and make it economically viable. Although there has been some criticisim concerining the effects of compactness which is not really the only factor that promotes social interaction. It can also lead to congestion and gentrification issues due to the high price of land. In fact, none of these models can be generalized as a perfect example for all cases as it has little emperical attention (Zumelzu A. , 2015; Jenks & Jones, 2010).

In summary, the application of the sustainability concept on urban form has been widely discussed during the last two decades, in which discussions have mainly focused on the

search for ideal urban models that contribute more than others to sustainability (Ehlers, 2011; Jabreen, 2006; Gringonis, 2013). These views suggest that sustainable urban form (SUF) should be compact from the centre to the edge (Breheny *et al.,* 1996; Burton, 2000, 2002). Other researchers suggest that the city should consist of decentralized compact settlements though connected, through a public transport network (Jenks & Dempsey, 2005; Neuman, 2005). More to mention that the theoritical and practical debate which has been so far confusing and still uncompleted, since researchers have only focused on a limited number of aspects (Jenks & Jones, 2010; Naess, 2014). The research indorses more the discussion to follow an empirical trajectory with the intention of interrelating the debate towards developing methods, tools and instruments to achieve optimal solutions (Kärrholm, 2011; Zumelzu *et al.,* 2015). More importantly is to highlight the study of the causes of the city problems before solving them and the development of methods and tools for practical application of sustainability (Doust, Toward a typology of sustainability for cities., 2014). Definetly the challenge in the urban design and planning is not in constructing new settlements and cities, but in the redesign of what has already evolved and calminated as a result from the last two decades (Frey, 1999; Barton *et al*., 2010; Talen, 2011). In this sense, design appreciation should push towards a possible way to generate more sustainable urban environment conditions (Zumelzu, 2016).

2.3.1 Scale as an important topic influencing urban form

In reference to understanding the city components, urban form can be considered as a number of different spatial scales (Jenks & Jones, 2010) . In theories, the issue of scale is, and has always been, one of the main debates of urban form (Zumelzu, 2015). In the topic of understanding human settlements of carbon cities, there is a range of ways to try to understand and measure them (Jenks & Jones, 2010; Kropf, 2009).

The city is a complex, multiscale and open system, which is composed of many components or entities that interact with each other (Batty M. , 2015; Buchanan, 2002). These interactions are non-linear, which literally means that everything can affect everything else, and either directly or indirectly. This is enriched by Salthe (1989) who has formulated the “hierarchical structuralism” based on the idea of things as wholes and parts. In other words, the shift to larger scales means that the relationships between scales need to be re-examined. In relating scales appears the basic principle of “hierarchical structure”:

a system has a hierarchical structure if at a given level of resolution is composed of interacting components “lower level entities” and is itself a component of a larger system “higher level entity” (Zumelzu, 2015).

With relation to complexity, it was observed from the repetitive records of Canniggia & Maffei (2001) about their definition of city scale through urban tissue. They generally identified scale of a city as “different levels of complexity of the components internally arranged for the construction of a whole”. Following the modularity concept, the city can be explained as units that are organised internally and connect to each other for complementing.

Further discussions show that scale is seen as level and size (Wilson, 2001; Zumelzu , 2012; Marston, Jones, & Woodward, 2005). For Howitt (2002), scale is not as size and level but a relational element in a complex mix that also includes space, place and environment. In other words, level and size are interacting facets or dimensions that constitute scale. Acoordingly, scale is produced by human interaction as both outcome and process of social relations occurring through space (Moore, 2008; Randles & Dicken, 2004; Howitt, 2002).

In this regard, Kärrholm (2011) addressed the scale concept as an analytical concept associated with different complexities of components which produce effects and considered that these effects can be seen as different scales. The analysis of scale has target recognition patterns at different spatial scales, where the scale of organization – from regional to local - of a city is a key factor in determining the sustainability of a community.

Applying the scale debate, the neighbourhood can be translated as a basic modular unit in the hierarchical structure of the city. However, its scale in relevance to other neighbourhoods is analysed through the two characters of level and size. Both of these criteria are detected through the morphological physical form as well as human interaction in space.

2.3.2 The city as a spatial modular structure

Urban form may be intuitively interpreted to the way in which the city is observed, i.e. its visual manifestation. The visual characterization of a city’s urban morphology was a

mainstream approach until the 1960s. Kevin Lynch (1981) was the first to anticipate urban morphology in its broader vision of human settlements' form as the spatial arrangement of three elements: persons doing things, the resulting spatial flows of people, goods and information, and the physical features in some way significant to those actions. Later, Batty & Longley (1994) pointed out that the form of an object is a diagram of forces. Hence, any meaningful city investigation must include form as well as the knowledge on the processes which initiated it (Rodríguez-Álvarez, 2014).

Urban morphology is a valuable tool to connect typical multi-disciplinary sustainable strategies to urban design and architecture. It allows us to plan, with 'authentic' awareness, interventions within the process of change. As explained earlier the common challenges of carbon cities, urban morphology could classify an interesting socio-building scale that can serve as the basic strategy for sustainable city planning in the twenty-first century (Maretto, 2014). Learning from Oliveira (2013), the research acknowledges the fact that urban form and structure of cities are usually influenced by social and economic drivers. The physical form reflects these drivers indirectly, however in a way it affects human behaviour and can make contemporary societies.

Through identifying the main elements of urban form, it would be clearer to visualize the city's urban morphology and assess its sustainability. The following section would lead the discussion towards urban morphological patterns of a city which is explained by identifying the modularity concept.

Complex systems – such as cities – are mainly made up of interconnected components interacting with each other. Attempts have been made from planners to understand how cities work, launching a shift in ideas from the late 1960s, followed by contributions of Alexander (1977) as well as Rossi (1984). One of the vital changes that was attempted is how to understand the city as a system. It was derived from the system theory that called it "system view". The idea was to break down the system into a set of inter-related components to form what is called a "complex unity" or a "Module" (Frey & Yaneske, 2007; Batty M. , 2005). Moreover, Batty (2005) explained that each module in the network structure consists of *nodes and links*. Additional nodes are always added to the system to give as a result an organized network structure. Consequently, simplifying the complex system with a comprehensive few interactions was termed by some researchers as

"Modularity" in which strong interactions between nodes form a module and few interactions with other nodes outside it (Zumelzu, 2015).

In this respect, Frey and Yaneske (2007) have claimed the failure of implementation of sustainability policies on cities due to the vagueness of a comprehensive view. In their book, through understanding the concept of complex systems via modular structures, a framework was established to guide a systematic assessment of cities' sustainability. As a basic description, a module is a subsystem of a larger one and has its own internal structure, e.g. nodes and links. Promoting this theoretical basis of breaking complex systems into modular subsystems was initially constructed because of three rational reasons. The first reason is that modularity can help the prevention of spreading effects through the whole system, due to its containment. The second reason is that the incremental change in each particular subsystem – modular units - can be independent and feasible. And the third reason is related to the success of modern science in breaking problems down to be able to deal with each one easily. The modularity is similar in that aspect to natural and human-made systems. It was also highlighted that the division of a complex issue should be subdivided properly from the beginning in order to find optimal solutions for each. In this regard, Frey and Yaneske (2007) have made a great contribution in subjects of urban form related to sustainability. They argued that city can be seen as a modular construction system, and this modularity is the basic hypothesis of their vision to bring sustainability to urban form.

The vision of modularity has been confirmed by a number of authors under the topic of "Retrofitting Suburbia" (Pfeiffer, 2014; Krier & Thadnai, 2009). One of the outstanding human scale proposals was done by Krier (1984) who condemned the failure of the modern movement to create spaces for people and the disastrous dependence on fossil fuel. He proposed the concept of "urban quarters" as the physical and cultural materialisation of the individual needs. An urban quarter is simply an expression of a collective community and personal interests. It has a spatial centre of a defined size that is composed of all of the urban activities, functions and uses, regular and irregular, public and private, whether commercial, industrial, residential, educational or recreational. It should integrate all of the daily functions of urban life within a walking distance. Each one is structured as a centre, periphery and boundary. Some authors agreed on the success of such a concept to promote mixed use developments, higher residential densities,

affordability, accessibility to services and public transport, and hence leading to a sustainable urban lifestyle (Winston, 2013; Karimi, 2013; Luederitz *et al.,* 2013). This may contradict the modern neoliberal idea of a city, based on separation of functions and car-dependant mobility system.

Relating to Frey and his co-workers' idea of modular system, the urban quarter is a modular unit in an urban district, representing the neighbourhood in which certain criteria need to be achieved for sustainability (Frey *et al.,* 2010). In this manner, the city can be seen as an active functioning entity with a system of modules summarized in its neighbourhoods. It also represents the micro-structure of the city where its component is inevitable.

Ever since city creation, neighbourhoods have been a fundamental element where urban form and social interactions define their territories. In one way or another, urban inhabitants have always lived in a neighbourhood where it represents the elementary link between the city and individuals (Hillier B. , 1996; Frey & Yaneske, 2007; Blanco J. , 2015). The conception of neighbourhoods was developed to be more than a physical determinism, however the definition of neighbourhood has a lot of meanings according to how people perceive their own space (Demiddel & Bustamante, Más que una suma de casas. La unidad vecinal Villa Pedro de Coronel , 2009). Most importantly, the association between spatial urbanisation processes with social organization identifies the neighbourhood as the basic sustainable unit of the city (Zumelzu, 2016; 2015). At different spatial scales, neighbourhoods can be identified as the basic units of sustainable urban form (SUF) in which socio-urbanistic concepts are tangible (Hillier B. , 1999; Maretto, 2014; Zumelzu, 2015).

As a reflection on the Chilean cities, a concept of neighbourhood units - what is called "Unidades Vecinales" - was an idea from the late 1940s that was promoted by the architect Paul Lester to expose it in the Chilean context. The application of the concept was excuted later in the South of the country on the existing neighbourhoods according to the socio-economic level. Nevertheless, it is important to mention that the current divisions of neighbourhoods has formed social organizations; e.g. Juntas Vecinos; that reinforces the ownership idea of a neighbourhood (Demiddel & Bustamante, 2009).

2.4 Dimensions of Sustainable Urban Form

Several researchers have started in the early 1980s with the urban morphological concepts and methods. Hillier and Hanson (1984) introduced the initial methodology of space syntax which assessed one element of urban form that is the street system. This was based on one criterion assessment of accessibility. Over the past three decades space syntax research has developed mathematical urban models to help assess patterns of land use and economic viability in relation to urban form (Hillier B. , 1996). At the same time, Kropf (1996) expanded the application to include the plot systems into the assessment to be called place syntax (Ståhle *et al*., 2006; Oliveira, 2013). Kropf set the elements of urban form as: streets and blocks, plot series, plots, buildings, rooms and spaces, and more detailed to include walls and roof structures. Later, Scheer (2001) defined the human built dimensions as elements of "static tissue" of urbanism which includes: streets, lots, and blocks. This classification was also adopted by Talen (2011) to support her research assessing the sustainability of urban form, claiming that they can easily relate to different planning topics in that way.

Space is a more difficult topic relatively in comparison to physical form. Two reasons were explained by Hillier (2007) to examine this difficulty. First, space is void rather than solid, and hence even its bodily nature is not obvious and cannot be visualized or granted. Second, related spaces cannot be seen all at once, but require movement from one point to another to experience the whole. The emphasis of this research is to consider space as an independent entity rather than simply as a by-product of, say, the arrangement of physical things.

To begin with, the future city - that a number of organizations has put into account to achieve certain sustainability standards - is definitely the existing city but transformed in another direction than the current development. Therefore as questioned by Zumelzu (2015), there are certain urban forms that have contributed more than others in the path of sustainability. In the literature, city models and concepts had followed the design suggestions of a utopian city. Despite the variety of city typical models that have been spread in the last three decade, it was hard proven that cities have followed a certain specific model. In order not just to criticize models, they can guide the urban practice towards better sustainability (Breheny *et al*., 1996; Williams *et al.,* 1996; Holden, 2004;

Neuman, 2005; Jabreen, 2006; Kenworthy, 2006). Contrariwise, the power of design lies in the appreciation for a possible way to generate more sustainable urban environmental conditions, if research would take a turn in the development of methods, instruments and tools for practical application of sustainability (Kärrholm, 2011; Leon, 2013; Doust, 2014; Zumelzu *et al.,* 2015). As a way forward towards new methodologies, setting SUF as an operational concept can be seen as an attractive one from the perspective of assessing the current trajectories in order to re-design existing neighbourhoods and thereby picked up as a key focus of this research (Frey, 1999; UN-HABITAT, 2009; Barton *et al*., 2010; Talen, 2011; Zumelzu & Doevendans, 2015). Zumelzu (2015) also suggested the following in relating the latter theoretical review with the following discussion:

"The discussions on sustainable urban form need to follow a more heuristic trajectory, addressing methods rather than producing one-rule models, one-liners or optimal solutions. The ability to change scales lies at the heart of the design process, as well as of the ways in which we are related to our surroundings in our everyday lives. Therefore, the vision of the city as a modular construct represents an important tool, as a point of departure, to follow this trajectory." – (Zumelzu A. , 2015)

In line with this discussion, the research will confirm – as will be seen further – that tools and methods for assessing our built-up environment as well as its influence is a challenge, however but possible. The field is not a mainstream, until now a number of practices had been founded to take into consideration and to build upon them.

Sustainability concept has appeared recently on the urban platform borrowing models from different disciplines (Hillier B. , 1996). A number of authors had shown their concern about transforming unsustainable forms, e.g. suburbias, however few of them took the lead in quantifying sustainability in the context of urban morphological form - such as Frey (1999), Batty (2005), Hillier (2007), and Talen (2011). Their main challenge was to relate modular units – in this case is the neighbourhoods - with criteria of sustainability (Zumelzu, 2016).

Frey & Yaneske (2007) developed a framework to guide and direct sustainability assessment in cities, through establishing criteria to guide the sustainable development of urban areas that can be adjustable for all types of conditions and preferences. The criteria are classified to tackle the morphological, social and economic viability of urban areas

(Frey & Bagaeen, 2010). Although these criteria have been successfully applied in cities - such as Glasgow, Freiburg, Eindhoven and Amstelveen - for regeneration programs of urban areas, the application of the criteria has demonstrated the importance of the concept of sustainability as a practical tool to integrate economic, environmental, social and morphological issues to address urban problems (Frey H. , 1999; Doevendans *et al.,* 2014; Zumelzu , 2014; 2015). It was mentioned the concern of its application in developing countries, due to the lack of clarity regarding database of the scale (Zumelzu & Doevendans, 2016). On the other hand, Talen (2011) identified the SUF as an analytical approach with a set up dimensions in order to evaluate the strengths and weakness in places in relative terms. The method was applied in a number of case studies, arguing that planners can help prioritize retrofitting strategies based on a better, more contextualized understanding of SUF and its dimensions.

As mentioned earlier the elements of urban form could be summarized in its size, shape and type. Talen (2011) started her argument that the definition of SUF has drifted among authors – including Frey (1999), Jenks & Dempsey (2005), and Jabreen (2006) - from one side to another in the last two decades. It was termed also in the literature as “sustainable urban neighbourhoods” or “sustainable urbanism”. There were some common features between authors such as: walkable and connected streets, compact building forms, well-designed public spaces, diverse uses, mixed housing types. She had also highlighted that these features were borrowed from the old concepts of a city before the current generation cities that promote segregation, superblocks, malls and car-dependent suburbs.

The dimensions of SUF are based on the sustainable qualities of built-up environment, rather than the definition of sustainability. The five dimensions, *viz.* accessibility, connectivity, density, diversity and nodality were set by Talen (2011) as a compilation of concepts of different researchers dated back to the 1960s. Each of these dimensions was defined in detail and was empirically tested in different case studies. Briefly, accessibility as the first dimension relates to the access of neighbourhoods’ residents to their work places and services (Dittmar & Ohland, 2003). It mainly promotes walkability as a main factor for the sustainability equation. The second dimension is seen to be connectivity in which its main objective is to maximize gridded street networks, short blocks, and provide well connected facilities as shared spaces. Connectivity considers maximizing opportunities for social interaction through increasing number of routes within an area.

Density is the third essential dimension in assessing SUF, apart from the critics of its exact relationship with sustainability. Authors have confirmed on the benefits of density for diverse quality of life, security and vibrancy (Jacobs, 1961; Kunstler, 1994; Newman & Kenworthy, 2006). The fourth dimension is land-use diversity which provides an economic vitality, social exchange and diverse services. More concepts are merged with diversity such as mixed income, races, ethnicities which would lead to sustainable communities (CNU, 2000; Talen, 2008). Noteworthy to mention, it promotes the active land-uses that complements each other. Lastly, the fifth dimension is nodality – termed in other literature as polycentric or multinucleated urbanism. Relating to the scale debate, nodes are considered as areas where urban development should be organized. Nodes support SUF by providing public spaces as a hub for social interaction and hence, buildings are organised around it.

From defining the dimensions of SUF, it can be summarized that all the five of them revolve around the same principles and are directed towards more social interaction in the neighbourhood. Building upon this concept, Hillier (2007) confirms that public spaces are centres for social interaction. Through tackling the morphological form of human activities and interaction, public spaces in neighbouhoods were chosen as an interesting subject to assess.

2.4.1 Nodality as a concept for sustainable urban form

The more successful a city generates diversity and vitality in its neighbourhoods, the better buildings success of deserted places (Jacobs, 1961). One of the pioneers to mention the importance of vital urban areas creating vibrant communities was Jacobs (1961), criticizing the massive modern urbanisation processes in American cities at her time. She referred to the definition of vitality in neighbourhoods as places where people can easily interact with one another and benefit from social networks. Human interaction in public spaces was an agent for safety, and promotes a variety of social stability and economic vitality. Although it was pointed out that all of the Jacob's view at that time, including her opponents, was applied but never tested empirically (Bosselmann, 2008).

Also, the work of Gehl (1987) and his team in improving the quality of outdoor space has provided a wider evidence that urban spaces can be converted to places full of vitality

(Bosselmann, 2008). He proved through the observation of a number of public areas in different cities that human gatherings are attracted in the presence of others. His argument was built on the anthropologic concept of "Proxemic Theory" that explains human interaction in space in cultural contexts. The empirical evidence has proven the same in Northern and Southern European cities that people attract others. He sorted outdoor activities in three main categories of necessary, social and optimal activities which inter-relate and sometimes are dependent on each other promoting vitality.

Vibrancy of public spaces was also a mandate of H. Whyte (1988) who made direct observations on public plazas that were deserted in a number of American cities, e.g. Manhattan, New York. He conducted a series of direct observations in combination with time-lapse photographs and interviews. His recommendation was outlined in detailed guidelines about built-up form of outdoor spaces concerning comfort, accessibility and orientation of seating.

Other researchers - Mozingo and his co-workers (1995) – assessed the difference in people's frequency in public areas of San Francisco. The two comparative cases were chosen to be a street corner plaza and a larger park within a short distance. Their findings explained three reasons of why people would prefer to crowd the plaza rather than sit in the park. It was remarkable to mention the first reason considering design, location that can help people leave the place. The other reason ascertained Gehl's findings that people come to watch others and therefore, in case of nobody existing in space, people would be hesitant to spend time there. The third reason belonged to people's perception about parks where it represents a place only for recreational activities such as reading, talking, and sports.

Four decades after Jacob's critics about the 1960s urbanism, her concepts about vitality in relation with the urban form were taken to be experimented through observation and surveys by Katoh and his co-workers (2003) in San Franciscan streets. The selected streets were chosen based on the socio-economic income. Of interest is to highlight about their findings that people's income had an effect on the degree and nature of activities along local streets. Middle- and high- income individuals are more frequent on public areas than others. If high-quality of public spaces exists, middle- and –high income people

socialise in public streets. In difference with the case of low-income groups, residents do not have the time and means to participate in street life.

All these concepts of interrelating the vital sense of morphological forms, have risen out of the apparent social and urban changes caused by Modern and Post-modern eras. Few architects and urban planners had been trying to heal the wounds of sprawl on landscape with more communal and environmental concern. Ellin (2006) claimed that this revolutionary react has remained unsounded despite its numerous initiatives around the world, since practitioners are not united under the same school or umbrella of relating design to sensitivity of society and environment.

Through investigations, common topics have often related to vitality of neighbourhoods such as density, diversity, and mixed used as terms to affect human preferences in public spaces. Researchers had observed each factor in relation to the intensity of human activities in order to draw out recommendation. From this view, Hillier (2007) confronted that space is consistent of two main elements: form and society. Therefore, the constant decrease of the social element opposes the concept of vitality of neighbourhood which is under a persistent threat.

2.5 Applying Nodality on Neighbourhoods of Transformation

Relating to what authors had mentioned about the vibrant neighbourhoods, it was noted that public areas were the main and common term to revolve around. Gehl (2010) highlighted that the traditional function of city spaces are seen as meeting places and social forums. Therefore, public spaces are an expressive notion of human perception about their communities.

Through relating to the five dimensions of SUF from Talen (2011), places that have the potential to catalyse sustainable urbanism are called “nodes” that can be assessed on the basis of how they score on different dimensions of urban form in a relative way. In addition, nodality is one of the dimensions that associates both concepts of urban form and space that was mentioned earlier. Nodes afford a physical articulation of the community, by providing a common destination for residents of the surrounding area. Such spaces support other aspects of sustainable urbanism, such as increased density in the

surroundings, mixed types of housing anchored by a space centralized, or the viability of commerce at the neighbourhood scale (Ellin, 2006; Frey, 2010; Talen, 2011). This endorses the idea of polycentric or multi-nuclei city that can be organized around different nodes of levels and sizes (Frey H. , 1999; Wilson, 2001; Batty M. , 2005; Kärrholm, 2011).

Nodality is defined as the centres of human interaction in public areas which vary in their capacities. Nodes promote SUF through providing public spaces where all the retails, local services and social interaction occur (Talen, 2011). The definition has taken a long drift in its terms through literature, despite its short age. This criterion is associated with what could be called urban planners as "polycentric" city or "Multi-nuclei" notion that urban development must be organized around different node levels and sizes (Frey H. , 1999; Wilson, 2001; Batty M. , 2005; Kärrholm, 2011).

Another related concept to nodality was touched – however different - in literature is the *phenomena of centrality*. It has been initially defined as the concentration and mixture of land uses and activity in a determined locality (Hillier B. , Centrality as a process: accounting for attraction inequalities in deformed grids, 1999). It also refers to the capacity of certain spaces or urban elements to articulate flows of every type. The degree of centrality of a space is variable according to its capacity of attraction and articulation of flows (Zumelzu *et al.,* 2014). One of the most important aspects on centrality – which can be referenced to nodality - is the collective significance of space that is highlighted by both human activities as well as urban form. This was also demonstrated by centrality as an opportunity to produce certain activity or community interactions that facilitate casual meetings in public areas (Barton, 2000). As a conclusion from the centrality concept is that all centralities are considered as nodes, however not all nodes are considered as centralities, i.e. live centres.

CHAPTER 2

RESEARCH METHODOLOGY

3.1 Introduction

The study intends to strengthen the physical-social relation of the city through setting a framework for a better sustainable planning (Zumelzu, 2015). In order to achieve the objectives, a new methodology is created from investigating the previous practitioners and researchers – mentioned below - who produced a set of methods and tools to examine urban morphological form that influence human activities in space. The methodology was adapted to the context of Latin American cities and is validated through a case study as an example of method operation.

The methodology of research follows a qualitative empirical case study following Yin (1994) and updated by Tellis (1997). Initially, the methodology utilizes Talen's (2011) approach for assessing the sustainability of urban form to assist decision makers (Zumelzu *et al*., 2015) for re-scaling and re-designing cities (Frey & Yaneske, 2007; Bosselmann, 2008; Talen, 2011; Hillier, 2007; Kropf, 2009) in Latin America. The research mainly aims to restructure the spatial organisation through understanding residents' perception about space in order to compulse a new urban unit to put in value to the sustainability of neighbourhoods. The research is challenged to explore new tools and adapt methods in order to quantify urban sustainability for neighbourhoods in intermediate-sized Latin American cities (Leon, 2013). The strategy could be achieved by using multiple sources of data following sequentially several approaches to increase the confidence of interpretation (Denzin, 1984; Yin, 1984; Tellis, 1997). Therefore, the case study strategy

is categorized under the methodological triangulated research to insure validity and accuracy of data, protocols used to ensure their accuracy (Tellis, 1997).

Furthermore, the study is supported by Flyvbjerg (2006) who explained the “five misunderstandings about case-study research”. The empirical fieldwork approach demonstrated the applicability of analytical methods and to build conclusions based upon real-practical situation. Therefore, the pragmatic approach took place in Osorno city. As explained in Chapter 1, unit of analysis is selected to be the neighbourhood of Rahue Bajo, representing a basic modular unit of the city (Hillier, 1999; Dur *et al.,* 2014; Maretto, 2014; Zumelzu , 2015).

The case study was chosen under specified criteria. The first criterion is its location in Southern Chilean cities of intermediate range, since little have been carried out in the field of urban morphology in relation to human activities (MINVU, 2006; Zumelzu, 2016). The second criterion is that the city presented areas in constant transformation process and spatial expansion. The third criterion is that the case study should have initial characteristics of urban dimensions that promote sustainability (Zumelzu, 2016). The selection is based on the fact that the neighbourhood had suffered from major transformation and evolution of its urban form where aspects of diversity and nodality could be identified.

From the above, the illustration in Figure (3-1) was designed to represent a triangular model to operate the concepts on the case study research. The triangular form demonstrates the three phases of the study: Remap, Re-scale and Re-organise, respectively. These phases are arranged in an assembled order, since the results of each phase depends on the succeeding one. In the following text, each phase is explained in details to present the methods compiled and the materials used.

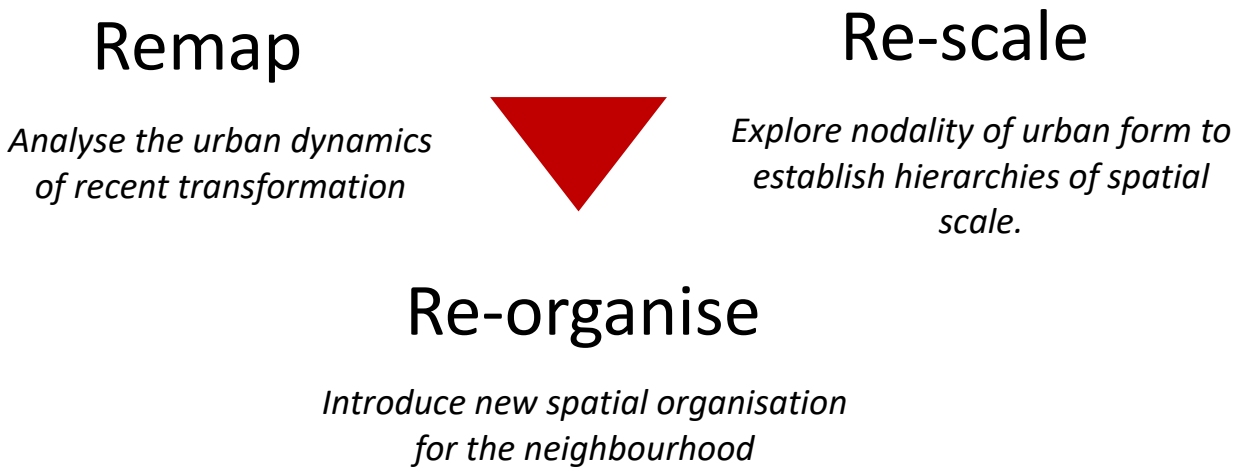


Figure 3-1: Methodology design model structured; Author's construction, 2017.

3.2 Analysing the Urban Dynamics of Recent Transformation

The first phase is an application of a set of designed tools to "remap" the spatial organisation of the neighbourhood. The general idea of this phase follows the concept of vitality of space that is promoted by urban form (Jacobs 1961; Gehl; 1987; Whyte, 1988; Hillier, 2007; Frey 2007; Bosselmann, 2008; Talen, 2011; Rodríguez-Álvarez, 2014). The aim is to analyse the urban dynamics of the recent transformation and identify potential nodes that could promote human activities. Regarding the transformation, historical maps were tracked down from the available resources to be compiled in timeline representing a series of city development. Since the present secondary data was insufficient to build upon, the method was created to adapt tools for the new set of data that was required. Subsequently, a preliminary urban morphological analysis of the neighbourhood was conducted adapting the framework of physical elements that influence sustainability as suggested by Dempsey and his co-workers (2010). They mentioned that elements are briefly identified as layout, density, building type, and land-use (Dempsey *et al.,* 2010). As

shown in Table (3-1), urban morphological analysis was organised as a selection of different tools from various researchers – explained below in detail. In Chapter 3, the components of the urban morphological analysis are firstly analysed and then cross-linked together in a spatial map of potential nodes in RB to form seven potential areas to study in detail. Based on this, the seven selected nodes are filtered in a matrix to compare them together, using the criteria of land-use, density, typological identity, physical identity, and building alignment. As a result of this phase, four nodes are selected to proceed with the following Re-scale analysis.

3.2.1 Urban morphology analysis

The urban morphology analysis is to understand the process of transformation of the recent occupation. It consists of an integration of methods that will be explained below.

Block system

Beginning with the urban grain analysis, the research applied Kropf's (2013) method to the block system analysis. During his comparative research of collective case studies, he demonstrated the necessity for identifying the hierarchical relationship between buildings, plots and streets in order to reveal the ambiguity of urban tissues. Blocks are a fundamental element of the city structure. Despite their central importance, remarkably knowledge about their properties and performance has little to say in this field (Sikna, 1997; Oliveira, 2013). In the literature, smaller blocks have a preference among researchers, since they provide a greater range of social interaction than larger blocks. The production of a fine-mesh circulation pattern gives a coherent urban fabric(Jacobs, 1961; Maitland, 1984; Siksna, 1997; Hillier, 1999; Oliveira, 2013). The range of small and large blocks was explored by Siksna (1997) where block dimensions indicates an optimal performance of circulation patterns of block and hence the urban fabric. Throughout his research of tracking the original layout of twelve North American and Australian city centres, optimum block performance was presented by size, form, layout, and circulation pattern and mesh. Moreover, layouts of rectangular blocks were found out to optimize development land, although square blocks were to maximize circulation space. From the

above, the following criteria for asssessing dimensions were taken into consideration for assessing the block system.

Morphological Analysis	Objectives	Categories	Outcome
Layout (Urban grain)	Identify hierarchical relationships between buildings, plots and streets	-Block system -Block Pattern -Alignment of building -Ratio of building height to street	Prototype of block and plot form Urban mesh Percentage Urban grain map Original form of blocks and plots
Land-use	Identify detailed Land-use	-Mixed use - (Commercial + Residential) -Residential -Educational -Religious -Commercial -Administrative -Sports facilities -Industries -Civil facilities (Police, ambulance, etc). -Open space -Roads	Map of land-uses Matrix of their areas
Typology	Identify the type of buildings	Detached house Semi-detached house Terrace house Building mass	Map of typology Matrix of prototypes
Density	Identify potential densities that promote social activities	One floor Two floors Three floors More than 3 floors	Map of densities Matrix of their areas

Table 3-1: Urban Morphological Analysis Model for Remap phase, Author's construction (2017) based on the urban morphological elements of Dempsey and his co-workers (2010)

Block Pattern

Siksna (1996) made a study about the effects of block size and form comparing twelve North American and Australian cities. Her tool offered a comparative study of block system as well as patterns. The analysis of block pattern presented mesh network structure based on the block system that had already examined before. The research adapted the tool to assess the block pattern of RB.

A standard was set for comparison from literature regarding the circulation pattern and mesh. Street spacing with 80 -110 m were concluded to offer a convenient mesh for both pedestrian and vehicle movement. For intense pedestrian activity - particularly in retials core blocks – finer mesh of 50 -70 m were found out to be appropriate for pedestrian network. Refrencing to Siksna's findings (1996), plot patterns with 15-20 m wide and 30-40 m deep constituted a fine modular structure for city center developments.

Building Alignment

Oliveira (2013) also proposed a methodology for assessing urban form through seven assessment criteria based on space syntax methodology as well as others. The methodology was named as *"morpho"*, characterizing the seven criteria which are: accessibility of street system, accessibility of plots, age of buildings, dimensions of street blocks and plot series, alignment of buildings, ratio of building height to street width, and building use. All these dimensions were mainly assessing three main elements of streets, plots and buildings, as well as concerning their relationships to each other. Along the research analysis of "Remap" and "Re-scale", five of these criteria followed his method and were reviewed by other author's to relate assessing urban morphology to nodality.

Regarding building alignment, the morpho method demonstrated that it has not been predominant in planning studies, despite its influence on the built-up environment (Oliveira, Morpho: a methodology for assessing urban form, 2013). For each side of the street under analysis, building alignment was identified according to the street dominance. Then, the number of buildings in the street that have a dominant alignment is expressed as a percentage of all buildings.

Ratio of building height to street

According to the morph analysis, the street width was divided by the building height instead of the opposite that was commonly used. This was to give a scale from zero to give a sense of enclosure.

Land-use

Buildings and land-use have been greatly utilized in the planning literature and practice to the extend that it was sometimes misused accordingly (Oliveira, Morpho: a methodology for assessing urban form, 2013). The analysis of land-use adopted the categorization of Doevendans & Zumelzu (2016) for assessing sustainable neighbourhoods. They stated that the preference of mixed-use spatial to establish values of 40% of land for non-residential uses (including workplaces, shops, recreational areas, open areas, parks…etc.), and values of 60% for housing land. The required local amenities in a neighbourhood are local shops/mini-market, bank auto-teller, post office counter, primary school, police station, community facilities, access to open green spaces, surgery, catering, workplaces, and other facilities at city level (Doevendans & Zumelzu, Urbanism and the post-carbon city: Framing Planning and Design as Spatial Technology for a Sustainable approach, 2016).

Typology

The typology is also known by “age of buildings”. It is worth mentioning that construction of buildings has been long associated with the typological process and was clarified that the contribution of *time* in the process of the city is an important aspect (Muratori, 1959; Caniggia & Maffei, 1979; Oliveira, 2013). In that sense, buildings could be classified according to their typological features that can demonstrate its construction period. The research adopted the method from the “morpho” –explained earlier.

Density

Density is definitely a complicated concept with a number of inter-related dimensions (Dempsey, *et al.*, 2010). The density was analysed according to the number of floors in order to interpret results with building use and reflect on the horizontal or vertical mixed-use.

3.2.2 Data collection

To start with the pragmatic analysis, desk review is necessary to contextualize the case study of Rahue Bajo according to Osorno, e.g. historical maps, current maps, and pictures. It also categorized the urban occupation of the neighbourhood in respect of land use, typologies, socio-economic profiles, densities per hectare, and distribution of services. The collection of data and analysis are configured firstly from secondary data sources of systematized GIS and AutoCAD files, official databases, documents and cartographic review. Following the desk review to update the current plans, a field work was necessary for re-checking the required data through primary resources - e.g. detailed land-use, typology, and density- in addition to conducting an interview with the municipality. The output of this phase is realized in an analytical framework from the literature review as well as cartographic maps in order to explore the morphological change of the neighbourhood.

3.3 Exploring Nodality of Urban Form to Establish Hierarchies of Spatial Scale

Re-scaling is the foundation of re-planning and re-design process, which meets the requirements of sustainability (Besteliu & Doevendans, 2000; Doevendans & Zumelzu, Urbanism and the post-carbon city: Framing Planning and Design as Spatial Technology for a Sustainable approach, 2016). The second phase of the research is dedicated to explore nodality of the built-up environment for establishing new hierarchies of spatial scale in RB neighbourhood (Zumelzu, 2016). Following the re-scale phase, the four selected nodes were analysed according to their morphological features as well as the existing human interaction in space. The results of this phase were presented in Chapter 4 where nodailty of space in RB was characterized by defining its scale through three factors: size, level and type. Each contributes in the identification of hierarchical level of public areas and hence, reflecting together on the scale debate. In respect to previous results, the four selected nodes were compared among themselves in order to define their hierarchical order of space. In Figure (3-2), a model is organised to present the steps taken for this phase. It describes the factors, aims and methods mandated to support assessing nodes in RB. At the end, the methods are cross-linked together through creating a matrix to compile size, level and type in order to help the following “Re-organise” phase to interpret results. So as to illustrate more, the model is explained in details in the following text to present each method plan for this.

3.3.1 Size

Defining the size of nodes was based on desk review of their urban form dimensions and their physical morphological conditions influencing public activity. The main aim of the method is to demonstrate how urban form can influence people’s movement in space. It highlights the ability of urban spaces to attract people in the neighbourhood through walkability options. The results also help in contrasting the concept of influence of urban form through size with the real influence of spaces according to people’s movement. The method was adopted from the previously mentioned methodology of *morpho* analysis from Oliveira’s (2013), assessing block street frontages. Assessment of block size entails the division of blocks into groups, defined by the influence of each node. The method is applied

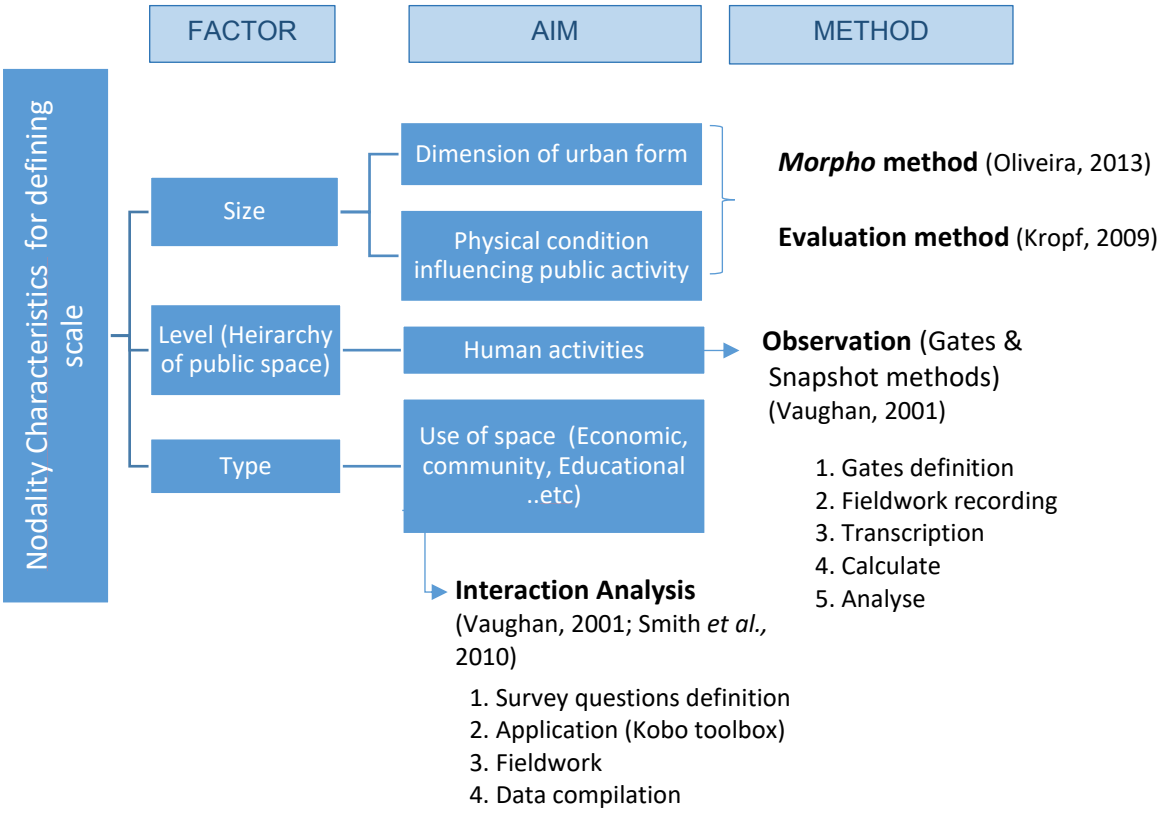


Figure 3-2: Re-scale description model for characterizing nodality; Author's construction, 2017

through a qualitative selection of blocks, by selecting the expected influence of nodes according to their mixed use and tyopolgical features. The blocks that lie in the area of influence were assessed according to their dimensions where maximum and minimum values were observed to calculate the mean dimension of each one, as well as the length gap. As a result, street frontages were categorized in six categories, ranging from a high degree of walkability to a low degree of walkability. The method used Siskna's (1997) range of optimal to inconvenience of pedestrian movement as an assessment for secondary data sources to analyse urban blocks and calculate the maximum and minimum length.

3.3.2 Level

The level of nodes were defined through observing human activities in public areas. Since human activities can be classified in static and dynamic state, Space Syntax is a methodology that could provide a certain method for each state of human activity.

Referring to the Space Syntax observation manual that was initially written by Grajewski (1992) and updated by Vaughan (2001), three methods were adopted to assess the level of nodality in RB. First, Gates method was chosen as a pragmatic manifestation of the dynamic movement through recording observation of pedestrians and vehicles in a certain period of time. The method is specifically applied through choosing a number of street locations that cover the range of well-used, moderately and poorly-used spaces (Vaughan L. , 2001). The second method is called static Snapshots (SS) which is relevant to recording stationary activities in public areas. It is a recommended method for direct comparisons between different nodes of spaces. SS(s) are only presented at crucial time periods that represent the high use of areas. Moreover, the third method adopted was the method of Smith and his co-workers (2010) which is known as the travel origin survey. This method detects relatively stable activities in space and tends to involve activity users in action through responding to a questionnaire about their frequency and duration of using space. The following paragraphs illustrate in detail each method and stress on its applicability in RB neighbourhood.

Gates method

Initially, the Gates method was set up to divide the neighbourhood of RB into four main quarters, representing a wider range of the selected nodes - Please refer to Appendix (B). Each quarter was surveyed to record a number of 20 gates in order to serve a total of 80 gates in the neighbourhood. These gates were chosen according to the area of each node is expected to record optimal, medium and minimal movements. Following the methodology, an imaginary line was drawn crossing the street space as a “gate”. Pedestrians and Vehicles passing through the imaginary line were counted (Vaughan, 2001). This act was repetitive every one hour along the day (11 hours), through a scheduled time slot for each gate. In summary, the total gates were spatially selected in a range of 19 streets in the neighbourhood for recording in three scheduled days. Days of the week selected were Tuesday, Wednesday and Saturday, signifying common working days patterns in comparison to a weekend pattern. The two weekdays were calculated in an average of pedestrian and vehicle patterns per day. Similarly, the weekend was also calculated in the same hours in order to contrast it with the weekdays to see the change of movement pattern.

Four observer participants were assigned per quarter to stand at each gate position and record two and half minutes in eight rounds across the day. Figure (3-4) shows the schedule planned for fieldwork, illustrating a number of eight rounds of recording videos for the selected gates through the day. The rounds were planned to fill five time slots of the day – illustrated in Figure (3-3) - representing early morning, late morning, noon, afternoon, and evening. On field work, a video was recorded at cross-roads which amplifies the view to tape four gates at a time. The four gates were summarized in the schedule to be called a Portal, i.e. a total number of 16 portals were recorded in the neighbourhood at the same minute. Additionally, a difference of ten minutes were considered to move between the portals. Later, each gate was transcribed separately to calculate the number of people passing and categorizing them by type and direction - Please refer to Appendix (B). Concluding from the above, the four observer participants were requested to record and transcribe in parallel 36 videos per day. Along the three days fieldwork, the data were merged and analysed to calculate the average pedestrian and vehicle movement per weekday and on a weekend.

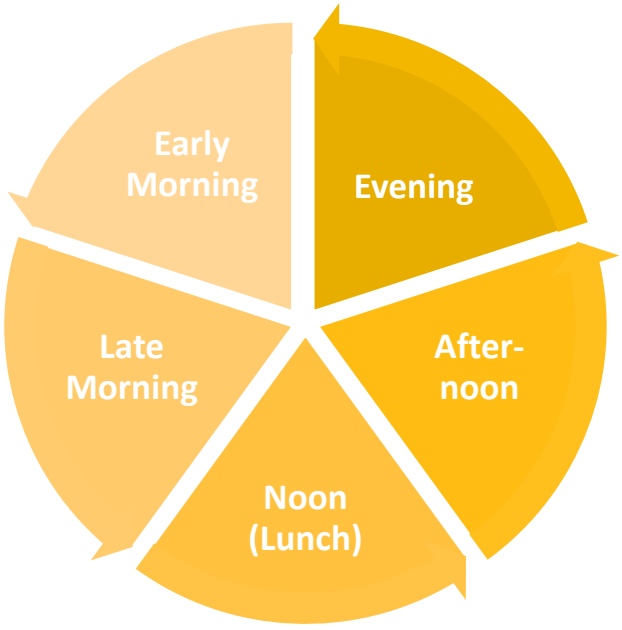


Figure 3-3: Street Liveability hours. Five timeslots scheduled to be covered along the day; Author's construction (2017) based on Vaughan (2001) methodology.

	7:40		PORTAL 1
	7:50		PORTAL 2
	8:00		PORTAL 3
	8:10		PORTAL 4
	8:20	ROUND 1	PORTAL 5
	8:30		PORTAL 5
	8:40		PORTAL 4
	8:50		PORTAL 3
	9:00		PORTAL 2
	9:10	ROUND 2	PORTAL 1
	9:20		
Mañana	9:30		
temprana -	9:40		
Early	9:50	Survey +	
Morning	10:00	snapshot	
	10:10		PORTAL 1
	10:20		PORTAL 2
	10:30		PORTAL 3
	10:40		PORTAL 4
	10:50	ROUND 3	PORTAL 5
	11:00		PORTAL 5
	11:10		PORTAL 4
	11:20		PORTAL 3
	11:30		PORTAL 2
	11:40	ROUND 4	PORTAL 1
	11:50		
	12:00		
	12:10		
	12:20	Survey +	
Media	12:30	snapshot	
mañana -	12:40		
Late	12:50		
morning	13:00	BREAK	
	13:10		
	13:20		
	13:30		
	13:40		PORTAL 1
	13:50		PORTAL 2
	14:00		PORTAL 3
	14:10		PORTAL 4
	14:20	ROUND 5	PORTAL 5
	14:30		
Almuerzo -	14:40		
Noon	14:50	Survey +	
(Lunch time)	15:00	snapshot	
	15:10		PORTAL 5
	15:20		PORTAL 4
	15:30		PORTAL 3
	15:40		PORTAL 2
	15:50	ROUND 6	PORTAL 1
	16:00		PORTAL 1
	16:10		PORTAL 2
	16:20		PORTAL 3
	16:30		PORTAL 4
	16:40	ROUND 7	PORTAL 5
	16:50		
	17:00		
	17:10		
	17:20	Survey +	
	17:30	snapshot	
	17:40		
Media tarde	17:50		
- **Afternoon**	18:00	BREAK	
	18:10		
	18:20	Survey +	
	18:30	snapshot	
	18:40		PORTAL 5
	18:50		PORTAL 4
	19:00		PORTAL 3
	19:10		PORTAL 2
	19:20	ROUND 8	PORTAL 1
	19:30		
	19:40		
Tarde noche	19:50	Survey +	
- **Night**	20:00	snapshot	

Figure 3-4: Time schedule for fieldwork to cover a full-day record in Rahue Bajo; Author's construction (2017) based on teamwork decisions.

SnapShot method

The benefit of SS(s) is to observe and analyse the static social interaction in a convex space. In addition, it can easily reflect the human activities through quick observation and documentation in a repetitive technique using space syntax technique (Vaughan, 2001). The method here was mainly valid as part of analysing the level of nodes as shown before in Figure (3-2). Making reference to each node, a minimum of one SS was chosen to be observed in specific timings as shown in Figure (3-4). The application of the SS method was applied on RB through identifying certain criteria for choosing the selected areas to be observed. More SS(s) were selected according to the area's potential and the node extension that was previously identified. Potential public areas within each node were identified to represent spaces with people's interaction and more diverse activities. The idea was to contrast already designed public areas with cross-roads that were expected to attract people. The potential cross-roads were chosen according to the nodes identified earlier.

Alluding to application of SS method, each quarter was selected to have at least one SS, however some nodes had a number of three SS(s) and others had two SS(s). Data collection was made as a team work collaboration, since nodes had to be observed within the same time slots. Observer participants on the ground had to document through drawing the allocation of people and their actions by eye glimpse (Vaughan, 2001). Detailed plans of urban form were prepared pre-fieldwork for each SS to provide an imaginary setting for public space. Each observer participant was provided with a set of 12 copies of the node plan with a unitary legend to standardise observations in the whole neighbourhood.

All four observer participants had to be in place at the same scheduled timing as shown in Figure (3-4). Likewise, the same strategy of Gates method was followed to capture space within fixed and specified timings. Six time-slots were scheduled to observe space throughout the day. One more option that was given to observer participants was to write their short-written comments and observations to describe condition of space in each time-slot of the SS, e.g. foggy weather, morning rush dark hour, crowded lunch hour, sunset, the dead hour of space… etc. This could help the analysis to clarify the absence and presence of people in relation with time and weather conditions. All the SS(s) were recorded in Appendix (C) for further information.

Travel - origin survey method

The aim of the survey is to explore the level and type of node attraction. The tool is regarded as a simple random sampling following Yin's (2009) design instructions for surveys. Here, the sampling process selected for the research universe was the city inhabitants and the unit of analysis was the space users. The sample surveys were designed in a way that they must be able to identify the user-origin and what do they perceive in spaces of RB- please refer to Appendix (D). A sample of 60 surveys per node was targeted to represent a reliable source of information to analyse, in order to observe a responders pattern. Raw data of excel sheets were collected from all questions. As a second step, data were organised according to similar patterns in each category for each node. Percentage of each value was calculated to be able to compare all nodes. The outcome of the survey was amplified on illustrated comparative graphs and two maps representing the level of nodal activities based on responders' residents and the type of nodes as will be explained below.

Each survey was designed of seven closed-ended questions, corresponding to seven demanded criteria for the analysis. Each question had a set of a minimum three categories to choose among. These categories were chosen according to the necessity of the researcher to respond to the demanded criteria. The validated categories were cross-linked with the Municipality's plan to understand the terms of neighbourhoods' distribution of Osorno (IMO & SECPLAN, 2013).

Based on the rational order of criteria chosen, the seven questions were declared to ask people who were attendants on the earlier specified nodes to define their gender, age group, activity, intensity, frequency, mode of transport, and living place. Also, Table (33-2) illuminates the method through which the sample test was built, clarifying the criteria, questionnaires, categories specified and the serving targets that were conducted in the field.

The survey format was designed to occupy two minutes each, including the introduction to the project and the questionnaire. Therefore, a total of 120 minutes of survey per node was intended to be included in the daily fieldwork schedule. To calculate the overall data collected in fieldwork, a minimum of eight hours of survey questionnaires were conducted in all of the specified nodes to indicate a fair distribution among all. For more details about the questionnaires format and raw data collected, please refer to Appendix (D).

#	Criteria	Questions	Categories	Target
1	Gender	What is your gender type?	o Male o Female o Other	Node Type
2	Age group	What is your age range?	o < 17 o 18-25 o 26-35 o 36-59 o > 60	
3	Activity	What is the main activity that you are doing in this place?	o Shopping o Studying o Working o Praying o Leisure / recreation (play, sport, social gathering, etc.) o Others (Administrative procedures, banking procedures, etc.)	
4	Residence area	Where do you live?	o Rahue Bajo o Rahue Alto o City Centre o Others (Outside this range)	Node Level
5	Frequency	How often do you come to this place?	o Daily o Weekly o Twice a week o Three times a week o Monthly o Less than once a month	
6	Intensity	When do you usually come to this place?	o In the morning (7:00-13:00) o In the Afternoon (13:00-20:00) o In the morning and afternoon o At night (20:00-7:00)	
7	Transport	Which modes of transport do you take to come to this place?	o Walking o Bicycle o Bus o Taxi / Collectivo o Motorcycle o Car	

Table 3-2: Survey construction table based on criteria selected and categories; Author's construction (2017)

3.3.3 Type

The nodality type was designed to be included within the same Travel-origin survey analysis as mentioned above. Questions regarding gender, age groups and people's activities were specified. Most importantly, the identification of the kinds of activities were later transcribed and analysed according to Gehl's (1996) categorization of outdoor activities, specifying demands on physical environment in his book of "Life between buildings". Therefore, a map of human activities in nodes was identified in three main categories: economic, functional, and communal activities. He described in his book that the quality of outdoor space depends on the kind of activity. The activities that take mere time and use space signified a better quality than those that take less time and do not use space.

3.3.4 Matrix formulation for nodal hierarchies

As a result of the previous steps, a matrix was formulated to describe the characteristics of nodes classified by size, level and type. The compiled matrix helped compare nodes in order to relate factors of urban form that influence human activities in space. This facilitates understanding the nodality hierarchy and hence scale level.

3.3.5 Data Collection

All methods deployed in Chapter 4 are regarded as primary data collection techniques. Gates method was used to record videos, transcribe and analyse manual excel, and AutoCAD for spatial application. The SnapShot method had similar specifications for data collection, namely AutoCAD, cartography, manual transcription and Photoshop presentation. In terms of executing the field survey, questionnaires were indorsed to be conducted as an electronic survey that runs on an online - offline application. In order to minimize the risk of manual errors and reduce the time of transcription after fieldwork, KoBoToolbox application was selected to support conducting the survey. It is a free open-source tool for mobile data collection in field using electronic devices. It is mainly used by humanitarian actors in emergencies and difficult field environments, in support of needs assessments, monitoring and other data collection activities. The adoption of KoBoToolbox for humanitarian use is a joint initiative between OCHA, Harvard

Humanitarian Initiative (HHI) and the International Rescue Committee (IRC) which makes it a reliable tool to serve the targeted rapid questionnaires (KoBoToolbox, 2014).

CHAPTER 3

CASE STUDY OF RAHUE BAJO, OSORNO CITY: URBAN ANALYSIS

4.1 Introduction

The Chapter envisions the change in urban pattern of the case study in order to understand the status quo current situation and organizational patterns. As mentioned earlier, space consists of form and society. In this Chapter, the main focus is more on the form aspect with an overview of the social condition of Rahue Bajo (RB) as a case study. In the following chapter while assessing nodality, deeper studies on people's activities in space are taken into consideration. In order to give an orientation of space, the first aspect was to make a projection of the case study in its wider context, according to the city and its Region. In turn, it positions the neighbourhood in comparison to its companions not only geographically but also socially and economically. Furthermore, tracing the evolution of city where RB was part of its development so as to understand the origin of the current transformation patterns. This is obtained through tracing historical maps, texts, and illustrations that are available to be contextualized.

Chapter 2 is referenced to mention the elements of urban form to influence sustainability which are briefly identified as layout, density, building type, and land-use (Dempsey, *et al.*, 2010). As a result, the second half of this Chapter focused on the neighbourhood in four of these dimensions that serve defining nodality. For that, the urban analysis of RB is directed to assess the neighbourhood urban form through analysing each of its urban grain (layout), land-use, typology and finally density. The four aspects are then cross-linked to

define the neighbourhood main nodes and to draw a conclusion of the current organizational patterns.

4.2 General Background of the City

The city of Osorno is located in the central South of Chile in the 10th Region of Los Lagos, 913 km away from the capital city (refer to figure 4-1). The whole region consists of four provinces of Osorno, Llanquihue, Chiloé and Palena, compromising a total area of 48,584 km^2 approximately. The province of Osorno covers a number of seven communes, however the main commune; under the same name; holds 68.6% of the province's population with 154,137 inhabitants (IMO & SECPLAN, 2013).

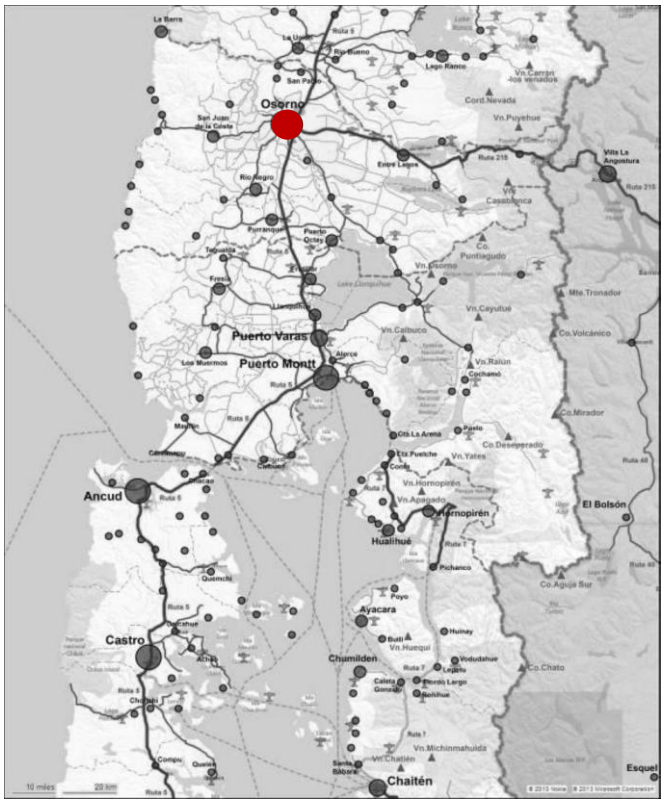


Figure 4-1: Map of Region of Los Lagos including the four provinces; source; IMO & Centro De Estudios Para La Accion Social, 2013

The location of Osorno prolongs between 40 ° 21 'and 40 ° 46' South latitude and 73 ° 26 'and 72 ° 46' West longitude, limiting the North with the commune of San Pablo, the South with Black River, the East with Puyehue and Puerto Octay, and finally the West with San Juan de la Costa. The total area of commune represents 951.3 km^2, signifying 10.3% of Osorno's Province and 2.0% of Los Lagos Region (IMO & SECPLAN, 2013).

Given that the city's geography, Osorno exists in an altitude of 65 MAMSL, while the city's central terrace elevates more than 30 m where most of the housing constructions and administrative buildings are located. With regard to natural boarders, Damas and Rahue rivers flow within the city, separating a number of neighbourhoods away. On one hand, the main city river Rahue River passes from the South to North, separating the entire

population of Rahue district from the rest of the city, while the other hand, Damas river streams East - West through the North of the city. Referencing to Chapter 1, the concept of neighbourhood units started to be organized in the Southern of Chile in 1992 where Osorno consisted of 25 main neighbourhood units.

4.2.1 Osorno's demography and its growth rate

Taking into account that Osorno is an intermediate city, it had gone under pressure of industrial growth, feeding its surrounding rural sector. The city is considered the second most populated city in the region of Los Lagos after the regional capital Puerto Montt. According to 2012 Census, the city populates 154,137 inhabitants, showing a growth of 5.8% in respect to 2002 (IMO & SECPLAN, 2013). Its growth rate is not considered higher than the regional rate, however in comparison to other cities, Osorno has registered 20% growth rate in 20 years while the regional rate was 29%. The highest age segment in the city is recorded between 35-44 years who in turn reflect the population age of employed workforce.

4.2.2 Economic profile

Osorno city is a special case for its apparent amount of micro-enterprises that have been increasing from 2006. This can clarify the stable number of unemployment rate from that year until 2009 and decreasing 4 points in 2011. Currently, the unemployment rate was considered to be 5.5% in 2011. This act of installing family business from inhabitants, has helped the city reduce its unemployment rate as explained by the municipality. The city was long reputed for its agricultural products due to the processing industries that are collected from the surrounding rural areas. However, this agricultural reputation was contrasted by observing the number of industrial enterprise activities in the last decade. Evidence shows that the largest number of business is manifested in the retail sector for spare parts, vehicles, automotive, household goods; following transport, storage and communication (IMO & PRAGMAC, 2016). This is an important aspect in understanding the current transformation in the city. Consequently, the effect on block patterns can demonstrate the land-use change and hence the street life, due to the change in customer types as well as their demands. This can be furtherly explained through morphological analysis of the case study of RB

4.3 Historical Transformation of Osorno City

Osorno was initially founded in 1558 by Garcia Hurtado de Mendoza, Governor of Chile. The first foundations were set to occupy East of Rahue river and South of Damas River – as shown in figure (4-2). The initial design of the city was first divided into equivalent plots (MINVU, 2010; IMO & PRAGMAC, 2016). Soon after, Osorno witnessed a remarkable growth rate in its first 46 years in comparison to other cities in Chile. During the indigenous repetitive attacks in the South of the country, Osorno was the last city left to resist for four consecutive years. Later in the early 1600s, the city was de-populated and the majority of inhabitants were displaced to the Chiloé[1] (IMO & Centro De Estudios Para La Accion Social, 2013; IMO & PRAGMAC, 2016).

In 1793, a treaty was signed from both Spanish and Mapuches to deliver Osorno as a settlement for the Mapuche (MINVU, 2010; IMO & PRAGMAC, 2016; IMO & Centro De Estudios Para La Accion Social, 2013). While re-population was mandated by the governor Ambrosio O'Higgins three years after the treaty, the city was promoted to be an agricultural resource to supply the surrounding cities. Meanwhile, a segregated neighbourhood area was designed to be for the Mapuche – Huilliche in the sector of Rahue to isolate them from the city with a river (Montesinos & Neira Navarro, 2012).

To flee the impoverished situation in Europe in 1846, the first families of German settlers arrived in and around Osorno who succeeded in converting the impenetrable forest into agricultural and livestock lands, which helped to boost industry development and city modernization (IMO & PRAGMAC, 2016). This has resulted in the appearance of the first urban plan of Osorno in 1859. The city's plan was initially designed as a grid distribution of streets with a 90 degree angle in which four streets formed a block. The city center as well as the city expansion was formed in the same urban pattern to include the services; like the church, the town hall building, the jail and the governor's house; in the old square (IMO & Centro De Estudios Para La Accion Social, 2013).

By the end of 19th century, the Western edge of Rahue River prolonged with population and urban growth due to the expansion of industrial activities along the river bank (Montesinos & Neira Navarro, 2012). Despite the continuous population growth around the

[1] Chiloé is a Chilean island that is located on the West of the shore, Southern Puerto Montt city.

river, the city had no formal plan except in the 1924 to determine the future vision of Osorno's modern plans, led by the Architect Carlos Buschmann[2], determining the city's future vision for expansion. Due to the industrialization demand, Buschmann initiated the West extension of at least 60% of the current social housing, dedicated to the working class who migrated from the rural areas searching for better labour conditions. (IMO & Centro De Estudios Para La Accion Social, 2013; Barria, 2014). Meanwhile, the sector of Rahue was established in the 1930s as the first suburb in Osorno, connecting the city with San Pedro Bridge. This act impacted the city's construction of the urban periphery as well as the spatial and social transformations that housing has had over time.

Inauguration of the mid-twentieth century, great political and economic transformations have occurred in the whole country towards economic liberalism and industrial development. In the 1950s and 1960s, Osorno was characterized by the economic boom, which continued to favor migration from the countryside in the search of employment opportunities, leading to increased population densities (Montesinos & Neira Navarro, 2012). This was reflected on the urban transformation pattern of Osorno as well as others. And since Rahue was considered the working class neighbourhood, its extension continued to follow the same grid system with a slight influence of the garden city approach and sub urbanity extended where the concept was popular that time in Chile. Rahue sector was then divided in two categories of RB and Rahue Alto (Barria, LA CONSTITUCIÓN DE LA VIVIENDA SOCIAL PLANIFICADA EN LA PERIFERIA URBANA: Conjuntos habitacionales de la Caja de Habitacion: 1936 - 1952, 2014). Both categories were divided due to the geographical and social class difference. Alongside, the city continued to grow to the East and West demanding more land for its extension.

In the 1980s, one could observe the different patterns in design shifting the 90 degrees angle and changing the parallel street grid. In alignment of the political changes in the 1990s and the change of the state's housing policy, a number of informal occupation changes occurred in Osorno's peripheries. By the end of the 20th century Osorno had established about 18 Urban centers and 12 suburbans "periféricos", which gave a general sum of 30 units comprising an average of 3,800 families (Peralta & Hipp, 2004).

[2] Carlos Buschmann was awarded the National Prize of Architecture of Chile in 1979 for planning Osorno back in 1933.

Later in 2000, the city witnessed an urban expansion along the same directions consuming more agricultural surrounding land. As shown in Figure (4-2), this includes the expansion of Rahue Alto as well as the Eastern city wing. From that year on, the urban growth continued in both East and West directions.

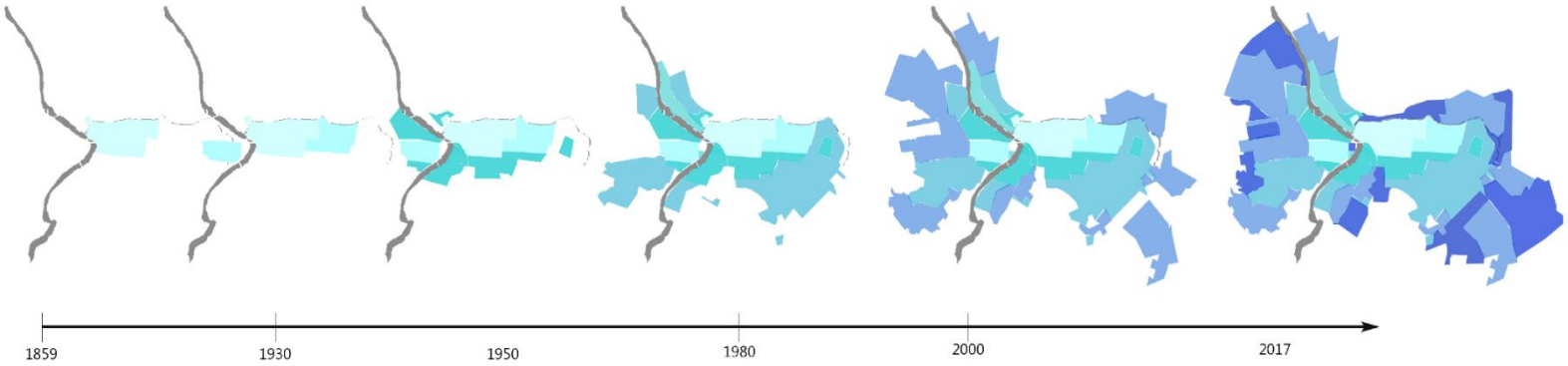


Figure 4-2: Historical evolution timeline of Osorno city; Source: Author's construction, 2017

4.4 Case Study of Rahue Bajo

4.4.1 Location

The neighbourhood is configured to encompass two main Streets of Republica and Concepción with a total area of 102 hectares (1.02 km^2), approximately. Illustrating the map in Figure (4-3), RB extends North to include the blocks from Pedro Montt St until Colgante Bridge in the South. The area is accessible to the rest of the city by three separate bridges; named Trapaca, Republica, and San Pablo; and two pass-by of San Pedro, and Colgante Bridges. The current official boarders of the neighbourhood RB is officially defined by the “Unidades Vecinales” to include former three neighbourhoods of David Rosas, Republica Sur Oriente and Bella Vista as shown in Figure (4-4). The characterization of RB is significant; from its name “bajo” or “low”; to separate the area from its surrounding neighbourhoods is mainly defined by its geographical boarders, in which it is isolated from the city center by the river Rahue in the East and from the Western neighbourhood by a terrace with a height of 40 m.

RB is characterized by the emergence of many services and a large amount of warehouses. It is also recognized by its fresh fruit Open market; called Feria Libre or Feria Rahue; which is considered the terminal of Osorno’s main food supply that is supplied from the rural surroundings. The Open market is branded as one of Osorno’s landmarks where local culture is represented, linked mainly to marine products brought from the coast, as well as fruits and handicrafts. In addition, the market’s terminal area is not only considered as a stop for the off-loading goods but also as a bus terminal where 28 buses arrive daily from the rural areas. Whereas, it has a group of 180 merchants who are officially integrated in the fruit market. The area is vibrant from the early morning due to the market activity until afternoon where the market reduces its sales activities. It is important to recognize the different activities and uses, in order to be able to analyze the current transformation pattern.

4.4.2 Historical transformation of the neighbourhood

The neighbourhood’s age dates back to the 1930s, where city’s expansion was set seriously to solve the increasing housing demand. Named as Rahue back then, it was

designed to absorb the working class population that immigrated to support the industrial extension and was known as the first suburb in Osorno. The neighbourhood when planned by Buschmann was inhabited by mostly farmers who were displaced to work on processing products of the field, as well as by families whose head of household worked in private industry, or employees of public works (Barria, 2014).

RB consolidates three main neighbourhood units of David Rosas in the North, and Bella Vista and Republica Sur Oriente in the South. Among the three units, Republica Sur Oriente and followed by Bella Vista are considered the oldest as they were constructed between 1937 and 1942 where houses can still be witnessed to take the German wooden style. Later, the Northern area was constructed to absorb the increasing migration with an industrial extension.

Due to the constant migration waves that RB witnessed as latterly explained, the neighbourhood has transformed its urban form through time to adapt with the current situation. Nevertheless, the morphological transformation respected Buschmann's original design of the neighbourhood, unlike other cities. The grid pattern has remained the same, however the transformation has occurred within the same block, changing its land-use and densities. Far on, within the same block a number of plots has been combined to form bigger constructions. Moreover, other plots have increased their densities by constructing more and hence increasing their footprint. Consequently, the neighbourhood concept has drifted to lose its significance to sustain the continuous change. The following urban analysis will focus deeply on the typology of this transformation.

4.4.3 Socio-economic status of the neighbourhood

According to the Census of 2002, RB is considered a neighbourhood within a whole sector of Rahue which populates 55,157 inhabitants. In general, Rahue is considered the most populated district of Osorno adapting 38% of total residents. Among those, 59% of the age segment is concentrated between 15 to 54 years living in the neighbourhood. Interesting to know that despite the low percentage of the neighbourhood to a higher education, the population almost have a 0% of illiteracy rate. A total of 53% of the population has a medium education level in variation with others. Moreover, the neighbourhood nearly forms the 25% of the city's organizations which reflects high percentage of its active members (IMO & SECPLAN, 2013).

According to the municipality, the economic activities of Rahue are based on commerce and services with no differentiation from one point to another, especially if observed in RB. Regarding the employment rate, Rahue marks a 2% lower percentage of unemployment than the average of the city. Nearly 43% of the population have an income, while the rest are stated as students; who indicate a 13% of the inhabitants of the neighbourhood; and retired people. While reviewing the cartographic maps of the municipality, RB rates a high percentage almost all are working, except two blocks on the West and South periphery marked as households.

Figure 4-1: The historical evolution of RB; Author's construction. 2017

4.5 Morphological analysis of Rahue Bajo

The whole sector of Rahue is considered to occupy 30% of Osorno's urban density. Moreover, the sector mainly consists of a number of neighbourhoods named as: Rahue Alto, RB, Rahue 2, Mirasur and Villa Almagro (MINVU, Una Historia de esfuerzo y supracion: Barrio Carlos Condell - Rahue Alto, 2010). Among all, RB is considered the most vulnerable neighbourhood in its housing quality and social status despite its apparent available services.

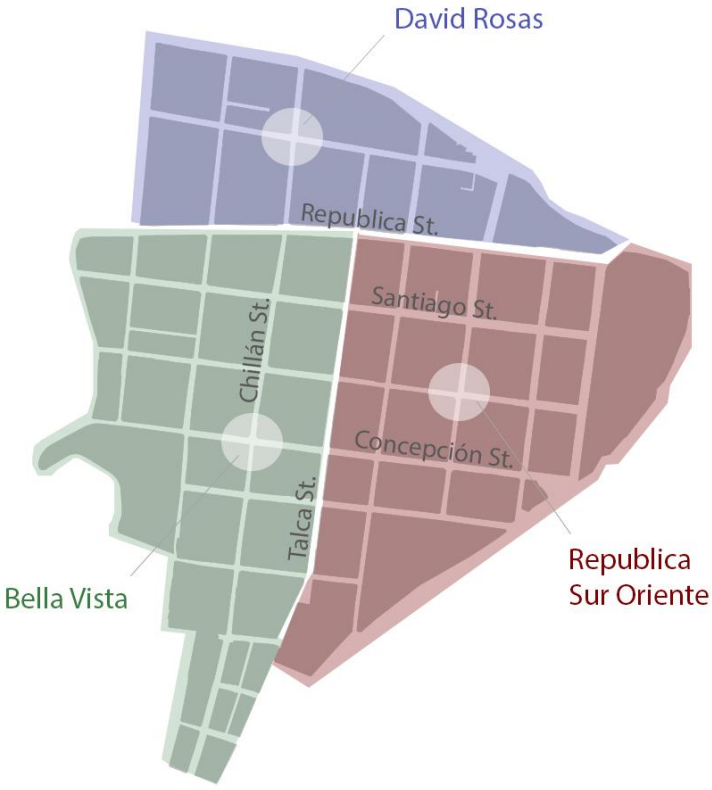


Figure 4-2: The location of three neighbourhood units (Unidades Vecinales) of RB; Source: Author's construction

RB consolidates three main neighbourhood units of David Rosas in the North, and Bella Vista and Republica Sur Oriente in the South. As explained in Figure (4-3) and (Figure 4-2), the orientation of each unit was according to the neighbourhood evolution, as Republica Sur Oriente was the first suburb to rise with a Northern sector of Bella Vista. Later, David Rosas and the Southern sector of Bella Vista were added during the 1950s. More in the 1970s, the extension of RB grew on a strip of land in the South bordered by the West with a slope and the East with a Municipal Park where the river Rahue puts an end for the neighbourhood. RB continued to grow within its geographical boarders, respecting the planned street patterns. However the urban transformation was apparent to change within its block, increasing its density. The following explains the urban morphology of the by cross-linking its features of blocks, their land-uses, typology as well as density.

4.5.1 Urban grain analysis

The city block is the basic element of physical structure of urban areas. Therefore, its properties of sizes, shapes and arrangement is an essential matter to be documented, however it was never the case in many parts of the world including Southern Chile (Siksna, 1997). For that, the urban grain analysis investigated the layout pattern of the subjected case study of RB through testing block forms and sizes; i.e. it assessed the relation with streets, buildings and plots (Dempsey, *et al.*, 2010). As mentioned by Sikna in his conclusion of comparing the effects of block sizes in 12 cities, the location and topography create differentiated land-use patterns within a block (Siksna, 1997).

As a general overview, the urban footprint of the selected area of RB is around 278,899 m^2 with a percentage of 27.5% of the whole neighbourhood area. The hierarchy of RB's urban grain is a construction of its basic elements of built form. Having this lens, the urban tissue of the neighbourhood is apparent through identifying the main module as mentioned by Caniggi and Maffei (1979) to be the plot. The plot itself is a consistent of solid and void, combining the building and private open space, shown in Figure (4-5) (Kropf, 2014). This can open-up the discussion that open spaces are not only public but also people can meet in their private open space if it is sufficient. Following the hierarchy, a series of plots together defines the second level of the urban tissue to be the block as shown in Figure (4-6). The collective block system is a form of a certain grid that can formulate a mesh and that will be explained later in this section in details.

Block system

Owing to the initial design of RB, the neighbourhood can still be seen to be divided into on equivalent square block system with an average size of: 130x130 m., apart from a percentage 25% that has a rectangular shape of an average size of: 90x130 m. The area is divided into 54 street blocks, which are observed to have the grid system from the East until the blocks adapting with the landscape of the shoreline of Rahue River. The block offsets an average distance of 5 m to form a sidewalk and leaving perimeter of internal plots.

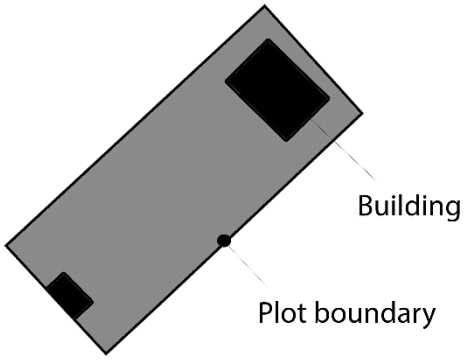


Figure 4-5: Illustration of a prototype for RB's plots; Source: Author's construction

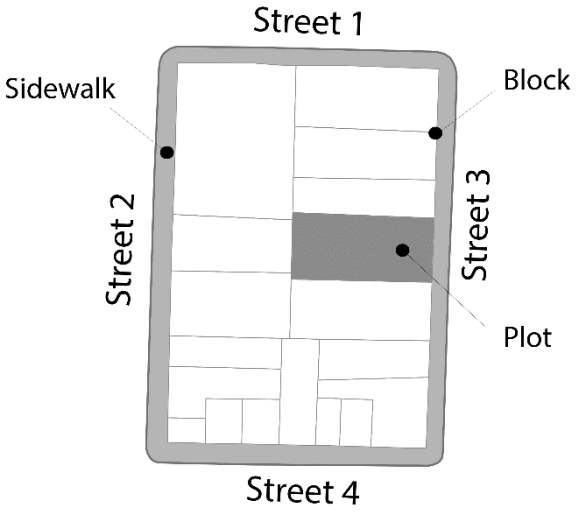


Figure 4-6: Illustration of a prototype for RB's block system, containing a number of plots; Source: Author's construction

The average distance between each block are set to vary between 17 to 20 m with a 7 m street width in the internal grid system; i.e. the distance is calculated from a plot to the adjacent parallel plot, since the building alignment varies according to each street. On the other hand, Republica St separates the street blocks with a distance of 26.5m with a net nine meters street width.

4.5.1.1 Block Pattern

The block pattern observed to be a pioneer of the neighbouhood urban form in the 1930s is shown in Figure (4-7) as mixture of rectangular and square blocks, however the topography of the area has shifted the blocks to adapt with it. Later, the pattern has drifted away from its original design in the 1950s, trying to form rectangular blocks heading South. The same pattern has been repeated in Northern Republica St with observed larger blocks, due to the addition of non-residential uses; e.g. industries; as well as adapting with the typology of the river bank. It is important to mention that in the 1950s there was the first transformation owing to the neighbourhood's expansion towards the river and hence adapting with the geographical boarders. In the 1970s, a clear transformation in block size and structure has occurred as a strategy to construct social housing on the Southern edge of the neighbourhood. These blocks had been broken down into quarters in comparison to the average rectangular blocks that were produced in the 50s, giving a pedestrian

dimension an average block size of 107x45 m, approx. Building results from Chapter 2, the average block size is considered a convenient mesh for both pedestrian and vehicles.

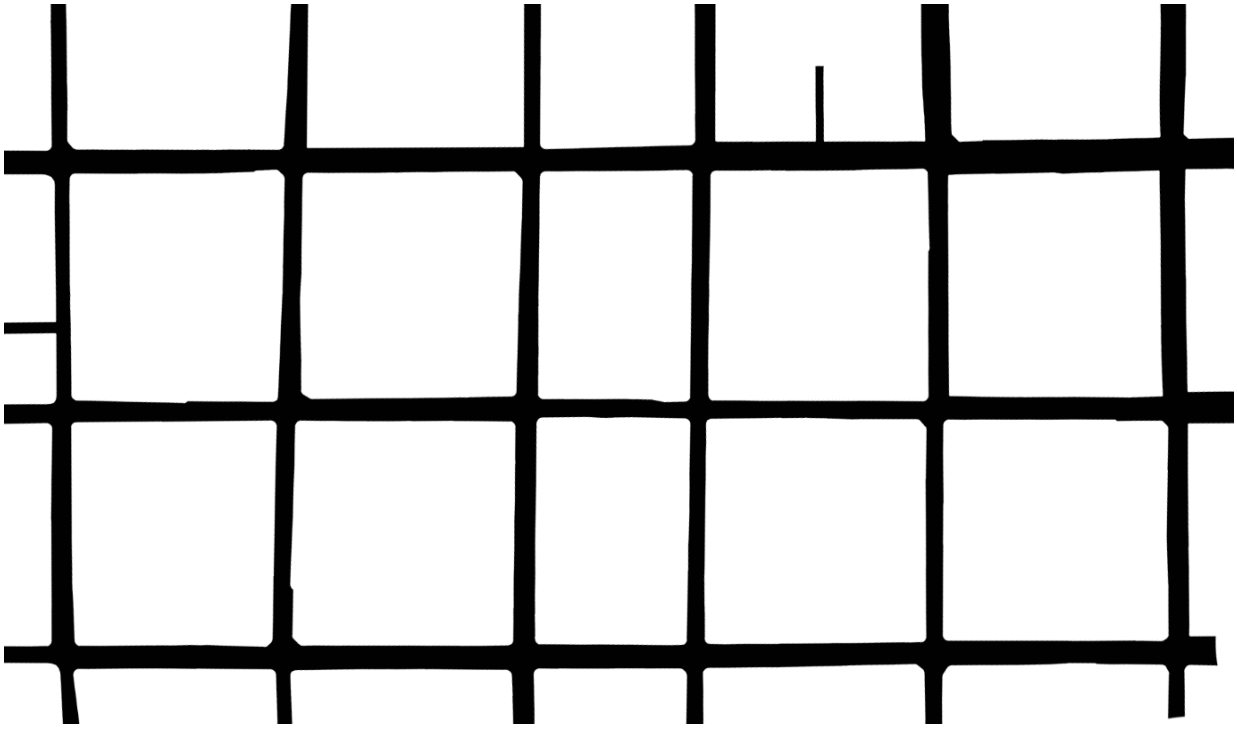


Figure 4-7: Street pattern of RB with an illustration of its block system; Source: Author's construction. 2017

From the street pattern in Figure (4-7), it is important to mention that the designed mesh was to serve the neighbourhood equally. The presented mesh gives a coherent and harmonized block fabric to serve the urban tissue effectively. The proof of its success is its persistence over time, without significant changes. The only missing pattern is the pedestrian pattern that was not recognized in the whole neighbourhood. Pedestrians are only permitted to walk around each of the blocks despite their differences without inner mesh.

The latter explanation of block patterns clarifies the pedestrian mesh of the neighbourhood. Concluding from the above, RB's block pattern has a significant similarity with Chicago's block forms and sizes in the 1830s (Siksna, 1997). It can be possible that the model was copied from the North American city version which had functioned 100 years before. Nevertheless, tracking the transformation of internal plots within a block through observing the repeated patterns in the neighbourhood of RB, the original block

pattern could be traced and visualized as a hypothesis. This could be seen through the overlapping common prototypes of current blocks, tracing their common features as shown in Figure (4-7). The original design is explained to have an average plot size of 20x40 m with a back yard and a pedestrian pathway of 3m in the rectangular blocks. On the other hand, the square blocks had the same plot sizes with an internal court that can be brought from the European approach of neighbourhoods. In reference to Siksna's (1996) findings, the original plot sizes constituted a fine modular structure – as mentioned in Chapter 2. However, the current divisions that is occurring within the same plot could give a difficulty with an easier accessibility.

4.5.1.2 Alignment of buildings

Analyzing the urban grain, the dominant alignment of buildings were strictly observed to occur in the main street of Republica, since majority of the buildings are non-residential maximizing the use of space and facilitating the closest access to customers. More observations were seen to follow dominant building alignment in two more cases. One case is explained to follow the European old style of development, witnessed in the remaining wooden German buildings. The other is observed that more than 50% of a plot is privately owned within one block to develop a non-residential project, however it's not commonly repeated. The common case observed is to offset an average distance of 2 m away from the pedestrian St which ranges from 2 - 2.5 m.

4.5.1.3 Ratio of building height to street width

Relating the building heights with the street width, is observed in the main St of Republica to express a ratio of 1:3.3. The common case for the internal streets have an average a ratio of 1:2.5 for those who have the two-story buildings and represents the area. Moreover, on the peripheral sides of the neighbourhood, the building height decreases to include one-story residential units. This is represented in St David Rosas in the North and Valdivia in the South.

The urban grain is generally remarked to intensify its mass on the periphery of each block, leaving the internal area with an opened space. This can be understood if it is claimed that yards are preferred to be more enclosed to each private plot. Another thoughtful explanation is thought that the residential buildings take an inner view, while it is preferred to extend local commercial markets and repair shops on the front. More concept in each

plot is observed to extend horizontally for more residential demands. Smaller plots are analyzed to have an inverse relation with the distance of the main streets and the shore line. As a result, the plot size relatively decreased as the blocks move West and away from the Republica St and Concepcion St. This can be clearly perceived along Republica St and two horizontal blocks around. This pattern diverges due to the new large surfaced mass, characterized in the commercial markets, schools and the Casino. Furthermore, the grain is interesting to compare with the density of RB, to compare if mass is relatively reflected on the urban density.

Total area of	Area (m2)	% of the whole area
Buildings	278,899	27.5%
Plots	876,413	86.5%
Open spaces incl. streets	734,183	72.5%
Private open-areas	597,514	59.0%
Buildings Aligned	993,402	98.1%
Streets	136,669	13.5%
RB	1,013,082	

Table 4-1: Areas and percentages of urban grain elements

Figure 4-8: Urban grain map; Author's construction ascribed due to the collection of secondary data and fieldwork analysis. 2017

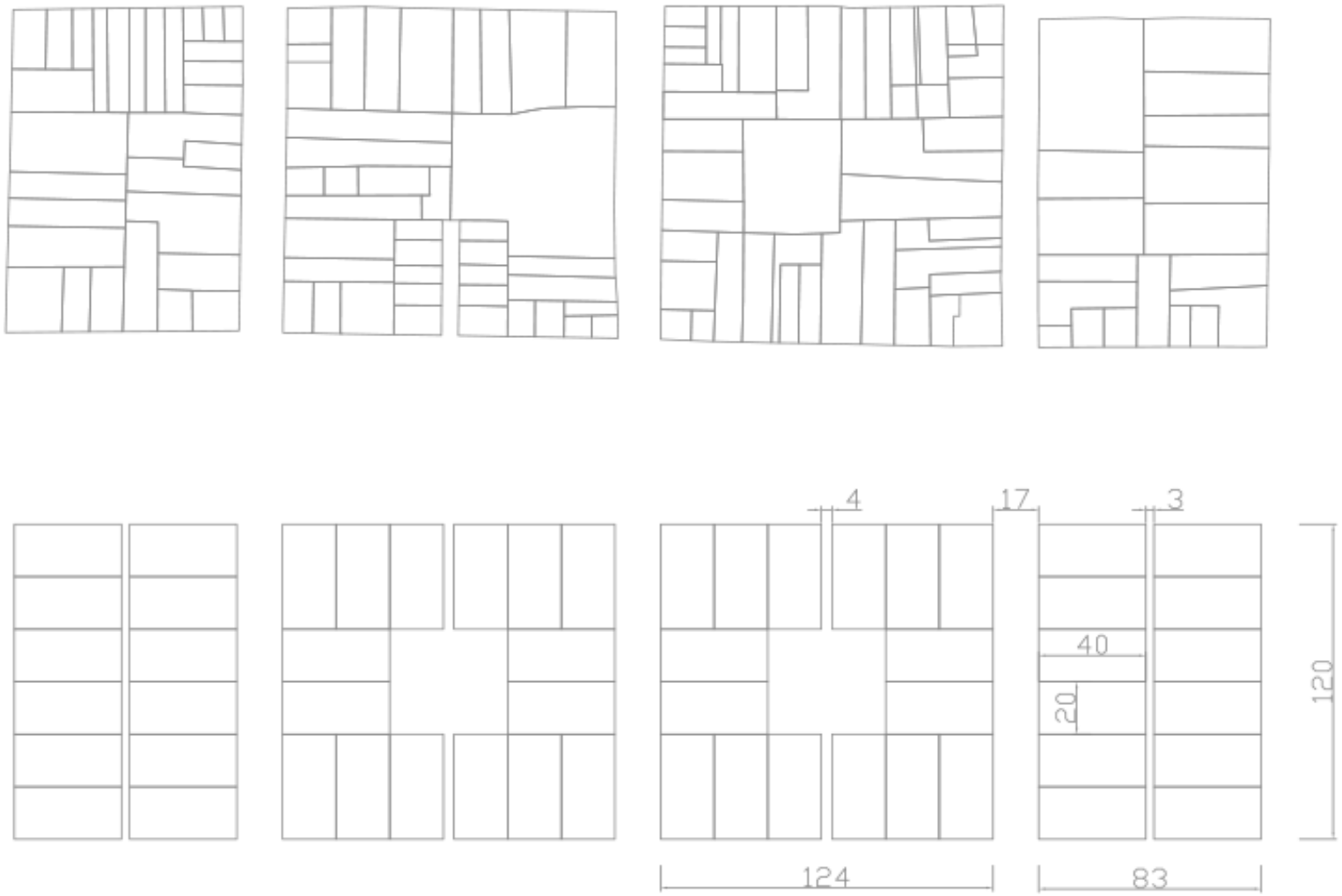


Figure 4-9: Tracing transformation; Comparison between the current structure of plot series and the hypothesis of the original structure; Source: Author's construction, 2017

4.5.2 Land-use analysis

Fieldwork analysis was done to evaluate the detailed land-use of each plot in RB. The building uses were set to classify them in eight categories; Residential, Commercial, Mixed-use, Educational, Industrial, Civil, Sporting and Religious facilities. Mixed-use is defined to combine the vertical alignment of commercial ground floor and residential upper floors. The map in Table (4-1) shows the categories of land-uses in addition to two more categories indicating opened space and roads. In relation with assessing land-use as explained in Chapter 2, the total non-residential services – e.g. commercial, educational, and mixed-use - occupied around 30% of the total building area. The percentage is categorized as a lower than the standard average (40% at least).

Land-use Type	Description	Total Area	Footprint
Residential	Building used only for living purposes, either owned or rented	198,373	71.1%
Commercial	Building used for vending goods; can also be catering	38,254	13.7%
Mixed-Use	Building used for both commercial and residential uses.	10,045	3.6%
Educational	Building used by an educational institution. Can vary from pre-school to high school.	13,871	5.0%
Sports facilities	Building used for sports	3,902	1.4%
Religious facilities	Building dedicated to religious purposes.	3,303	1.2%
Industries	Building used as a warehouse or workshops or factory.	9,794	3.5%
Civil facilities	Building used for services. E.g. police, Ambulance	1,353	0.5%
Open space	Land dedicated for public use and in most cases is a green area.	734,183	-

Table 4-2: Detailed description for land-uses of RB

Since neighbourhoods are examples of organized complexity as mentioned by Jane Jacobs, illustration is explained on the map according to the observation analysis in order to cross-link land-uses with different features such as: typology, densities, time and people's activities. This analysis is made to understand how uses and activities are organized and transformed in such a specific way according to people's own perception of their neighbourhood.

The percentage of non-residential use is identified to increase along Republica St and Chillàn St. Moreover, Republica St occupies the highest percentage of horizontal mixed-use street in the neighbourhood. The street is occupied by repairs, catering and commercial shops in the first floor, where the second floor is commonly residential. This phenomenon has a ripple effect on the percentage of horizontal mixed-use per block. Despite the well connectivity of Concepcion St to link the neighbourhood to other parts of Osorno, the percentage of non-residential use is not recognized to compete with Republica St or Chillàn St. However, new large-sized supermarkets seem to be constructed on the road, taking advantage of its automobile accessibility. On the other hand, Chillàn St combines small plots of mixed-use buildings with educational and commercial blocks. The increase of catering shops are also obvious to serve the Open market and the vibrancy of the area. One of the most significant landmarks of RB is the Open market. This block is recognized by its intensive commercial use in certain hours of the day and its occupancy with inter-change of human activities. The effect of the market does not only lie in its land, however it extends through the Chillàn St and Temuco St. A number of Street vendors are apparent during the market opening hours.

Further within the same block, plot sizes seem to transform in relation with the change of land-use. This can be obviously observed through the larger plot sizes occupied by the commercial and educational uses. Taking the example of the Open market, the construction seem to inhabit nearly 50% of the block area. Although the Open market is a market designated as commercial-use, it also has other service functions such as the bus terminal and catering services. There is a strong relation between land-use influences with the densities. This is illustrated more deeply in the following section, concerning density in which it is related in the map.

4.5.2.1 Land-use, activities and time

Since time is the fourth dimension of space, the change of uses of land is important to assess in relation with daytime and nighttime. In fact, time is not only considered as a factor of 24 hour activities but also seasonal change of activities, e.g. schools are not running all year-long. Firstly, to point out the types of activities that differ day from night are analyzed through the change in services that varies in relation with time. Vibrancy are observed to occur in the early morning in certain areas owing to the existence of the Open market that only functions in the morning until noon as a fruit market. Since the Open market is opened until noon, activities seem to decrease afterwards leaving still the catering services and some Street vendors around it. The same phenomenon occurs for school blocks, where students have to attend their classes at 7:30 and leave for lunch time at 13:00, return at 14:00 and are given permission to leave at 16:00. This time-laps gives the chance for street activities to change as a result of the change of people's age and types. This can be observed by the different Street vendors that are apparent not only for students but also for teachers and parents, and the Kiosks in front of the school which is closed after school days and even on school vacation. This can be seen at the node identified in land-use map; Figure (4-10); no. 6 within the cross road of Chillàn St and Valparaiso St. Another cross-road is identified between Republica St and Tarapaca St in no. 1 to have a school in the context of a vertical mixed use buildings with commercial shops close and the typical kiosk in front of it. Taking afternoon and night activities into consideration, it is obvious from the map that the Casino could have a vibrant night life in addition to Chillàn St that seems to have a couple of bars.

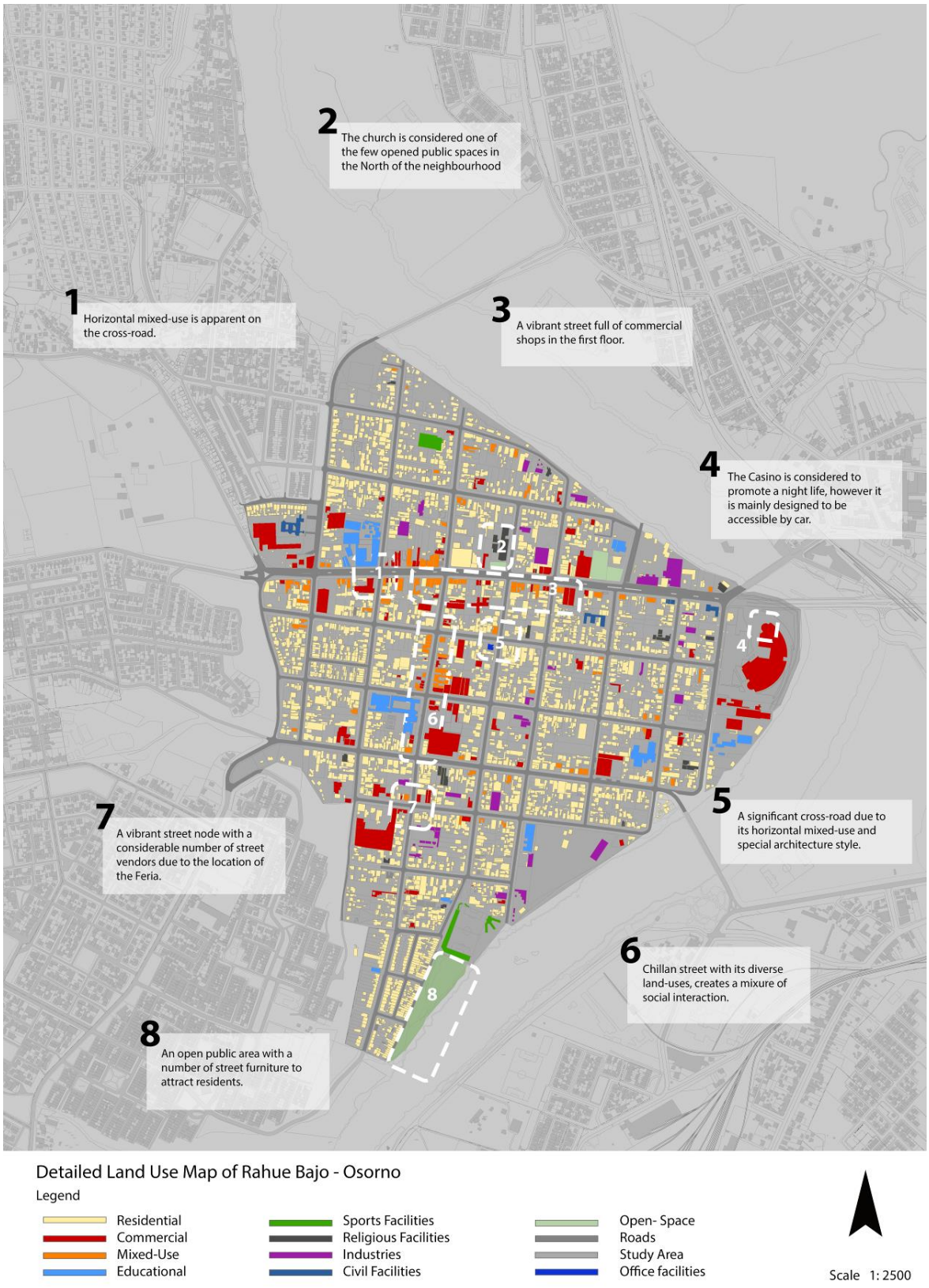


Figure 4-10: Detailed Land-use map; Author's construction due to the collection of fieldwork analysis. 2017

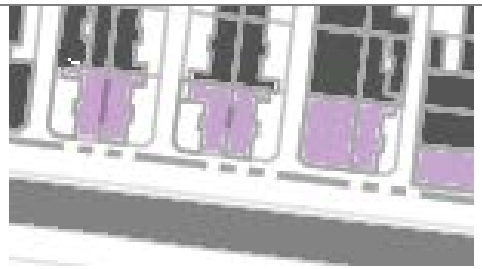
4.5.3 Typology

The typology is analyzed to understand the identity of the neighbourhood and the transformation of urban morphology. The type of data collected was carried out by fieldwork analysis and primary data collection since this kind of analysis was never made in Osorno before. In that sense, according to the analysis done, RB has four various categories of building typologies. The building typology mainly focuses on residential or mixed used buildings which filters out other land-uses. However, specific type of non-residential buildings were important to mention owing to their strong intervention in the typology of space. These types are significant with their high build-up area according to the block size, called as 'Mass Buildings'. Conversely, the first residential; or mixed-use; typology is defined as detached houses in which houses are constructed individually and are not meant to attach its walls. This type of houses varies from one to two floors maximum with a single family inhabitants. What is currently happening, is that detached houses use their backyard to build-up more houses for rental purposes. This can be understood if related with the history of the neighbourhood when density has been increasing through time and hence housing demand increased. The second type is defined as Semi-detached housing which is explained in Table (4-3) as houses which were designed to share a wall with a twin house. This type of houses can be barely seen in RB, however their existence signifies that this style was established and was quickly transformed. The third typology is called terrace houses in which its urban feature can be instantly recognized by its continuous façade. In the neighbourhood, terrace houses appear in two forms. As shown in table (4-3), Type 1 from of terrace houses, i.e. buildings which became semi-detached to each other through time and was not initially designed to share walls with a neighbor. However such development in housing is due to the demand for footprint maximization. The other type of terrace houses; known by Type 2; are recognized by their harmony in its design owing to the consideration to be attached from the beginning.

The common pattern in the neighbourhood is observed to be single detached houses between blocks as visualized in the typology map; Figure (4-11). This can be explained through the transformation process where small plots were sold individually for construction. Terrace housing are transformed through time on the main St of Republica, due to the necessity to maximize the commercial façade use. The majority of this typology;

especially type 1; are concentrated are detected to be mixed use buildings and located on vibrant streets such as: Republica and Chillàn. The second type of terrace houses; Type 2; was only observed in the South of the neighbourhood to form four blocks with the same typology. This type was part of the housing policy of the state in the 1990s for rapid displacement of people and therefore, resulted in an exceptional typology added to RB. The last but commonly seen typology, is the Mass buildings which are not necessarily constructed of high story buildings, but rather their horizontal occupancy of land is the most significant feature. Most of these buildings are modernly designed with commercial or educational or industrial use. The commercial use is most commonly found in the massive building typology in which it occupies more than ¼ of the block area or minimum area of 1350 m^2. The other educational uses are most commonly transformed and extended residential houses to fit the new demanded use.

Detached housing are most commonly existent in the area, however its remaining old typology flourishes within the neighbourhood, persisting its identity. Part of this identity has to be mentioned as wooden edge structured houses with a German- rural style in building. A number of these buildings were saved and renovated, however its use has changed to be for offices or commercial purposed. The rest remains in poor conditions in necessary demand for renovation, but the fact that residential and the social conditions of the residents do not allow them to cover the cost of restoring a very old house.

Type	Description	Prototype illustration	Photographic illustration
Detached House	A stand-alone residential or mixed-use building that doesn't share any walls with other building or at lEast was not designed to be. Defined to be one or two floors.		
Semi-detached House	A residential or mixed-use building that shares a wall with another house. The design is taken into consideration. Defined to be one or two floors.		
Terrace Houses	Residential or mixed-use buildings sharing their sidewalls to form a row of houses. **Type 1 (T1):** Terrace houses were not designed which to be attached, however the urban transformation helped it to maximize the built-up area.		

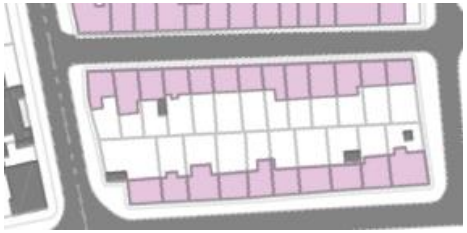
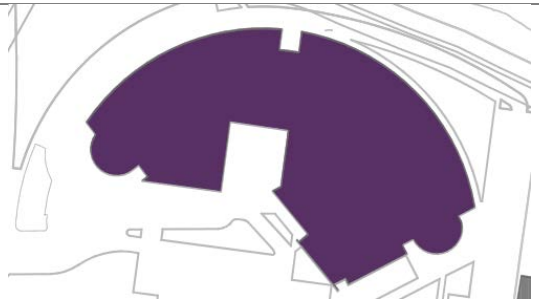
	Type 2 (T2): Terrace houses were designed to which share their sidewalls.		
Building Mass	Non-Residential stand-alone building occupying more than ¼ of the block area or minimum area of 1350 m^2. It is not necessarily apparent as a multi-story building.		

Table 4-3: Typology classification of the neighbourhood; Author's construction, 2017

Figure 4-11: Typology map of RB; Author's construction due to the collection of fieldwork analysis, 2017.

4.5.4 Density

Density is definitely a complicated concept with a number of inter-related dimensions. (Dempsey, *et al.*, 2010). In the case study, the density of urban form is calculated through number of floors per building. This was done through primary data collection in the fieldwork, since this data was not documented in any official document. In the descriptive map shown in Figure (4-12), explanation is given to the relation between density and land-use. The overlap between the two layers clarifies the concentration of services in certain areas influenced by different land-uses. Density is a form of vibrancy to the neighbourhood. The following table explains the relation between the horizontal built-up area and the vertical alignment of forms.

Category	Area	Percentage of total area
One floor	169,052	60.6%
Two floors	98,685	35.4%
Three floors	2,179	0.8%
More than 3 floors	8,981	3.2%

Table 4-4: Categorizing urban densities and comparing them according to their built-up area

Figure 4-12: Urban density map; Author's construction due to the collection of fieldwork analysis. 2017

4.6 Reflections

The chapter is a mixture between empirical fieldwork data collection and desk-review analysis as explained in the Chapter 2. The historical narration of the growth of the city as well as the neighbourhood was functional to understand the current transformation pattern. The conclusion of the urban grain analysis was sufficient to prove the latter discussion. In regard to street networks, the grid mesh has proved its supremacy to persist the transformation of its urban form which proves its sufficiency. It can also be referenced to Siksna's study that the block size is nearly to the optimum dimensions of pedestrian and vehicle. However, the current transformation has delaminated the hierarchy of pedestrian walk which can be noted as a missing feature in the neighbourhood, owing that to the fact that all the sidewalks are always shared with a minimum 17 m vehicle road.

Regarding the urban grain analysis, it was clearly evident that the urban morphology has changed within the block forming smaller sized plots and increasing the density within one plot. Owing to the pressure that RB had passed through continuous growth of working class, owners had to either sell part of their land or build in the backyard to rent for the demand. This phenomenon could be explained through the land-use review that several buildings had a mixed-use function facing the main St and the rest are residential in the back-yard. Other services were apparent as well to transform the plot structures. Unlike the fragmentation of plots into smaller structures, commercial and educational services seem to occupy an average number of six plots to maximize the building footprint. These structures had transformed the scale of neighbourhood unit forming isolated islands of mass buildings that is not harmonized with the rest of the urban form.

Cross-cutting through the four elements of urban form of RB, each has been explained on its own and in relation to the other elements. In turn, a number of seven potential nodes were apparent in RB to clarify the overlaying land-use, typology, as well as density. Those nodes can give a primitive indication of people's activity in public spaces due to the identification of place of meetings. The seven potential nodes are numbered according to the illustrative map in Figure 14 and explained as follows:

1. **Node 1.1:** It is considered an official plaza that lies in RB with some facilities to be used as a recreational area. It lies in front of a commercial building and is considered a backyard of a school.
2. **Node 1.2:** It is one of the feWest public spaces in RB in front of a church, which can indicate people's activity in space. It also lies North of Republica St.
3. **Node 1.3:** The cross-road of Santiago St and Antrofagasta St is considered a potential for people's activity due to the influence of a significant landmark and the appearance of a new type of land-use in the area.
4. **Node 2.2:** The node is located North of Republica St as a vibrant space due to the emergence of a dense mixed-use St. The cross-road is considered as a horizontal mixed-use space, since at one corner is a school and the other side are shops.
5. **Node 3.1:** A side St that serves a school and a supermarket is remarked to occupy a dense mass in both blocks. It is also observed to be a new typology that is introduced to the neighbourhood in addition that the St is considered another example of horizontal and vertical mixed-use.
6. **Node 3.2:** A vibrant area of a diverse land-use as well as people's activity due to the location of the Open market and the terminal of RB. Street vendors are observed to occupy the place in certain hours of the day. More catering services are apparent to exist closer to this node.
7. **Node 4.1:** A designed area for public space with several Street furniture and facilities for recreation. The location of the node is on the edge of RB, facing the river and one block from Rahue Alto. Despite the single Node of this use while it is still important to assess people's interest of space.

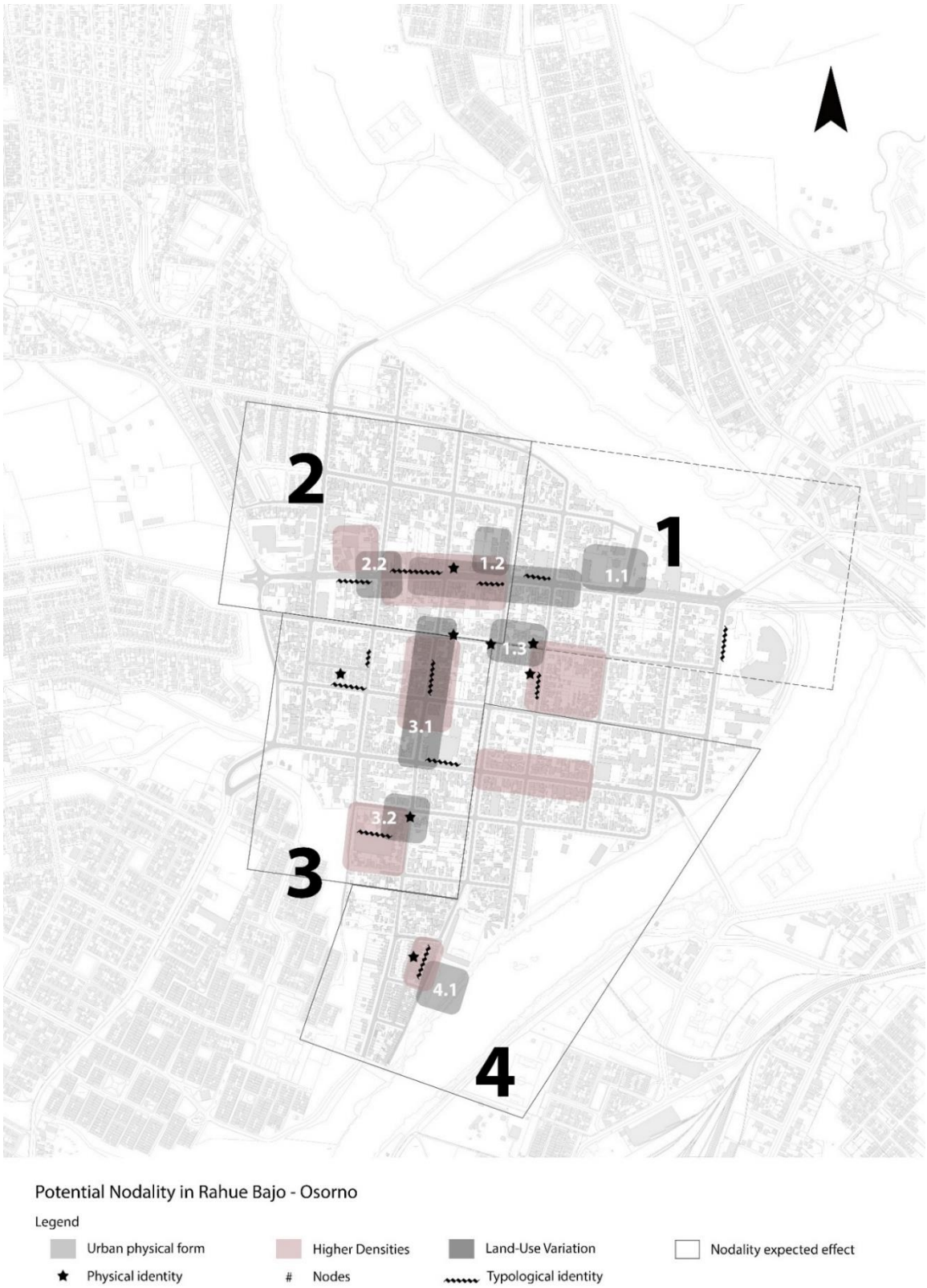


Figure 4-13: Nodal potentiality map; Author's construction due to the collection of fieldwork analysis. 2017

According to the explained methodology in Chapter 2, the seven nodes are evaluated qualitatively according to the above criteria of land-use, density, typology, physical identity and building alignment. The nodes are ranked and highest potential four ones were chosen to be assessed in fieldwork for the following Chapter. Table (4-5) is shown as the evaluation that was under taken for Nodality. Each node was described in the following text to describe its context as well.

Potential Node	Space definition	Form Definition				
		Land-use	Density	Typological Identity	Physical Identity	Building Alignment
Node 1.1	Plaza	●				
Node 1.2	Street	●	●	●		●
Node 2.2	Corner	●	●	●		●
Node 1.3	Cross road		●	●	●	
Node 3.1	Street	●	●		●	●
Node 3.2	Cross-road	●	●	●	●	
Node 4.1	Public area	●	●	●	●	

Table 4-5: Nadality evaluation matrix

Node 1.1: The node is promoted North of Republica St as a vibrant space due to the emergence of a dense mixed-use street. The cross-road is considered as a horizontal mixed-use space, since at one corner is a school and the other side are shops.

Node 1.2: It is one of the fewest public spaces in RB in front of a church and in the main street of neighbourhood, which can indicate people's activity in space. It also lies North of Republica St.

Node 1.3: The cross-road of Santiago St and Antrofagasta St is considered a potential of people's activity due to the influence of a significant landmark and the appearance of a new type of land-use in the area.

Node 2.2: It is considered an official plaza that lies in RB with some facilities to be used as a recreational area. It lies in front of a commercial building and is considered a backyard of a school. Despite the low density of the area, it is interesting to see the horizontal mix of activities. The garden is bordered by the East with an industrial building and by the West with a supermarket.

Node 3.1: A side street that serves a school and a supermarket is remarked to occupy a dense mass in both blocks. It is also observed to be a new typology that is introduced to the neighbourhood in addition that the street is considered another example of horizontal and vertical mixed-use.

Node 3.2: A vibrant area of a diverse land-use as well as people's activity due to the location of the Open market and the terminal of RB. Street vendors are observed to occupy the place in certain hours of the day. More catering services are apparent to exist closer to this node.

Node 4.1: A designed area for public space with several street furniture and facilities for recreation. The location of the node is on the edge of RB, facing the river and one block from Rahue Alto. Despite the single use of this use while it is important to assess people's interest of space.

As a result, since a number of nodes had the same potential rank, the four nodes – as shown in Figure (4-13) – were chosen to take have an ampler investigation for Chapter 4 to assess their size, level and type.

CHAPTER 4

NODALITY APPLICATION IN RAHUE BAJO

5.1 Introduction

The main purpose of the chapter is to explore the effects of urban form on human activities through nodality formation in RB. As mentioned in Chapter 2, nodality of space is characterized through defining its size, level and type. Through assessing nodality in RB, both of hierarchical level of public areas and the neighbourhood scale could be identified. After comparing the seven nodes among themselves according to their morphological definitions in order to analyse four selected nodes according to people's behaviour in space – refer to Chapter 3. Consequently, the four nodes in this Chapter follow the mentioned methodology to assess nodality in space and to discuss the results based on the second fieldwork analysis. The result analysis elaborates a matrix of nodalities categorised by size, level and type which guides the conclusion of neighbourhood hierarchies. As a summary, general reflections are discussed to combine both fieldwork analysis of Chapter 3 and 4 to elaborate the contribution of nodality to re-define scaling of neighbourhoods. In the end of the Chapter, a matrix is formulated to compare each node with its size, level and type.

5.2 Nodality Identification in Rahue Bajo

The following result of nodality analysis are explained through four main nodes, assessing their size, level and type. The first characteristic of nodality size is achieved by defining its morphological dimensions as well as their physical condition influencing public activity. On the other hand, the second characteristic of nodality level is defined to explore the change

of uses through observing human activities in relation to the built-up form attributes. Node levels are discussed in this Chapter through two specified methods of Space Syntax technique of Gates method, Snapshot (SS) (Vaughan, 2011) and Survey analysis (Smith *et al.*, 2010) (explained in details in Chapter 2). Finally, the third characteristic of nodality type is derived through assessing people's activity in space. The results of Snapshots SS(s) and survey analysis are cross-linked to define the type of each node in the neighbourhood. Since nodality level and type are inter-related using the same methods of SS(s) and survey analysis, the following results are subdivided according to fieldwork findings of every method. Each node was explained in details separately in each method, while reflections on RB were further illustrated as well.

5.2.1 Characterizing nodality Size

Since street blocks are the fundamental element of physical structure of cities, the focus of size analysis were suited to determine the potential of node blocks to promote walkability. The blocks of each node was defined according to the extended influence of the node according to the previous chapter results. Following the *morpho* methodology (Please refer to Chapter 2), results are presented in Table (5-1) and (5-2) to identify the number of blocks in each node - their maximum and minimum dimension length – calculating their length gap and their mean value. Taking the mean value forward, blocks were categorized according to their potential frontages to promote walkability. Six categories were indicated from the greater scope of interaction (0-99m) until less favoured interaction (more than 250m).

Node 1 influence lay in 5 blocks in Republica main St. The five street blocks differed in their average categories due to their difference in dimensions as shown in Figure (5-1). Three of these blocks - at the side of the neighbourhood - were categorized as the greatest scope interaction while the other two have medium and medium high scope of interaction. In fact, among all, Node 1 had the largest sized blocks which halt pedestrian motion.

As well, Node 2 was spatially located on Republica crossing Chillàn St with 5 blocks influence. The average block street frontage of the node was detected to be of a fairly great scope of interaction. The blocks ranged in the first and second category of greatest interaction. However, the length gap signified that the lack of diverse modes of transport.

Moving away from the main street, Node 3 had an influence of six blocks that are located along the Open market area. As calculated, the node is the second greatest scope of interaction among the four blocks. That meant that the blocks still promoted pedestrian movement, with a minimum uncomfortable level. The similarity in dimensions as seen in Figure (5-1) and indicated in specifically in Table (5-1) that shows that a minimum length gap does not promote diversity in interaction levels.

On the other hand, Node 4 is located along side of the park influencing morphologically three blocks. These blocks have been ranked the greatest scope of interaction due to their lowest mean. It signifies that blocks promoted walkability of its residents. In addition, from its length gap promoted more diverse transport modes. Remarkably, the node was ranked to morphologically promote human interaction, despite its minimal nodal influence affecting only three blocks.

Nodality	Block	Maximum (m)	Minimum (m)	Length Gap (m)	Mean (m)
Nodality 1	Block 1	218.8	135	83.8	176.9
	Block 2	191.3	135.5	55.8	163.4
	Block 3	137.3	84.4	52.9	110.9
	Block 4	136.5	106.7	29.8	121.6
	Block 5	132	120	12	126.0
Average				**46.86**	**139.75**
Nodality 2	Block 1	151.4	93	58.4	122.2
	Block 2	156	125	31	140.5
	Block 3	134	91	43	112.5
	Block 4	135	126	9	130.5
	Block 5	136	127	9	131.5
Average				**30.1**	**127.4**
Nodality 3	Block 1	135	125.7	9.3	130.4
	Block 2	137	133	4	135.0
	Block 3	121.5	97.8	23.7	109.7
	Block 4	135.9	94.8	41.1	115.4
	Block 5	136	117.6	18.4	126.8
	Block 6	136	134.4	1.6	135.2
Average				**16.4**	**125.4**
Nodality 4	Block 1	107	35.5	71.5	71.3
	Block 2	88.3	22.1	66.2	55.2
	Block 3	85	45	40	65.0
Average				**59.2**	**63.8**

Table 5-1: Detailed street block frontage definition in relation to neighbourhood nodality; Author's construction, 2017.

Nodality	Maximum (m)	Minimum (m)	Mean (m)	Length Gap(m)
Nodality 1 (5 Blocks)	218.8	84.4	139.75	46.86
Nodality 2 (5 Blocks)	156	91	127.4	30.1
Nodality 3 (6 Blocks)	137	94.8	125.4	16.4
Nodality 4 (3 Blocks)	107	22.1	63.8	59.2

Table 5-2: Dimension of street block frontage in RB; Author's construction, 2017.

In summary, the block street frontage is to assess the physical condition of nodes. It was clear that Node 1 has by far the longest average of street frontage, while Node 4 has the shortest. This means that Node 1 had larger blocks which makes it harder for pedestrian to reach certain places in convenience. Moreover, the dimensions of the three blocks in Node 4 which is located in front of the park are seen as optimal for pedestrian use. Coming along with Node 3, despite the high intensity of people's activity noted during observation – Gates and SS methods – still block enhancements has to be made, since its mean didn't range in the comfortable category. The suggestion can be achieved through subdividing blocks and giving local pedestrian accessibility between plots.

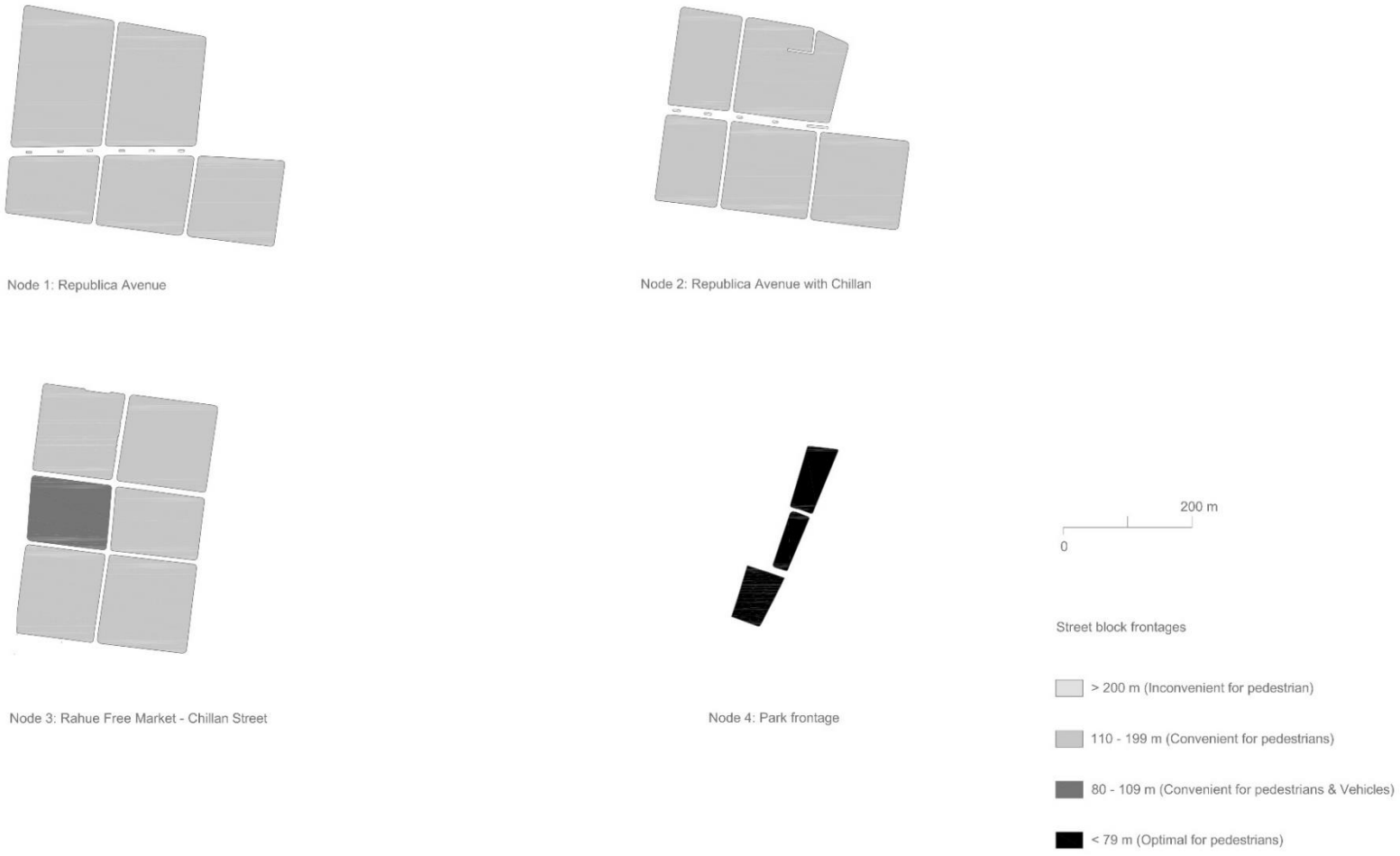


Figure 5-1: Dimensions of street block frontages according to nodality in RB; Author's construction, 2017.

5.2.2 Characterizing nodality level and type

The results of Nodality level includes the analysis of human activity in relation with built-up form characteristics that influences in the node formation. These results are structured to be discussed with the same methodological order of both Gates method, following SS(s). Additionally, the survey compliments the results defining the place of users' provenance.

Referring to Chapter 3 and according to its description, the survey analysis explored people's residential origin, defining each node's level, i.e. levels were mainly targeted in the survey through investigating whether space users live in or out of the neighbourhood of RB. Specifically, it demonstrates if the space beneficiaries are only from the neighbourhood or from the surrounding neighbourhood or from outside the city. This can give a direct approach that can influence the node scale. Another criterion used to define the level was the frequency of people passing by space. It reflected the urgency of space to users, and so demonstrated the importance of the node. On the other hand, the mode of transport was a criterion to be taken into consideration. It also characterized the dominance of each node as a pedestrian or vehicle-led one. Likewise, the node type was targeted with a specific question of declaring users activity in space, owing to categorizing them lately as functional, economic or communal activities (Gehl, 1996). Other related questions to clarify the type of activity were asked to identify the age group and gender.

5.2.2.1 Gates Method Result Analysis

Referencing to the methodology explained in Chapter 2, Gates method was applied in RB to assess people's activity in space. The result represents the analysis of 80 gates recorded in the field during three days along the week. A total of one thousand recorded minutes were transcribed by the team sorted in rounds per gate, in order to calculate the average pedestrian and vehicle movement per weekday and on a weekend - For more details, please refer to Appendix (B).

As a result, two maps are both outcomes to illustrate the analysed data spatially. Accordingly, the first map in Figure (5-3) represents the social organization of people's movement on 13 streets on a week day in RB. Likewise, the second map in Figure (5-5) indicates the vehicle's movement on the same hours. Vehicles included cars, motorcycles and bicycles. Buses and service cars were transcribed, although they were not included

in the result analysis due to their regular circulation routes. The research was more interested to analyse the spontaneous movements of local movements in space. Both maps are divided in six categories from high to low intensity of activity movement. The numbers presented represent the total number passing in street per weekday.

Additionally, weekends were transcribed for two time slots of the day in order to compare it with the weekdays. From the records, a higher charge of people were observed in the late morning and at noon and therefore the decision was taken to accommodate both of them for transcribing the highest time slots to assess liveability of public space. Other graphs are analysed in the chapter to give more insights about the movement variation along daily hours of weekdays and weekend, considering each node and the neighbourhood. The following text explains more in details about the pedestrian and Vehicle movement in each node.

Node 1

Foot-travellers showed a fair amount of movement in the main Republica St, ranging 13,056 to 32,500 pedestrian per weekday. This is distinguished as the highest load of people walking along the node. This can be related with the highest pedestrian movement in the afternoon, representing 88,000 people per weekday approx. A lower intensity of people's movement are seen on the perpendicular secondary streets of Republica St throughout the whole day. Remarkably, the node expected lowest pedestrian movement during lunch time on weekdays and weekends as well. However, weekends seemed to have higher charge of people on street during late mornings and at noon, compared to weekdays.

Vehicle's movement seemed to be manifested as the highest in the neighbourhood due to the direct connection of the city centre with Republica St through the bridge. The node only compromises more than 1 million vehicle passing daily through the node. The highest rates were analysed to take place in the early morning and afternoon. In parallel, Santiago Street have witnessed a fair number of vehicles passing by, however it is considered to be ten times less than what passed by in Republica St On weekends, the node seemed to witness higher numbers of Vehicle movement in late morning and lunch time than weekdays.

Node 2

Equally, the range of pedestrian movement continued the pattern of Node 1 in Republica St, although higher intensity can be seen in Chillàn and Tarapaca Streets than other secondary streets in the neighbourhood. In spatial terms, Chillàn St began to witness higher movements on the cross-road Santiago Street, marking 40,128 pedestrian per weekday. It is interesting to note that despite the high pedestrian intensity on one block away from Santiago Street and on its cross-road, few people were observed to pass by it. This could be related with the fact that only residential buildings were surveyed in the street. Moreover, Node 2 observed lower number of pedestrians on weekends than on weekends. That is due to the fact that the land use influence of the node is dominant in its activity on weekdays; e.g. educational activities. This is clearly explained in the Chapter conclusion, owing to the relation with the following SS(s) and Survey analysis.

Node 2 is considered the second area in RB with highest load of vehicles' movement, calculated to be more than 921,000 vehicle per day. While vehicle movement recorded the highest range in Republica St, the load of vehicles decreased as moving west on the street, i.e. the Western bridge received less numbers than that on east side receiving cars from the centre. Chillàn St received lower number of vehicles than Republica St, yet at the same time fairly high compared to the surrounding area. In the early morning, more than quarter of a million cars and bicycles passed by the node, recording the highest time slot of the weekday with vehicle charge. A similar close rate was noted in the afternoon with more than 233,000 vehicles. In comparison with the weekend, vehicle numbers increased during late morning and lunch time with nearly 353,000 vehicles.

Node 3

In difference with Santiago St, the inner road of Valparaiso St was analysed with a high intensity of pedestrian movement. On the cross-road of Chillàn St and Santiago St recorded one of the highest movements in the whole district with 57,400 approx. pedestrian per weekday. The highest walking load was analysed close to the Open market with 64,512 pedestrian per weekday. Furthermore, Node 3 marked even higher numbers of pedestrians on weekends during late mornings and noon, compared to a normal weekday. In fact, the peak pedestrian load marked 188,544 people passing only in late morning. This highlights a difference of 67,400 people who pass on weekends more than on weekdays during that time slot. Lastly, the node was detected to stand as the most vibrant area in RB for pedestrian movement. It is feasibly clarified through the

morphological features of its mixed-use and commercial influence which is logically more active in the weekends.

The node is not ranked as a vehicle oriented one, despite its daily capacity to receive 735,000 vehicles on weekdays. Concepcion St is highlighted to accept the highest rates of vehicles, especially when getting closer to Chillàn St. Observing the maps in Figure (5-3) and (5-5), Chillan St seemed to be a busy road for vehicles and pedestrians. Nevertheless, it is worthwhile saying that the Open market didn't receive high numbers of vehicles as expected which promotes the commercial activity as a pedestrian dominant node. During weekends, the vehicle movement are noted to have a heavier traffic load only in late morning than weekdays.

Node 4

At first, the Node marked the lowest charge of pedestrian movement as shown in Figure (5-3). In consideration, more people appeared in the early morning in comparison to the other time slots. The drop was observed at noon where only 4,416 pass by each day. On weekends, a higher intensity of pedestrians was shown in late mornings to topple more than double that of the weekday. In spite of the noticeable rise of people's movement on weekends during late mornings, a drop was seen at noon to be nearly equivalent to weekdays.

Likewise, vehicles are barely noted in the specified gates for Node 4 in comparison with others, regardless receiving 320,640 vehicles. The highest charge of cars and bikes were seen on early weekday mornings with a number of 91,580 vehicles approx. An observation was made by a slight increase of vehicles during weekends for late mornings and lunch time. Later, this node will be explain from the point of view of its phenomenon in relation to size and survey analysis.

Node 1

Node 2

Figure 5-2: A collection of pictures for each node as a prototype for four gates per photo. Node 1 : two pictures represent the difference in people's movement in Eastern of Republica St. Node 2: the left picture presents the internal movement throught the day, however the right picture represents the morning movement on Western side of Republica St.; Teamwork captures. 2017

Node 3

Node 4

Figure 5-3: A collection of pictures for each node as a prototype for four gates per photo. Node 3: The left picture presents a calm weekday movement at the Open market, while the right picture presents the main stream supermarket corner. Node 4: The left picture presents an internal neighbourhood street, meanwhile the right one presents a connecting street; Teamwork captures. 2017

Reflections on Rahue Bajo

In general terms, the analysis showed that more than one million pedestrian (1,025,472) walk through the neighbourhood during the day. Surprisingly, the number of pedestrians passing by RB represents a remarkable rate higher than the whole population of Osorno. The peak hours were noted in the afternoon to record 368,832 people walking in RB which represents 36% of the total pedestrian load per day. Likewise, the highest number of pedestrians were recorded in the same time slot for Node 1, Node 2 and Node 3. This is due to the concentration of mixed land uses in these nodes e.g. schools, retail, that promote the active pedestrian movement after lunch. On the other hand, the uppermost pedestrian movement of Node 4 was noted in the early morning which represents the typical expected movement of a residential area for inhabitants to go to work.

Nevertheless, weekends seemed to be more crowded by pedestrians during late mornings and lunch time in RB. On weekends, around 471,100 pedestrian movements were recorded passing by the neighbourhood in only the two indicated time slots. One reason for that, is the high pedestrian load in Node 3 – due to its Open market - representing nearly 56% of the pass byers during those time slots. In other words, employees prefer to go to the market place on weekends which was reflected on the high intensity of human activities on weekends in commercial areas and mixed-used streets.

Republica St is the main avenue in the neighbourhood, even though Chillàn St seemed to be more crowded with pedestrian activity. The load is recognized to increase close to certain areas than others within Chillàn St due to the existence of certain activities that promotes pedestrian activity, e.g. the school in Valparaiso St, and the Open market in Temuco St. Other streets were observed in eastern side of the neighbourhood that doesn't promote social activities, even if their physical morphological dimensions are similar to Chillàn St i.e. the same street dimensions and block patterns are similar in comparison with the parallel streets, in spite of their low occupancy of pedestrian act. This could also be related with the built- up form that is dominant in a slight higher dense residential area – please refer to Chapter 3. The reason is that urban form in the eastern side does not promote interaction activities, in contrast to the western side of the neighbourhood.

Despite the fact that RB has a pedestrian urban form structure – emphasized in the BSF results – its vehicle movement had exceeded its pedestrian one by three times. RB received a total of more than three million vehicles per weekday. In comparison with all

time slots of nodes, vehicles were marked to have a higher number than foot travellers. It can be explained by its direct accessibility from the city centre and high connectivity to the highways of U40 and U22.

Referencing to the hourly observations, the neighbourhood was realized to have lower pedestrian and vehicle movement at lunch time in comparison to other time slots. That means that the type of activities in RB does not promote lunch services, e.g. catering services, cafes. This is not the case for Node 3, where its lowest pedestrian movement is in the evening, due to the type of morning activities that the Node promotes, e.g. schools, open market. The latter discussion regarding the vehicle oriented strategy of RB could be related with the scale debate, since it refers that activities are reached more by people who use cars, i.e. people come from other neighbourhoods to use space. For in more in-depth analysis, the chapter conclusions can explain through cross checking SS(s) and origin survey analysis to reveal the residence area of public users and the type of activities.

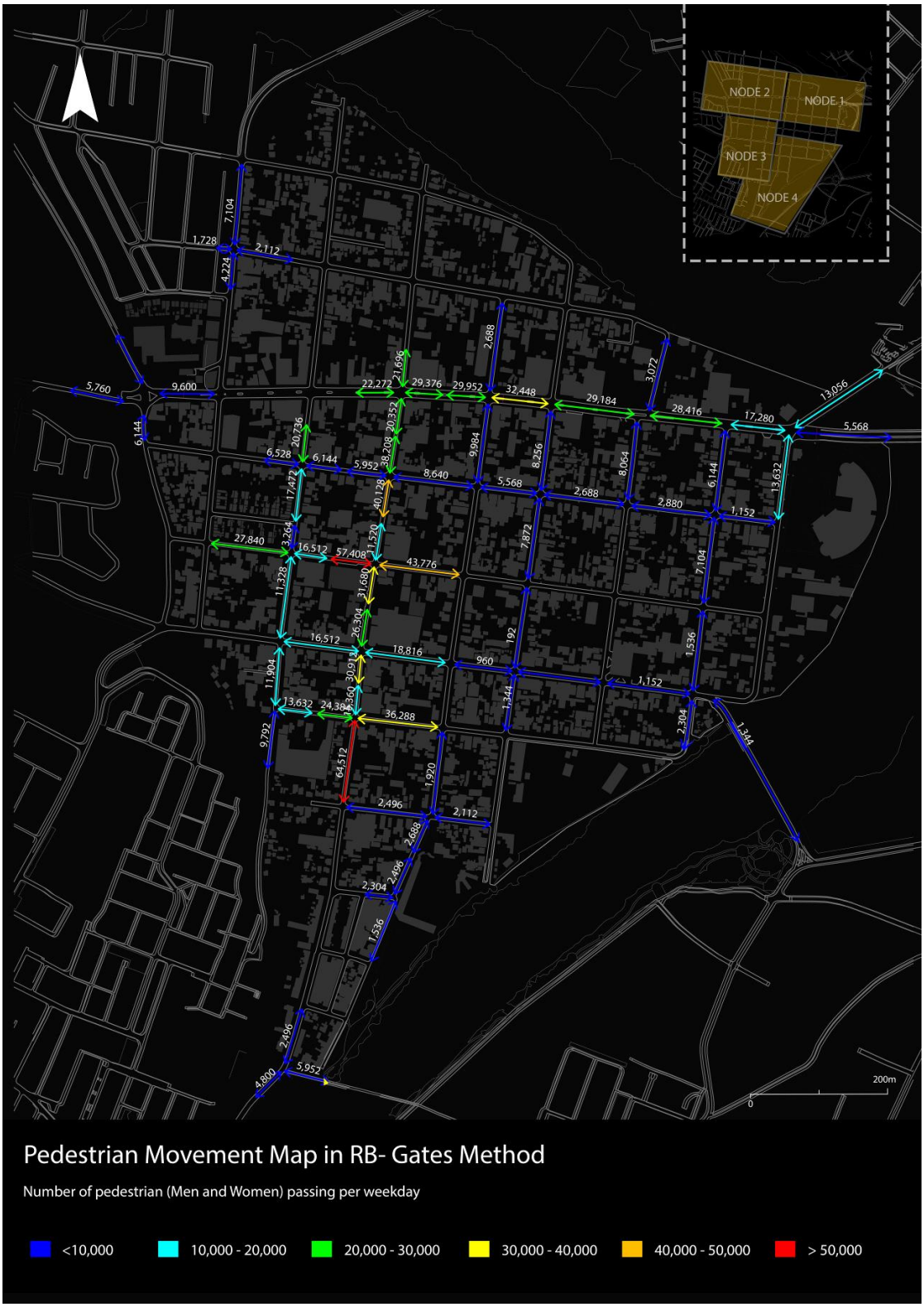


Figure 5-4: Pedestrian Movement Map in RB; Author's construction,2017

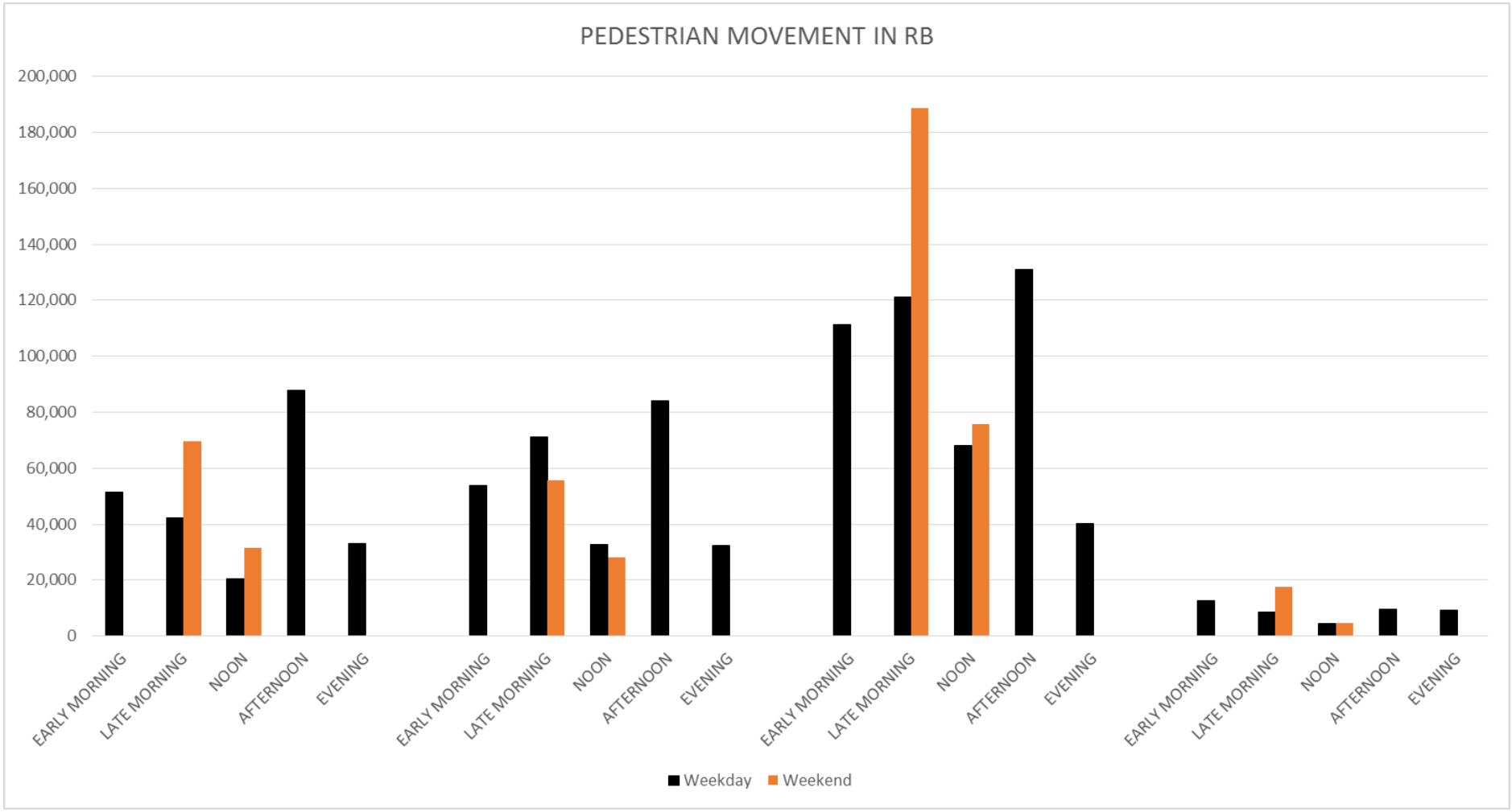


Figure 5-5: Pedestrian Movement across time slots for the four nodes; Author's construction, 2017

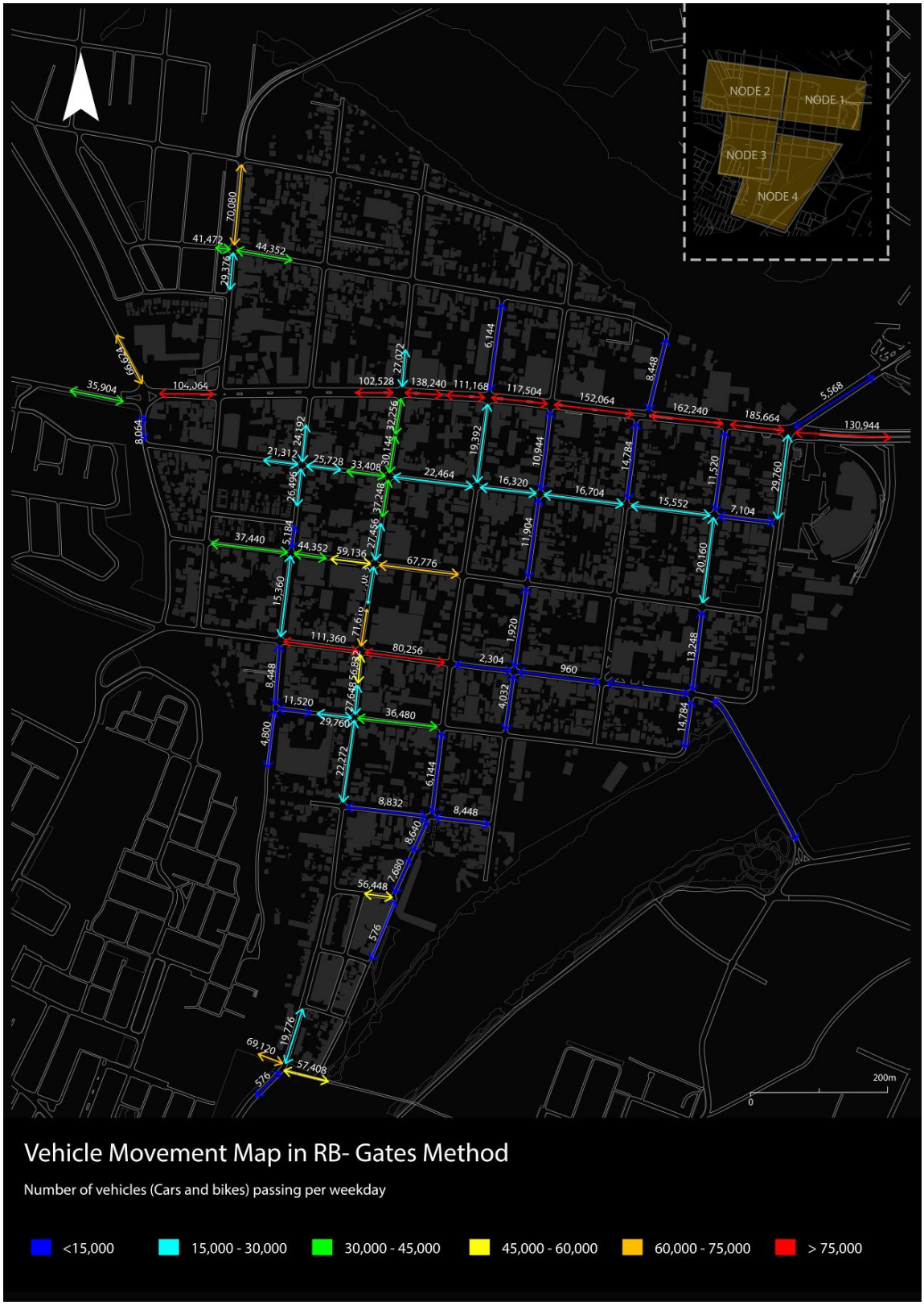


Figure 5-6: Vehicle Movement Map for RB; Author's construction, 2017

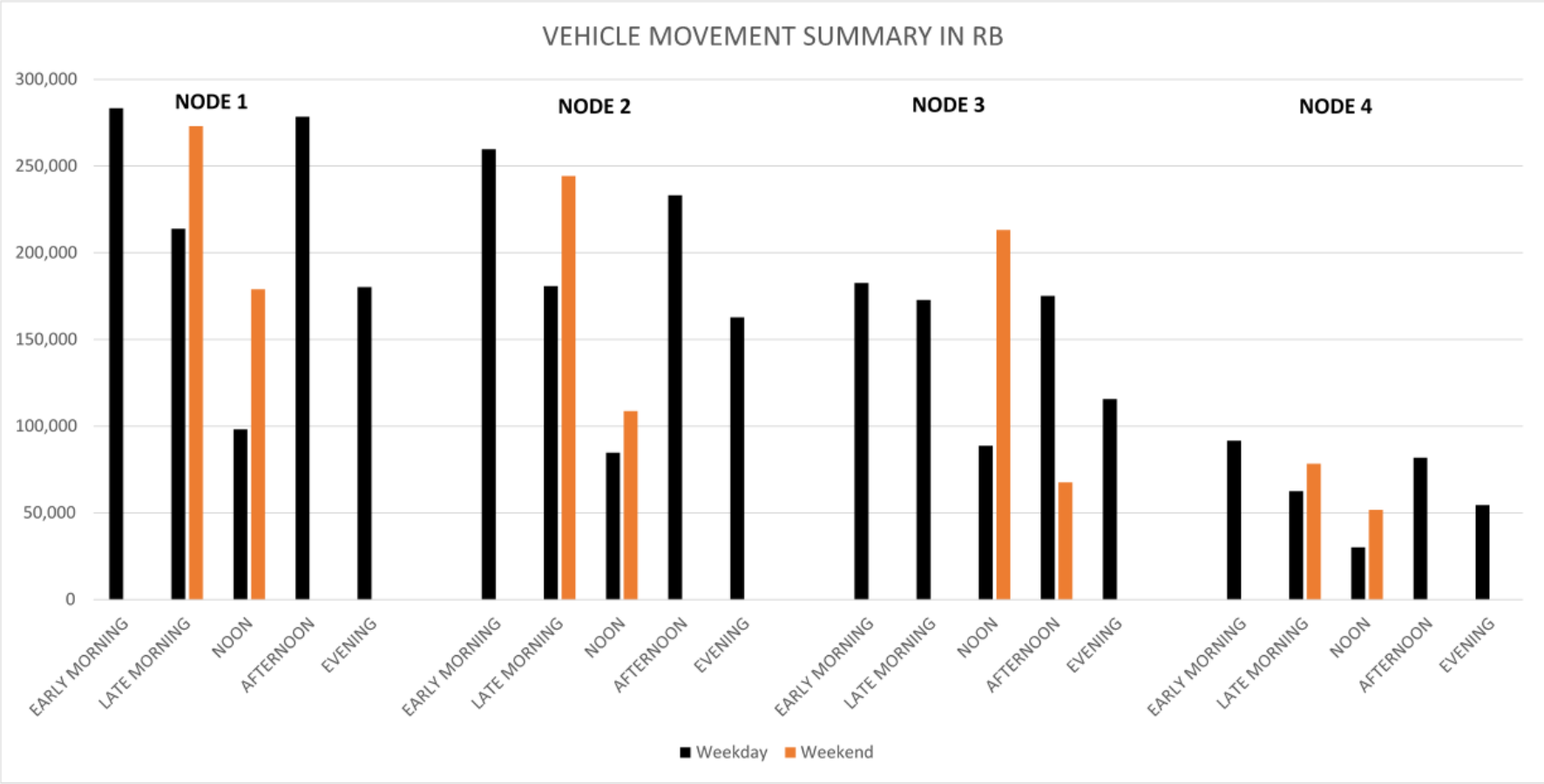


Figure 5-7: Vehicle Movement across time slots for the four nodes; Author's construction, 2017

5.2.2.2 Snapshot Method Result Analysis

A total number of 66 SS(s) were documented in the field distributed on the four nodes. Nodes 1 and 2 were chosen to have one SS to analyse repetitively, however separate SS(s) were identified in Node 3 and 4 according to the difficulty to capture the whole space within an insight. The first day, five captures were transcribed for each SS according to all nodes. The range of each SS was adjusted to 40 minutes. The five time slots were scheduled to be in late morning, lunch time, late afternoon, and at night. Subsequently on the second day, a sample of three captures were transcribed to include early morning, late morning, and lunch time. The third fieldwork day was carried out on a Saturday weekend. A sample of three captures were set in the late morning, lunch, and late afternoon. The three days are overlapped in the transcription of two sample time slots of late morning and lunch time, which gave a platform of cross-cutting analysis of the three time slots in the expected rush hour time. It was intended to transcribe a whole day and to overlap sample captures with the other transcribed days. The two mid-week days were overlapped from late morning and lunch time. On the other hand, the first and third day were overlapped from late morning to afternoon. Since the day condition supposed to influence the movement of the people, two samples of a weekday and a weekend were compared. Here in Chapter 5, it is clearly demonstrated five SS(s) out of the manual 66 documented ones were picked out to show the most vibrant time slots.

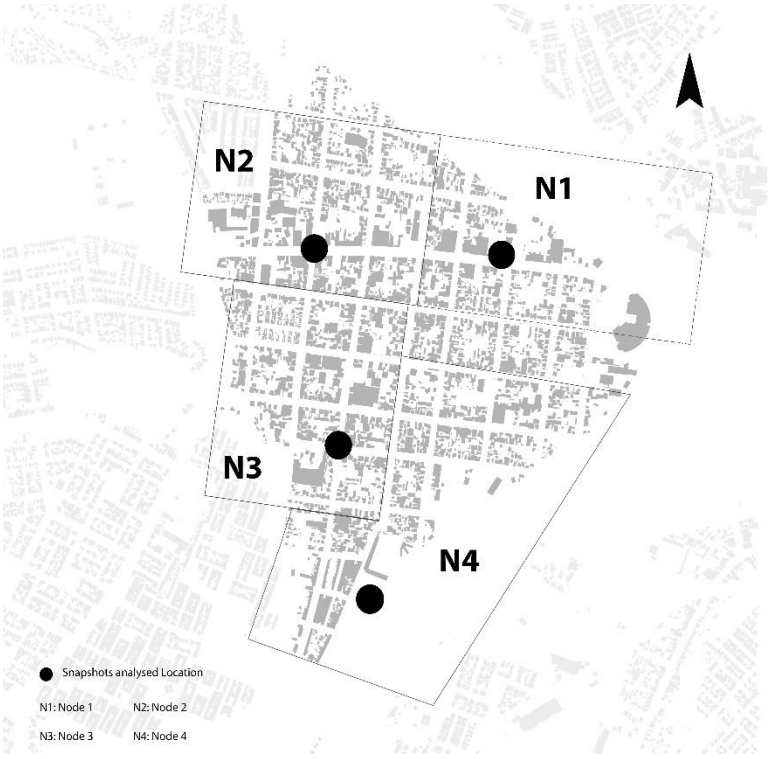


Figure 5-8: Location of Analysed Snapshots in RB; Author's construction, 2017

A potential of assessing three SS(s) in Node 3, since the node was rather intriguing to expect more people due to the concentration of the commercial attractions. The first SS (S3.1) was confronted to be in Chillàn St, on one side of a school and a mainstream supermarket on the other side. This SS was specifically chosen to observe if the current horizontal separated functions promote a node of people's concentration or not. The second SS S(3.2) was an extension of Chillàn St but on the cross-road with Concepcìon St This case is challenged to have another urban morphological form with a commercial function in its corners. The third SS S (3.3) was located to analyse the cross road and the extension in front of the Open market of RB. As well, Node 4 had to be documented and transcribed in two adhesive SS(s); as shown in Figure (5-16) and (5-17); of the park located on the periphery of RB in the South-east side of the neighbourhood.

According to the analysis, SS of maximum concentration of use were chosen to be sampled and prototyped for each node. Figure (5-6) shows the location of the transcribed SSs that would be discussed in the following analysis. In addition, Figures (5-9), (5-11),(5-13),(5-16) and (5-17), represent a detailed documentation of the maximum people's load according to each node.

Node 1

Orienting SS of Node 1, the plaza is located on the neighbourhood's main street of Republica. The plaza is edged with Iquique St from the East, and bordered by a factory and a school from the West and South, respectively. As shown in Figure (5-9), a basketball court separates the public space from the school with an opened access to the plaza. The plaza seemed to be nearly deserted in the early and late morning, according to the documentation of the two week days - Please refer to Appendix (C). It was noticed that people use the edge of the plaza as a pass-by area, barely passing by the green plaza. Later on, the plaza started to witness more people in the late afternoon with kids playing in the court and senior citizens sitting on the bench. An observation that was realized that despite the several benches in the plaza, one certain bench only was noticed to be always occupied when there are senior citizens sitting. A reason behind that might be the location of the bench at the edge of the plaza that gives a certain sense of security because of its orientation to have a building on the back side and a whole view of the plaza on the front side. On the weekend, it was astonishing to observe that on no account there were no kids playing in the court, although the weather conditions were allowing it. Unlikely, the plaza

witnessed another occupancy rate with different age groups in late morning SS of the weekend. However, the SS of the late afternoon had barely witnessed people in the plaza except passing by its sidewalk edge. As demonstrated in Figure (5-9), the highest number of people using space were children who seemed to come only to play in the basketball court after school. Furthermore, senior citizens were transcribed to appear in the same hour (17:30) at the edge of the plaza.

Figure 5-9: Three pictures of Node 1: The first is a capture of the plaza during a weekend. The second and third pictures presents the same area in different hours of the day; Teamwork capture, 2017.

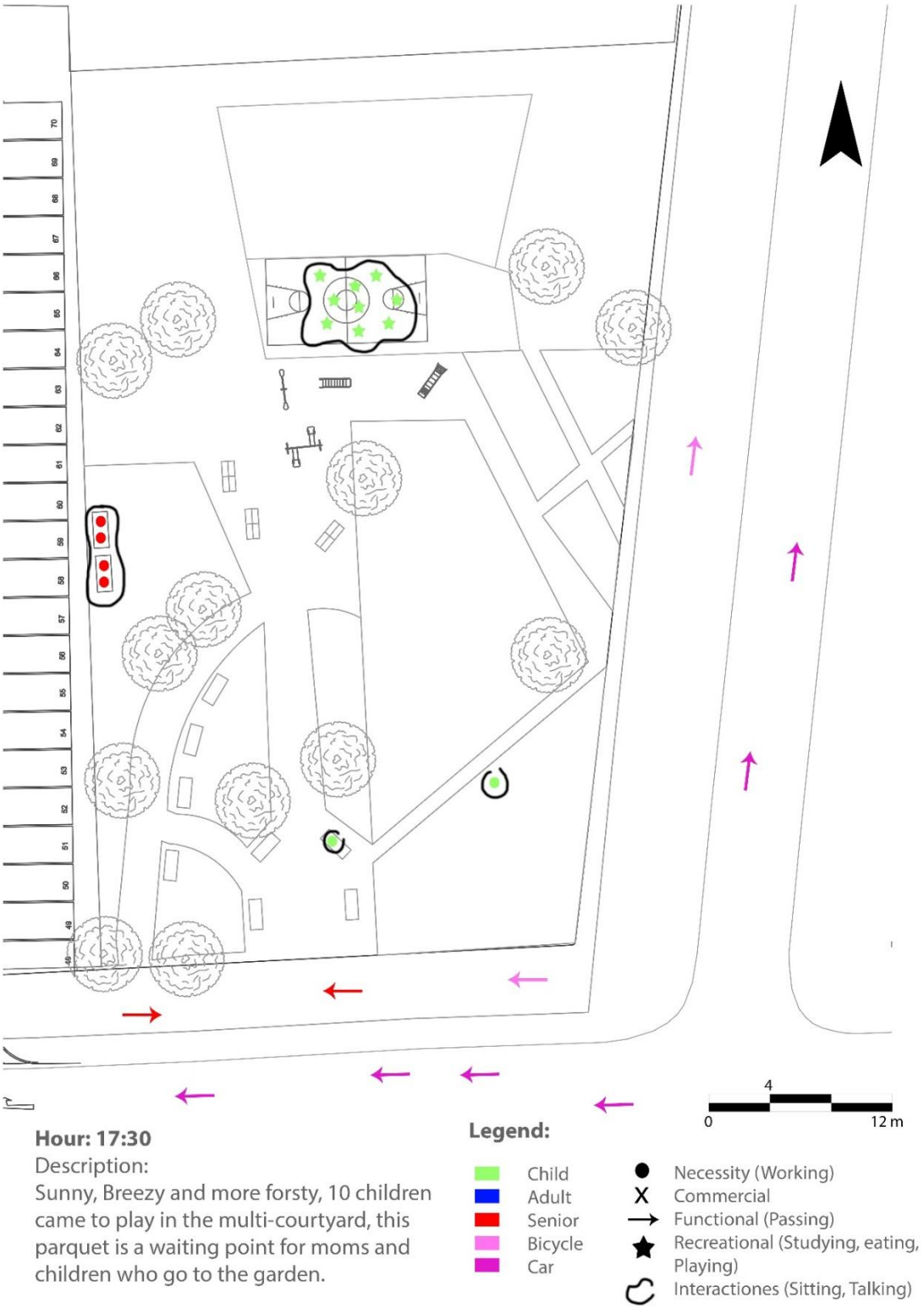


Figure 5-10: Snapshot analysis of Node 1. Author's construction,2017.

Node 2

On the contrary, the morphological type of Node 2 is a cross-road of Republica and Tarapaca Streets where the educational and commercial mixed-use activities are apparent in its corners. Owing to the node observation throughout the day, people used space as a transit area for weekday mornings and lunch time. The results show that the node was vibrant on weekdays during late afternoons. However, still the number of people passing by (dynamic movements) were more dominant than people standing by (static movements). In spite of the low intensity for people's interaction, it was observed to often take place at the school corner. For example, Figure (5-11) is a SS that transcribes the public area at 16:40 for the maximum load of people. The concentration of adults and children were located at the school corner. On weekends, the same rhythm of people's presence was detected to witness less interaction in the mornings till afternoons and a slight higher intensity after four o'clock in the afternoon. In this case, the built-up environment was clear to explain the phenomena. The use of school had a greatly influenced the movement of the area, where weekdays are more observed with pedestrians than weekends. Moreover, the existence of features that promote people's interaction e.g. kiosk, had influenced a static vibrancy. Otherwise, the commercial area around the educational area does not promote interaction of pedestrians, since the retails are more related to mechanical spare parts which does not address common pedestrian customers e.g. parents and teachers.

Figure 5-11: Two snapshots for Node 2 in different hours of the day; Teamwork Capture, 2017

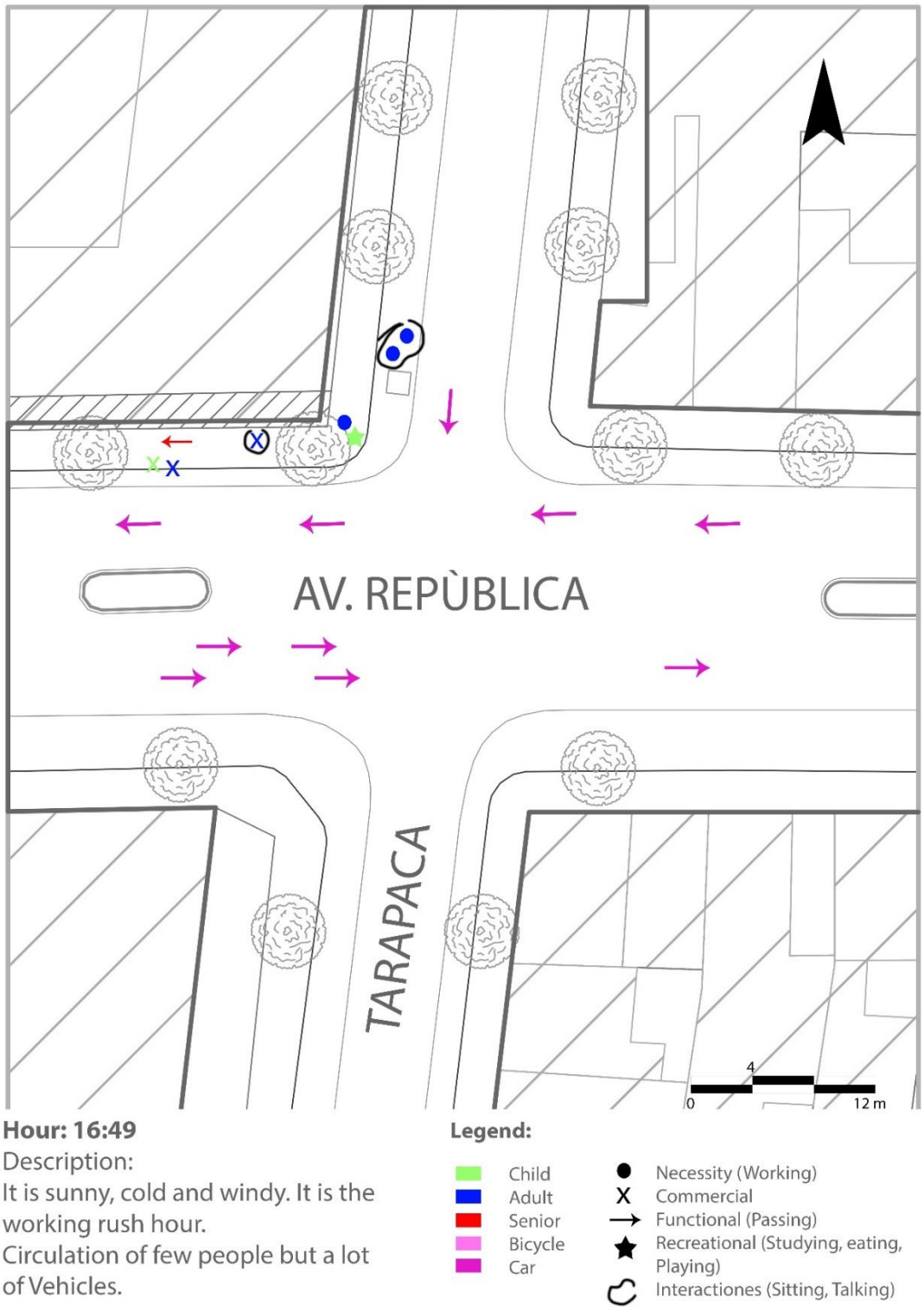


Figure 5-12: Snapshot analysis of Node 2. Author's construction, 2017.

Node 3

Among the three SS documented in Node 3 - Please refer to Appendix (C), the Open market witnessed to have the largest amount of people - S3.3 – Appendix (C). This can be explained due to the attraction of its diverse commercial activities and well connected services. In addition to the Open market as a physical structure, the commercial informal sector were apparent to occupy the public area in front of the market and in its parking area. The vibrancy of the area can be tracked from the morning until late afternoon. The peak hours of people's interaction can be seen in weekdays during lunch time, represented in the time slot between 12:00 until 15:00. Moreover, weekends revealed to rank the highest charge of people, especially from noon until 14:00. This is demonstrated in Figure (5-13) which records the number and location of outdoor commercial activities that takes place in the public area. A number of 38 local sellers were transcribed in space for the highest charge of people on the weekend. However, a noticeable decline in people's movement were recorded to occur from 18:00 on weekdays and earlier from 15:00 on weekends. Crossing the Open market, a local supermarket is located with four chairs that are often occupied by people resting. As well, a common observation perceived was the continuous occupation of parking cars on its side. The interesting reflection is the dynamics of area, due to its high charge of people in the mornings and its minimum uninhabited charge at night. Certain types of urban forms can promote vibrancy at certain hours of the day, therefore the diversity of land-uses that provide this dynamics was needed to maintain the liveability of the node.

On one hand, the cross road of Chillan and Concepciòn Streets was captured during the planned SS time slots. From the transcription, the area was always dominant for dynamic inflows of people. The corner of the supermarket was an occasional waiting area for a single or a couple of people at most A few meters away on Concepciòn St, a bus station with a seat bench was regularly occupied by adults who barely took the bus. In that sense, the public area provided a potential for people's interaction despite its lack of design properties. That is why, people can change the purpose of public furniture due to the necessity of other activities in space; i.e. sitting in a bus station for recreational activities. On the other hand, an SS (S3.1) was to observe the movement on extension of Chillàn St in front of a main stream supermarket. Results showed the instant movements, entering and exiting the supermarket with a minimum people's interaction. A couple of people were

seldomly transcribed in the SS which shows without any doubt it is a vehicle-dominant market. Cross linking land-use and typology analysis revealed that not only commercial activities on its own promote human interaction, however the combination of typological form. For example, the main stream supermarket in Chillàn St has observed a minimum interaction, due to its typological influence in space and its design to be car-oriented.

Figure 5-13: Three pictures for the Snapshots in Node 3; the first two pictures represents the Open-market in different hours of the day. The third picture presents the entrance of the supermarket. Teamwork Capture, 2017.

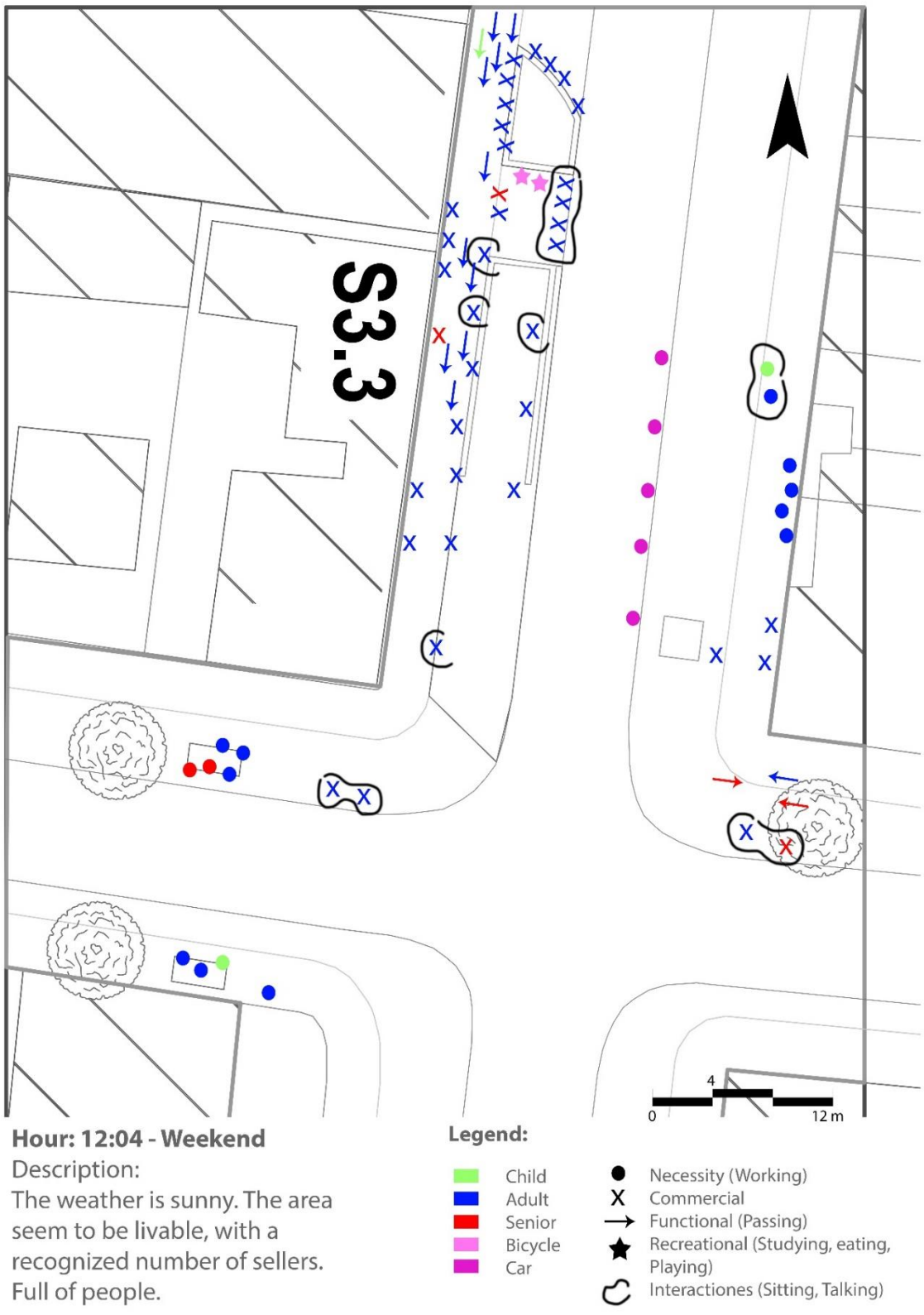


Figure 5-14: Snapshot analysis of Node. Author's construction, 2017.

Node 4

The public park in Node 4 was seen to be deserted of people, in spite of its capacity to accept a number of recreational activities. Due to its large area, two SSs – in Appendix (C) - were transcribed to be able to cover the whole park. On weekdays, the park could be barely used by people for recreational activities. Parents with their children start to appear to use space around 18:00, which can be explained by the fact that their appearance is always after school and working hours. Besides, teenagers were also seen in the same hours meeting for different training activities. Although on weekend the park showed higher liveability, people presence were still witnessed later on in the late afternoon around 18:00 – as shown in Figure (5-15) - with a slight higher occupancy rate than in weekdays. Although the node has rated in BSF as an optimal pedestrian mesh, the park was sensed to be an imposed design, since people are not apparent frequently. This can be related to the morphological form (Please refer to Chapter 3) that revealed the low residential density of the area around it - in addition to the lack of diverse activities – that doesn't promote interaction.

Figure 5-15: The two pictures presents the Snapshots in Node 4 of different places in the park. Author's construction, 2017

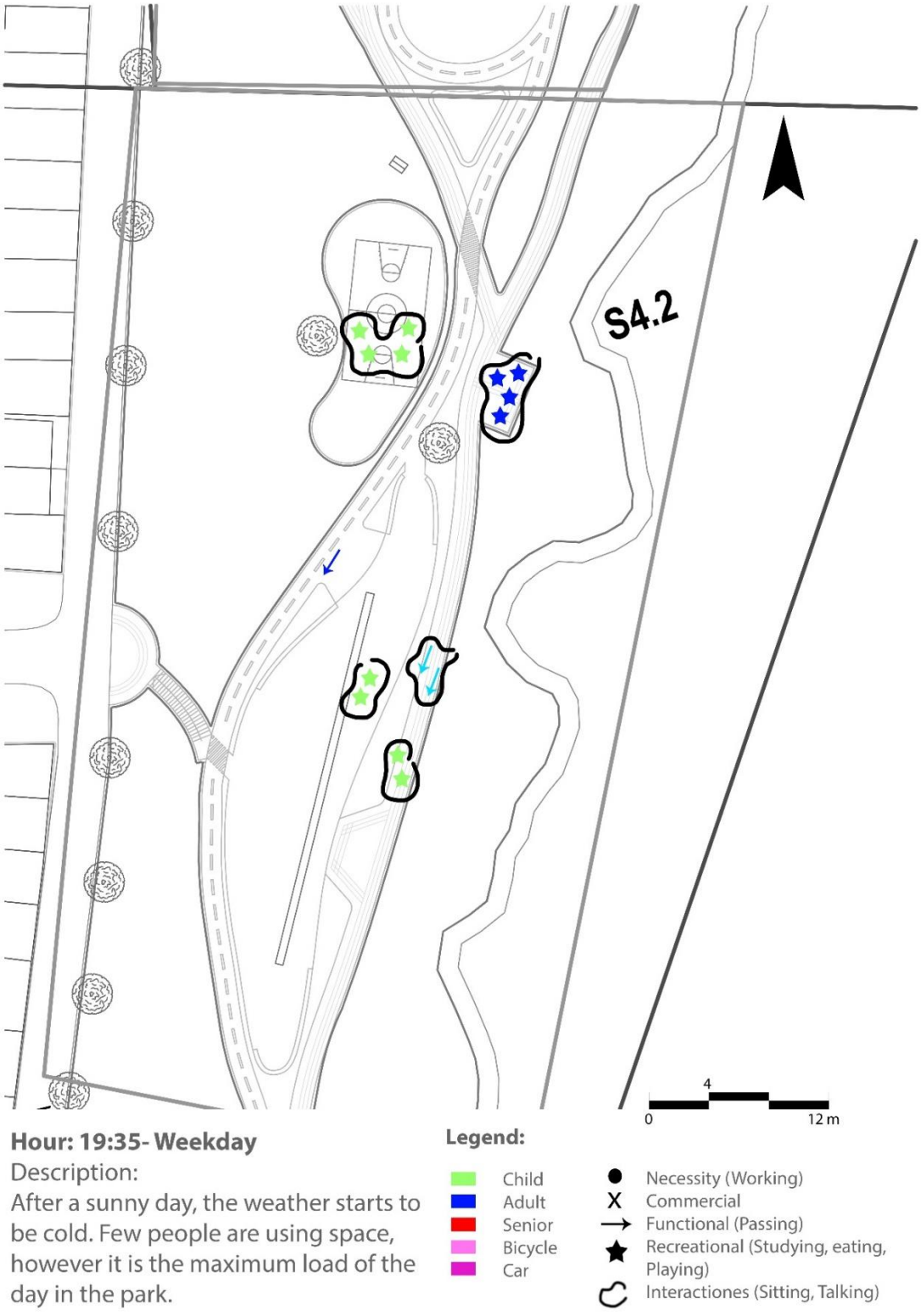


Figure 5-16: Snapshot analysis of Node 4 for the Northern area of the park. Author's construction, 2017.

Figure 5-17: Snapshot analysis of Node 4 for the Southern area of the park. Author's construction, 2017.

5.2.2.3 Travel Origin Survey

Despite that the targeted number of surveys were 240, the team was able to collect 280 surveys which is considered a positive result in the fieldwork. The following results obtained are discussed per node by cross-cutting through the seven questions. The seven questions were analysed in graphs to compare the four nodes together. Occasionally, the information transcribed in a question is cross-checked with another question to analyse the linking gaps and to illustrate the different behaviour of space users. The method of linking information is only done by filtering information on the processed excel sheets. This can be observed throughout the results analysis of nodes. Moreover, the results are explained with the aim of comparing the seven survey criteria between the four nodes reflected in the nodes which would contribute to the final chapter concerned with conclusion of characterizing nodes with their levels and sizes. Regarding the terms used in the following text, survey responders were referenced as space users, beneficiaries, or visitors.

A total number of 280 surveys targeted for collection in the different nodes of the neighbourhood. According to the results shown in Figure (5-1), (5-2), (5-3), (5-4), and (5-5), the majority of the survey was accomplished in the first two week days that were conducted. As shown in Figure (5-17) responders were sorted according to their age group for the whole neighbourhood of RB to give an overview of the fieldwork analysis and responders. As a general citation for the whole analysis and nodes, a majority of 39% of the responders belonged to the age group between 36-59 years. This represented the dominance of middle-aged adults who are apparent in public areas of RB throughout the day. Responders who occupied the second place with a 23% belonged to

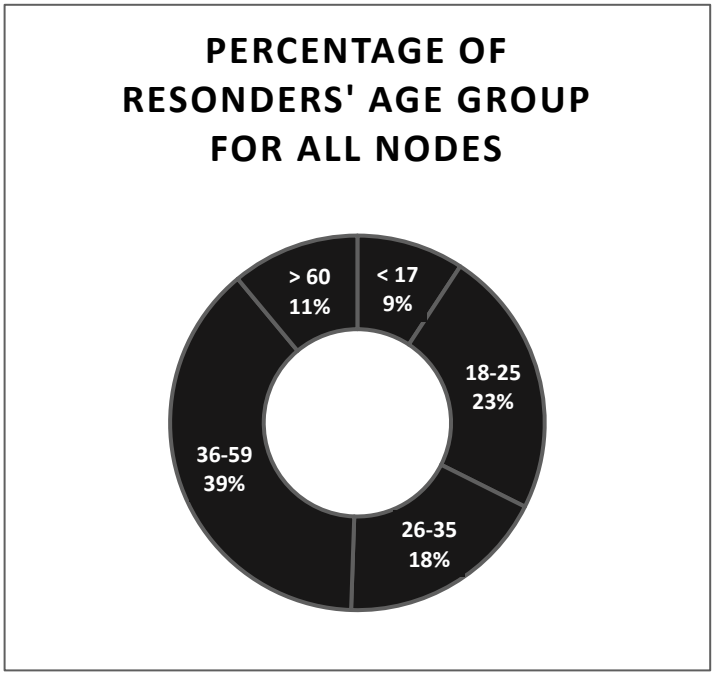


Figure 5-18: Total percentage of responders according to their age group; Author's construction, 2017

the age group of youth between 18-25 years. This can be further explained by their high percentage of responses in Node 1. A common observation recognized was the low percentages of responders of senior citizens and teenagers. This can be explained through two assumptions; the first is that teenagers were not easily present in public spaces. A reason for that, the survey days coincided with school hours which limited the presence of teenagers in such public spaces. The second assumption is built on actual experience - during collecting field data – which was the disinterest of senior groups to respond to the questionnaires.

Node 1

From the random sample surveyed, the percentages of responders are closely equal with a slight surge in females with 55% and 44% representing males. In further detail, the majority of responders belonged to the youth group (18 to 25) with 35%, followed by two equal percentages of 25% in both groups of (26-35) and (36-59).

According to the study conducted in Node 1, it showed that nearly 30% of the people who exist in public spaces live in Rahue Alto passing by the neighbourhood for their work activities. This came from users who benefit from space for recreational activities. A similar percentage of responders live in RB and their main activity was related to work followed by recreational purposes. It was found that a low percentage of 2.7% of responders only live in the city centre, despite the close distance between Node 1 and city centre. Considering the activity analysis, it was recorded that 36% of space users were passing by the node for working purposes, which sets the node mainly as a functional activity one. This can be explained in the conclusions. Moreover the rest of the other activities were studying, shopping, and administrative purposes; follow a nearly equivalent flow by responders.

Close to half of the space users, 46.8% were analysed to have frequent daily visits to the node with a majority of intensity two times a day. The majority of the frequent daily visits were investigated to find out that the greater number are residents of RB. In order to additionally detail frequency, half of responders were using space in morning periods. It could have been even of a higher percentage (83%) if responders who answered the questionnaire to come in the *morning and afternoon (33%)* were both taken into consideration. Considering visitors on a daily basis, it was recognized that nearly almost of them came to public space on foot. However in general terms, walking on foot is

considered the main mode of transport (36%) among visitors. A nearly equivalent percentage (33%) of visitors use the bus as a means of transport.

Node 2

The survey tackled both genders equally in Node 2 with a percentage difference between females and males (50% and 49.2%), respectively. More interesting, Node 2 has the highest percentage of questioned senior citizens among other nodes occupying 37% approx. of its total of survey responders. However, a higher percentage of half of the node responders belonged to the age group of 36-59 years.

Due to the location of the node being exposed to mixed-used and commercial buildings in Chillàn St, it was more likely to expect the result that nearly half of space users were shopping in the node. Approximately 27% of the responders claimed to be using the space for working purposes. This can have the possibility of either responders just passing by space to reach work or occupying space for commercial purposes as their work place. This information can be verified when linked with the SS results to confirm and correlate the people's movement in space. Unlike Node 1, the majority of responders had been marked with nearly 46% of them living in RB, and passing mainly for shopping, in addition to some groups who were pass-byers to work or for administrative purposes. The succeeding group has been found to live in Rahue Alto with a 40.7% of the total number of responders and mainly involved in commercial activity purposes.

With reference to the frequency category, more than half of visitors came on daily basis to the node. The intensity of people visiting the space seemed to differ than other nodes, i.e. mark-up for multiple visits in mornings and afternoons more than single daily visits – Figure (5-21). Through correlating both information, it was proven by filtering data that nearly half of the daily visitors were the same who came in both mornings and afternoons. Adding a third layer of activity correlation, various purposes were observed by this group from shopping, administrative and working purposes. The majority of them came from the neighbourhood of RB and Rahue Alto on foot. Nevertheless, the bus and taxi seemed to be more or less an equal preference (20% and 22% respectively) to space users.

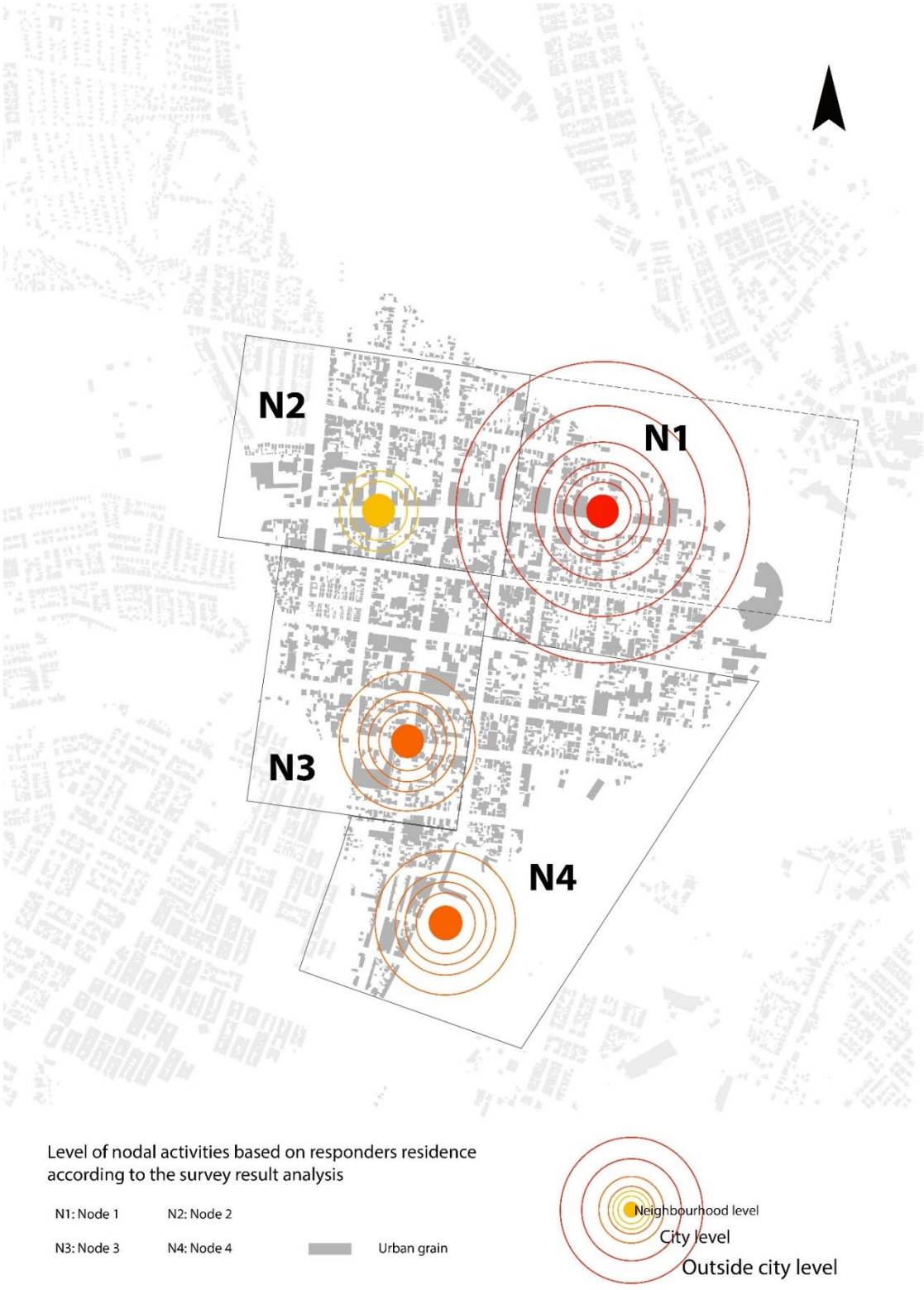


Figure 5-19: Level of Nodal activities based on responders residence according to the survey analysis. Author's construction, 2017.

Node 3

Female responders occupied a slightly higher percentage in Node 3 (57%) than male responders (43%). Similarly to Node 2, nearly half of the responders belonged to the age group 36-59 years. However, the second highest percentage belonged to the youth age group (23.8%). Worth mentioning, another close percentage was that of the age group of 26-35. In this sense, 92% of the survey responders belonged to three main age groups (18-59) representing the main working force.

According to space users who were questioned in the node, close to half of them (46%) are residents of Rahue Alto. It was also interesting to witness that an equal percentage of space users were from RB residents and people who lived outside of the vicinity of the adjacent neighbourhoods. During fieldwork, when the latter users were further questioned about their residence areas, a recognized number of them responded to live outside of Osorno in the surrounding farms. Noticeably, both groups of RB residents and outsiders use public space for the same reasons of commercial benefits and work purposes.

Recognizing the dominant commercial location of the Open market in Node 3, close to half of the users claimed to use space for working purposes (46%). It was obvious in SS analysis that most of the working purposes were related to commercial interactions. Therefore, the percentage that followed after, occupied 27% of responders who come for commercial purposes and this is expected to follow the supply and demand rule. A smaller percentage was detected for recreational purposes occupying 13% approx. of space users.

Following the main stream of nodes' frequency, the highest percentage of visitors were marked to come daily. Half of these visitors seem to come twice a day and the other half was equally distributed between people who came often in the morning and others who came at night. These visitors are further known to come mainly either by bus or on foot. Moreover, the general analysis of intensity indicated that visitors seemed to come in mornings and afternoons. While 32% of the total visitors came in the morning, 43% of them use the bus to commute in the node. A practical notice was observed in the field, that were people who referred to the bus as the same preference of taxi due to the special system used in some of the Chilean cities called the *collectivo* or collective taxis.

Node 4

Given this node special situation, the public targeted area was a challenge to the aspect of finding people to respond to the survey. Another practical challenge faced was that responders were met in groups and replied to one questionnaire which resulted in a shortage of the number of targeted surveys. Despite the challenge, a number of 48 surveys were conducted in the field to make a random sample for the park visitors. The sample was taken as it is to calculate its percentages as a sufficient prototype.

A slightly higher percentage of male (56.2%) responders were observed in the analysis, whereas 43.8% were occupied by female responders. With regards to age group, the same pattern of the earlier two nodes followed here in Node 4 which allowed 38.4% of its responders to be represented by the age group 36-59 years. Generally, the rest of the groups were witnessed to have a harmonic indicative range of responders from 10% to 18% approx.

From the findings of space users' residence area, the highest percentage of users were living in the city centre, marking the highest percentage amongst all nodes, i.e. most of the residents who passed through RB and live in the city centre, mainly visited Node 4 for the park. Following the same pattern of the previous nodes, residents from Rahue Alto occupied the second place of responders. The residents of RB came in the third place of space beneficiaries. This demonstrates the scale debate of this node, since beneficiaries come from outside the neighbourhood. However, it reveals the same dramatic problem that was discussed in the latter chapter of the minimum occupancy of residents, especially from the neighbourhood that was designed for, despite the well-designed pattern of the park. According to the activities occupied by space users as mentioned above, more than 69% of beneficiaries were using the park for recreational purposes. Additionally, shopping and working activities had ranked the same in comparison with each other (12.2%). The results are quite predicted, since the node was selected as an example of separation of functions in the neighbourhood.

The frequency recorded in this node seemed to take another track than the previous nodes, in which 25% of visitors came weekly for recreational activities. The intensity is assessed to record approx. 43% of visitors to come in the morning followed by a 30% preference to come mornings and afternoons. Consequently, this would maximize the intensity of morning visitors to reach 73%. More about the mode of transport, this node

succeeded the other nodes with the highest number of visitors who come on foot occupying 66% of its comers.

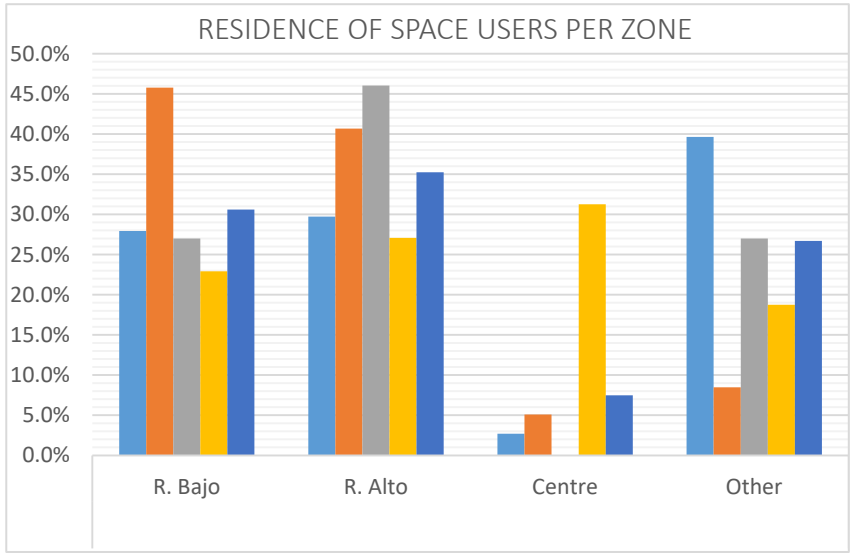


Figure 5-20: Living place of space users for RB; Author's construction based on the result analysis; 2017

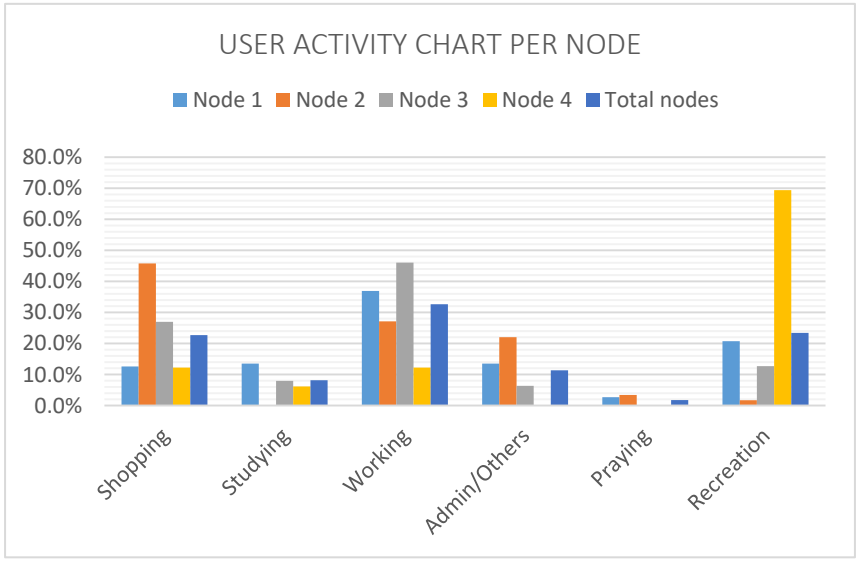


Figure 5-21: User activity chart for RB; Author's construction based on the result analysis; 2017

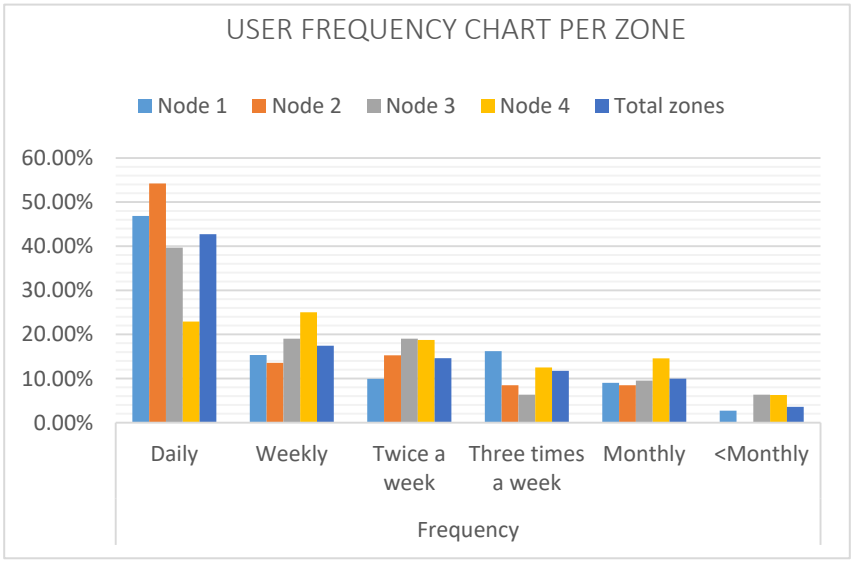


Figure 5-22: User Frequency chart for RB; Author's construction based on the result analysis; 2017

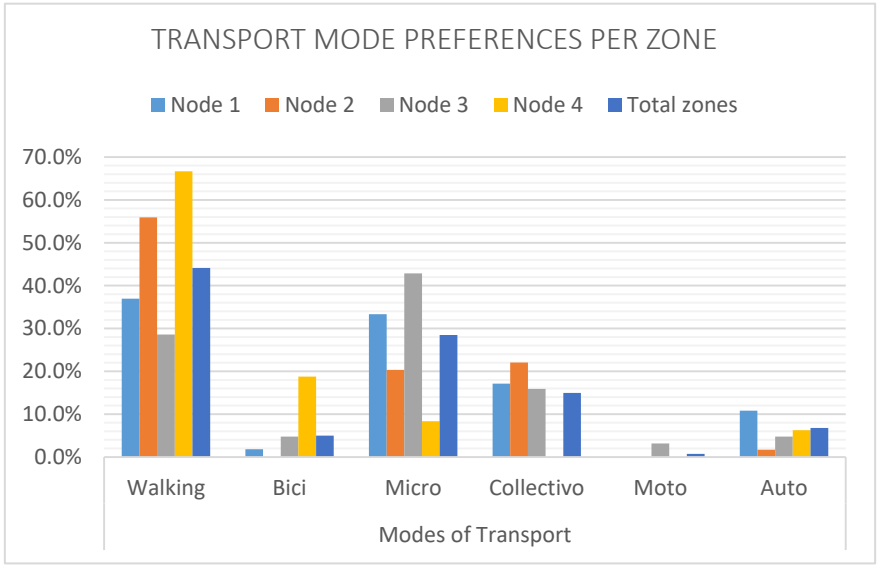


Figure 5-23: Transport modes used by space users for RB; Author's construction based on the result analysis; 2017

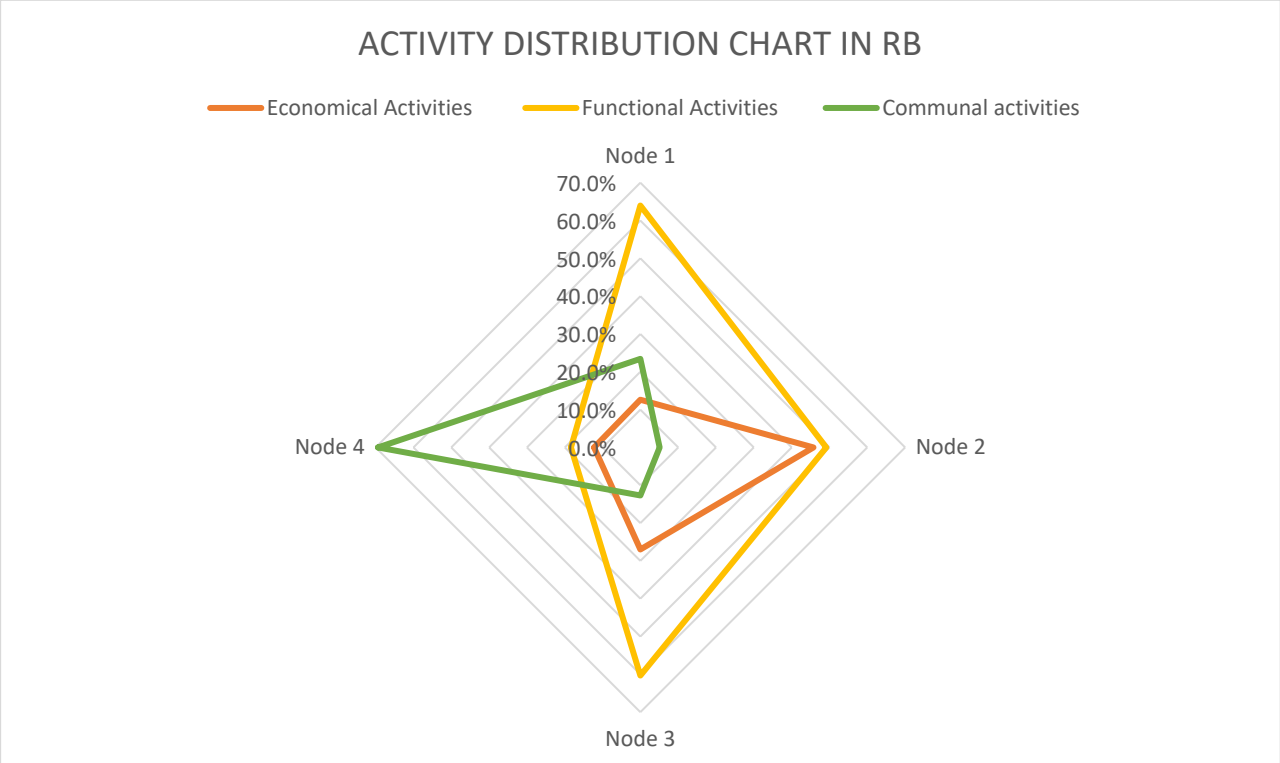


Figure 5-24: Activity distribution chart per node based on compilation analysis; Author's construction; 2017

Concluding from Interaction Analysis, a map of nodal activities and their hierarchical influence was created to demonstrate the dominant activities of each node in RB as well as their level of influence. As a result, Figure (5-24) explains the four selected nodes with their main activities in a map. To begin with Node 1, it is characterized as a functional activity node with an influence of city level, since the majority of people who seek the node come from the city peripheries. Node 2 is slightly dominant as a functional activity followed by an economic activity. That means people who use space are either seeking their work or school or shopping. Since the majority of users live in Rahue Bajo, that ranks Node 2 as a neighbourhood influenced node. Sequentially, Node 3 has a dominant functional activity of its space. It was recognized that this node has a lot of beneficiaries from Rahue Alto, which ranks it in the medium influence attracting users from the surrounding neighbourhoods. Finally, Node 4 leads in its communal activities which people demonstrated to use. The nodal influence is in the same hierarchical level of Node 3 as it attracts its majority of users from the surrounding neighbourhoods, despite that people live in the city centre. The survey analysis characterized nodal activities to be dominated in

functional activities among all nodes, which categorizes public spaces as of poor quality according to Gehl's method to relate outdoor activities and the physical environment (Gehl, 1996). In RB, space users seemed to maximize their necessary activities (either functional or economic) and at the same time minimize their communal activities

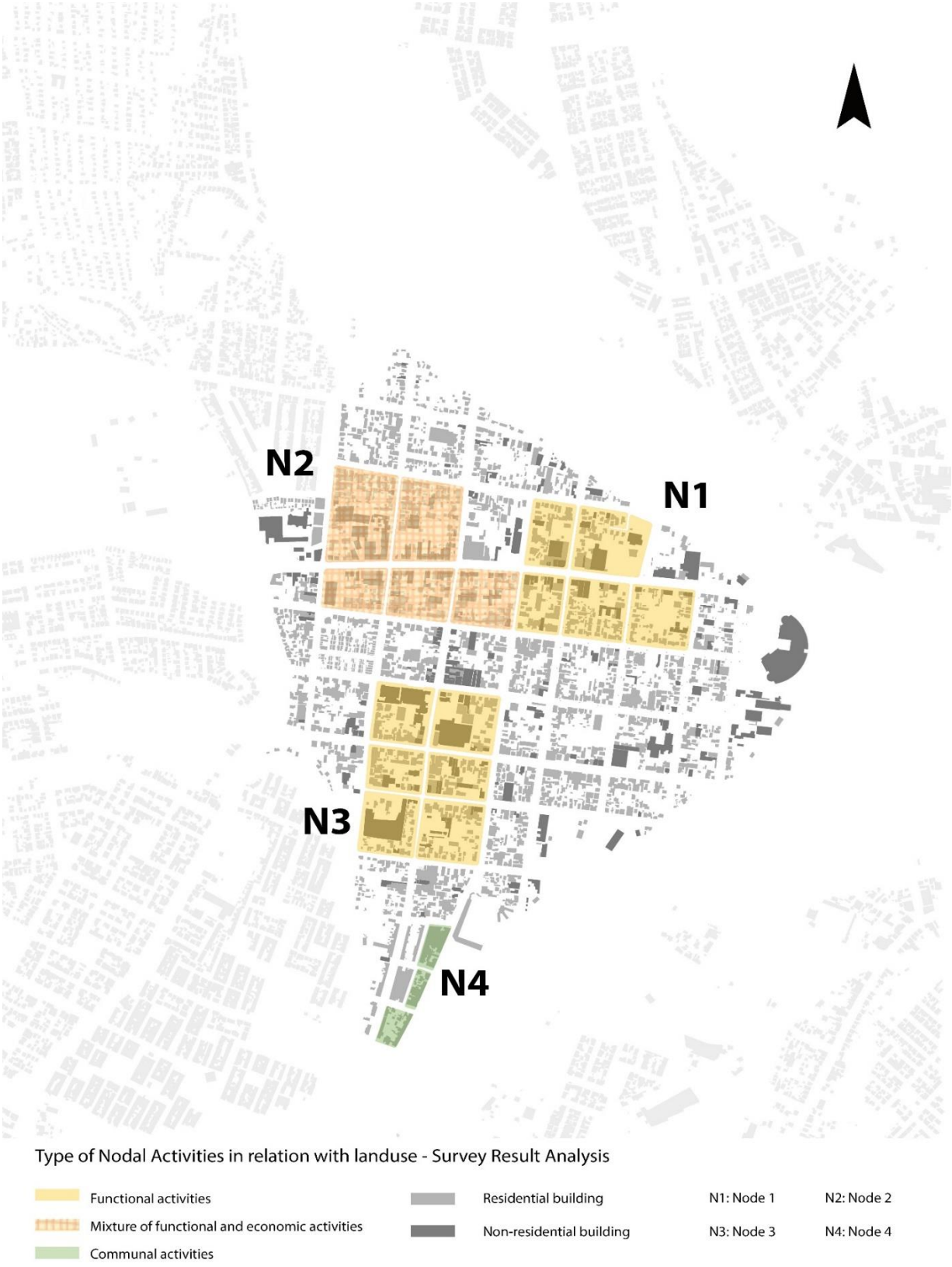


Figure 5-25: Map for type of nodal activities in relation with land use

5.3 Collective Reflections on Rahue Bajo

As mentioned in the literature, model designs have resulted in a subsequent gap between good looking designs and people's interaction in space. In fact, this phenomenon was clearly seen in the case study of RB. What the research was trying to demonstrate is the missing link that should be known by planners of how urban form can influence people's activity in a space. People's perception about space and how they interact outdoor activities is an adaptable response of built-up environment. Through putting nodality into act, the following results help determining the general trend of RB through characterization of size, level and type of nodes. The collective reflections on RB is a composite of a summary results of nodal characteristics through an illustrating matrix.

In general terms, the analysis shows that more than one million pedestrian movements (1,025,472) are taking place in the neighbourhood during the day. Surprisingly, the number of pedestrians passing by RB represents a remarkable rate higher than the whole population of Osorno. The number is not signified as an absolute number, however it demonstrates the number of movements in the area. Peak hours were noted in the afternoon to record 368,832 people walking in RB which represents 36% of the total pedestrian load per day. Likewise, the highest number of pedestrians were recorded in the same time slot for Node 1, Node 2 and Node 3. However, the uppermost pedestrian movement of Node 4 was noted in the early morning. Nevertheless, weekends seemed to be more crowded by pedestrians during late mornings and at lunch time in RB. On weekends, around 471,100 were passing by the neighbourhood in the two only time slots. One reason for that, is the high pedestrian load in Node 3 representing nearly 56% of the foot travellers during those time slots. One claim that could arise from the previous findings, is the high vibrancy of the neighbourhood. The unexpected numbers can reveal the importance of RB according to Osorno, however the identity.

In spatial terms, the preference of pedestrians in RB seemed to take more frequently Republica St and Chillàn St than others. Even though Republica St is the main avenue in the neighbourhood, Chillàn St seemed to be more crowded with pedestrian activities. The load is recognized to increase close to certain areas than others within Chillàn St due to the existence of certain activities that promote pedestrian activity, e.g. the school in Valparaiso St, and the Open market in Temuco St. In contrast, the Eastern side of the

neighbourhood was observed to be less crowded and hence doesn't promote social activities, despite the fact that their morphological dimensions have similar features. That is to say, Chillàn St has the same street dimensions and nearly similar block patterns in comparison with the parallel streets, in spite of their low occupancy of pedestrian act.

In summary, RB is considered a car oriented neighbourhood receiving more than three million vehicles per weekday. This is considered three times higher than the pedestrian load on its streets. In comparison with all time slots of nodes, vehicles were marked to have a higher number than foot travellers. Referring to the hourly observations, the neighbourhood was realized to have lighter of both pedestrian and vehicle movements at lunch time in comparison to other time slots. That means the type of activities in RB does not promote lunch services, e.g. catering services, and cafes. This is not the case for Node 3, where its lowest pedestrian movement is in the evening, due to the type of morning activities that the Node promotes, e.g. schools, and the Open market.

The latter discussion regarding the vehicle oriented strategy of RB could be related to the scale debate, since it refers explicitly that activities are reached more by people who use cars, i.e. people come from other neighbourhoods to use space. For more in-depth analysis, the chapter conclusions can also be explained by cross checking the SS and Interaction Analysis via questionnaire to reveal the residence area of public users and the type of activities.

According to the SS analysis, it was realized that the intended designed public areas have barely witnessed people to interact in space. The second point to be noted that the expected areas to promote human activities was observed as more rapid dynamic actions than static ones. The only node that experienced the highest contact of human activities was Note 3 due to the promotion of commercial activities. The Open market was seen as a successful example, however the diversity of activities had not been apparent.

With reference to the analysis, nearly 50% of the responders in Nodes 2 and 3 were of the same group, while 37% in Node 4 and 35% in Node 1 also belonged to the same age group, compromising the majority of responders. Unlikely to what has been demonstrated in Node 1, responders seemed to be of a majority age group between 18-25 years; with a 35% of total responders in the node; followed by equal respondents from 26-35 and 36-59 years with each at 25%. The gender dominance was not recognized in the survey results with reference to all nodes.

The majority of people using public spaces in RB lived in Rahue Alto with 35% of the total space users, followed by the neighbourhood residents who represented a 30% share in public areas. The rest of space users came from outside the categorised fields, representing the city peripheries and the peri-urban area around Osorno. More about the type of activities used in public spaces in RB, Figure (5-24) explains the dominance of the activity of each node. As a result, three nodes were recognized to be dominant in the functional activities, which means that the majority of people using public space were targeting their work place, schools or public institutions. Except in Node 4 which was identified to be dominated by communal activities, in spite of the low frequency of people.

Node 4 was noted that it is the least attractive area to neighbourhood residents, in spite of the existence of a large park. This case can be related with previous researchers – such as: Whyte (1988), Mozingo (1995) and Andreson (2011) - who observed vitality of urban space as mentioned in Chapter 2. The observation on Midtown Manhattan where he faced the same phenomena that corner plazas were more attractive than a large park (Bosselmann, 2008). This can be explained in several possible reason that could be applied on RB case. The first is that the invisibility of the park to pedestrians and therefore people who visit the place must seek it. This makes sense that people from other neighbourhoods are recorded to frequently visit the park more than RB residents. Another factor is the location and design of the park that could discourage people going. More specifically, it can be observed in public space by the lack of seats which he recommended to be there. One more factor that could explain the minimum charge of people is the idea of this park as a place to rest, read a book or talk to a person who one had come with. Further explanation can be reflected on the “Proxemic Theory” of Gehl (1987)– please refer to Chapter 1 – which explains that people can sit and watch in the presence of others. In that sense, people are discouraged to sit in deserted areas.

According to modes of transport, the highest percentage of responders among all nodes claimed to walk to the determined nodes. This is interesting to relate this outcome with the morphological structure of nodes. (Morphological structure of RB promotes pedestrian movement). This is why, the majority of space users come from the surrounding neighbourhoods. It was observed that the highest percentage in all nodes were responders who had a daily duty occupying 40-60% among others. However, Node 4 seemed to have a lower percentage in daily occupancy than weekly frequency. Analysing the nodes

summary shown in Figure (5-15) - in spite of the fluctuation that appears in each node - weekly visits occupied the second percentage of space users after the daily visits. This gives the necessity of the four nodes, according to 60% of space users in realizing RB being part of their daily and weekly life.

5.4 Nodal Hierarchy Matrix

As a result, a matrix of nodal hierarchy is formulated to describe the characteristics classified by their size, level and type. The compiled matrix shown in Table (5-3) helped to correlate the four nodes in order to relate factors of urban form that influence human activities in space. In addition, the overview of holistic overview could help relating the three characteristics to understand the scale of the neighbourhood.

Node 1 could be summarized that the blocks are nearly convenient for pedestrian movement, however a finer mesh is recommended to promote people to move within the block. People usually pass by the node for functional activities which can be understood in the deserted open areas. The following features characterize the level of nodality:

- The highest pedestrian movement is on afternoon weekdays. (87,936 ped./day)
- The highest vehicle movement is on early morning weekday. (283,392 veh./day)
- Highest static interaction in outer space is recorded on late afternoon with children playing in court.
- Outer space is deserted especially in the morning.
- The nodal influence extends to outside city level, i.e. people come from outside the city are apparent.

Concerning Node 2, the average dimensions of block size are in the range of convenient pedestrian movement, despite the necessity for the bigger blocks to have internal finer mesh. People come for economic as well as functional activities on daily frequent basis. In spite that Node 1 and Node 2 are located on the same street with the similar typological features, Node 2 appeared to have more commercial activities. In relation with nodality level, the following characteristics are explained:

- The highest pedestrian movement is on afternoon weekdays. (84,096 ped./day)
- The highest vehicle movement is on early morning weekday. (180,672 veh./day)

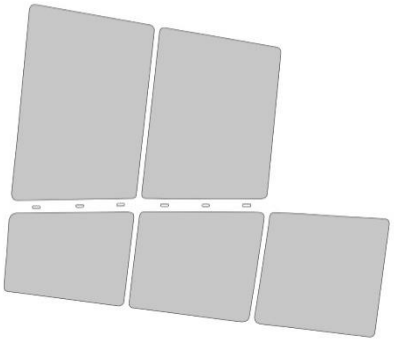
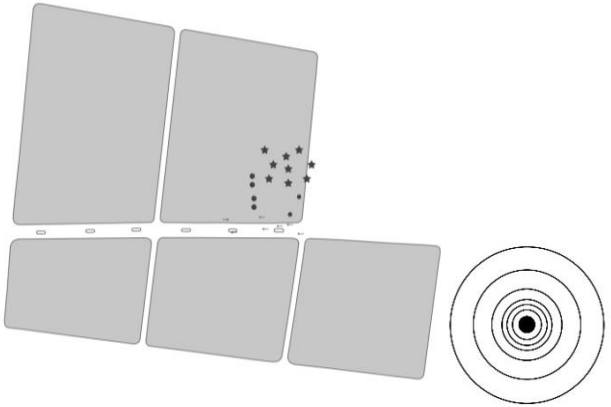
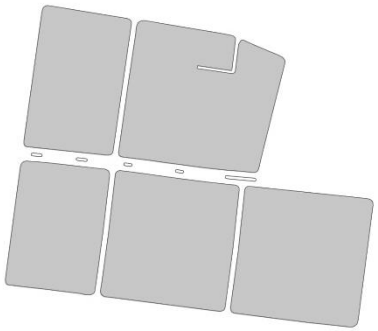
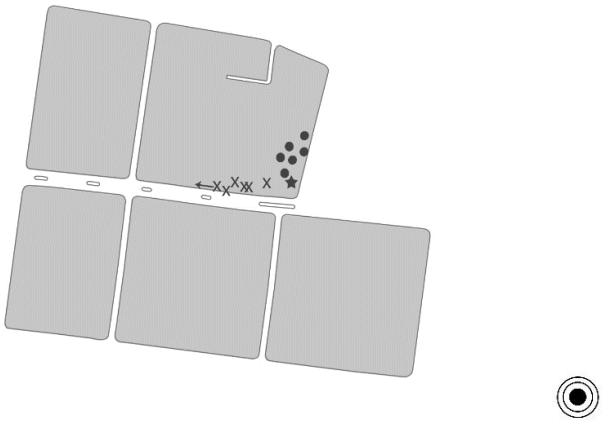
- Highest static interaction in outer space is recorded during the rush hour (after work).
- Node influence is on neighbourhood level.

As for Node 3, the average block size records better convenience for pedestrians than the previous nodes. The node is well known for its commercial activities, so it was quite obvious that people come to shop or to work in retails. Also nodality level is explained as follows:

- The highest pedestrian movement is on late morning weekends. (188, 544 ped./day)
- The highest vehicle movement is on noon weekend. (213,120 veh./day)
- Highest static interaction in outer space is recorded on weekends at noon.
- The outer space is deserted after 18:00.
- Node influence is on city level.

In the end, Node 4 was marked for its most convenient pedestrian block sizes. People usually come weekly to the node for communal and recreational activities. However, the type of people who use space are not from RB. In relation with nodality level, the following characteristics are explained:

- The highest pedestrian movement is on late morning weekends. (17,664 ped/day)
- The highest vehicle movement is on early morning weekday. (91,584 veh./day)
- Outer space was barely seen with people's interaction in comparison to the park's large area. The area can be observed by people after 17:00.
- Node influence is on city level.

	Nodality Characteristics		
	Size	**Level**	**Type**
Node 1	Convenient for pedestrian (Av. Dimension =139.8 m) 		Functional activities node. Daily frequent node.
Node 2	Convenient for pedestrian (Av. Dimension = 127.4 m) 		A mixture of functional activities with economic activities. Daily frequent node.

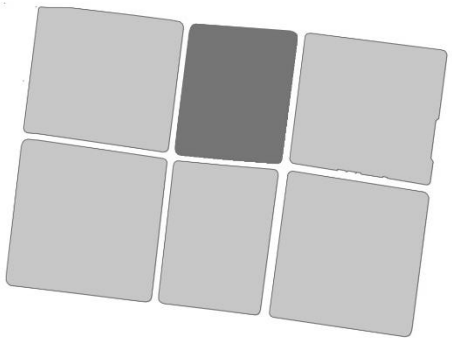
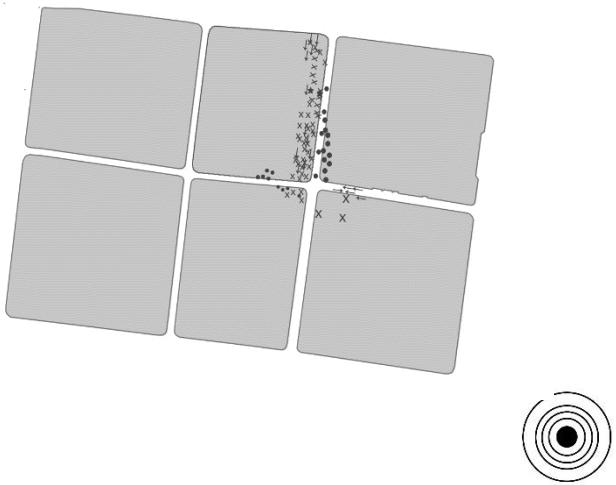
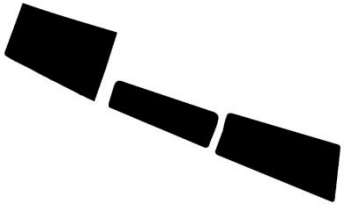
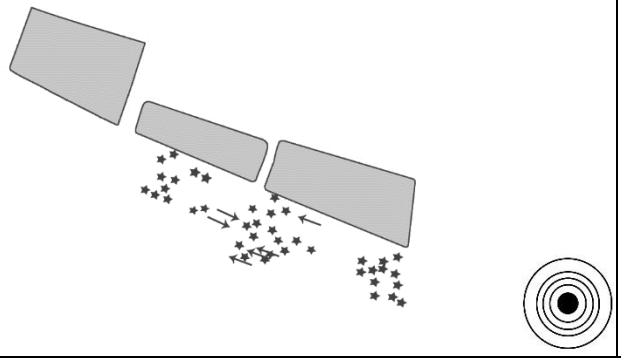
Node 3	Convenient for pedestrian with the least potential for diversifying transport mode (Av. Dimension = 125.4 m) 		Functional activities related to commerce. Daily frequent node.
Node 4	Optimal for pedestrian with the highest potential for diversifying transport mode. (Av. Dimension = 63.8 m) 		Communal activities. Weekly frequent node.

Table 5-3: Matrix of Nodal characteristics of RB, defining its size, level, and type; Author's construction, 2017

CHAPTER 5

CONCLUSIONS AND RECOMENDATIONS

As an overview of the consequences of the modern development trend in Latin American cities from changing the individual lifestyle approach to changing the city scale, one could denote the fact that cities have transformed to a stagnated transformation stage where catastrophic environmental and social degradation are clearly apparent. It has been 50 years since few researchers had begun to oppose the main stream wave of private projects that promote enormous expansions of cities and the rigid way of separation of functions. However, the awareness came later when international organisations had put pressure on the necessity to shift to more sustainable approaches preparing for the post-carbon era. The pioneer researchers - such as Jacobs, Whyte, Gehl and others – had separately agreed on a starting point of vibrant communities and the vitality of public life in neighbourhoods that witnessed transformation procedures. Nevertheless, few solutions were given since planning models were not well-developed enough to save “the catastrophe” of trial and error that had ended up diminishing the human scale of the city.

From this point, the research contributes to the incremental approach of spatial planning that has been initially brought to indorse the recovery of the current deformations that had occurred to modern cities. Without primary understanding how urban structures could affect people’s behaviour, no proper solution or model can be given to sustain. Therefore, the study had been in line with the various methods and tools to assess public areas. The value of the research lies in its methodology creation for nodality assessment. The methodology is consistent of different methods compiled together and tools, e.g. space syntax, morpho, specially adopted for the context of Southern Chilean cities.

In order to assess nodality in public spaces, the research was designed to represent a triangular model to operate the investigated concepts on a case study approach. The three

components of triangular model were named as: remap, re-scale and Re-organise. Remapping was set as the first phase of the study to analyse the urban dynamics of recent transformation processes in the neighbourhood of RB. The preliminary studies focused on the urban morphological analysis of land-use, density, typological identity, and urban grain – as analysed in Chapter 3. The second phase of Re-scaling was to explore nodality of urban form to establish hierarchies of spatial scale through characterizing public spaces by their size, level and type. In Chapter 4, nodes were analysed mainly according to human interaction in space in relation with nodality size. Finally, the third phase - re-organise - was planned to introduce new spatial organisation for the neighbourhood according to overlapping results of both previous phases. As will be explained, the neighbourhood was defined by its centre, periphery and boundary as shown in Figure (6-1). The following text correlates potentials and challenges of urban form with the nodality concept in order to understand the missing links, aiming towards a more sustainable approach of neighbourhood development.

The analysis results from Chapter 3 reveals that the block pattern observed to pioneer the neighbourhood urban form, is a mixture of rectangular and square blocks. Nevertheless, the topography of the area has shifted the blocks to adapt with the urban extensions. The common square block size of the neighbourhood is 130x130 m., apart from a percentage 25% of RB has a rectangular shape of an average size of 90x130 m. The morphological transformation was observed to occur internally within the block structure and not in its size. Plots were either broken down from their original design (20x40 m) to be sold on individual basis for residential uses, or sold collectively from different individuals for massive building use e.g. supermarket. This could be seen clearly in the current urban grain to vanish the internal pedestrian mesh within each block. Therefore, block pattern currently does not differentiate between the pedestrian and vehicle mesh structure. However, this was not seen as a problem since the grid still lies in the range of the pedestrian convenience level. The grid mesh had proved its supremacy to persist the transformation of its urban form which proves its sufficiency.The presented street mesh gives a coherent and harmonized block fabric to serve the urban tissue effectively. More reflections of mixed land-use and higher densities were seen in the potential nodes formulation, clearly apparent in Republica St and Chillàn St. From the typological view point, two types of terrace mixed-use buildings were evident for that. The old type was observed to be built based upon incremental development of individual residents to align

houses from the street boundary to give an internal private plot access. The new type was already designed to share their sidewalls which made it more residential oriented buildings than the old type. In both cases, the potential was seen in the typological identity of RB to adapt with land-use change and preserve the block pattern.

After assessing the human activities in public spaces of RB, it was quite obvious that the neighbourhood was used as a transit hub for different types of people. In Chapter 4, result analysis showed that more than one million pedestrian movements and three million vehicle movements were taking place during the day. The peak hour movements were recorded in Nodes 1, 2 and 3 to be in the afternoon, while Node 4 in the early morning. The shocking numbers of pedestrian and vehicle movement in the neighbourhood gave the clue that RB's influence has far exceeded its city boundaries. As surveyed, people were said to come from the adjacent neighbourhoods to benefit from the cheap services and high accessibility of RB. Others come especially from the peri-urban areas to work and commute daily or weekly. It is worth mentioning, during the comparison of the dynamic and static actions - from Gates and SnapShots methods - it was challenging to observe the huge dynamic movements and very few meeting places of local inhabitants. Residential blocks were barely observed with pedestrian movement or activities that in turn affects the vitality of some areas in comparison to others. However, only Node 3 was distinguished with a high charge of human interaction in space due to the Open market location and several commercial services around.

Cross-cutting through both Chapter 3 and 4, a number of aspects could be logically understood in relation with human interaction and urban form. One issue is the preference of pedestrians who seemed to take more frequently Republica St and Chillàn St than others. Even though Republica St is the main avenue in the neighbourhood, Chillàn St seemed to be more crowded with pedestrian activities. This is due to the influence of some morphological elements that are not apparent in Republica St. For example, the division of smaller plots and narrower street dimension (10m) in Chillan St, gave a human scale dimension for pedestrian interactions. Another reason was the typological element of terraced houses that could promote inhabitant to use their plots for providing daily commercial services, e.g. catering, fruit market… etc. The distribution of such mixed-use retail functions along the street have encouraged pedestrian activities to take place. In contrast, the Eastern side of the neighbourhood was observed to be less crowded with

dynamic as well as static actions. The lack of social activities could be explained by the single-use of residential detached houses that isolated the urban form by a distance from street interactions. In addition, plots were further divided to smaller dimensions that have fragmented the whole block structure – with a façade less than 15 m – resulting in low dense isolated blocks.

Addressing the challenge of deserted public areas that was clearly seen in Node 1 and 4, it could be explained in relation to Jacob's (1961) experience claiming that people's income had an effect on the degree and nature of activities along local streets. Since RB is a low-income neighbourhood community, public life could be a luxurious idea due to the lack of time and means. In spite of this reason, people's rights to have vibrant street life is a predominant necessity for security. Another reason was explained by Gehl (2010) that people are discouraged to sit in places where no one exists. People could come to sit, walk and talk only in the presence of others.

From the above, RB could be seen as one of the oldest urban quarter of Osorno with a number of morphological valid qualities for promoting nodality. Yet, the neighbourhood suffered from the lack of efficient public spaces for its local inhabitants. Three nodes out of four proved to be dominant in the functional activities, which means that the majority of people using public space were targeting their work place, schools or public institutions. According to Gehl (1987), it signifies the poor quality of outdoor space which makes people minimize their stay on streets. In addition, public designed areas had been rarely taken into consideration, since the evidence is seen in their peripheral location and abundance of people.

In fact, the current notion in neighbourhood development shows that services indorsed were not targeted for the benefit of its inhabitants. The evidence for that is the highest percentage of non-residential buildings come from commercial services. The majority of these commercial services are characterised by their massive building structures and car oriented circulation system, e.g. Open market, supermarkets, Casino… etc. This act has definitely amplified nodal hierarchies (Node 3) and in turn tolerated the neighbourhood scale to exceed the city level.

In line with the latter discussion, the research suggests a new spatial organisation of neighbourhood - as illustrated in Figure (6-1) - for further effective intervention. Based on

urban quarter definition in the literature and nodality analysis on fieldwork, the division of re-organised areas is by their vitality level, since every case should follow a different development approach. Five areas were categorized according to their vital nodality in RB explained as follows:

Area A The central node of the neighbourhood is the significant aspect in the area, consisting of commercial and mixed-use buildings. Convenient public space is required to be applied for residents, especially in front of the Open market.

Area B The urban boundary of the neighbourhood located along a car-oriented street. The typology of façade helped an adaptable transformation of retail activities. It is required to increase the quality of pedestrian life and street crossings.

Area C The neighbourhood Northern periphery with industrial-based function. It is necessary to develop better block pattern and mixed-use activities in order to increase the vitality aspect.

Area D The Eastern boundary of the neighbourhood has a typical historical building type. The necessity to increase the diverse activities on the horizontal streets in order to increase pedestrian movement with Area A. The block system should be overlooked to have an internal court and a finer pedestrian mesh for a better quality of urban space.

Area E The neighbourhood Southern periphery with a terraced houses typology. It is necessary to increase density and diversity in order to make use of the existing park.

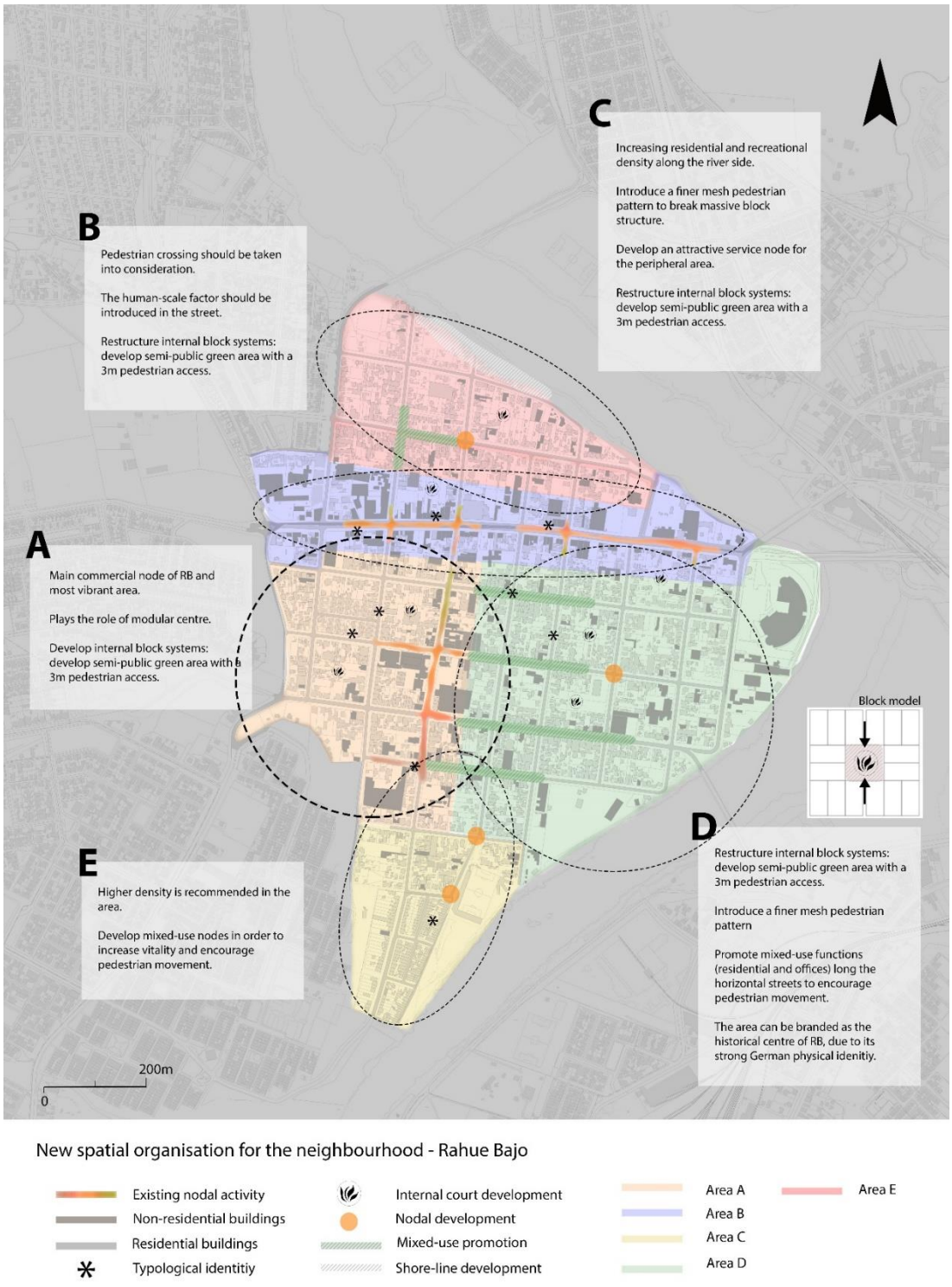


Figure 5-1: A map to introduce new spatial organisation for RB neighbourhood based on its vitality level; Author's construction, 2017.

Concluding from the above, the new spatial organisation of RB could help the municipality of Osorno to introduce new types of development intervention in each area. As shown in Figure (6-1), RB was divided into “the center” representing the main neighbourhood node in Area A, “the boundary” in Area B and D, and “periphery” in Area C and E. The case study helped to identify a recommended set of factors that influence hierarchy of public spaces and elements on how to promote vitality in neighbourhoods as explained in detail below and illustrated in Figure (6-1).

Concerning the factors that influence hierarchy of public spaces in RB, the following could be considered with evidence in the neighbourhood:

- Accessibility of streets shaped by urban block pattern that could give the opportunity for pedestrian or vehicle movement. i.e. the average block sizes of Nodes 1, 2 and 3 could promote both movements, however Node 4 promoted finer and more pedestrian convenience.
- Indorsed services have an impact on the pedestrian and vehicle movement pattern: services that are complimentary should be introduced to have a certain circulation pattern, reducing vehicle movement, e.g. the increase of catering shops attached to the Open market was a successful example of that.
- Adaptability of typological elements to adapt with new uses, such as: continuous facades in RB accepted certain transformation patterns in retail services.
- Building densities of a minimum two floors were observed to give more vital areas: this could be observed in low dense areas that were barely seen
- Division of plots to less than 15 m wide and more than 40 m depth reduces the opportunity for social interaction. Chillàn St combines small plots within the range of 20x40 m of mixed-use, educational and commercial blocks and was observed to be vibrant. However Concepción St and Santiago St have smaller plot divisions which couldn’t encourage pedestrian movement.

As for the elements recommended to promote vitality of space, they are as follows:

- The charge of certain mixed uses in the neighbourhood, giving an accessibility to daily functions to local residents within a walking distance.
- The strength of grid fabric could preserve the block system from transformation, in the case of pedestrian convenient dimensions.

- Finer pedestrian mesh introduction for blocks with more than 100 m length.
- Internal semi-public court yards could increase the social interaction with a sense of security.

Through putting in value the neighbourhood as a new urban unit of the city, certain potentials were seen in RB provided that certain aspects should be taken into consideration. By evaluating the quality of public spaces, this would definitely improve and lead to a better sustainable urban form that eventually contributes to the wider platform of sustainability. In this way, the research could help decision-makers to allocate functions and seek better spatial planning from another perspective.

BIBLIOGRAPHY

Alexander, C. (1977). *A pattern Language: Towns, Buildings, Construction.* New York: Oxford University Press.

Andersen, H., MØller-Jensen, L., & Engelstoft, S. (2011). The End of Urbanization? Towards a New Urban Concept or Rethinking Urbanization. *European Planning studies Vol. 19, No. 4*.

Atkinson, A. (2007). Cities after oil—1: 'Sustainable development' and energy futures. *City*.

Atkinson, A. (2007). Cities after oil—2: Background to the collapse of ‘modern’ civilization. *Routledge*.

Atkinson, A. (2008). Cities after oil-3. *City, 12*(1), 79-106.

Atkinson, A. (2010). Where do we stand? Progress in acknowledging and confronting climate change and "peak oil". *City, 14*(3), 314-322.

Atkinson, A. (2014). Urbanisation: A brief episode in history. *City: analysis of urban trends, culture, theory, policy, action, 18*(6), 609-632. Retrieved from http://www.tandfonline.com/doi/abs/10.1080/13604813.2014.971509

Barria, T. (2014). *LA CONSTITUCIÓN DE LA VIVIENDA SOCIAL PLANIFICADA EN LA PERIFERIA URBANA: Conjuntos habitacionales de la Caja de Habitacion: 1936 - 1952.* Santiago: Pontificia Universidad Católica de Chile.

Barria, T. (2015). *LA CONSTITUCIÓN DE LA VIVIENDA SOCIAL PLANIFICADA EN LA PERIFERIA URBANA: Conjuntos habitacionales de la Caja de Habitacion: 1936 - 1952.*

Barton, H. (2000). *Sustainable communities: The potential of eco-neighbourhoods.* London : Earthscan.

Barton, H., Grant, M., & Guise, R. (2010). *Shaping Neighbourhoods: For local Health and Global Sustainability.* (2nd ed.). Lond; New York: Routledge.

Batty, M. (2005). *Cities and complexity: understanding cities with cellular automata, agent-based, models and fractals.* Cambridge mass: The MIT press.

Batty, M. (2015). Cities in a completely urbanised world. *Environment and Planning B: Planning and Design 2015*.

Batty, M. (2015). Cities in a completely urbanised world. *Environment and Planning B: Planning and Design, 42*, 381-383. doi:10.1068/b4203ed

Batty, M., & Longley, R. (1994). *Fractal Cities: Geometry of Form and Function.* Academic Press.

Besteliu , I., & Doevendans, K. (2000). Bringing in Landscape, developing a morphological analyses method for the urban fringe. *European network for housing research conference on housing in the 21th century: fragmentation and reorientation.* Gavle Sweden.

Blaikie, P., Brown, K., Stocking, M., Tang, L., Dixon, P., & Sillitoe, P. (1997). Knowledge in Action: Local Knowledge as a Development, Resources and Barriers to tis Incorporation in Natural Resource Research and Development. *ELSEVIER*.

Blanco, J. (2015). Panorama teórico y tendencias contemporaneas de barrios sustentable. Especulaciones en torno a un modelo de desarrollo para Chile. *Revista de Urbanismo, 32*, 72-86.

Blanco, J. (2015). *Panorama teórico y tendencias contemporáneas de Barrios Sustentables. Especulaciones en torno a un modelo de desarrollo para Chile. Revista de Urbanismo, 32 (1), 70-86.*

Borsdorf, A., Hidalgo, R., & Sánchez, R. (2007). A new model of urban development in Latin America: The gated communities and fenced cities in the Metropolitan Areas of Santiago de Chile and Valparaíso. *Cities, 24*(5), 335-398.

Bosselmann, P. (2008). *Urban Transformation.* Washington: Island Press.

Breheny, M., Williams, K., Jenks, M., & Burton, E. (1996). *The compact City: A sustainable Urban form?* SPON, E.& F. N., LONDON.

Bridge, G. (2010). Geographies of peak oil: The other carbon problem. *Geoforum*, 41, 523-530 .

Buchanan, M. (2002). *Small world: uncovering nature's hidden networks.* London: Phoenix, new ED edition.

Burnett, J. (2007). City buildings—Eco-labels and shades of green! *Landscape and urban planning, 83*, 29-38.

Burton, E. (2000). The compact city: just or just compact? A preliminary analysis. *Urban Studies, 37*, 1969-2006.

Burton, E. (2002). Measuring urban compactness in UK towns and cities. *Environment and Planning B: Planning and Design, 29*(1), 219-250.

Cáceres, & C. (2015). Ciudades satélites periurbanas en Santiago de Chile: Paradojas entre la satisfacción residencial y precariedad económica del periurbanita de clase media. *Revista INVI, 85*(30), 83-110.

Caniggia, M., & Gian Luigi, M. (1979). *Composizione Base, Composizione Architettonica e tipologia Edilizia: 1. Lettura dell' Edilizia di.* (Marsilio, Venezia): OPAC SBN. Retrieved May 7, 2017, from http://www.sbn.it/opacsbn/opaclib?db=solr_iccu&resultForward=opac/iccu/full.jsp&from=1&nentries=10&searchForm=opac/iccu/error.jsp&do_cmd=search_show_cmd&fname=none&item:1032:BID=IT\ICCU\TER\0010249

CNU. (2000). Charter of the New Urbanism Congress for the New Urbanism. New York: McGraw-Hill.

Davoudi, S. (2012). Resilience: A Bridging Concept or a dead end? In *Planning Theory & Practice.*

Dawodu, A., Akinwolemiwa, B., & Cheshmehzangi, A. (2016). A conceptual re-visualization of the adoption and utilization of thePillars of Sustainability in the development of NeighbourhoodSustainability Assessment Tools. *EL SEVIER*.

Demiddel, S. F., & Bustamante, L. P. (2009, November). Más que una suma de casas. La unidad vecinal Villa Pedro de Coronel. *revista, 24*, 127-152.

Demiddel, S. F., & Bustamante, L. P. (2009). Más que una suma de casas. La unidad vecinal Villa Pedro de Coronel . *revista*, 127-152.

Dempsey, N., Brown, C., Raman, S., Porta, S., Jenks, M., Jones, C., & Bramley, G. (2010). Elements of Urban Form. In M. Jenks, & C. Jones, *Dimensions of the Sustainable city* (pp. 20-37).

Denzin, N. (1984). *The research act.* NJ: Prentice Hall: Englewood Cliffs.

Dittmar, H., & Ohland, G. (2003). *The New Transit Town: Best Practices in Transit-oriented Development.* Washington, DC: Island Press.

Dix, G. (1986). The Small Cities in the World System.

Doevendans, K., & Zumelzu, A. (2016). Urbanism and the post-carbon city: Framing Planning and Design as Spatial Technology for a Sustainable approach. *Unpublished Article*.

Doevendans, K., & Zumelzu, A. (2017). Urbanism and the post-carbon city: Framing Planning and Design as Spatial Technology for a Sustainable approach. *Unpublished Article*.

Doevendans, K., Zumelzu, A., & De Meulder, B. (2014). Modern city as modular construct. *21th International Seminar on Urban Form "Our common future in urban morphology",*. Porto, Portugal.

Doust, K. (2014). Toward a typology of sustainability for cities. *Journal of traffic and Transportation Engineering*, 180-195.

Doust, K. (2014). Toward a typology of sustainability for cities. *Journal of traffic and Transportation Engineering, 1*(3), 180-195.

Dur, F., Yigitcanlar, T., & Bunker, J. (2014). A Spatial-indexing model for measuring neighbourhood-level land-use and transport integration. *Environment and Planning B: planning and Design*, 792-812.

Ehlers, E. (2011). City models in theory and practice: a cross-cultural perspective. *Urban Morphology 15*, 97-119.

Ellin, N. (2006). *Integral Urbanism.* New York: Routledge.

Escobar, A. (2005). El "postdesarrollo" como concepto y práctica social.

Evan, R. (2005). Urban Morphology. *Urban Design*, 16-33.

Filion, P. (2012). Evolving suburban form: dispersión or recentralization? *Urban Morphology, 16*(2), 101-119.

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry, 12*(2), 219-245. doi:10.1177/1077800405284363

Frey, H. (1999). *Designing the city: Towards a more sustainable urban form.* London: Spon press.

Frey, H. (2010, February 8). “New approaches in urban development”, how do they work, and do they (potentially) achieve sustainable urban forms. Presentation in the master class on energy and climate, . *Geothermal Energy & Energy in the Built Environment*.

Frey, H., & Bagaeen, S. (2010). Adapting the City, In: Dimensions of the Sustainable City. Jenks, M, and Jones, C, (eds). Springer.

Frey, H., & Sammer, B. (2005). Plus project: Urbanising suburbia. *Urban Studies, University of Strathclyde*, (pp. 1-7).

Frey, H., & Yaneske, P. (2007). *Visions of sustainability, Cities and Regions. New York: Taylor & Francis.*

Frey, H., Bagaeen, S., G. C., & Faria, P. (2010). *Establishing threshold, average and target values of sustainable urban quarters.* Urbanising Suburbia. Retrieved from city-: (http://www.city-form.org/uk/pdfs/CityForm_US_Handbook.pdf)

Gehl, J. (1987). *Life between buildings.* New York: Van Nostrand Reinhold.

Gehl, J. (2010). *Cities for people.* ISLAND PRESS.

Gomez, K., Xue, M., Ohno, R., Rojas, C., & Villagra, P. (2014). A GIS-base exploration of the relationships between open space. *Applied Geography*.

Grajewski, T. (1992). *Interaction in the Work Environment unpublished PhD thesis.* London: University College London.

Griffiths, S. (2015). The High Street as a Morphological Event. In *Suburban Urbanities: Suburbs and the Life of the High Street* (pp. 32-51).

Gringonis, V. (2013). World cities and urban form: Fragmented, polycentric, sustainable? *Urban Design International, 18*(2), 182-183.

Guevara, T. (2015). Abordajes teóricos sobre las transformaciones sociales, económicas y territoriales en las ciudades latinosamericanas contemporáneas. *EURE, 21*(124), 5-24.

H. Whyte, W. (1988). City: Rediscovering the Center. *Doubleday*.

Haan, L., & Zoomers, A. (2005). Exploring the Frontier of Livelihoods Research.

Han, L., Xu, Z., & Wang, L. (2014). Open space and urban morphology. *Urban Morphology, 18*(2), 164-166.

Hennink, M., Hutter, I., & Bailey, A. (2010). The Design Cycle. In *Qualitative Research Methods* (pp. 33-60).

Hidalgo, R., & Castillo, M. (2007). *1906-2006: 100 años de vivienda y barrio.* Santiago de Chile: Universidad Católica de Chile, U. Andrés Bello y U. Central de Venezuela.

Hillier, B. (1996). *Space is the machine.* London: Press Syndicate.

Hillier, B. (1999). Centrality as a process: accounting for attraction inequalities in deformed grids. *Urban Design International, 4, No. 3&4*, 107-127.

Hillier, B., & Hanson, J. (1984). *The Social Logic of Space.* Cambridge: Cambridge University Press.

Hodson, M., & Marvin, S. (2010). Urbanism in the Anthropocene: ecological urbanism or . *City, 14, 3*, 298-313.

Holden, E. (2004). Ecological footprints and sustainable form. *Journal of housing and the Built Environment, 19, 1*, 91-209.

Howitt, R. (2002). Scale and the other: Levinas and geography. *Geoforum, 33*, 299-313.

IMO, & Centro De Estudios Para La Accion Social. (2013). *PLANES URBANOS ESTRATÉGICOS.*

IMO, & PRAGMAC. (2016). *Plan de Desarrollo Turístico.* Osorno.

IMO, & SECPLAN. (2013). *DIAGNÓSTICO PLADECO 2013 - 2017.*

Inzulza, J. (2014). La recuperación del diseño cívico como reconstrucción de lo local en la ciudad intermedia: el caso de Talca, Chile. *AUS, 15*(1), 4-8.

IOM. (2014). *World Migration Report 2015 - Linkages between Urbanization, Rural–Urban Migration and Poverty Outcomes in Africa.*

Jabreen, A. (2006). Sustainable Urban forms: Their typologies, models, and concepts. *Journal of Planning Education and Research*, 26, 38-52.

Jacobs, J. (1961). *The Death and Life of Great Amercian Cities.* New York: Random House and Vintage Books.

Janoschka, & M. (2006). El modelo de ciudad latinoamericana. Privatización y fragmentación del espacio urbano de Buenos Aires: el caso del Nordelta. In Janoschka, & M., *La ciudad fragmentada: nuevas formas de hábitat.* (pp. 259-263). Ponce Herrero: Universidad de Alicante.

Jenks, M., & Dempsey, N. (2005). *Future Forms and Design for Sustainable Cities.* Oxford: Architectural Press.

Jenks, M., & Jones, C. (2010). *Dimensions of the Sustainable City.* Springer. doi:10.1007/978-1-4020-8647-2

Jenks, M., & Jones, C. (2010). Issues and Concepts. In M. Jenks, & C. Jones, *Dimensions of the Sustainable City* (pp. 1-18). Springer Science+Business Media B.V. doi:10.1007/978-1-4020-8647-2

Jenks, M., Burton, E., & Williams, K. (1996). *The Compact City: A Sustainable Urban Form?,.* London: E&FN Spon.

Karimi, K. (2013). “Retrofitting suburbia: urban design solutions for redesigning suburbs”. *Journal of Urban Design, 18*(1), 168-170.

Kärrholm, M. (2011). The Scaling of Sustainable Urban Form: A Case of Scale-related Issues . *European Planning Studies, 19, 1* , 97-112.

Katoh, J., Spencer, M., & Tencer, S. (2003). Vibrant neighbourhoods: The role of mixed-used design. *Ontario Planning Journal 18, 1*.

Kenworthy, J. (2006). The Eco-city: Ten key transport and planning dimensions for sustainable city development. *Environment and Urbanization, 18*(1), 67-85.

Kenworthy, J. (2006). The Eco-city: Ten key transport and planning dimensions for sustainable city development. *Environment and Urbanization, 18*(1), 76-85.

KoBoToolbox. (2014, September). *ABOUT KOBOTOOLBOX*. Retrieved May 28, 2017, from Kobotoolbox: http://www.kobotoolbox.org/

Krier, L. (1984). The city within the city. *Architectural Design, 54*, 70-205.

Krier, L., & Thadnai, D. (2009). *The architecture of community .* London: Island Press.

Kropf, K. (2009). Aspects of urban form. *Urban Morphology, 13*, 105-120.

Kunstler, J. H. (1994). *The Geography of Nowhere: The Rise and Decline of America's Man-made Landscape.* New York: Free Press.

Larkham, P. (2005). UNDERSTANDING URBAN FORM? *Urban Design*, 22-24.

Leon, S. (2013). Indicadores de tercera generación para cuantificar la sustentabilidad urbana. ¿Avances o estancamiento? *EURE, 39*(119), 173-198.

Long, N. (2002). An Actor-oriented Approach to Development Intervention.

Lorentzen, A., & van Heur, B. (2012). *Cultural Political Economy of Small Cities.* Routledge.

Luederitz, C., Lang, D., & Von Wehrden, H. (2013). A systematic review of guiding principles for sustainable urban neighbourhood development. *Landscape and Urban Planning 1888*, 40-52.

Lynch, K. (1981). *Good City Form.* London: MIT Press.

Madlener, R., & Sunak, Y. (2011). Impacts of urbanization on urban structures and energy demand: what can we learn for urban energy planning and urbanization management? . *Sustainable Cities and Society 1*, 45-53.

Maretto, M. (2014). Sustainable urbanism: the role of urban morphology. *Urban Morphology, 18*(2), 163-174.

Marston, S., Jones, J., & Woodward, K. (2005). Human geography without scale. *Transactions of the Institute of British Geographers NS, 30*, 416-432.

Marvin, S., & Hodson, M. (2010). Urbanism in the Anthropocene: ecological urbanism or premium ecological enclaves? *City, 14*(3), 298-313.

Maturana, F., & Rojas, A. (2015). Ciudades intermedias en Chile: Territorios olvidados. Santiago de Chile. *RIL Editores*.

Middleton, H. (2005). Creative thinking, values and design and technology education. *International journal of technology and design education, 15, 61*, 61-71.

MINVU. (2006). Diagnostico Urbano 1990-2006. . *Gobierno de Chile-Ministerio de Vivienda y urbanismo.*

MINVU. (2010). *Una Historia de esfuerzo y supracion: Barrio Carlos Condell - Rahue Alto.*

Montesinos, F., & Neira Navarro, M. (2012). MARGINALIDAD Y EXCLUSION SOCIAL EN OSORNO: EL CASO DE LA POBLACION V CENTENARIO, SECTOR DE RAHUE ALTO. *Universidad de Los Lagos*, 104-111. Retrieved from http://medioteca.ulagos.cl/biblioscripts/resumen_total.idc?numero=40291

Moore, A. (2008). Rethinking scale as a geographical category: From analysis to practice. *Progress in Human Geography, 32*(2), 203-225.

Mozingo, L., & Anderson, R. (1995). *Urban Plazas and parks.* UC Berkeley, Department of City and Regional Planning. Unpublished student research report.

Muratori, S. (1959). *Studi per una operante storia urbana di Venezia 1.* Roma : Roma Istituto poligrafico dello Stato 1960. Retrieved from http://www.worldcat.org/title/studi-per-una-operante-storia-urbana-di-venezia-1/oclc/265031952?ht=edition&referer=di

Naess, P. (2014). Urban Form, Sustainability and Health: The case of greater Oslo. *European Planning Studies, 22*(7), 1524-1543.

Neuman, M. (2005). The Compact city fallacy. *Journal of Planning Education and Research, 25, 1*, 11-26.

Newman, P., & Kenworthy, J. (2006). Urban design to reduce automobile dependence. *Opolis: An International Journal of Suburban and Metropolitan Studies, 2*(1), 35-52.

Núñez, A. (2010). La ciudad como sujeto: formas y procesos de su constitución moderna en Chile, siglos XVIII y XIX. *Revista de Geografía Norte Grande*, 46: 45-66.

Oliveira, V. (2013). Morpho: a methodology for assessing urban form. *Urban Morphology, 17*, 21-33.

Peralta, G., & Hipp, R. (2004). *Historia de Osorno, desde los inicios del poblamiento hasta la transformación urbana del siglo XX.* Osorno.

Pereira, C., & Hidalgo, R. (2008). *Producción inmobiliaria y reestructuración metropolitana en América Latina.* Santiago: Universidad Católica de Chile-Universidad de Sao Paulo.

Pfeiffer, D. (2014, May 7). Retrofitting suburbia through second units: lessons from the Phoenix Region. *Journal of Urbanism*. doi: 10.1080/17549175.2014.908787

Popper, D., & Popper, F. (2010). *Smart decline in Post-carbon cities,The Buffalo Commons Meets Buffalo, New York.* Post Carbon Institute.

Randles, S., & Dicken, P. (2004). “Scale and the instituted construction of the urban: contrasting the cases of Manchester and Lyon". *Environmental and planning A, 36*, 2011-2032.

Rodríguez-Álvarez, J. (2014). *Planning cities for the post-carbon age: A metabolic analysis of the urban form. PhD.* UNIVERSIDADE DA CORUÑA.

Romero, H., Moscoso, C., & Smith, P. (2009). Lecciones y conclusiones sobre la falta de sustentabilidad ambiental del crecimiento espacial de las ciudades chilenas. In R. Hidalgo, C. De Mattos, & F. Arenas, *Del País Urbano al País Metropolitano* (pp. 89-108). Santiago: Pontificia Universidad Católica de Chile.

Rossi, A. (1984). *The Archictecture of the City.* Cambridge, Massachusetts, and London: MIT Press.

Ruiz-Tagle, & J. (2016). La persistencia de la segregación y la desigualdad en barrios socialmente diversos: un estudio de caso en La Florida, Santiago. *EURE, 42*(122), 81-108.

Salinas , E., & Pérez, L. (2011). Procesos urbanos recientes en el Área Metropolitana de Concepción: transformaciones morfológicas y tipologías de ocupación. Revista de Geografía Norte Grande 49: 79-97.

Salthe, S. (1989). Self-organization of/in hierarchically structured systems. *Systems Research, 6*(3), 199-208.

Scheer, B. (2010). *Typology and Urban Transformation.* Washington DC: Planners Press.

Sikna, A. (1997). The effects of block size and form in North American and Australian city centres. *Urban Morphology, 1*, 19-33.

Ståhle, A., Marcus, L., & Karlström, A. (2006). Place syntax – geographic accessibility with axial lines in GIS. *unpublished paper, School of Architecture, Royal Institute of Technology, Stockholm*.

Talen, E. (2008). *Design for Diversity: Exploring Socially Mixed Neighbourhoods: Exploring Socially Mixed Neighbourhoods.* London: Architectural Press.

Talen, E. (2011). Sprawl retrofit: sustainable urban form in unsustainable places. *Environment and Planning B: Planning and Design*.

Tapia, V. (2015). ¿De qué hablamos cuando hablamos de barrio? Trayectoria del concepto de barrio y apuntes para su problematización. *Revista Antropologías del Sur 3*, 121-135.

Tellis, W. M. (1997). Application of a Case Study Methodology .The Qualitative Report,. *The Qualitative Report, 3*(3), 1-19.

Truffello, R., & Hidalgo, R. (2015). Policentrismo en el Área Metropolitana de Santiago de Chile: restructuración comercial, movilidad y tipificación de subcentros. *EURE, 41*(122), 49-73.

Truffello, R., & Hidalgo, R. (2015). Policentrismo en el Área Metropolitana de Santiago de Chile: restructuración comercial, movilidad y tipificación de subcentros. *EURE, 41*(122), 49-73.

UN HABITAT. (2012). *State of Latin American and Carribean Cities .*

UN HABITAT. (2014). *A new strategy of sustainable neighbourhood planning: Five principles.*

UN HABITAT. (2014). *The State of African Cities 2014: Re-imagining Sustainable Urban.*

UN HABITAT. (2016). *Urbanization and Structural Transformation, Series 2.*

UN HABITAT. (2016). *World Cities Report.* UN HABITAT.

UN HABITAT. (2009). *Global report of human settlements 2009: planning sustainable cities.* Nairobi: United Nations human settlements programme.

Valderrama, A., & Jorgensen, U. (2008). Urban transport system in Bogotá and Copenhagen. *Built Environment, 34, 2*, 200-217.

Van de Kaa, D. (2004). Is the Second Demographic Transition a useful research concept Questions and answers. *Vienna Yearbook of Population Research, Vol. 2*, 4-10.

Vaughan, L. (2001). *SPACE SYNTAX OBSERVAITON MANUAL.* London: UCL.

Vaughan, L. (2015). *Suburban Urbanities: Suburbs and the Life of the High Streets.* UCL Press.

Vaughan, L., Griffiths, S., & Haklay, M. (2015). The Suburb and the City. In V. Laura, *Suburban Urbanities* (pp. 11-31). UCL press.

Wilson, G. (2001). Complex spatial systems: The modelling foundations of urban and regional analysis. In B. M., *Urban Studies* (Vol. 38, pp. 1402-1404). Sage Publications, Ltd. . Retrieved from http://www.jstor.org/stable/43196711

Winston, N. (2013). Sustainable communities? A comparative perspective on urban housing in the European Union. *European Planning Studies, 22*(7), 1387-1406.

Yin, R. K. (1984). *Case Study Research: Design and Methods.* Calif: Sage.

Zumelzu, A. (2012). “Sustainability as a global problem in the carbon era: Eindhoven as an example of Anthropocene city”. *Revista AUS, 10*(1), 4-7.

Zumelzu, A. (2014). The city as a modular construct: the cases of Eindhoven and Amstelveen as examples of pragmatic sustainable redesign. In V. R. Bandieramonte, *The Next Urban Question* (pp. p.297-310). Rome: Officina.

Zumelzu, A. (2015). *SUSTAINABLE TRANSFORMATION OF THE CITIES; PHD.* Technische Universiteit Eindhoven.

Zumelzu, A. (2016). *Sostenibilidad y modularidad urbana: aplicación de una metodología para la medición y evaluación de los niveles de sostenibilidad de áreas urbanas en ciudades intermedias.* UACh, Valdivia, Chile.

Zumelzu, A. (2016). *Sostenibilidad y modularidad urbana: aplicación de una metodología para la medición y evaluación de los niveles de sostenibilidad de áreas urbanas en ciudades intermedias.* UACh, Valdivia, Chile.

Zumelzu, A., Doevendans, K., & De Meulder, B. (2015). “Eindhoven as an example of pragmatic sustainable design: Preparing the period of post carbon city”. In F. A. (ed.), *Architecture Anthology I: Sustainable Design* (pp. p.85-102). Athens: Athens Institute for Education &.

Zumelzu, A., Ostrowski, D., Navarro, S., Murùa, M., Bernucci, A., & Rodriguez, A. (2014). Centrality and urban transformations: An exploration of the process of live centrality in water related Cities in Southern Chile. *50th ISOCARP Congress 2014.* Gdynia, Poland.

CONTRIBUTIONS

This thesis will be published in the conference proceedings of the “23rd International Sustainable Development Research Society Conference” that takes place in Bogota on the 14th, 15th and 16th of June 2017.

Results of Chapter 3 and Chapter 4, would be a subject for publication in two selective Journals.

APPENDICES

Appendix A

Chapter 3: Morphological Analysis

Appendix A- 1: Urban grain information extracted from GIS map

Total area of streets	-
% of streets to the whole area	-
Total area of buildings	278.899 m²
% of buildings to the whole area (Built-up area)	-
Total area of plots	876 413 m²
% of plots to the whole area	-
Alignment of buildings	993402 m²
Ratio of building height with the street width	-
Total area of streets	-

Appendix A- 2: Land use information extracted from GIS map

Land-use Type	Description	Total Area	Footprint
Residential	Building used only for living purposes, either owned or rented	198373	GIS
Commercial	Building used for vending goods; can also be catering	38254	GIS
Mixed-Use	Building used for both commercial and residential uses.	10045	GIS
Educational	Building used by an educational institution. Can vary from pre-school to high school.	13871	GIS
Sports facilities	Building used for sports	3902	GIS
Religious facilities	Building dedicated to religious purposes.	3303	GIS
Industries	Building used as a warehouse or workshops or factory.	9794	GIS
Civil facilities	Building used for services. E.g. police, Ambulance	1353	GIS
Open space	Land dedicated for public use and in most cases is a green area.	GIS	GIS
Open space	Land dedicated for public use and in most cases is a green area.	GIS	GIS

Appendix A- 3: Density information extracted from GIS map

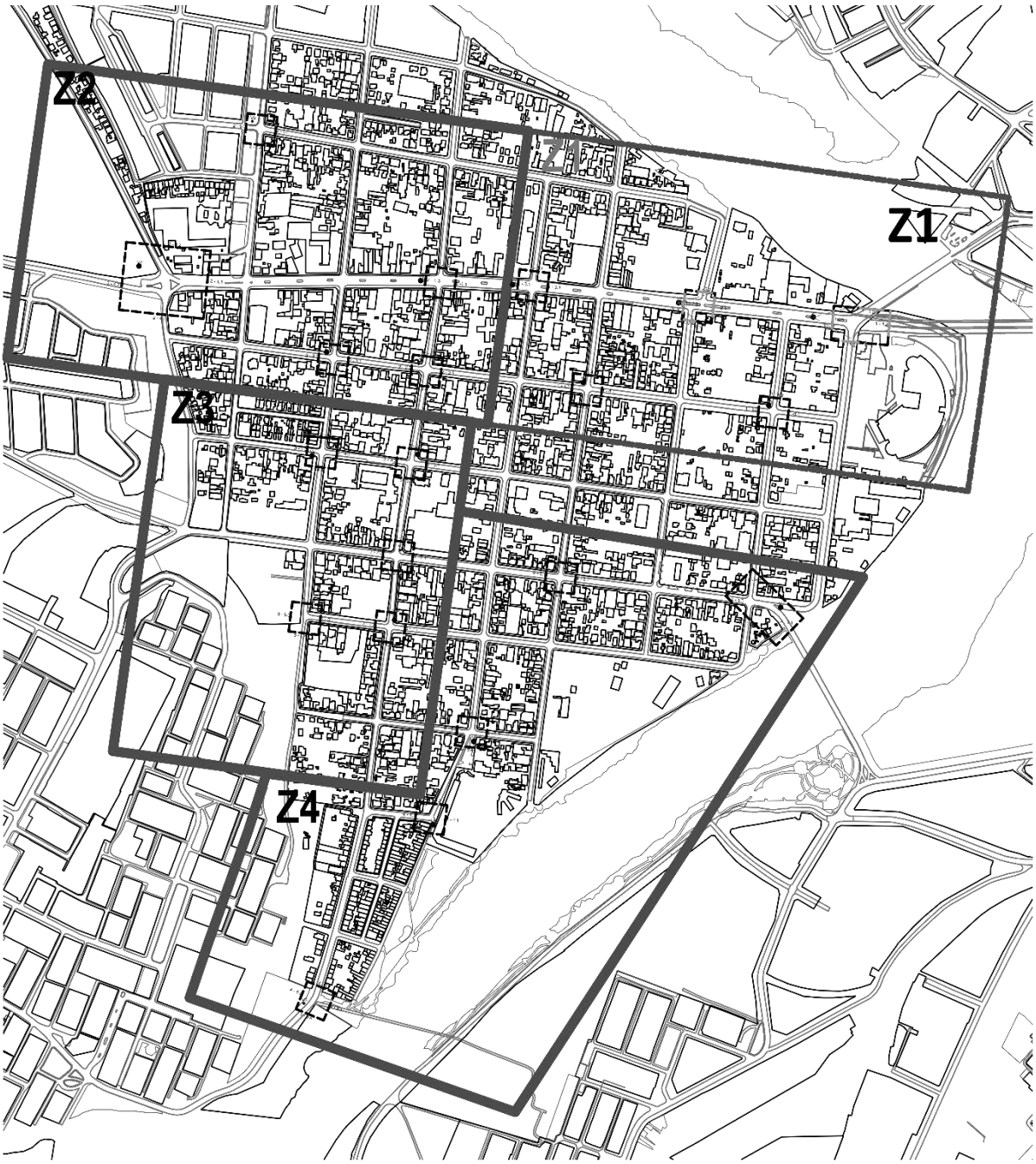
Category	Area	Percentage of total area
One floor	169052	60,61449209
Two floors	98685	35,38403066
Three floors	2179	0,781292018
More than 3 floors	8981	3,22018523

Appendix A- 4: Updated Fieldwork map of RB for detailed land-use, density, and typology data collection.

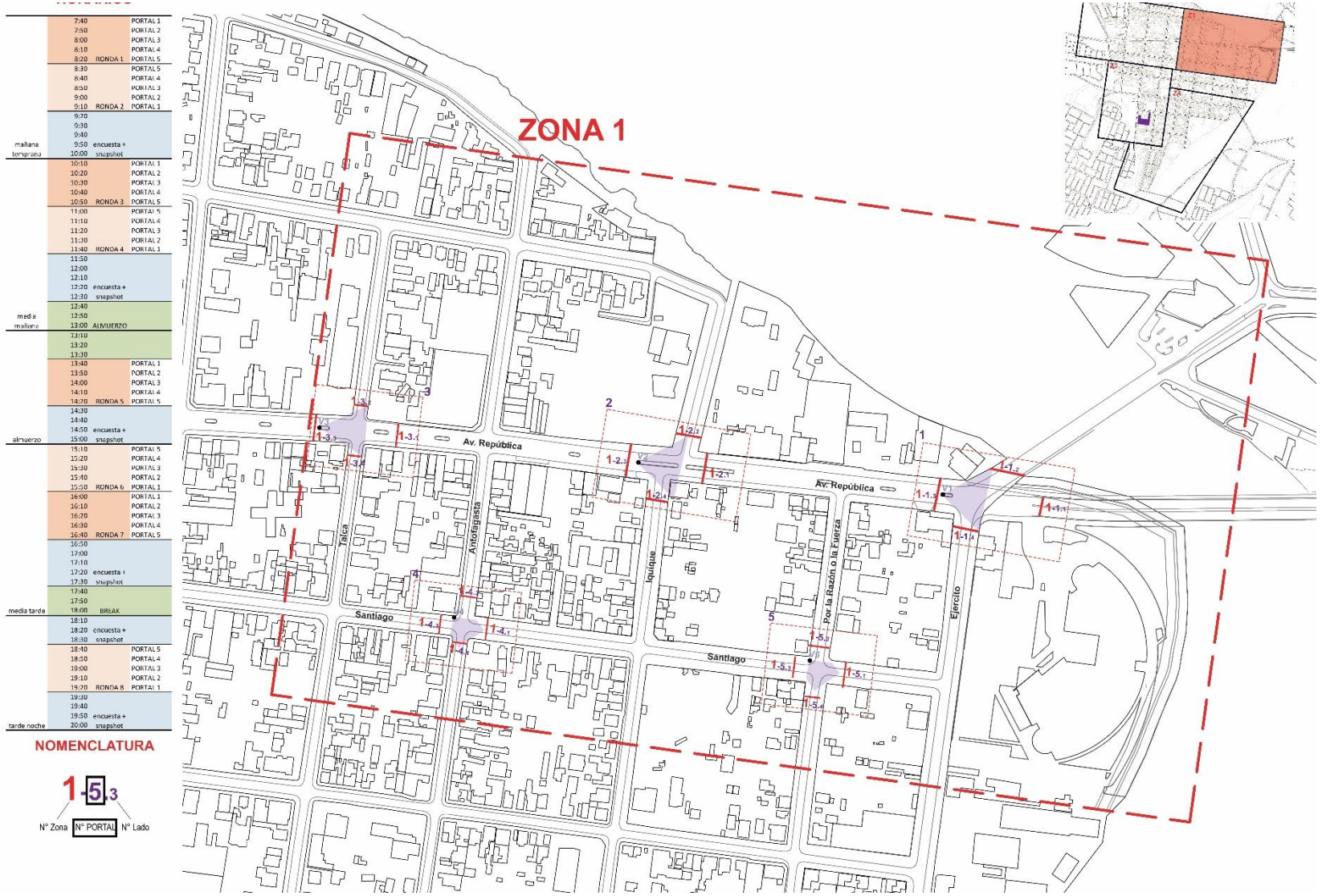
Appendix B

Chapter 4: Fieldwork analysis of Gates method

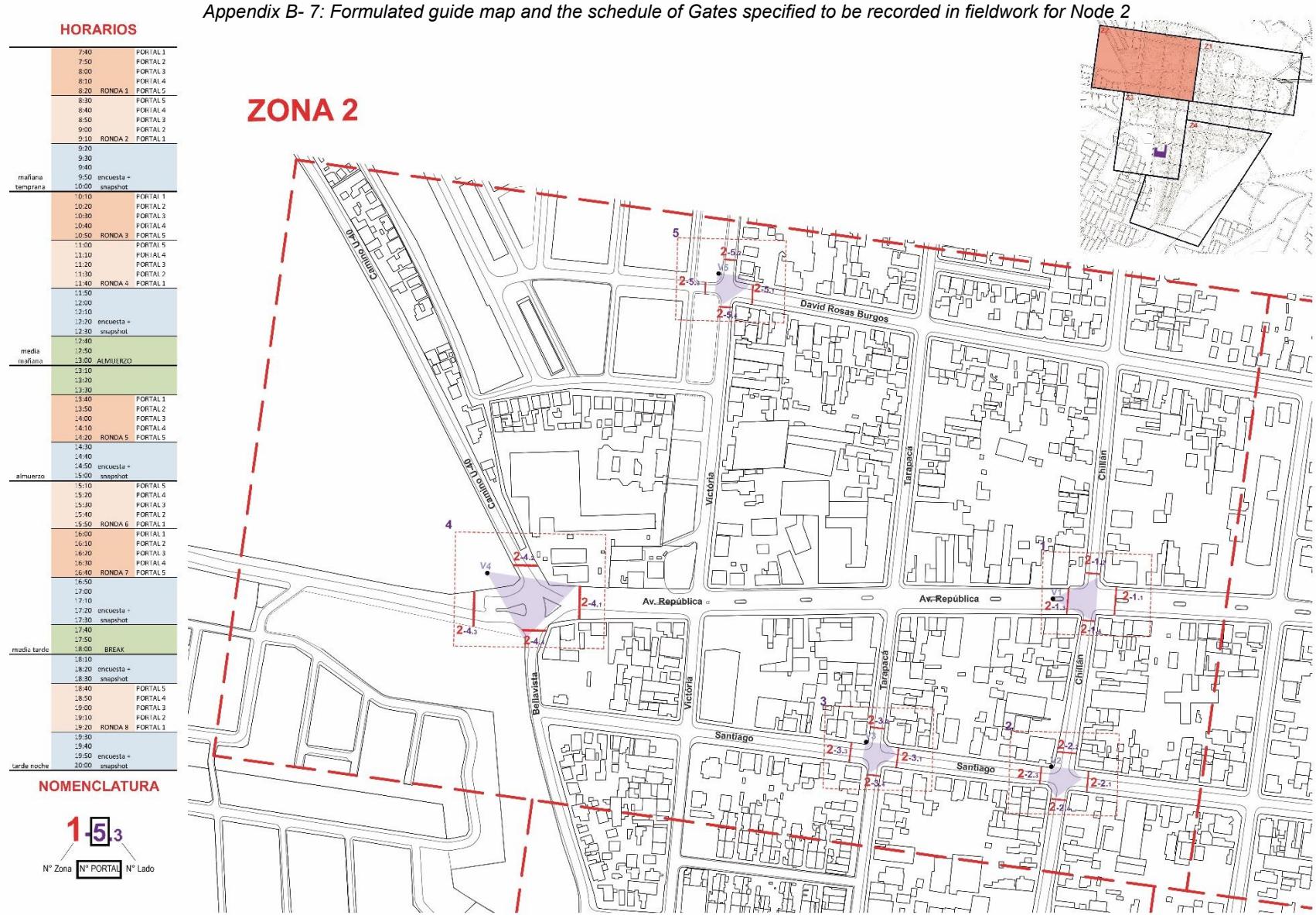
Appendix B- 5: A map of RB divided in four quarters for Gate's fieldwork analysis



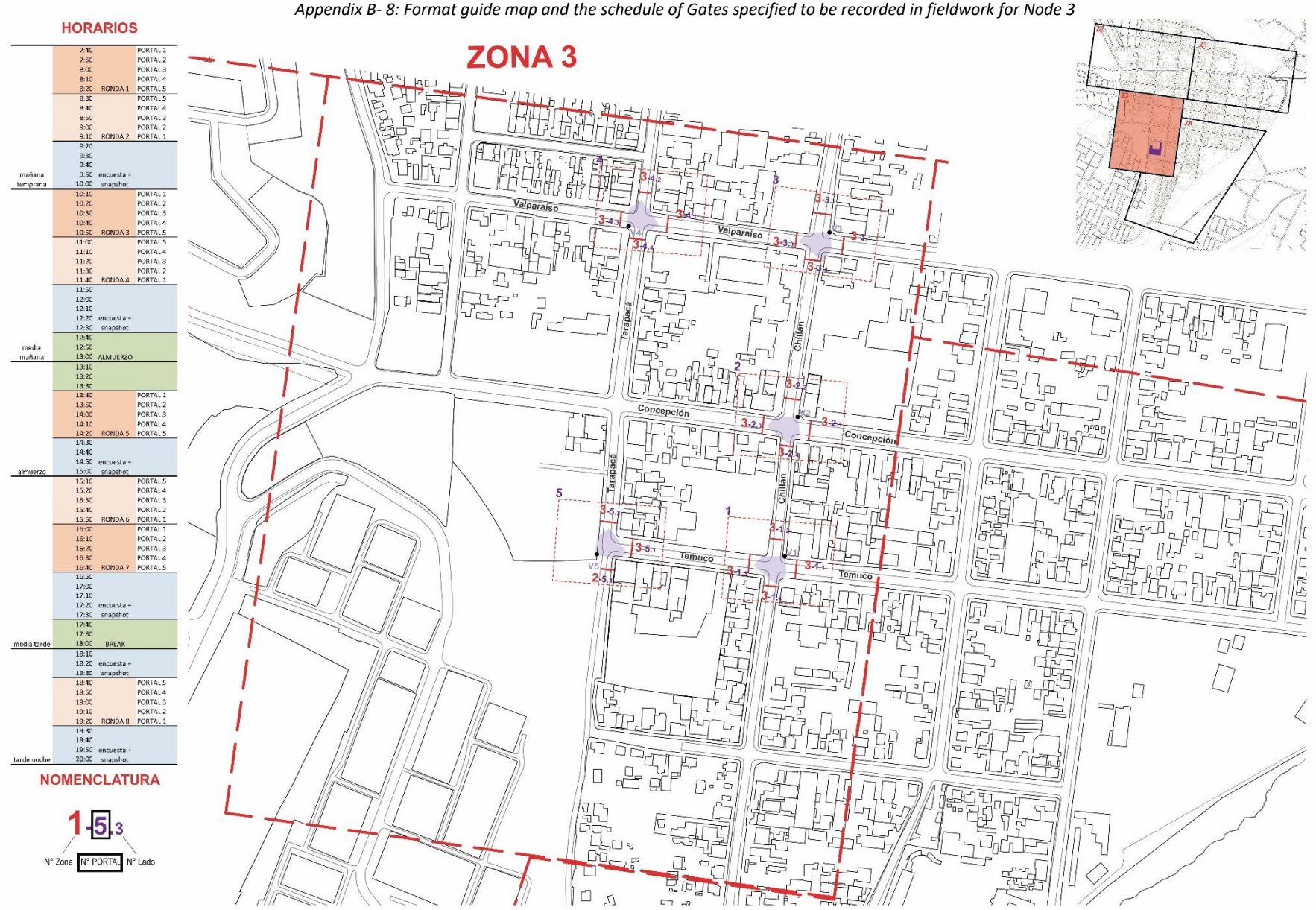
Appendix B- 6: Format guide map and the schedule of Gates specified to be recorded in fieldwork for Node 1



Appendix B- 7: Formulated guide map and the schedule of Gates specified to be recorded in fieldwork for Node 2



Appendix B- 8: Format guide map and the schedule of Gates specified to be recorded in fieldwork for Node 3



Appendix B- 9: Format guide map and the schedule of Gates specified to be recorded in fieldwork for Node 4

Appendix B- 10: A prototype of a gate transcription for Node 1 on the first day (The node has 25 gates in which each was transcribed on three days)

PORTAL 1.1.1			PERSONA			VEHICULO				DIRECCION			
			Mujer	Hombre	Joven (10-18)	Bicicleta	Auto-moto	Bus	Servicios	Desde Norte	Desde Sur	Desde Este	Desde Oeste
MAÑANA TEMPRANA	Ronda 1	Persona 1	0	0	0	0	0	0	0	0	0	0	0
		Auto 1	0	0	0	0	0	0	0	0	0	0	0
		Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		TOTAL PERSONA/VEHICULO		**0**			**0**						
	Ronda 2	**Total**	**0**	**2**	**1**	**1**	**50**	**12**	**36**	**0**	**0**	**50**	**52**
		TOTAL PERSONA/VEHICULO		**3**			**51**						
	TOTAL PERSONA/VEHICULO JORNADA			**3**			**51**						
	TOTAL JORNADA								**54**				
MEDIA MAÑANA	Ronda 3	**Total**	**0**	**0**	**0**	**2**	**56**	**7**	**44**	**0**	**0**	**67**	**42**
		TOTAL PERSONA/VEHICULO		**0**			**58**						
	Ronda 4	**Total**	**0**	**0**	**2**	**1**	**58**	**9**	**42**	**0**	**0**	**59**	**53**
		TOTAL PERSONA/VEHICULO		**2**			**59**						
	TOTAL PERSONA/VEHICULO JORNADA			**2**			**117**						
	TOTAL JORNADA								**119**				
ALMUERZO	Ronda 5	**Total**	**0**	**0**	**0**	**1**	**40**	**4**	**43**	**0**	**0**	**41**	**47**
		TOTAL PERSONA/VEHICULO		**0**			**41**						
	TOTAL PERSONA/VEHICULO JORNADA			**0**			**41**						
	TOTAL JORNADA								**41**				
	Ronda 6	**Total**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**
		TOTAL PERSONA/VEHICULO		**0**			**1**						
	Ronda 7	**Total**	**0**	**2**	**0**	**0**	**59**	**6**	**47**	**0**	**0**	**52**	**52**
		TOTAL PERSONA/VEHICULO		**2**			**59**						
	TOTAL PERSONA/VEHICULO JORNADA			**2**			**60**						
	TOTAL JORNADA								**62**				
TARDE NOCHE	Ronda 8	**Total**	**3**	**5**	**0**	**5**	**73**	**6**	**43**	**0**	**0**	**77**	**61**
		TOTAL PERSONA/VEHICULO		**8**			**78**						
	TOTAL PERSONA/VEHICULO JORNADA			**8**			**78**						
	TOTAL JORNADA								**86**				
TOTAL PERSONA/VEHICULO DIA				**15**			**347**						
FLUJO TOTAL DIA									**362**				

Appendix B- 11: A prototype of a gate transcription for Node 2 on the second day (The node has 25 gates in which each was transcribed on three days)

PORTAL 2.4.3			PERSONA			VEHICULO				DIRECCION			
			Mujer	Hombre	Joven (10-18)	Bicicleta	Auto-moto	Bus	Servicios	Desde Norte	Desde Sur	Desde Este	Desde Oeste
MAÑANA TEMPRANA	Ronda 1	**Total**	**2**	**1**	**0**	**0**	**17**	**0**	**0**	**0**	**0**	**0**	**4**
		TOTAL PERSONA/VEHICULO		**3**			**17**						
	Ronda 2	**Total**	**0**	**0**	**0**	**0**	**17**	**0**	**0**	**0**	**0**	**0**	**1**
		TOTAL PERSONA/VEHICULO		**0**			**17**						
	TOTAL PERSONA/VEHICULO			**3**			**34**						
	TOTAL JORNADA								**37**				
EDIA MAÑA	Ronda 3	**Total**	**0**	**0**	**0**	**0**	**6**	**0**	**0**	**0**	**0**	**1**	**0**
		TOTAL PERSONA/VEHICULO		**0**			**6**						
	Ronda 4	**Total**	**0**	**0**	**0**	**0**	**6**	**0**	**1**	**0**	**0**	**0**	**1**
		TOTAL PERSONA/VEHICULO		**0**			**6**						
	TOTAL PERSONA/VEHICULO			**0**			**12**						
	TOTAL JORNADA								**12**				
ALMUERZO	Ronda 5	**Total**	**2**	**2**	**0**	**0**	**6**	**0**	**1**	**0**	**0**	**1**	**4**
		TOTAL PERSONA/VEHICULO		**4**			**6**						
	TOTAL PERSONA/VEHICULO JORNAD			**4**			**6**						
	TOTAL JORNADA								**10**				
MEDIA TARD	Ronda 6	**Total**	**1**	**2**	**0**	**0**	**6**	**0**	**0**	**0**	**0**	**1**	**3**
		TOTAL PERSONA/VEHICULO		**3**			**6**						
	Ronda 7	**Total**	**0**	**2**	**0**	**0**	**20**	**0**	**0**	**0**	**2**	**1**	**0**
		TOTAL PERSONA/VEHICULO		**2**			**20**						
	TOTAL PERSONA/VEHICULO JORNAD			**5**			**26**						
	TOTAL JORNADA								**31**				
ARDE NOCH	Ronda 8	**Total**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		TOTAL PERSONA/VEHICULO		**0**			**0**						
	TOTAL PERSONA/VEHICULO JORNAD			**0**			**0**						
	TOTAL JORNADA								**0**				
TOTAL PERSONA/VEHICULO DIA				**12**			**78**						
FLUJO TOTAL DIA									**90**				

Appendix B- 12: A prototype of a gate transcription for Node 3 on the first day (The node has 24 gates in which each was transcribed on three days)

PORTAL 3.3.1			PERSONA			VEHICULO				DIRECCION			
			Mujer	Hombre	Joven (10-18)	Bicicleta	Auto-moto	Bus	Servicios	Desde Norte	Desde Sur	Desde Este	Desde Oeste
MAÑANA TEMPRANA	Ronda 1	Persona 1	0	0	0	0	0	0	0	0	0	0	0
		Auto 1	0	0	0	0	0	0	0	0	0	0	0
		Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		TOTAL PERSONA/VEHICULO		**0**			**0**						
	Ronda 2	**Total**	**3**	**9**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**1**	**27**
		TOTAL PERSONA/VEHICULO		**12**			**0**						
	TOTAL PERSONA/VEHICULO JORNADA			**12**			**0**						
	TOTAL JORNADA								**12**				
MEDIA MAÑANA	Ronda 3	**Total**	**1**	**4**	**0**	**0**	**33**	**1**	**0**	**0**	**0**	**15**	**23**
		TOTAL PERSONA/VEHICULO		**5**			**33**						
	Ronda 4	**Total**	**4**	**0**	**0**	**0**	**18**	**3**	**0**	**0**	**0**	**0**	**21**
		TOTAL PERSONA/VEHICULO		**4**			**18**						
	TOTAL PERSONA/VEHICULO JORNADA			**9**			**51**						
	TOTAL JORNADA								**60**				
ALMUERZO	Ronda 5	**Total**	**0**	**0**	**0**	**2**	**18**	**2**	**0**	**0**	**0**	**3**	**34**
		TOTAL PERSONA/VEHICULO		**0**			**20**						
	TOTAL PERSONA/VEHICULO JORNADA			**0**			**20**						
	TOTAL JORNADA								**20**				
MEDIA TARDE	Ronda 6	**Total**	**21**	**9**	**25**	**1**	**19**	**3**	**2**	**0**	**0**	**29**	**50**
		TOTAL PERSONA/VEHICULO		**55**			**20**						
	Ronda 7	**Total**	**2**	**4**	**0**	**0**	**27**	**5**	**0**	**0**	**0**	**3**	**35**
		TOTAL PERSONA/VEHICULO		**6**			**27**						
	TOTAL PERSONA/VEHICULO JORNADA			**61**			**47**						
	TOTAL JORNADA								**108**				
TARDE NOCHE	Ronda 8	**Total**	**6**	**4**	**1**	**0**	**26**	**2**	**0**	**0**	**0**	**7**	**32**
		TOTAL PERSONA/VEHICULO		**11**			**26**						
	TOTAL PERSONA/VEHICULO JORNADA			**11**			**26**						
	TOTAL JORNADA								**37**				
TOTAL PERSONA/VEHICULO DIA				**93**			**144**						
FLUJO TOTAL DIA									**237**				

Appendix B- 13: A prototype of a gate transcription for Node 4 on the first day (The node has 25 gates in which each was transcribed on three days)

PORTAL 4.3.1			PERSONA			VEHICULO				DIRECCION			
			Mujer	Hombre	Joven (10-18)	Bicicleta	Auto-moto	Bus	Servicios	Desde Norte	Desde Sur	Desde Este	Desde Oeste
MAÑANA TEMPRANA	Ronda 1	Persona 1	0	0	0	0	0	0	0	0	0	0	0
		Auto 1	0	0	0	0	0	0	0	0	0	0	0
		Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		TOTAL PERSONA/VEHICULO		**0**			**0**						
	Ronda 2	**Total**	**0**	**0**	**0**	**0**	**2**	**0**	**1**	**0**	**0**	**3**	**0**
		TOTAL PERSONA/VEHICULO		**0**			**2**						
	TOTAL PERSONA/VEHICULO JORNADA			**0**			**2**						
	TOTAL JORNADA								**2**				
MEDIA MAÑANA	Ronda 3	**Total**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**3**	**0**
		TOTAL PERSONA/VEHICULO		**0**			**0**						
	Ronda 4	**Total**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**2**	**0**
		TOTAL PERSONA/VEHICULO		**0**			**0**						
	TOTAL PERSONA/VEHICULO JORNADA			**0**			**0**						
	TOTAL JORNADA								**0**				
ALMUERZO	Ronda 5	**Total**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**3**	**0**
		TOTAL PERSONA/VEHICULO		**0**			**3**						
	TOTAL PERSONA/VEHICULO JORNADA			**0**			**3**						
	TOTAL JORNADA								**3**				
MEDIA TARDE	Ronda 6	**Total**	**0**	**1**	**0**	**0**	**2**	**0**	**1**	**0**	**0**	**3**	**0**
		TOTAL PERSONA/VEHICULO		**1**			**2**						
	Ronda 7	**Total**	**1**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**4**	**0**
		TOTAL PERSONA/VEHICULO		**1**			**3**						
	TOTAL PERSONA/VEHICULO JORNADA			**2**			**5**						
	TOTAL JORNADA								**7**				
TARDE NOCHE	Ronda 8	**Total**	**0**	**1**	**1**	**0**	**9**	**0**	**4**	**0**	**0**	**15**	**0**
		TOTAL PERSONA/VEHICULO		**2**			**9**						
	TOTAL PERSONA/VEHICULO JORNADA			**2**			**9**						
	TOTAL JORNADA								**11**				
TOTAL PERSONA/VEHICULO DIA				**4**			**19**						
FLUJO TOTAL DIA									**23**				

Appendix B- 1π: Compiled transcription of Node 1 for the first day, categorized by pedestrian movement of men and women

DAY 1	Gate 1.1.1		Gate 1.1.2		Gate 1.1.3		Gate 1.1.4		Gate 1.2.1		Gate 1.2.2		Gate 1.2.3		Gate 1.2.4		Gate 1.3.1		Gate 1.3.2		Gate 1.3.3		Gate 1.3.4		Gate 1.4.1		Gate 1.4.2		Gate 1.4.3		Gate 1.4.4		Gate 1.5.1		Gate 1.5.2		Gate 1.5.3		Gate 1.5.4	
	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me
RONDA 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RONDA 2	0	3	5	3	3	7	1	4	6	4	1	0	4	3	1	1	2	6	0	1	3	6	1	1	0	1	0	1	0	0	0	3	0	1	2	0	0	0	2	1
RONDA 3	0	0	6	4	6	3	3	0	3	4	0	1	3	2	0	0	4	2	0	0	5	2	0	0	2	0	1	1	1	0	2	1	1	1	3	0	0	1	2	0
RONDA 4	0	0	0	4	1	2	1	4	4	10	0	0	2	8	2	2	8	5	0	0	6	5	1	0	0	2	0	0	0	2	0	0	0	0	0	2	0	0	0	1
RONDA 5	0	2	2	2	1	2	0	0	0	7	0	0	0	6	0	1	6	5	0	0	6	5	0	0	0	0	0	2	0	0	0	2	0	0	2	3	0	0	2	3
RONDA 6	0	0	2	2	1	8	2	7	0	3	0	5	2	8	1	6	11	6	4	0	10	10	6	4	0	0	0	1	1	1	1	3	0	0	1	0	0	0	2	1
RONDA 7	0	2	3	5	3	6	1	6	7	9	1	0	6	10	0	2	6	12	0	2	7	6	5	8	0	1	2	2	1	3	3	1	0	0	0	0	0	0	0	0
RONDA 8	3	5	0	0	4	3	3	2	4	4	0	0	4	2	4	2	9	11	0	0	1	1	0	1	0	0	5	3	3	1	3	1	0	0	1	0	4	0	2	0

Appendix B- 1p: Compiled transcription of Node 2 for the first day, categorized by pedestrian movement of men and women

Gate 2.1.1		Gate 2.1.2		Gate 2.1.3		Gate 2.1.4		Gate 2.2.1		Gate 2.2.2		Gate 2.2.3		Gate 2.2.4		Gate 2.3.1		Gate 2.3.2		Gate 2.3.3		Gate 2.3.4		Gate 2.4.1		Gate 2.4.2		Gate 2.4.3		Gate 2.4.4		Gate 2.5.1		Gate 2.5.2		Gate 2.5.3		Gate 2.5.4	
Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	6	0	4	0	1	3	2	3	1	4	4	2	2	4	3	0	2	3	6	0	1	2	4	3	1	0	0	2	1	0	0	1	0	0	0	0	0	0	0
8	9	1	5	8	8	1	5	1	3	5	9	0	0	6	10	0	1	1	5	0	3	1	3	2	1	0	0	0	0	0	0	0	0	3	1	3	1	0	0
3	9	2	4	3	9	2	8	3	2	7	4	2	1	8	5	0	1	1	4	0	0	1	3	0	3	0	0	0	0	0	3	0	0	2	2	0	0	2	1
6	5	2	2	5	5	3	1	2	1	12	13	4	0	13	10	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0	2	1	0	1	1	1	1	0	0
7	11	7	7	6	11	3	10	0	0	16	7	0	2	16	10	3	0	7	4	2	1	3	4	3	3	0	0	2	2	2	4	0	0	1	0	0	0	0	0
4	4	3	2	1	3	2	3	1	0	8	3	0	0	7	3	0	3	1	1	0	2	0	3	1	3	0	0	1	2	1	2	0	0	1	0	0	0	0	0
6	4	6	2	5	2	8	2	4	1	0	5	0	0	4	9	2	0	3	5	3	1	1	3	0	1	0	0	0	2	0	3			1	0			1	0

Appendix B- 16: Compiled transcription of Node 1 for the first day, categorized by pedestrian movement of men and women

Gate 3.1.1		Gate 3.1.2		Gate 3.1.3		Gate 3.1.4		Gate 3.2.1		Gate 3.2.2		Gate 3.2.3		Gate 3.2.4		Gate 3.3.1		Gate 3.3.2		Gate 3.3.3		Gate 3.3.4		Gate 3.4.1		Gate 3.4.2		Gate 3.4.3		Gate 3.4.4		Gate 3.5.1		Gate 3.5.2		Gate 3.5.3	
Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	8	4	3	3	15	11	21	0	0	2	3	2	1	7	4	3	9	0	1	3	7	0	1	0	2	0	0	0	10	1	0	0	1	0	1	0	1
10	8	0	2	4	4	9	8	1	4	13	4	1	1	9	9	1	4	13	4	1	1	8	8	2	4	1	0	0	7	5	4	0	4	0	1	0	0
0	1	0	6	7	7	22	21	4	0	7	2	2	7	10	9	4	0	0	3	4	6	3	1	0	0	0	1	0	13	1	0	2	4	2	1	0	1
0	1	2	5	0	1	17	32	0	1	10	9	0	2	8	9	0	0	0	3	10	12	7	3	0	7	0	0	0	9	0	2	0	2	0	1	0	0
5	10	1	2	0	5	4	11	1	3	7	3	0	0	7	4	21	9	3	4	28	16	23	17	4	3	0	1	1	7	2	2	1	2	1	0	0	2
9	7	9	1	2	3	3	12	0	2	3	9	2	0	3	11	2	4	1	1	8	2	0	2	0	7	0	1	0	12	3	2	0	1	4	4	1	0
1	4	0	1	0	2	2	4	1	6	1	0	0	0	1	6	6	4	0	2	6	14	2	3	0	2	0	2	1	20	0	1	4	3	2	0	1	3

Appendix B- 17: Compiled transcription of Node 4 for the first day, categorized by pedestrian movement of men and women

Gate 4.1.1		Gate 4.1.2		Gate 4.1.3		Gate 4.1.4		Gate 4.2.1		Gate 4.2.2		Gate 4.2.3		Gate 4.2.4		Gate 4.3.1		Gate 4.3.2		Gate 4.3.3		Gate 4.3.4		Gate 4.4.1		Gate 4.4.2		Gate 4.4.3		Gate 4.4.4		Gate 4.5.1		Gate 4.5.2		Gate 4.5.3		Gate 4.5.4	
Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	1	0	1	0	2	0	0	0
0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	2	0	0	0	0	0	1	0	1
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	2	0	0	0	0	0	0	0	0	0	0
0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	1	0	0	0	1	0	2	1	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	0	2	0	1	0	1	0	0	0	1	1	1	0	1	0	0	1	0
0	0	0	3	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	1	0	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0
0	**2**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**2**	**0**	**1**	**1**	**0**	**2**	**0**	**2**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**2**	**0**	**2**	**0**	**2**	**1**	**0**

Appendix B- 18: Compiled transcription of Node 1 for the second day, categorized by pedestrian movement of men and women

	Gate 1.1.1		Gate 1.1.2		Gate 1.1.3		Gate 1.1.4		Gate 1.2.1		Gate 1.2.2		Gate 1.2.3		Gate 1.2.4		Gate 1.3.1		Gate 1.3.2		Gate 1.3.3		Gate 1.3.4		Gate 1.4.1		Gate 1.4.2		Gate 1.4.3		Gate 1.4.4		Gate 1.5.1		Gate 1.5.2		Gate 1.5.3		Gate 1.5.4	
	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me
RONDA 1	1	1	1	3	1	1	2	2	6	9	0	0	6	9	0	1	0	0	0	0	5	7	0	0	0	1	1	1	0	1	1	1	0	0	1	2	0	0	2	1
RONDA 2	0	0	1	0	0	0	1	0	6	2	0	0	6	2	0	0	2	3	0	0	3	1	0	0	0	1	1	1	0	1	0	1	2	0	4	6	2	0	4	6
RONDA 3	0	0	0	4	1	4	1	4	1	7	0	0	1	7	0	0	1	7	1	0	1	6	0	1	0	1	0	0	0	1	1	0	0	0	0	0	0	1	0	0
RONDA 4	0	0	2	1	2	0	0	1	0	0	2	0	1	3	0	0	3	3	0	0	3	5	0	0	0	1	0	2	0	1	0	2	0	1	0	0	0	0	0	0
RONDA 5	0	0	2	0	2	2	0	1	3	7	0	0	3	7	2	1	1	1	0	0	2	3	0	0	1	1	2	2	0	1	1	0	0	0	0	0	2	1	0	0

Appendix B- 19: Compiled transcription of Node 2 for the second day, categorized by pedestrian movement of men and women

Gate 2.1.1		Gate 2.1.2		Gate 2.1.3		Gate 2.1.4		Gate 2.2.1		Gate 2.2.2		Gate 2.2.3		Gate 2.2.4		Gate 2.3.1		Gate 2.3.2		Gate 2.3.3		Gate 2.3.4		Gate 2.4.1		Gate 2.4.2		Gate 2.4.3		Gate 2.4.4		Gate 2.5.1		Gate 2.5.2		Gate 2.5.3		Gate 2.5.4	
Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me
4	5	4	2	1	7	3	2	2	1	5	1	2	1	3	1	2	1	6	5	3	2	6	7	0	4	0	0	0	2	0	1	1	0	0	3	1	0	0	2
0	0	4	1	0	0	0	0	0	0	0	3	0	0	0	3	0	2	2	5	1	0	1	4	0	4	0	0	0	0	0	0	1	2	0	1	1	0	0	0
2	8	5	6	0	0	1	5	0	1	8	5	0	2	8	4	0	0	4	3	0	0	4	4	2	2	0	0	2	1	0	0	0	2	4	0	0	0	2	2
0	0	3	6	0	0	0	5	2	3	8	14	2	3	9	10	1	0	2	0	0	1	1	3	0	0	0	0	0	0	0	0	0	0	2	3	0	0	2	4
2	4	1	1	2	3	1	3	4	1	5	8	0	3	4	6	2	0	2	4	0	0	2	3	1	1	0	0	1	1	0	1	1	1	3	2	0	0	2	1

Appendix B- 2Л: Compiled transcription of Node 3 for the second day, categorized by movement of men and women

Gate 3.1.1		Gate 3.1.2		Gate 3.1.3		Gate 3.1.4		Gate 3.2.1		Gate 3.2.2		Gate 3.2.3		Gate 3.2.4		Gate 3.3.1		Gate 3.3.2		Gate 3.3.3		Gate 3.3.4		Gate 3.4.1		Gate 3.4.2		Gate 3.4.3		Gate 3.4.4		Gate 3.5.1		Gate 3.5.2		Gate 3.5.3	
Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me
4	10	2	1	2	6	3	7	4	3	1	2	2	6	0	0	11	10	1	2	9	8	9	7	5	7	0	1	2	2	6	3	4	6	0	11	4	7
9	9	0	2	2	6	8	17	2	7	1	3	4	3	1	1	6	3	0	0	6	5	2	2	0	3	0	2	0	2	0	1	0	2	0	0	2	3
4	6	1	3	0	2	16	1	10	3	1	1	11	3	2	6	8	17	0	0	11	12	0	2	1	5	1	0	2	3	0	3	1	2	0	2	0	0
9	5	0	8	9	2	22	18	0	3	7	11	2	2	10	9	10	8	0	0	11	11	0	2	1	3	0	1	1	2	0	1	2	6	0	4	1	4
7	6	7	3	6	19	14	7	13	10	4	7	13	12	1	2	11	10	4	4	5	12	0	0	0	2	0	1	0	6	0	3	1	2	2	4	0	3

Appendix B- 2М: Compiled transcription of Node 4 for the second day, categorized by movement of men and women

Gate 4.1.1		Gate 4.1.2		Gate 4.1.3		Gate 4.1.4		Gate 4.2.1		Gate 4.2.2		Gate 4.2.3		Gate 4.2.4		Gate 4.3.1		Gate 4.3.2		Gate 4.3.3		Gate 4.3.4		Gate 4.4.1		Gate 4.4.2		Gate 4.4.3		Gate 4.4.4		Gate 4.5.1		Gate 4.5.2		Gate 4.5.3		Gate 4.5.4	
Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me	Wo	Me
0	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	1	0	0	1	0	0	2	1	0	0	0	1	5	2
1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	2	3	0	2	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	2	0	0	0	0	0	1	2	0	0	0	0	0	1	0
0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	0	0	1	0	1	1	2	1	0	0	2	1	0	1	0	1	1	1
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	1	1	1	0	0

Appendix B- 22: Compiled transcription of Node 1 for the first day, categorized by movement of Bicycles and Vehicles

DAY 1	Gate 1.1.1		Gate 1.1.2		Gate 1.1.3		Gate 1.1.4		Gate 1.2.1		Gate 1.2.2		Gate 1.2.3		Gate 1.2.4		Gate 1.3.1		Gate 1.3.2		Gate 1.3.3		Gate 1.3.4		Gate 1.4.1		Gate 1.4.2		Gate 1.4.3		Gate 1.4.4		Gate 1.5.1		Gate 1.5.2		Gate 1.5.3		Gate 1.5.4	
	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V
RONDA 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RONDA 2	1	50	0	0	1	46	0	4	2	26	0	1	2	23	0	2	1	52	0	3	0	50	1	6	0	1	0	3	0	1	0	1	0	2	0	9	0	1	0	8
RONDA 3	2	56	2	0	4	51	0	5	2	46	0	6	0	39	1	3	0	38	0	1	0	39	0	5	0	5	0	4	0	4	0	3	0	6	0	13	0	5	0	12
RONDA 4	1	58	0	0	1	53	0	5	2	43	1	2	1	41	0	6	2	38	0	0	2	40	2	6	2	1	0	0	2	2	0	1	0	4	0	5	0	4	0	5
RONDA 5	1	40	0	1	1	41	0	1	1	22	1	0	0	23	0	1	2	46	0	0	1	46	1	0	1	3	0	1	1	5	0	3	0	1	0	13	1	5	0	10
RONDA 6	0	1	0	0	1	74	0	6	0	72	1	0	1	67	2	5	0	41	4	0	0	42	0	5	0	8	0	4	0	7	0	3	0	1	0	0	0	5	0	5
RONDA 7	0	59	2	0	1	56	1	3	2	48	1	2	1	47	1	3	1	44	0	2	1	47	0	8	0	2	0	8	0	1	0	7	0	6	0	5	0	6	0	5
RONDA 8	5	73	2	8	4	66	1	7	7	72	2	8	5	64	0	8	4	60	0	0	0	0	0	20	0	4	0	9	0	4	1	9	0	1	0	1	0	7	0	17

Appendix B- 20: Compiled transcription of Node 2 for the first day, categorized by movement of Bicycles and Vehicles

Gate 2.1.1		Gate 2.1.2		Gate 2.1.3		Gate 2.1.4		Gate 2.2.1		Gate 2.2.2		Gate 2.2.3		Gate 2.2.4		Gate 2.3.1		Gate 2.3.2		Gate 2.3.3		Gate 2.3.4		Gate 2.4.1		Gate 2.4.2		Gate 2.4.3		Gate 2.4.4		Gate 2.5.1		Gate 2.5.2		Gate 2.5.3		Gate 2.5.4	
B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V
0	0	0	0	0	0	0	0	0	0	0	0	0	0			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	39	0	8	0	3	0	26	0	7	0	13	0	5	0	9	2	6	0	10	2	7	0	9	0	28	0	22	0	17	0	1	0	15	0	25	1	21	0	1
0	34	0	1	0	25	0	7	0	4	0	6	0	6	0	7	0	6	0	7	0	5	0	8	0	23	0	22	0	17	0	1	1	15	0	25	0	21	0	0
0	45	0	1	0	41	0	10	0	2	0	4	0	2	0	0	1	2	0	4	0	3	1	3	0	34	0	25	0	6	0	0	0	11	0	17	0	5	0	1
0	32	0	4	0	22	0	6	0	4	0	8	0	2	0	0	0	5	0	6	0	4	0	8	0	34	0	23	0	6	0	0	0	11	0	17	0	5	0	0
0	48	1	11	0	49	0	9	0	6	1	8	0	9	0	11	0	7	0	10	0	5	1	10	2	22	0	13	0	6	0	1	1	19	1	21	0	13	0	8
0	65	1	9	0	57	1	8	0	11	0	13	0	10	0	12	0	6	0	7	0	6	0	5	2	22	0	13	0	6	0	1	1	16	1	20	0	13	0	8
4	70	3	12	0	64	2	7	0	6	0	8	0	9	0	9	1	11	0	12	0	10	2	12	0	58	0	32	0	20	0	7	0	17	2	22	0	13	2	9

Appendix B- 2П: Compiled transcription of Node 3for the first day, categorized by movement of Bicycles and Vehicles

Gate 3.1.1		Gate 3.1.2		Gate 3.1.3		Gate 3.1.4		Gate 3.2.1		Gate 3.2.2		Gate 3.2.3		Gate 3.2.4		Gate 3.3.1		Gate 3.3.2		Gate 3.3.3		Gate 3.3.4		Gate 3.4.1		Gate 3.4.2		Gate 3.4.3		Gate 3.4.4		Gate 3.5.1		Gate 3.5.2		Gate 3.5.3	
B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	13	0	1	0	13	0	10	0	51	0	13	0	49	0	9	0	0	0	5	0	14	0	4	0	12	0	1	0	10	0	4	0	5	0	4	0	2
0	14	0	6	0	10	0	8	0	33	0	16	0	36	1	7	0	33	0	16	0	36	1	7	0	8	0	0	0	7	0	1	1	4	0	3	0	2
0	12	0	8	1	17	0	9	1	32	0	14	1	0	0	0	0	18	0	2	1	16	0	2	0	14	0	0	0	13	0	2	0	7	0	5	0	1
0	12	1	8	1	13	1	8	0	28	1	22	1	43	3	12	2	18	0	7	1	13	0	0	0	11	0	1	0	9	0	4	1	1	0	1	1	0
0	16	0	10	0	6	0	5	0	36	0	0	1	49	2	8	1	19	0	8	1	15	2	6	1	13	0	1	1	7	0	5	0	4	0	5	0	3
0	15	0	9	0	8	0	7	0	34	1	23	0	40	1	6	0	27	0	0	0	24	0	1	0	12	0	2	0	12	0	3	0	3	0	2	0	1
0	9	0	6	0	4	0	2	0	42	2	24	0	61	1	2	0	26	0	29	2	13	0	14	0	21	1	6	1	20	1	9	0	3	0	1	0	1

Appendix B- 25: Compiled transcription of Node 4 for the first day, categorized by movement of Bicycles and Vehicles

Gate 4.1.1		Gate 4.1.2		Gate 4.1.3		Gate 4.1.4		Gate 4.2.1		Gate 4.2.2		Gate 4.2.3		Gate 4.2.4		Gate 4.3.1		Gate 4.3.2		Gate 4.3.3		Gate 4.3.4		Gate 4.4.1		Gate 4.4.2		Gate 4.4.3		Gate 4.4.4		Gate 4.5.1		Gate 4.5.2		Gate 4.5.3		Gate 4.5.4	
B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	1	0	16	0	5	2	14	0	0	1	14	0	2	0	18	0	0
0	0	0	1	0	0	0	3	0	0	0	0	0	2	0	2	0	0	0	0	0	3	0	2	2	11	0	3	1	9	2	0	0	31	0	6	0	15	0	0
0	0	0	4	0	0	0	0	0	0	0	3	0	1	0	2	0	0	0	0	0	2	1	1	0	9	0	1	0	16	0	0	0	19	0	7	0	25	0	0
0	0	0	3	0	0	0	4	0	1	0	1	0	1	0	1	0	3	0	1	1	5	0	2	0	9	0	0	1	19	1	0	0	12	0	7	0	23	0	0
0	0	1	4	0	0	0	1	0	0	0	0	0		0	1	0	2	1	2	0	3	0	2	1	15	0	2	0	28	0	0	0	18	0	4	0	29	0	0
0	0	0	2	0	0	0	6	0	0	0	1	0	1	0	2	0	3	0	2	0	5	0	4	0	13	1	3	0	10	0	0	0	20	0	7	0	19	0	0
0	0	0	12	0	0	0	6	2	0	2	0	0	0	0	0	0	9	0	5	0	5	0	3	0	20	0	4	0	16	0	0	1	28	1	10	0	18	0	0

Appendix B- 26: Compiled transcription of Node 1 for the second day, categorized by pedestrian movement of Bicycles and Vehicles

Day 2	Gate 1.1.1		Gate 1.1.2		Gate 1.1.3		Gate 1.1.4		Gate 1.2.1		Gate 1.2.2		Gate 1.2.3		Gate 1.2.4		Gate 1.3.1		Gate 1.3.2		Gate 1.3.3		Gate 1.3.4		Gate 1.4.1		Gate 1.4.2		Gate 1.4.3		Gate 1.4.4		Gate 1.5.1		Gate 1.5.2		Gate 1.5.3		Gate 1.5.4	
	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V
RONDA 1	4	36	0	0	5	90	1	42	2	55	0	1	2	55	0	5	0	2	0	6	0	35	0	5	0	21	0	1	0	21	0	5	0	2	0	1	0	11	0	1
RONDA 2	0	63	0	2	0	60	0	9	3	53	1	0	2	54	0	12	1	37	0	2	1	39	0	1	0	1	0	2	0	1	0	1	0	1	0	3	0	4	0	8
RONDA 3	0	0	0	0	0	63	0	2	0	50	0	1	0	46	0	1	0	36	0	1	0	36	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
RONDA 4	0	54	0	0	0	0	0	3	1	30	0	0	2	30	0	2	0	20	0	1	0	35	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
RONDA 5	0	0	0	0	0	52	0	4	1	47	0	1	1	44	0	1	0	35	0	0	0	40	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	4

Appendix B- 27: Compiled transcription of Node 2 for the second day, categorized by pedestrian movement of Bicycles and Vehicles

Gate 2.1.1		Gate 2.1.2		Gate 2.1.3		Gate 2.1.4		Gate 2.2.1		Gate 2.2.2		Gate 2.2.3		Gate 2.2.4		Gate 2.3.1		Gate 2.3.2		Gate 2.3.3		Gate 2.3.4		Gate 2.4.1		Gate 2.4.2		Gate 2.4.3		Gate 2.4.4		Gate 2.5.1		Gate 2.5.2		Gate 2.5.3		Gate 2.5.4	
B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V
1	35	0	12	0	1	0	16	0	16	1	13	2	32	1	30	1	18	1	4	0	14	0	8	2	41	1	25	1	21	0	9	0	17	1	27	0	18	0	18
1	33	0	10	0	1	0	14	0	10	0	10	0	15	0	17	0	5	0	8	0	7	0	9	2	39	0	24	1	14	0	0	0	14	1	29	0	16	1	19
0	25	0	8	0	34	0	7	0	7	0	9	0	10	0	12	0	9	0	8	0	7	0	10	0	32	0	25	0	7	0	4	0	7	0	16	0	13	0	14
0	24	0	7	0	33	0	6	0	1	0	11	0	4	0	15	0	3	0	8	0	2	0	7	0	30	0	24	0	6	0	0	0	6	0	15	0	7	0	9
0	39	0	4	0	33	0	6	1	3	1	7	0	6	0	8	2	5	0	7	0	4	0	7	0	22	0	14	0	5	0	0	2	7	3	27	3	10	2	16

Appendix B- 28: Compiled transcription of Node 3 for the second day, categorized by pedestrian movement of Bicycles and Vehicles

Gate 3.1.1		Gate 3.1.2		Gate 3.1.3		Gate 3.1.4		Gate 3.2.1		Gate 3.2.2		Gate 3.2.3		Gate 3.2.4		Gate 3.3.1		Gate 3.3.2		Gate 3.3.3		Gate 3.3.4		Gate 3.4.1		Gate 3.4.2		Gate 3.4.3		Gate 3.4.4		Gate 3.5.1		Gate 3.5.2		Gate 3.5.3	
B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V
0	9	2	13	1	4	1	6	0	0	0	40	0	22	0	40	2	25	0	5	1	21	0	6	0	20	0	0	0	16	0	6	0	2	0	2	0	0	0	0
0	12	1	9	1	10	0	13	1	4	0	36	1	14	0	41	0	29	0	11	0	21	0	4	0	15	0	1	0	9	1	5	0	2	0	0	0	2	0	2
0	13	0	12	0	12	0	7	0	4	0	28	0	24	1	39	1	14	0	6	0	15	1	6	0	13	0	0	0	10	0	5	0	6	0	0	0	2	0	2
0	0	0	9	2	16	1	8	0	28	1	29	0	40	0	19	1	22	0	6	2	19	0	2	1	16	0	1	1	13	1	3	0	5	0	8	0	1	0	1
0	16	1	8	2	11	0	9	0	12	0	33	0	25	0	44	0	15	1	5	1	15	0	4	0	7	0	3	0	9	0	6	0	4	0	3	0	4	0	4

Appendix B- 29: Compiled transcription of Node 4 for the second day, categorized by pedestrian movement of Bicycles and Vehicles

Gate 4.1.1		Gate 4.1.2		Gate 4.1.3		Gate 4.1.4		Gate 4.2.1		Gate 4.2.2		Gate 4.2.3		Gate 4.2.4		Gate 4.3.1		Gate 4.3.2		Gate 4.3.3		Gate 4.3.4		Gate 4.4.1		Gate 4.4.2		Gate 4.4.3		Gate 4.4.4		Gate 4.5.1		Gate 4.5.2		Gate 4.5.3		Gate 4.5.4	
B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V	B	V
0	0	0	4	0	0	0	13	0	0	0	0	0	2	0	3	0	2	0	2	0	0	2	5	0	17	0	2	0	39	0	0	0	16	0	7	1	35	1	0
0	0	0	0	0	0	0	3	0	0	0	0	1	0	1	1	0	2	0	2	0	3	0	4	1	8	0	1	0	17	0	0	0	20	0	8	1	23	0	0
0	0	0	4	0	0	1	1	0	0	0	0	0	0	0	0	0	2	0	2	0	1	0	2	0	10	0	3	0	11	0	0	0	5	0	2	1	15	0	0
0	0	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	2	0	2	0	1	0	0	0	9	0	3	1	17	0	0	1	16	0	7	2	14	0	0
0	0	0	8	0	0	1	6	0	0	0	0	0	1	0	2	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1	13	0	6	0	19	1	0

Appendix B- 30: Compiled calculation of gates per time slots for each node of an average weekday and a weekend. The above two schedules present pedestrians and the below two schedules present vehicle.

WEEKDAY (PPL)	Node 1	Node 2	Node 3	Node 4	TOTAL RB		WEEKEND	Node 1	Node 2	Node 3	Node 4	TOTAL RB
MAÑANA TEMPRANA	51,264	53,952	111,360	12,672	229,248							
MEDIA MAÑANA	42,240	71,040	121,152	8,640	243,072	368,832	MEDIA MAÑANA	69,504	55,680	188,544	17,664	331,392
ALMUERZO	20,544	32,832	67,968	4,416	125,760		ALMUERZO	31,488	28,032	75,648	4,608	139,776
MEDIA TARDE	87,936	84,096	130,944	9,600	312,576							
TARDE NOCHE	33,024	32,256	40,320	9,216	114,816							
TOTAL PER DAY	235,008	274,176	471,744	44,544	**1,025,472**	36%	**TOTAL PER DAY**	100,992	83,712	264,192	22,272	**471,168**
	87,936	84,096	130,944	12,672						0.560717		

WEEKDAY CARS	Node 1	Node 2	Node 3	Node 4	TOTAL RB		WEEKEND	Node 1	Node 2	Node 3	Node 4	TOTAL RB
MAÑANA TEMPRANA	283,392	259,776	182,592	91,584	817,344							
MEDIA MAÑANA	213,888	180,672	172,800	62,592	629,952	931,584	MEDIA MAÑANA	273,024	244,224	213,120	78,336	808,704
ALMUERZO	98,112	84,672	88,704	30,144	301,632		ALMUERZO	178,944	108,672	67,584	51,840	407,040
MEDIA TARDE	278,400	233,088	175,104	81,792	768,384							
TARDE NOCHE	180,096	162,816	115,584	54,528	513,024							
TOTAL PER DAY	1,053,888	921,024	734,784	320,640	**3,030,336**		**TOTAL PER DAY**	451,968	352,896	280,704	130,176	**1,215,744**

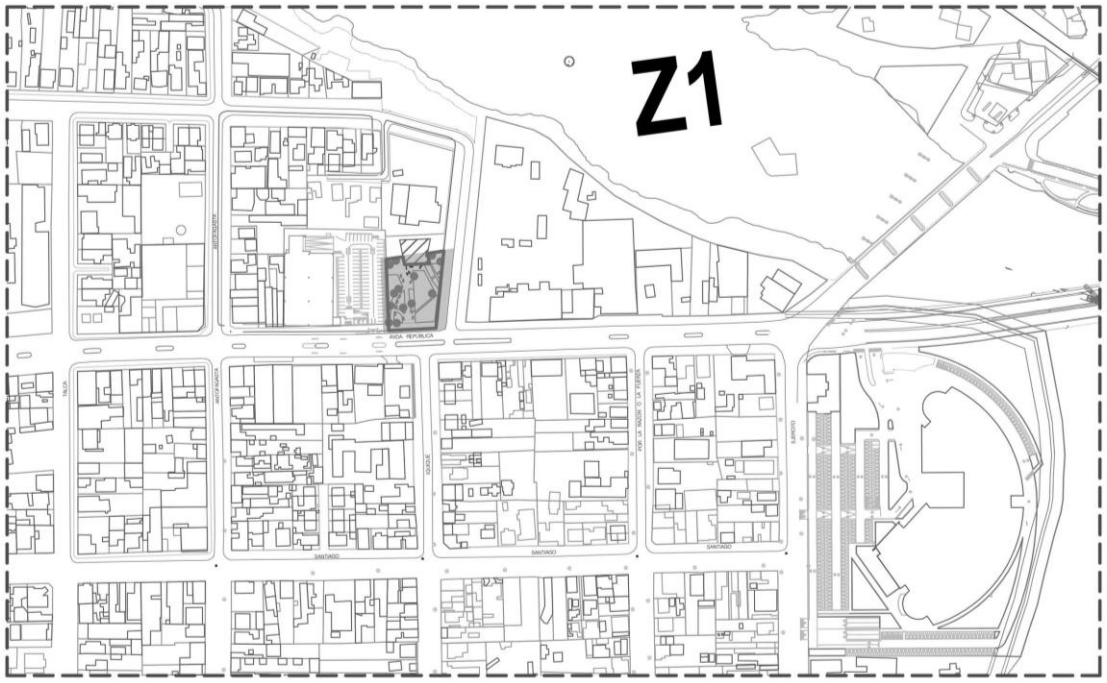
Appendix B- 31: Compiled calculation for each gate on a weekday and a weekend for nodes 1, 2, 3 and 4 respectively – Map preparation.

Weekend		Weekend		Weekday		Weekend		Weekday		Weekend		Weekday	
GATES	Vehicles	GATES	Vehicles	GATES	PPL	GATES	Vehicles	GATES	PPL	GATES	Vehicles	GATES	PPL
Gate 1.1.1	130,944	Gate 3.1.1	36,480	Gate 3.1.1	36,288	Gate 2.1.1	29,376	Gate 2.1.1	138,240	Gate 4.1.1	0	Gate 4.1.1	1,344
Gate 1.1.2	5,568	Gate 3.1.2	27,648	Gate 3.1.2	15,360	Gate 2.1.2	21,696	Gate 2.1.2	27,072	Gate 4.1.2	13,248	Gate 4.1.2	1,536
Gate 1.1.3	185,664	Gate 3.1.3	29,760	Gate 3.1.3	24,384	Gate 2.1.3	22,272	Gate 2.1.3	102,528	Gate 4.1.3	0	Gate 4.1.3	1,152
Gate 1.1.4	29,760	Gate 3.1.4	22,272	Gate 3.1.4	64,512	Gate 2.1.4	20,352	Gate 2.1.4	32,256	Gate 4.1.4	14,784	Gate 4.1.4	2,304
Gate 1.2.1	162,240	Gate 3.2.1	80,256	Gate 3.2.1	18,816	Gate 2.2.1	8,640	Gate 2.2.1	22,464	Gate 4.2.1	960	Gate 4.2.1	0
Gate 1.2.2	8,448	Gate 3.2.2	71,616	Gate 3.2.2	26,304	Gate 2.2.2	38,208	Gate 2.2.2	30,144	Gate 4.2.2	1,920	Gate 4.2.2	192
Gate 1.2.3	152,064	Gate 3.2.3	111,360	Gate 3.2.3	16,512	Gate 2.2.3	5,952	Gate 2.2.3	33,408	Gate 4.2.3	2,304	Gate 4.2.3	960
Gate 1.2.4	14,784	Gate 3.2.4	56,832	Gate 3.2.4	30,912	Gate 2.2.4	40,128	Gate 2.2.4	37,248	Gate 4.2.4	4,032	Gate 4.2.4	1,344
Gate 1.3.1	117,504	Gate 3.3.1	67,776	Gate 3.3.1	43,776	Gate 2.3.1	6,144	Gate 2.3.1	25,728	Gate 4.3.1	8,448	Gate 4.3.1	2,112
Gate 1.3.2	6,144	Gate 3.3.2	27,456	Gate 3.3.2	11,520	Gate 2.3.2	20,736	Gate 2.3.2	24,192	Gate 4.3.2	6,144	Gate 4.3.2	1,920
Gate 1.3.3	111,168	Gate 3.3.3	59,136	Gate 3.3.3	57,408	Gate 2.3.3	6,528	Gate 2.3.3	21,312	Gate 4.3.3	8,832	Gate 4.3.3	2,496
Gate 1.3.4	19,392	Gate 3.3.4	17,088	Gate 3.3.4	31,680	Gate 2.3.4	17,472	Gate 2.3.4	26,496	Gate 4.3.4	8,640	Gate 4.3.4	2,688
Gate 1.4.1	16,704	Gate 3.4.1	44,352	Gate 3.4.1	16,512	Gate 2.4.1	9,600	Gate 2.4.1	104,064	Gate 4.4.1	39,744	Gate 4.4.1	4,416
Gate 1.4.2	10,944	Gate 3.4.2	5,184	Gate 3.4.2	3,264	Gate 2.4.2	0	Gate 2.4.2	66,624	Gate 4.4.2	7,680	Gate 4.4.2	2,496
Gate 1.4.3	16,320	Gate 3.4.3	37,440	Gate 3.4.3	27,840	Gate 2.4.3	5,760	Gate 2.4.3	35,904	Gate 4.4.3	56,448	Gate 4.4.3	2,304
Gate 1.4.4	11,904	Gate 3.4.4	15,360	Gate 3.4.4	11,328	Gate 2.4.4	6,144	Gate 2.4.4	8,064	Gate 4.4.4	576	Gate 4.4.4	1,536
Gate 1.5.1	7,104	Gate 3.5.1	11,520	Gate 3.5.1	13,632	Gate 2.5.1	2,112	Gate 2.5.1	44,352	Gate 4.5.1	57,408	Gate 4.5.1	5,952
Gate 1.5.2	11,520	Gate 3.5.2	8,448	Gate 3.5.2	11,904	Gate 2.5.2	7,104	Gate 2.5.2	70,080	Gate 4.5.2	19,776	Gate 4.5.2	2,496
Gate 1.5.3	15,552	Gate 3.5.3	4,800	Gate 3.5.3	9,792	Gate 2.5.3	1,728	Gate 2.5.3	41,472	Gate 4.5.3	69,120	Gate 4.5.3	2,496
Gate 1.5.4	20,160					Gate 2.5.4	4,224	Gate 2.5.4	29,376	Gate 4.5.4	576	Gate 4.5.4	4,800

Appendix C

Chapter 4: Fieldwork analysis of SnapShot method

Appendix C- 1: Location of the three SnapShots of Node 1 - Fieldwork preparation



Leyenda

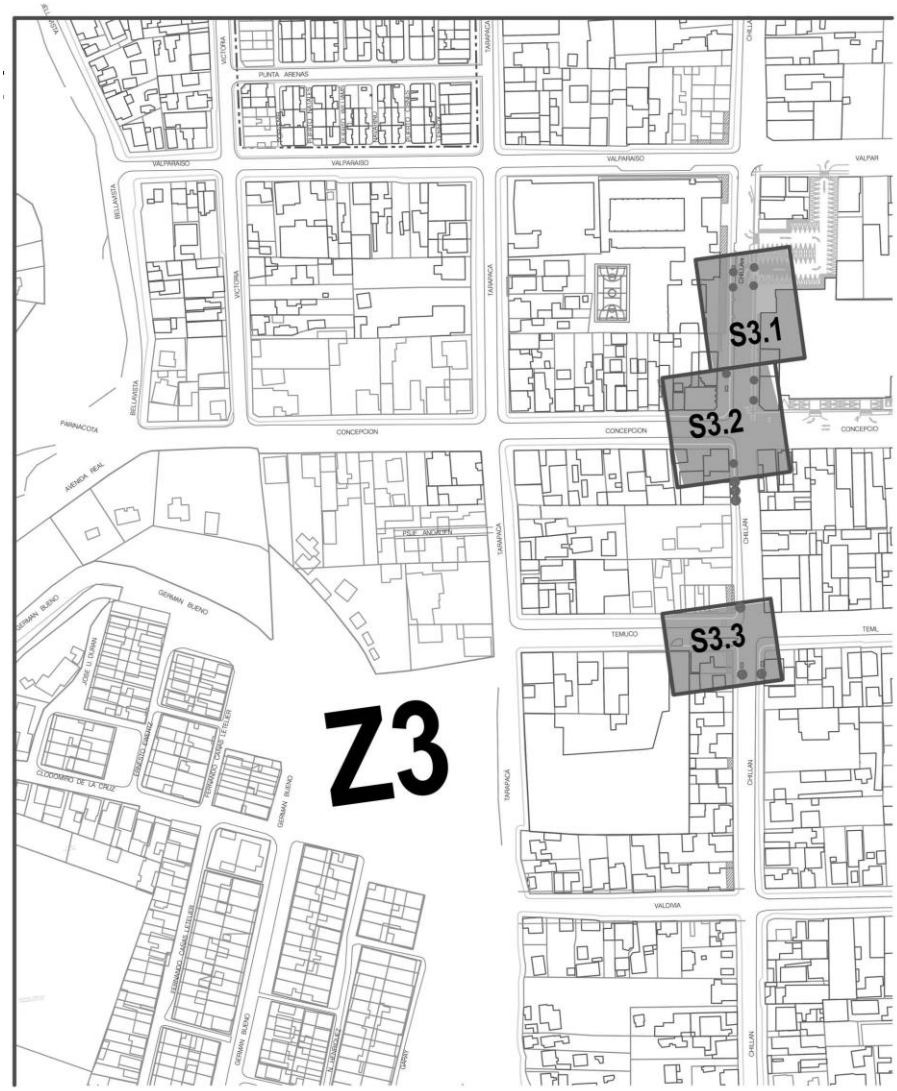
- Trabajar
- X Comercial
- Funcional (Pasando)
- Recreacionales (Estudiando, Comiendo, Jugando, Deportista)
- Interactiones (Sentando, Hablando)

- Niño
- Adulto
- Viejo

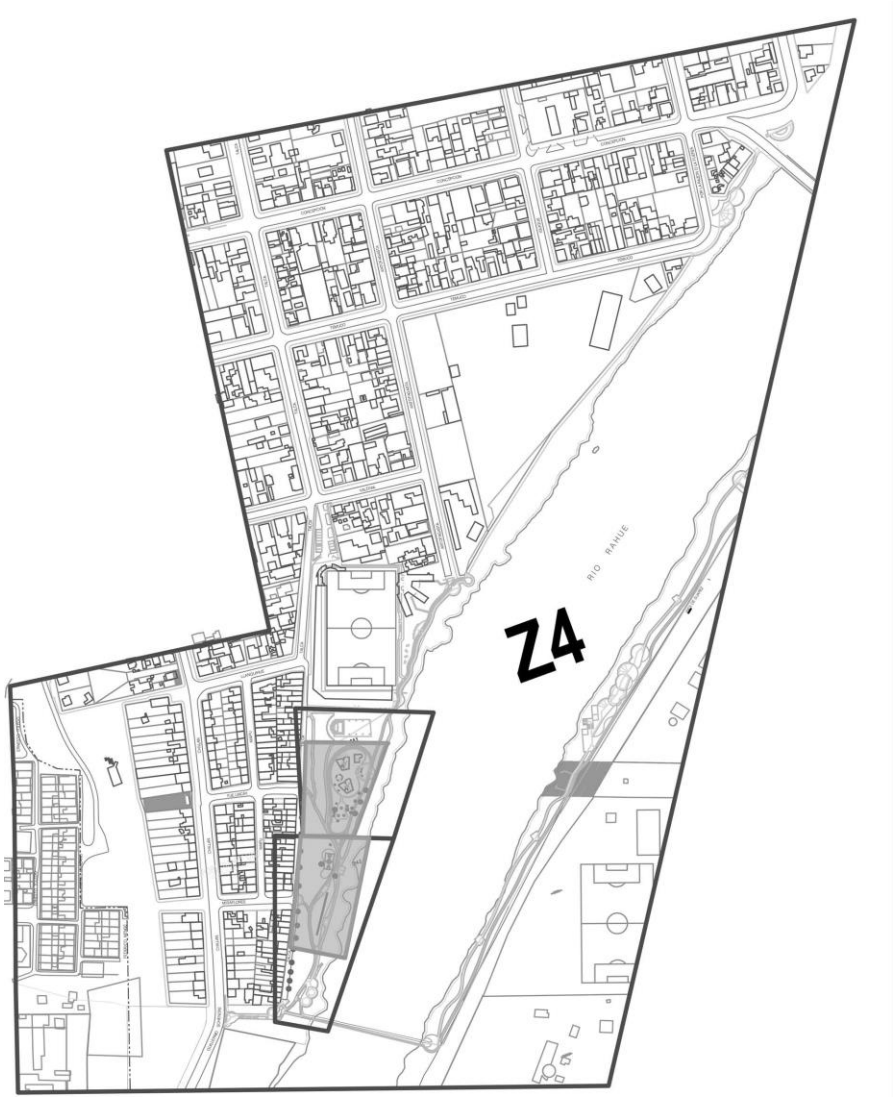
- A Auto
- B Bici
- P En pie

Appendix C- 2: Location of the three SnapShots of Node 2 - Fieldwork preparation

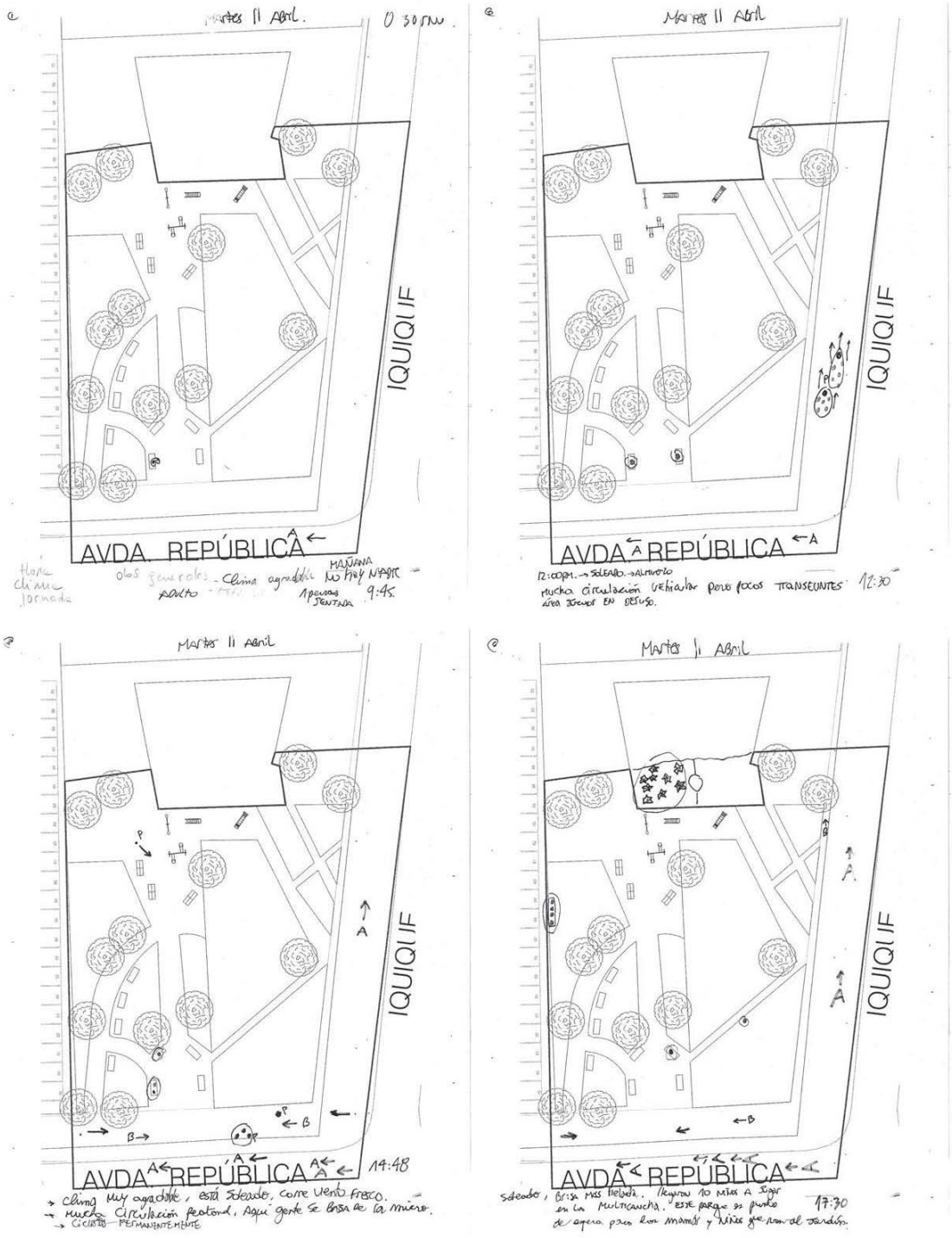
Appendix C- 3: Location of the three SnapShots of Node 3 - Fieldwork preparation



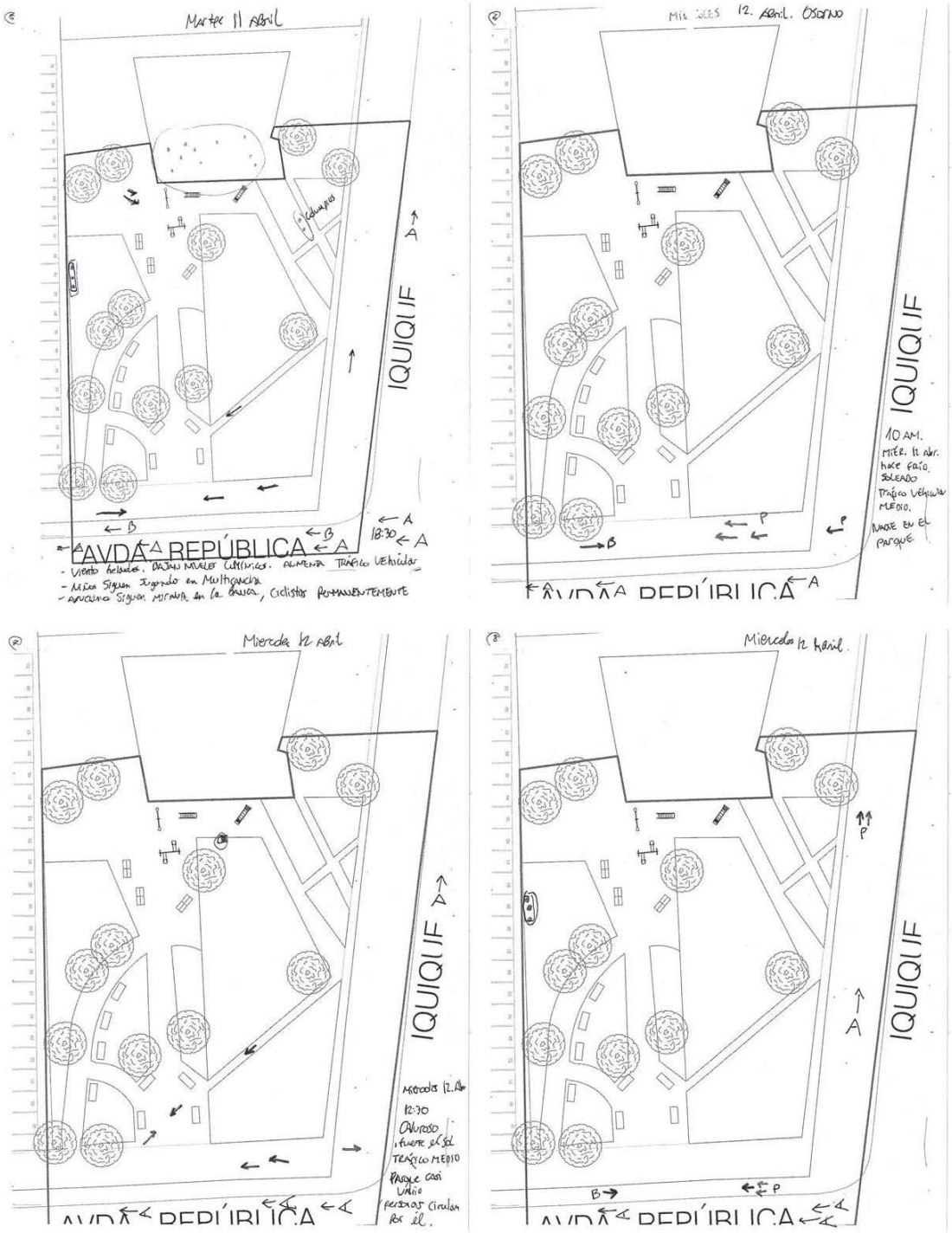
Appendix C- 4: Location of the three SnapShots of Node 4 - Fieldwork preparation



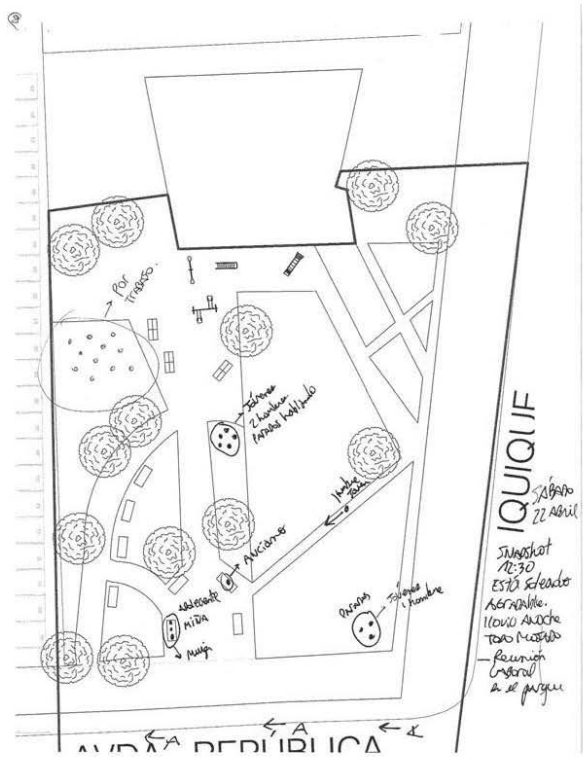
Appendix C- 5: Manual transcription of Node 1 Snapshots in fieldwork at different daily hours as scheduled for day 1

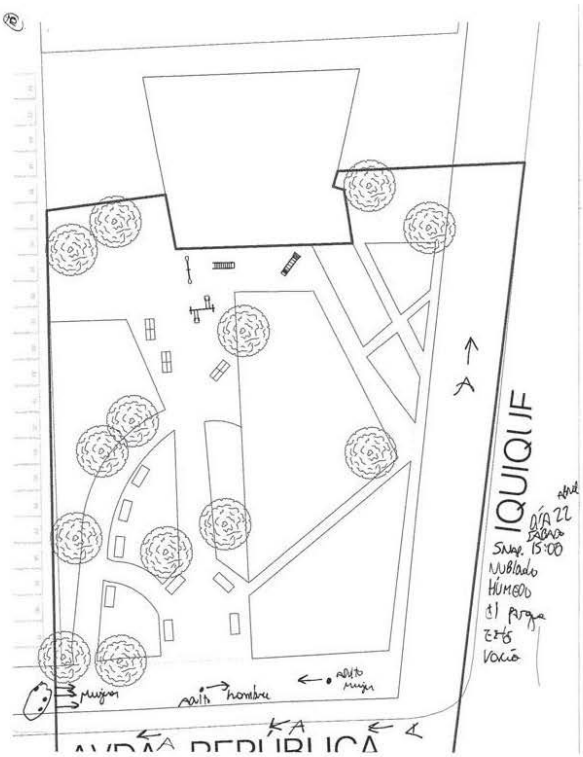


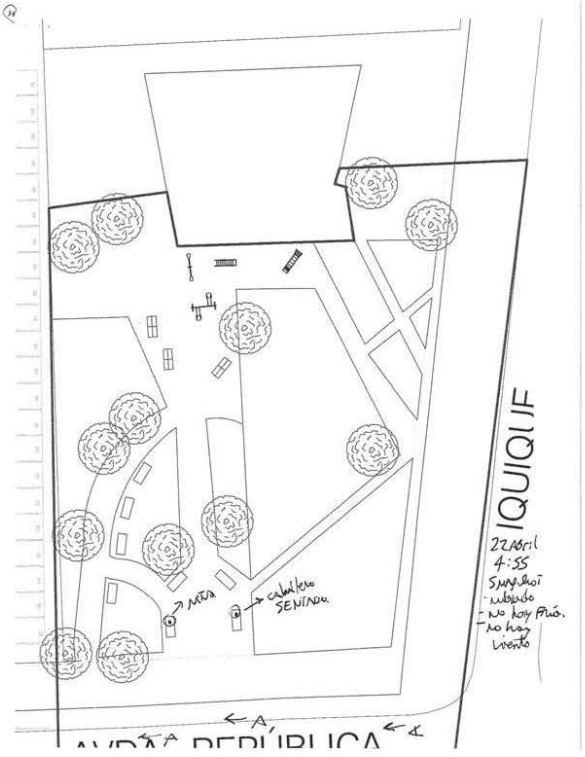
Appendix C- 6: Manual transcription of Node 1 Snapshots in fieldwork at different daily hours as scheduled for day 1 and 2



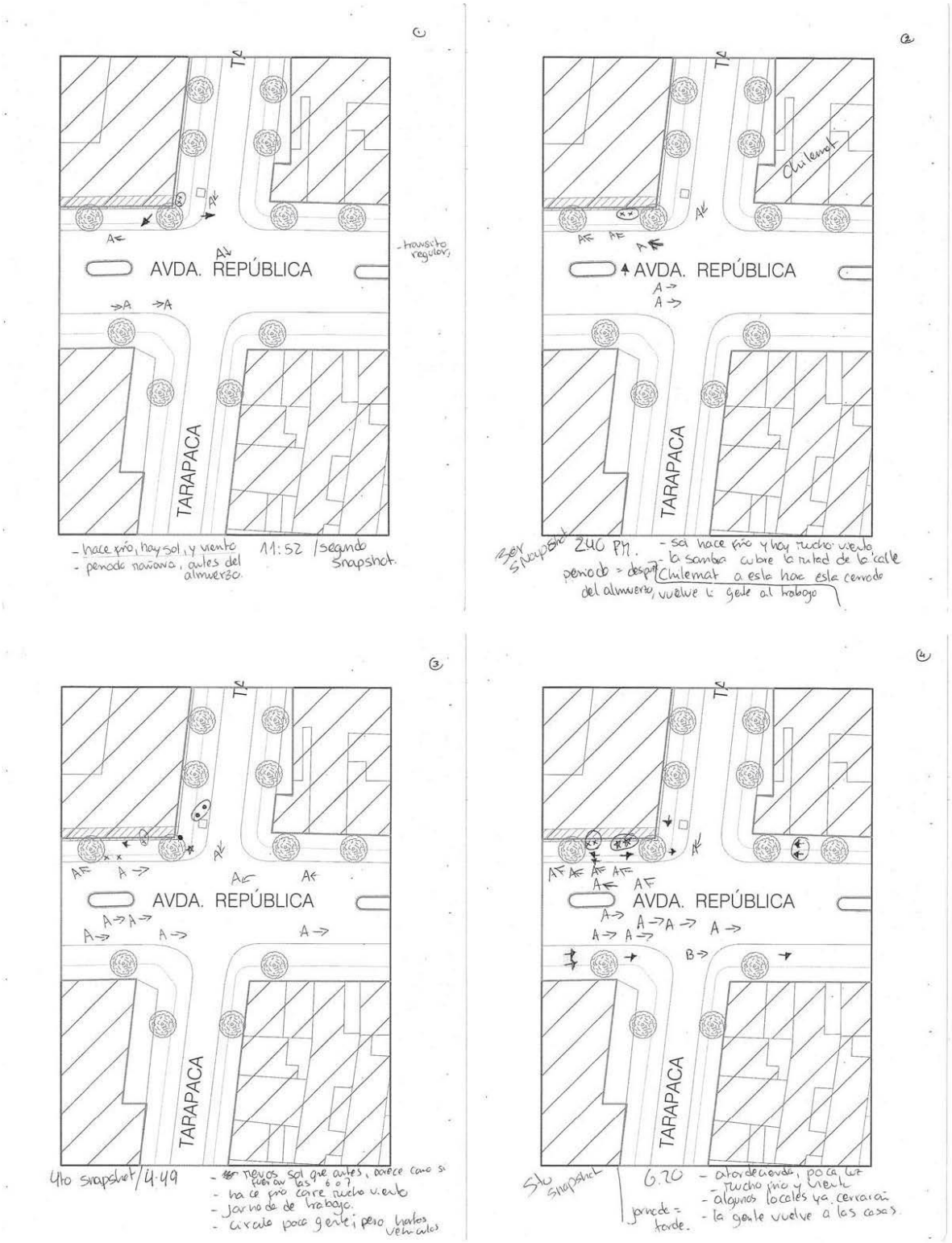
Appendix C- 7: Manual transcription of Node 1 Snapshots in fieldwork at different daily hours as scheduled for day 3



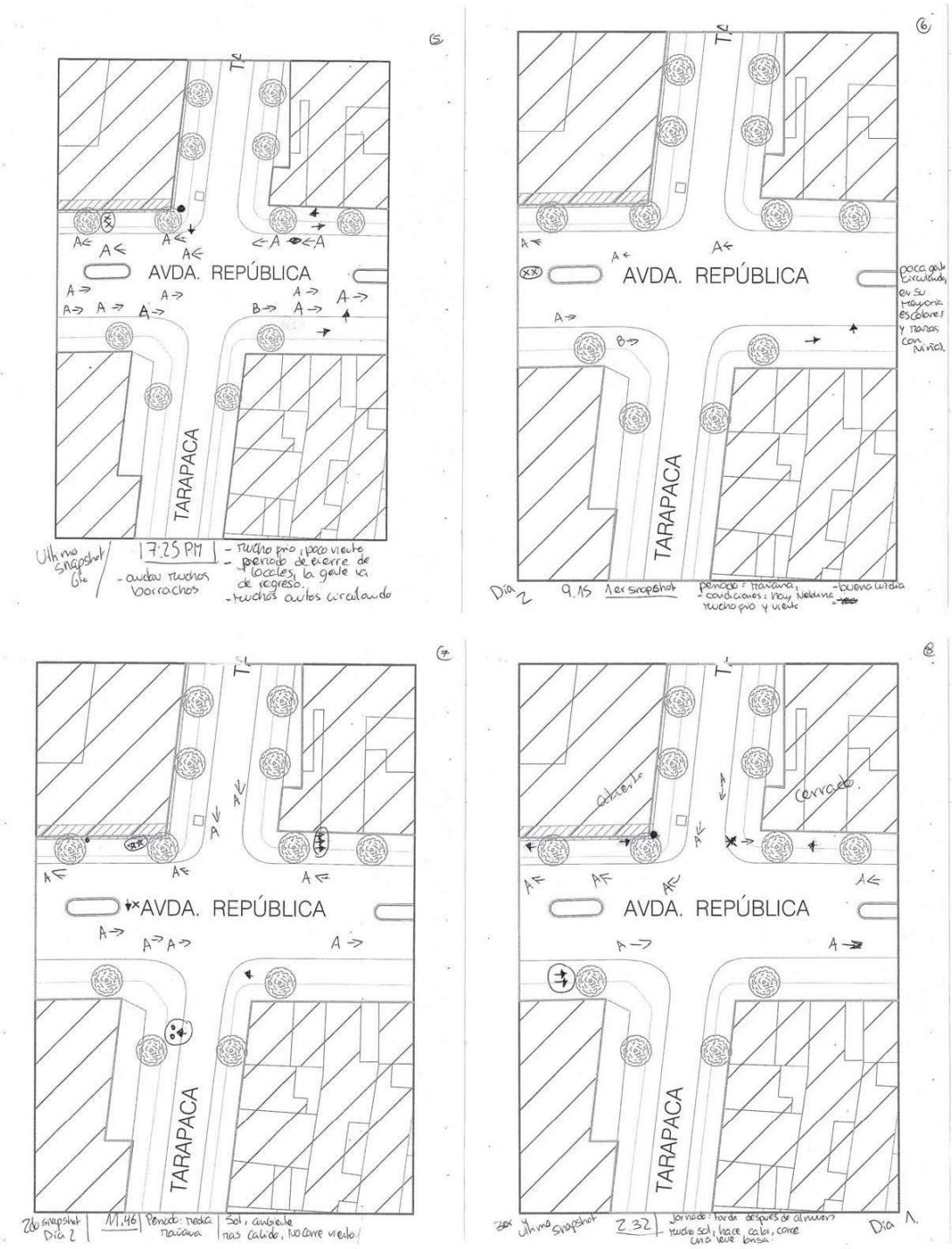




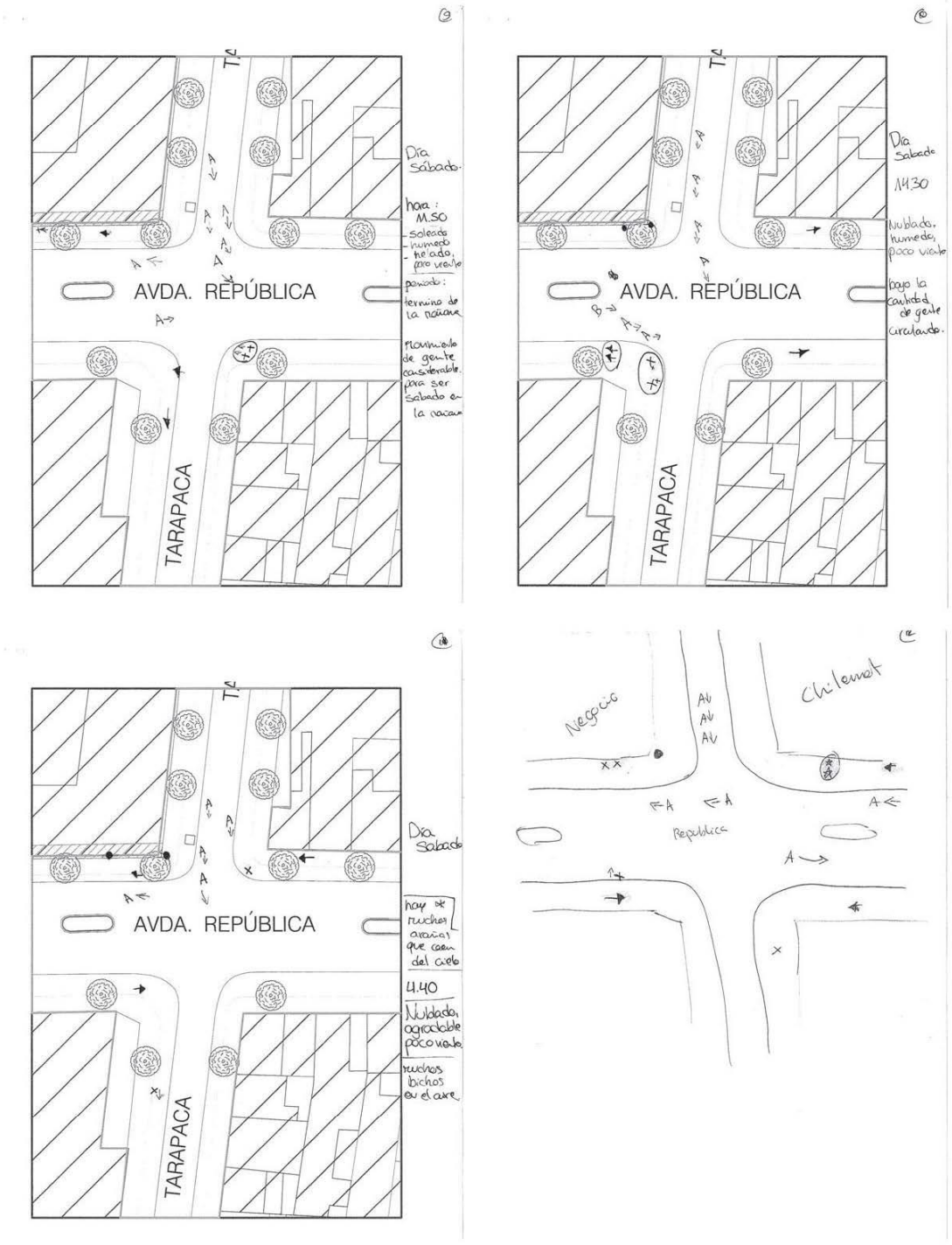
Appendix C- 8: Manual transcription of Node 2 Snapshots in fieldwork at different daily hours as scheduled for day 1 and 2



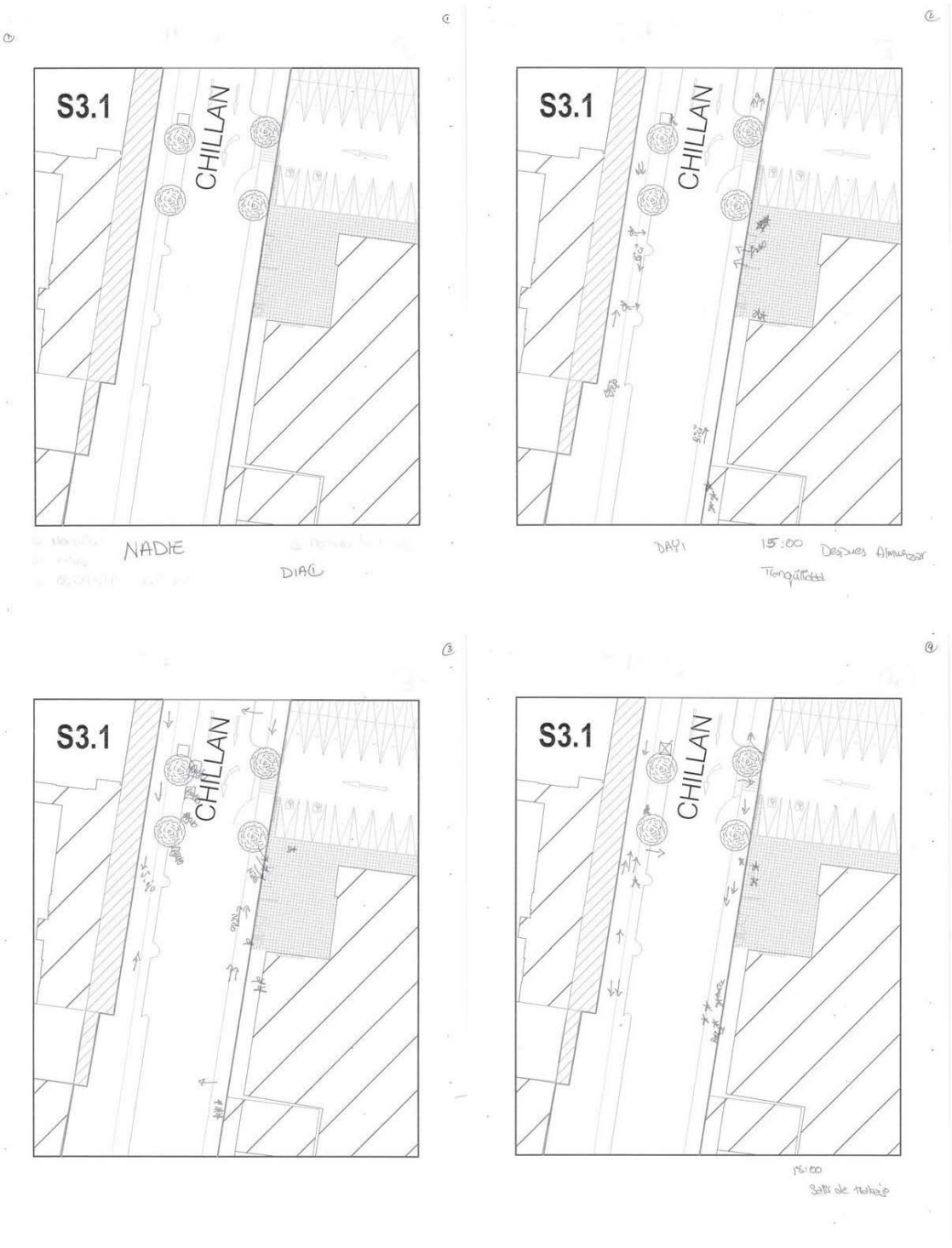
Appendix C- 9: Manual transcription of Node 2 Snapshots in fieldwork at different daily hours as scheduled for day 1 and 2



Appendix C- 10: Manual transcription of Node 2 Snapshots in fieldwork at different daily hours as scheduled for day 3

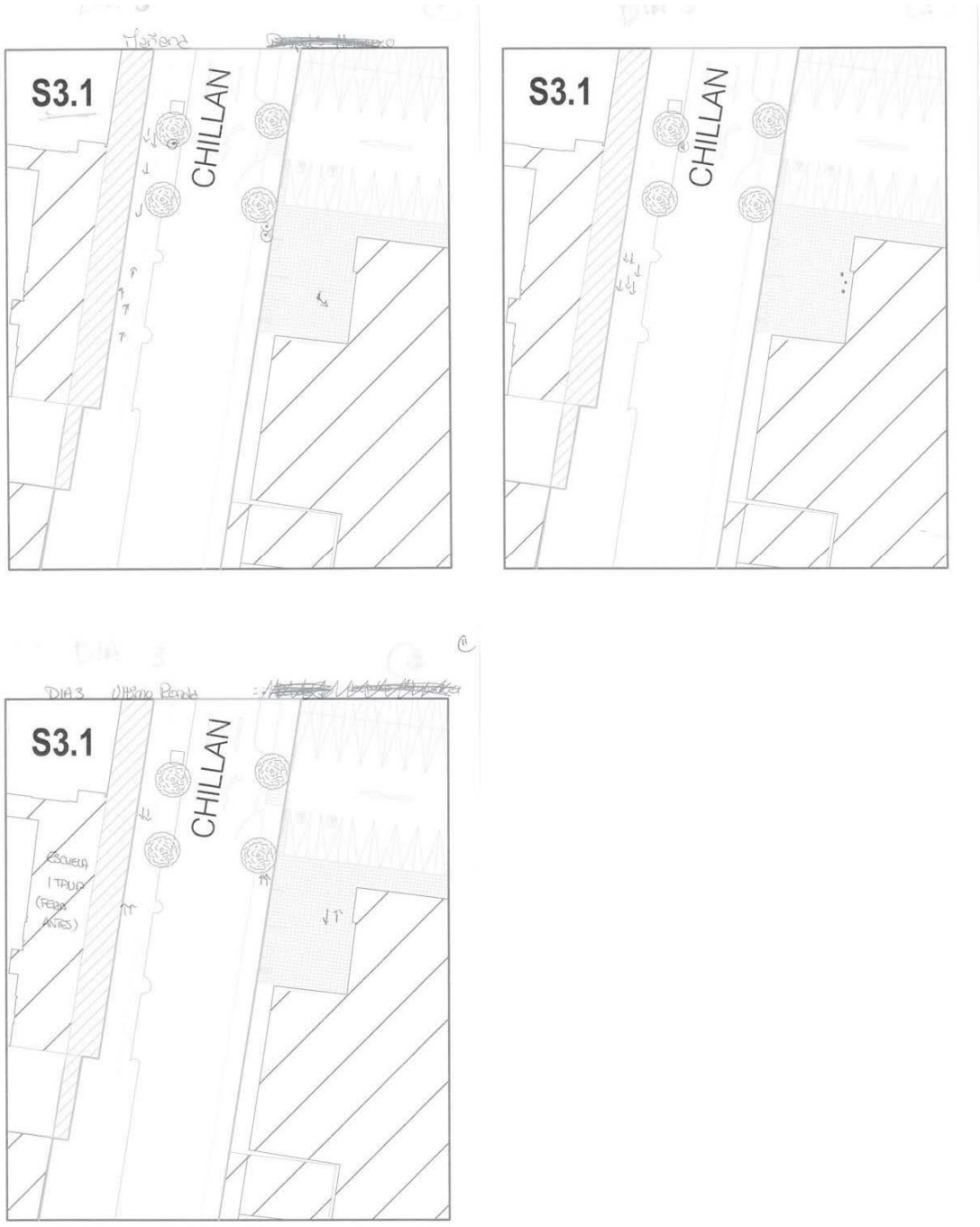


Appendix C- 11: Manual transcription of Node 3 Snapshots in fieldwork at different daily hours as scheduled for day 1 and 2

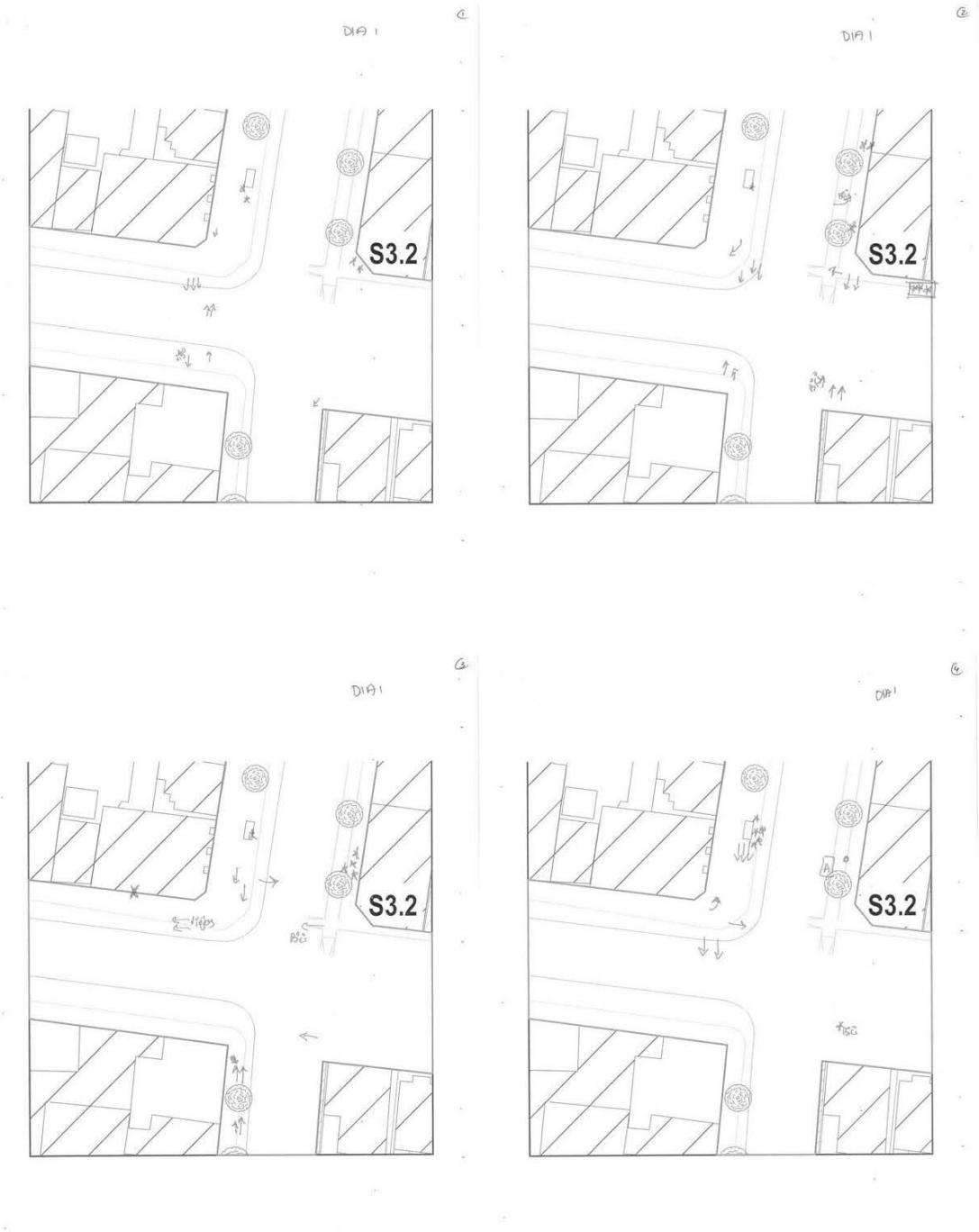


Appendix C- 12: Manual transcription of Node 3 Snapshots in fieldwork at different daily hours as scheduled for day 1 and 2

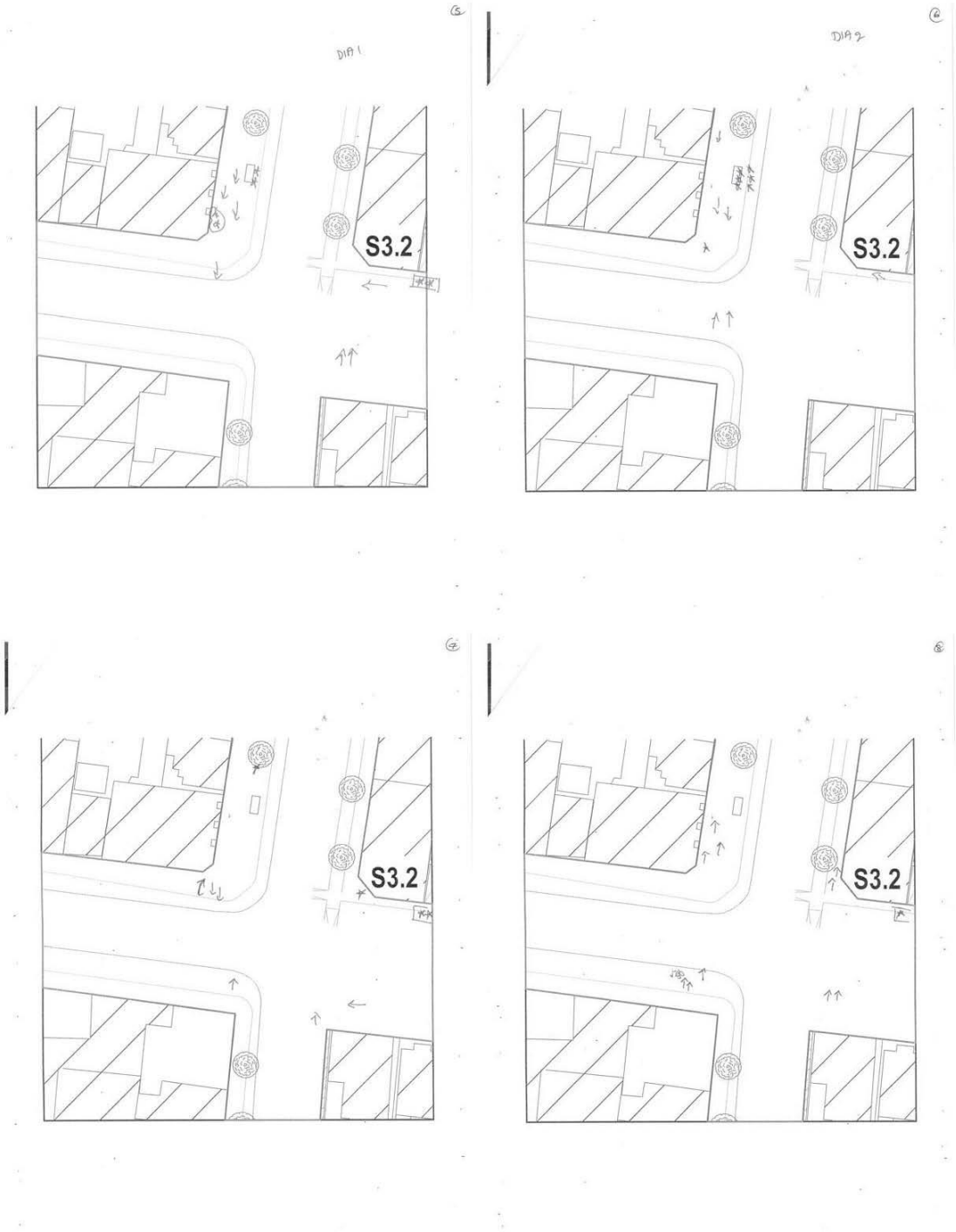
Appendix C- 13: Manual transcription of Node 3 Snapshots in fieldwork at different daily hours as scheduled for day 3



Appendix C- 14: Manual transcription of Node 3 Snapshots in fieldwork at different daily hours as scheduled for day 1 and 2

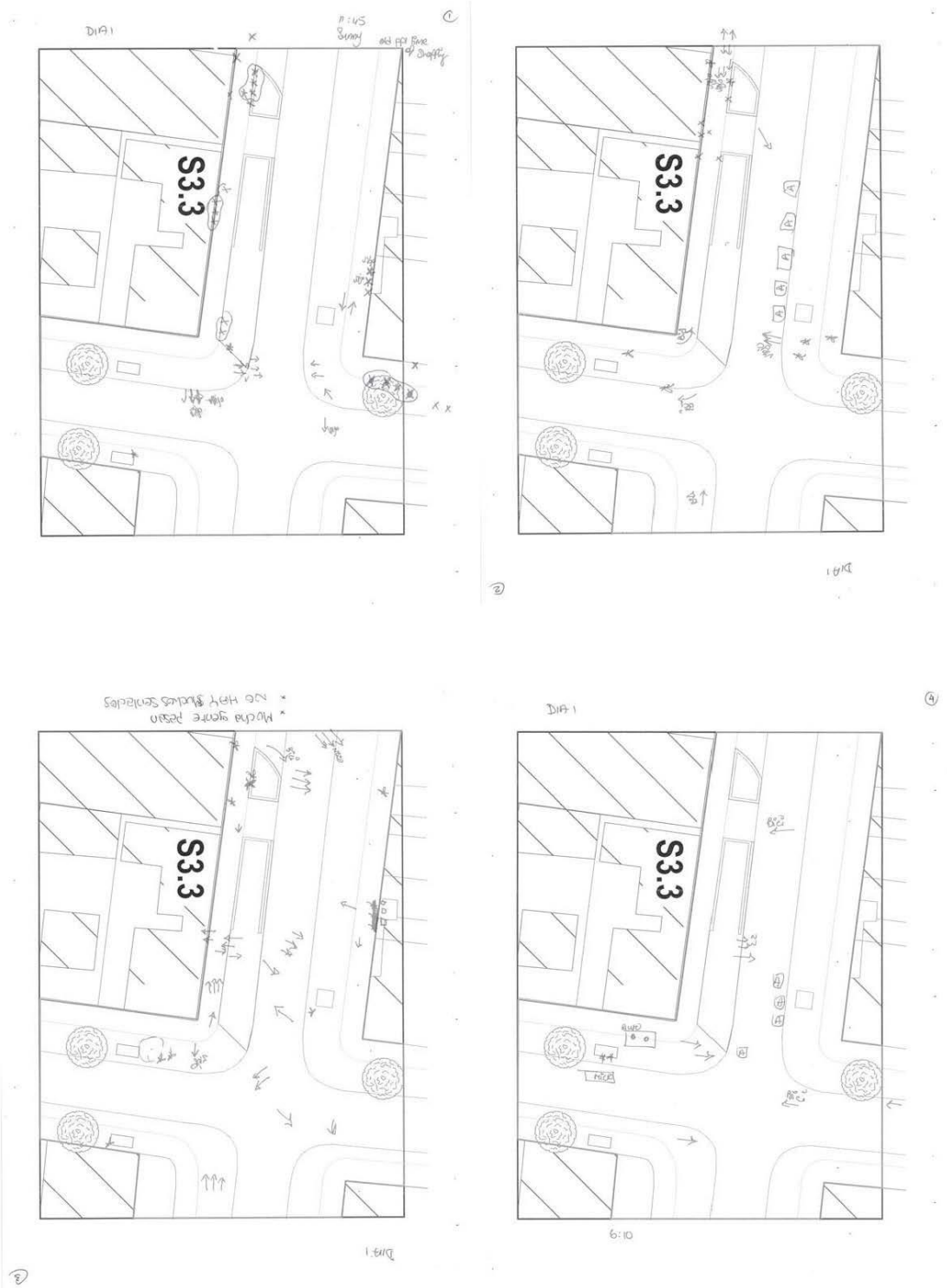


Appendix C- 15: Manual transcription of Node 3 Snapshots in fieldwork at different daily hours as scheduled for day 1 and 2

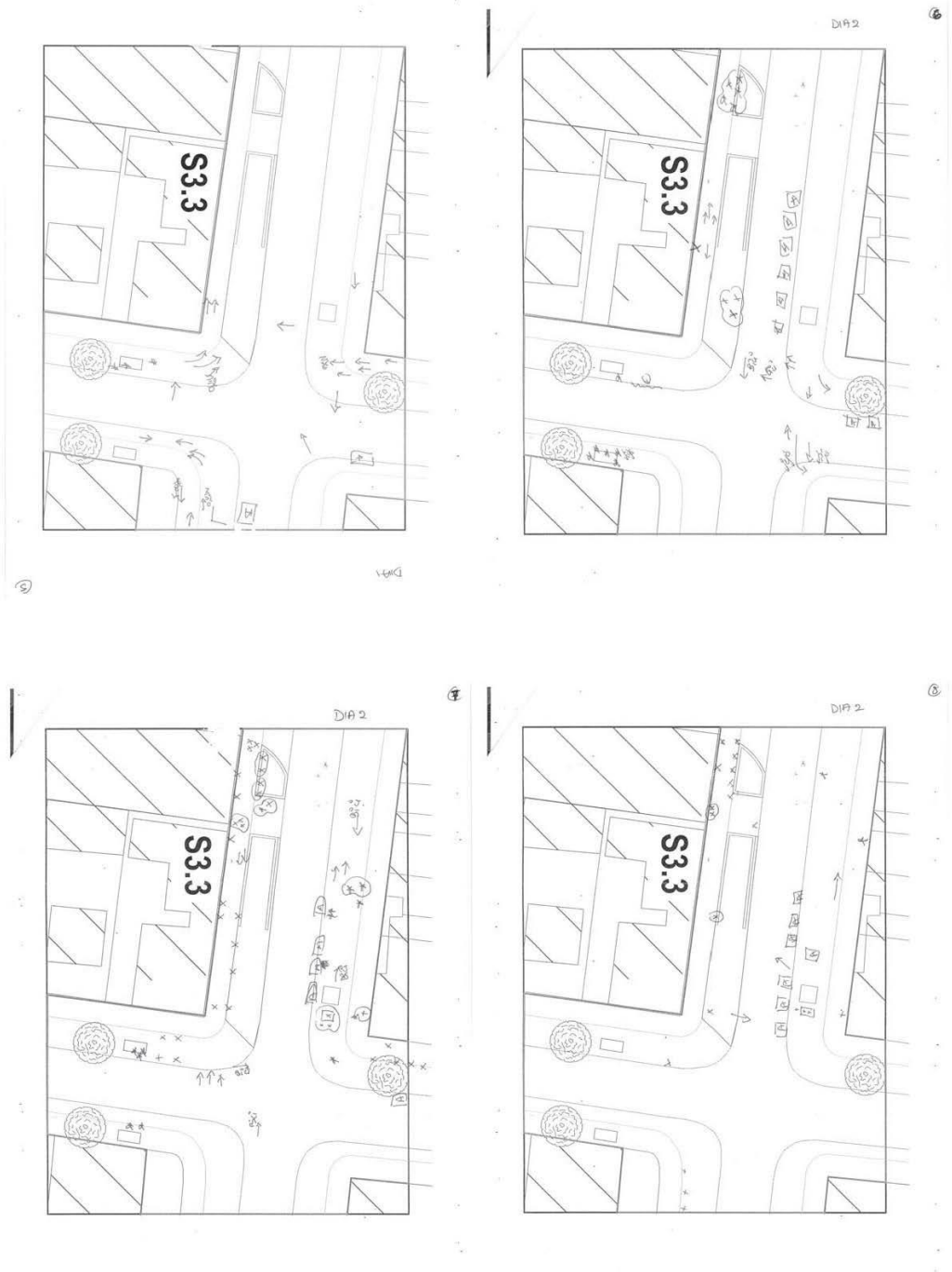


Appendix C- 16: Manual transcription of Node 3 Snapshots in fieldwork at different daily hours as scheduled for day 3

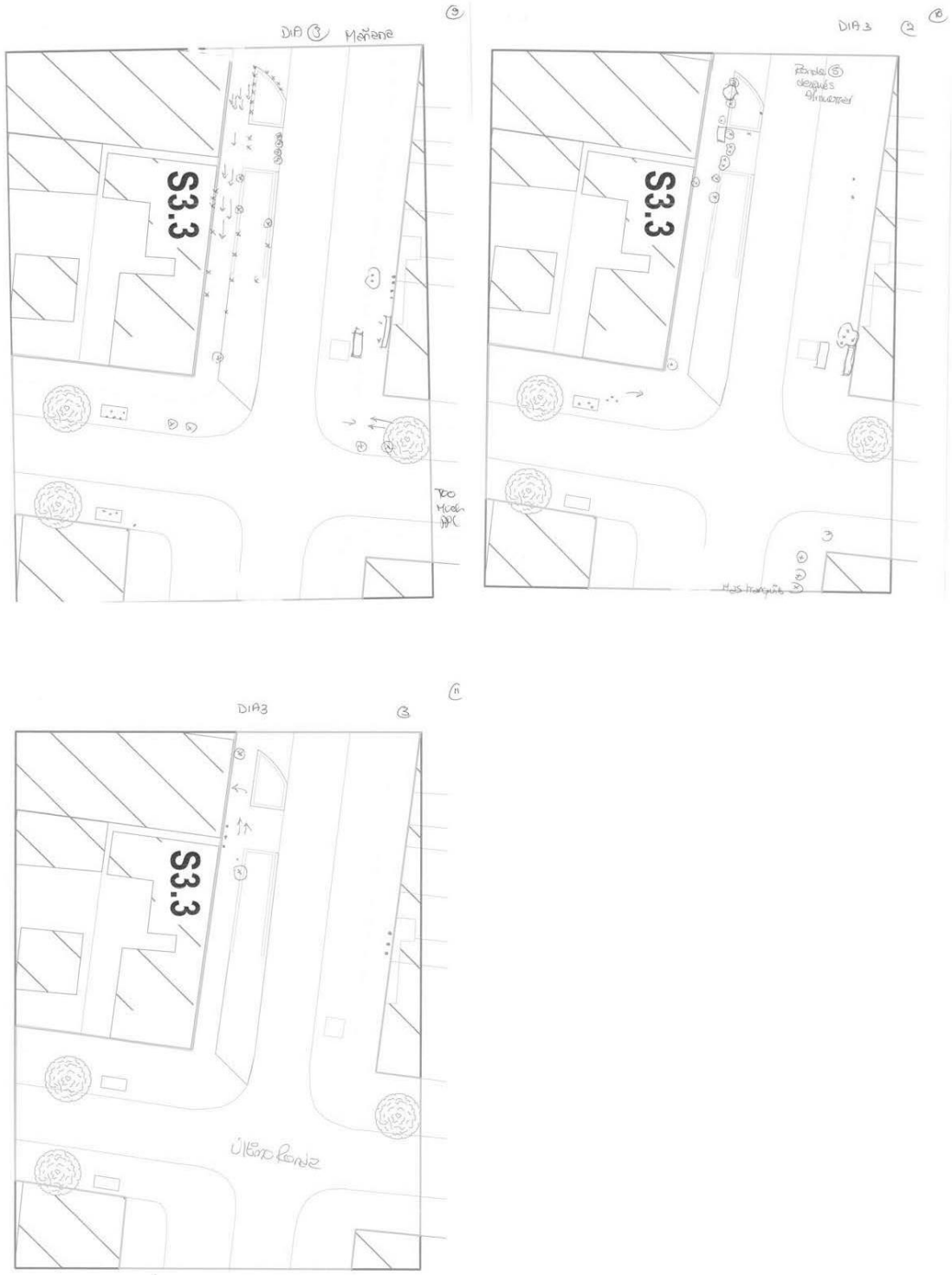
Appendix C- 17: Manual transcription of Node 3 Snapshots in fieldwork at different daily hours as scheduled for day 1 and 2



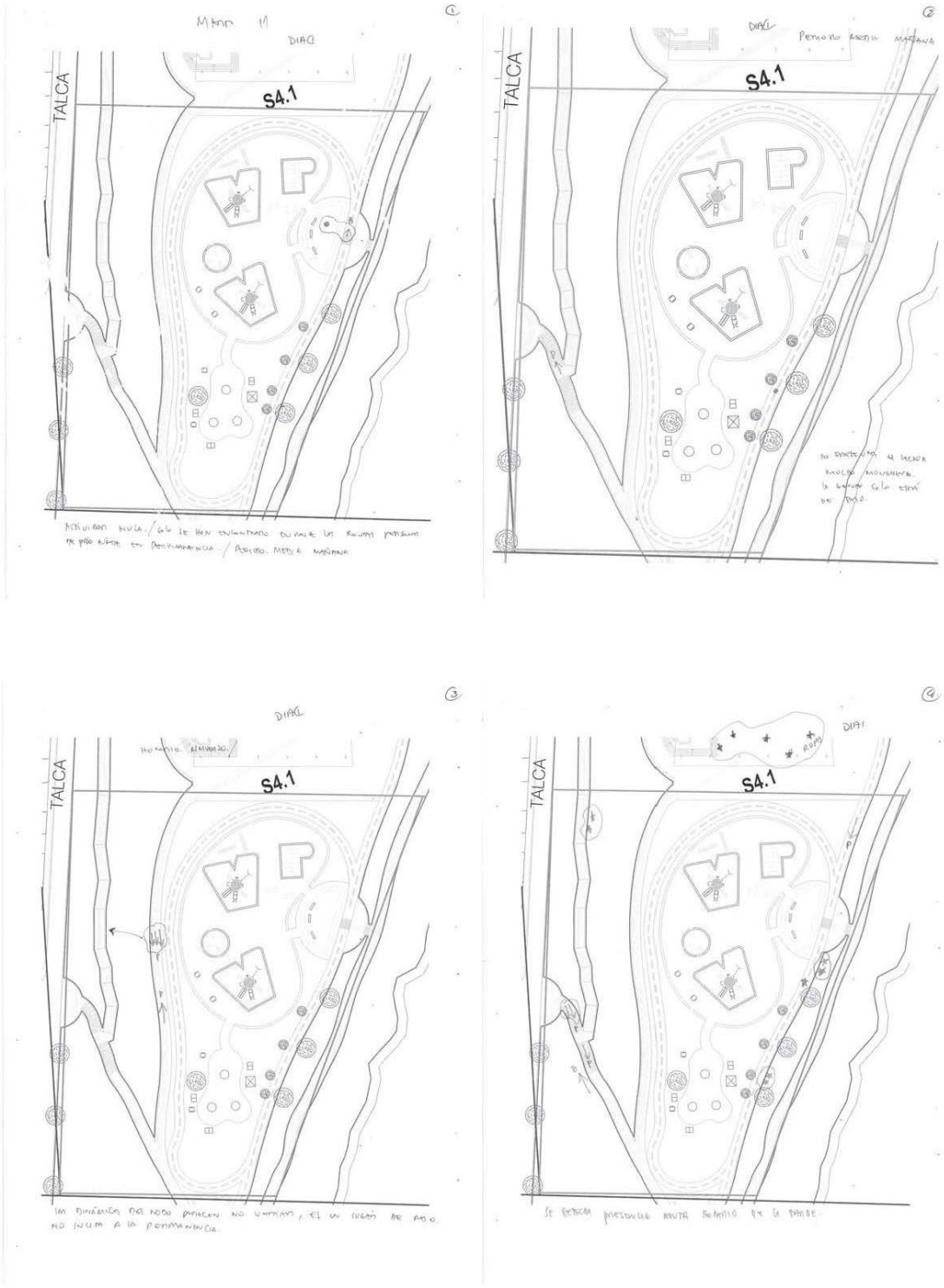
Appendix C- 18: Manual transcription of Node 3 Snapshots in fieldwork at different daily hours as scheduled for day 1 and 2



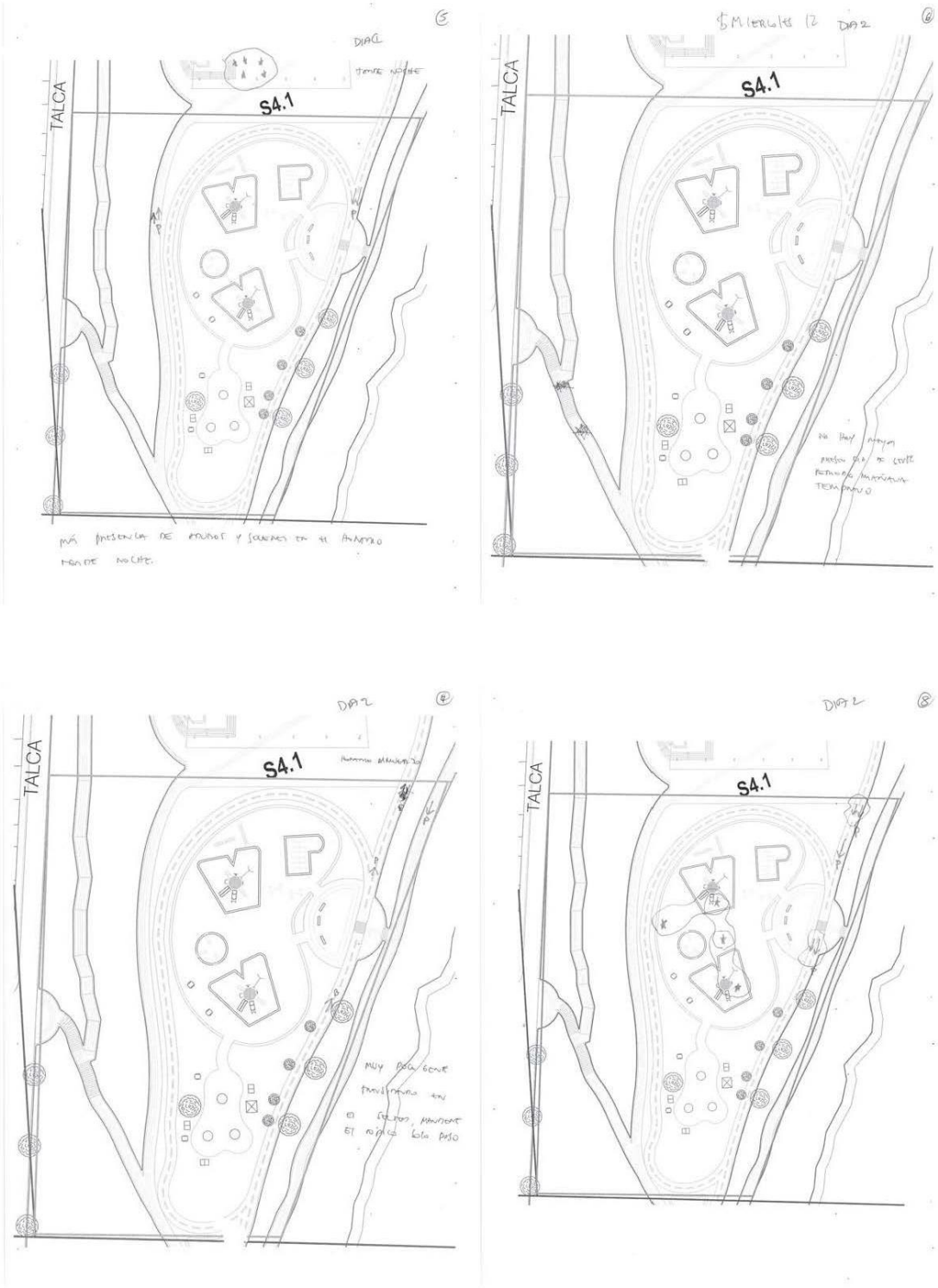
Appendix C- 19: Manual transcription of Node 3 Snapshots in fieldwork at different daily hours as scheduled for day 3



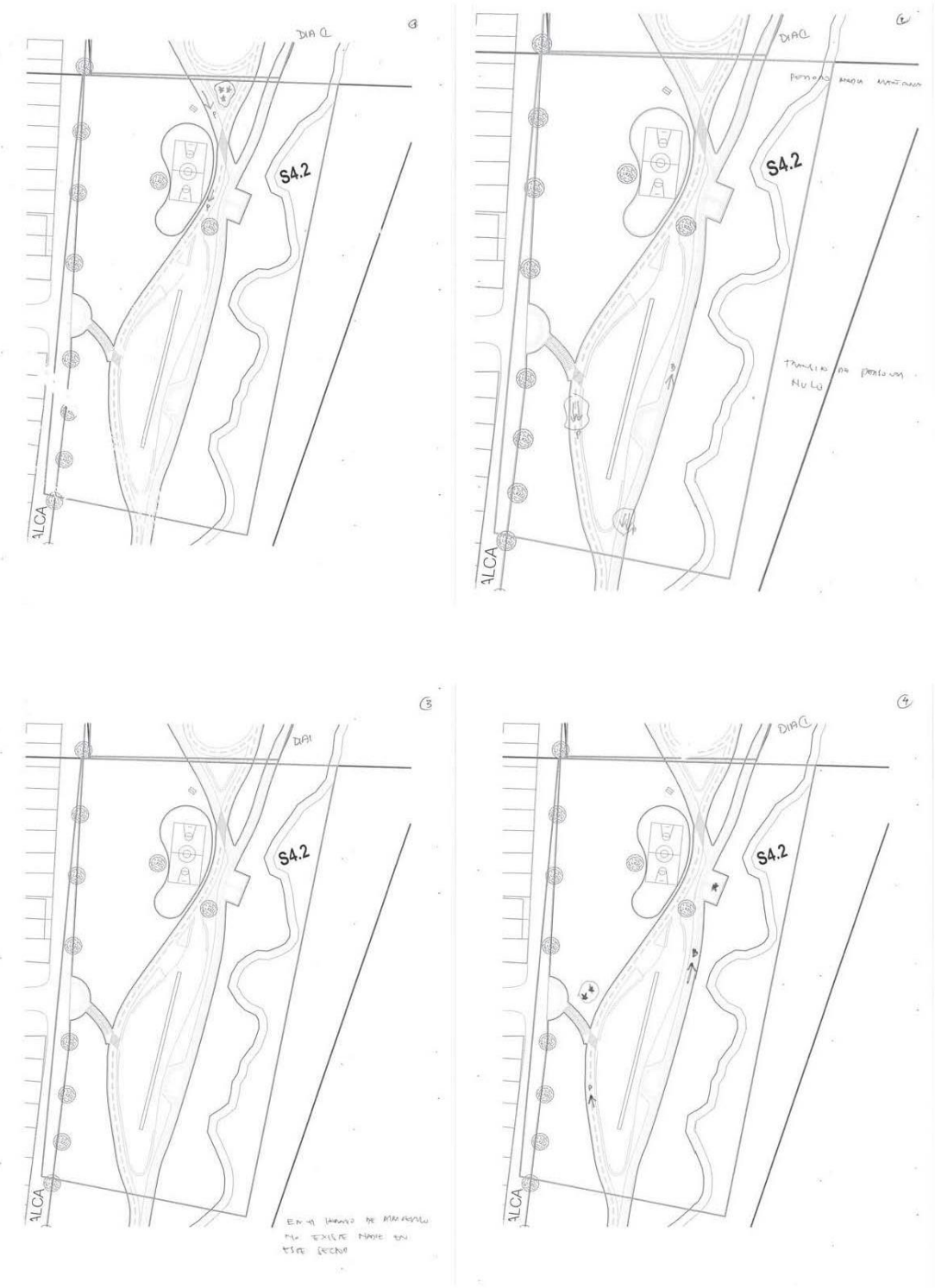
Appendix C- 20: Manual transcription of Node 4 Snapshots in fieldwork at different daily hours as scheduled for day 1 and 2



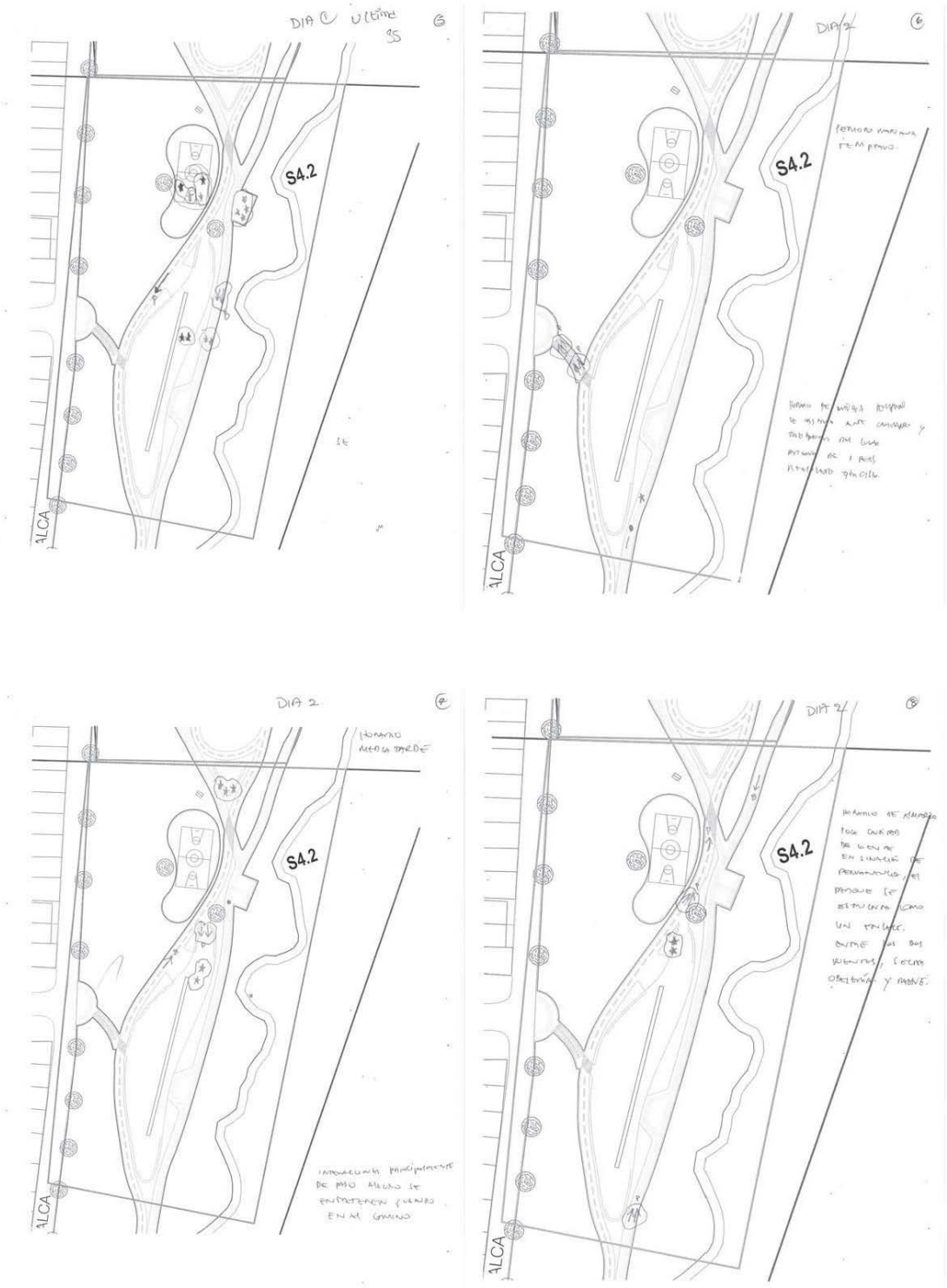
Appendix C- 21: Manual transcription of Node 4 Snapshots in fieldwork at different daily hours as scheduled for day 1 and 2



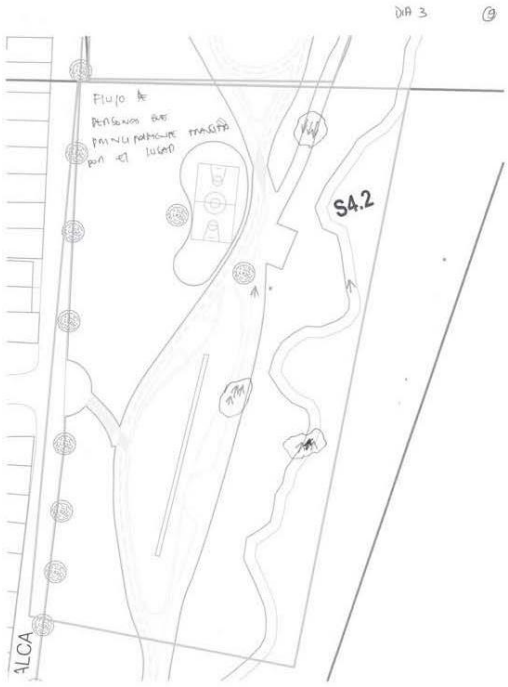
Appendix C- 22: Manual transcription of Node 4 Snapshots in fieldwork at different daily hours as scheduled for day 1 and 2

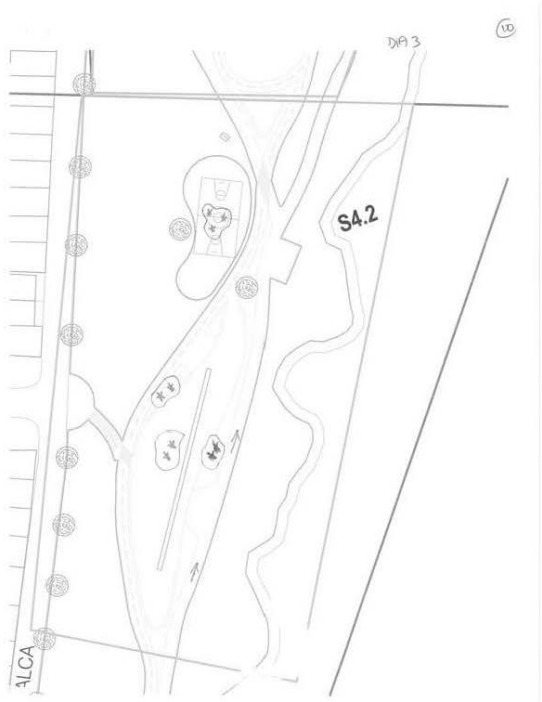


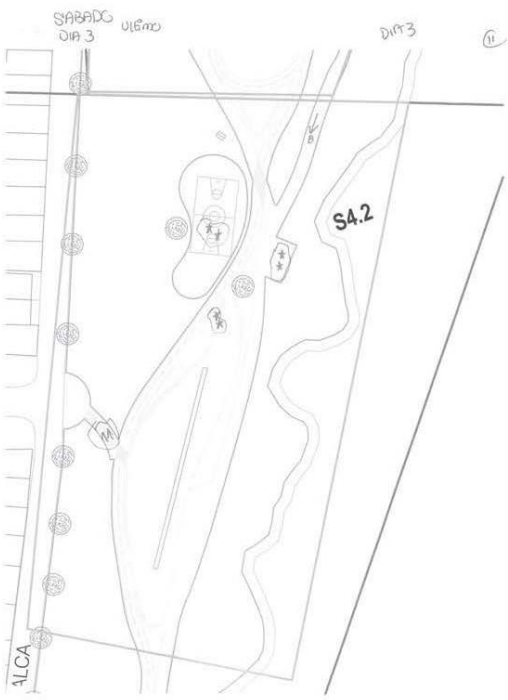
Appendix C- 23: Manual transcription of Node 4 Snapshots in fieldwork at different daily hours as scheduled for day 1 and 2



Appendix C- 24: Manual transcription of Node 4 Snapshots in fieldwork at different daily hours as scheduled for day 3







Appendix D

Chapter 4: Fieldwork analysis of Travel Origin survey method

Appendix D- 1: Survey Format in fieldwork for the seven questions

Osorno_April_Survey

Cual Zona?

- ◯ Zona 1
- ◯ Zona 2
- ◯ Zona 3
- ◯ Option 4

¿Cuál es su género?

- ◯ Hombre
- ◯ Mujer
- ◯ Otro

¿Qué edad tiene? (seleccione el rango de edad en el que se encuentra)

- ◯ Hasta 17
- ◯ 18-25
- ◯ 26-35
- ◯ 36-59
- ◯ 60-màs

¿Dónde vive?

- ◯ Rahue Bajo
- ◯ Rahue Alto
- ◯ Centro
- ◯ Ninguno de los anteriores, vivo en otro lugar de la ciudad

¿Cuál es la principal actividad que hace usted aquí?

- ◯ Trabajo
- ◯ Comprar
- ◯ Ocio / recreación (jugar, deporte, encuentro social, etc)
- ◯ Estudiar
- ◯ Orar
- ◯ Otro (tramites administrativos, tramites bancarios, etc)

Appendix D- 2: Survey Format in fieldwork for the seven questions

¿Con qué frecuencia vienes a este lugar?

- ◯ Todos los días
- ◯ Una vez a la semana
- ◯ Dos veces a la semana
- ◯ Tres veces a la semana
- ◯ Una vez al mes
- ◯ Menos de una vez al mes

¿En qué horario viene a este lugar, por lo general?

- ◯ En la mañana (de 7:00 a 13:00)
- ◯ En la tarde (de 13:00 a 20:00)
- ◯ mañana y tarde
- ◯ En la noche (de 20:00 a 7:00)

¿Qué medio de transporte utiliza para llegar a este lugar?

- ◯ Auto particular
- ◯ Taxi / colectivo
- ◯ Micro
- ◯ Bicicleta
- ◯ Moto
- ◯ Caminando

Appendix D- 3: Raw data collected from survey questions in Node 1

Cual Zona?	¿Cuál es su género?	¿Qué edad tiene? (seleccione el rango de edad en el que se encuentra)	¿Dónde vive?	¿Cuál es la principal actividad que hace usted aquí?	¿Con qué frecuencia vienes a este lugar?	¿En qué horario viene a este lugar, por lo general?	¿Qué medio de transporte utiliza para llegar a este lugar?	_index
Zona 1	Hombre	18-25	Ninguno de los anteriore	Comprar	Dos veces a la semana	En la mañana (de 7:00 a 1	Micro	144
Zona 1	Hombre	18-25	Rahue Alto	Trabajo	Dos veces a la semana	En la mañana (de 7:00 a 1	Taxi / colectivo	262
Zona 1	Mujer	18-25	Rahue Alto	Trabajo	Dos veces a la semana	En la mañana (de 7:00 a 1	Auto particular	261
Zona 1	Mujer	18-25	Rahue Alto	Trabajo	Dos veces a la semana	En la mañana (de 7:00 a 1	Taxi / colectivo	265
Zona 1	Mujer	18-25	Ninguno de los anteriore	Ocio / recreación (jugar, d	Dos veces a la semana	En la mañana (de 7:00 a 1	Caminando	226
Zona 1	Mujer	18-25	Rahue Bajo	Estudiar	Dos veces a la semana	En la mañana (de 7:00 a 1	Caminando	125
Zona 1	Hombre	36-59	Ninguno de los anteriore	Otro (tramites administr	Menos de una vez al mes	En la mañana (de 7:00 a 1	Caminando	186
Zona 1	Hombre	36-59	Rahue Alto	Ocio / recreación (jugar, d	Menos de una vez al mes	En la mañana (de 7:00 a 1	Micro	145
Zona 1	Mujer	18-25	Ninguno de los anteriore	Estudiar	Menos de una vez al mes	En la mañana (de 7:00 a 1	Caminando	31
Zona 1	Hombre	36-59	Ninguno de los anteriore	Trabajo	Todos los días	En la mañana (de 7:00 a 1	Auto particular	141
Zona 1	Hombre	18-25	Rahue Bajo	Otro (tramites administr	Todos los días	En la mañana (de 7:00 a 1	Caminando	189
Zona 1	Hombre	26-35	Rahue Alto	Comprar	Todos los días	En la mañana (de 7:00 a 1	Bicicleta	24
Zona 1	Hombre	36-59	Rahue Bajo	Trabajo	Todos los días	En la mañana (de 7:00 a 1	Caminando	246
Zona 1	Hombre	Hasta 17	Rahue Bajo	Trabajo	Todos los días	En la mañana (de 7:00 a 1	Caminando	257
Zona 1	Mujer	26-35	Ninguno de los anteriore	Trabajo	Todos los días	En la mañana (de 7:00 a 1	Auto particular	4
Zona 1	Mujer	26-35	Ninguno de los anteriore	Trabajo	Todos los días	En la mañana (de 7:00 a 1	Micro	228
Zona 1	Mujer	26-35	Rahue Alto	Comprar	Todos los días	En la mañana (de 7:00 a 1	Auto particular	149
Zona 1	Mujer	26-35	Rahue Alto	Trabajo	Todos los días	En la mañana (de 7:00 a 1	Auto particular	217
Zona 1	Mujer	18-25	Rahue Alto	Otro (tramites administr	Todos los días	En la mañana (de 7:00 a 1	Micro	48
Zona 1	Mujer	36-59	Rahue Alto	Trabajo	Todos los días	En la mañana (de 7:00 a 1	Taxi / colectivo	71
Zona 1	Mujer	18-25	Centro	Estudiar	Todos los días	En la mañana (de 7:00 a 1	Caminando	22
Zona 1	Mujer	36-59	Rahue Alto	Estudiar	Todos los días	En la mañana (de 7:00 a 1	Caminando	36
Zona 1	Mujer	26-35	Rahue Bajo	Ocio / recreación (jugar, d	Todos los días	En la mañana (de 7:00 a 1	Caminando	139
Zona 1	Mujer	60-màs	Rahue Bajo	Trabajo	Todos los días	En la mañana (de 7:00 a 1	Caminando	23
Zona 1	Hombre	18-25	Ninguno de los anteriore	Otro (tramites administr	Tres veces a la semana	En la mañana (de 7:00 a 1	Taxi / colectivo	220
Zona 1	Hombre	36-59	Rahue Alto	Trabajo	Tres veces a la semana	En la mañana (de 7:00 a 1	Auto particular	148
Zona 1	Hombre	36-59	Rahue Alto	Ocio / recreación (jugar, d	Tres veces a la semana	En la mañana (de 7:00 a 1	Caminando	150
Zona 1	Hombre	36-59	Rahue Alto	Trabajo	Tres veces a la semana	En la mañana (de 7:00 a 1	Taxi / colectivo	143
Zona 1	Mujer	26-35	Ninguno de los anteriore	Otro (tramites administr	Tres veces a la semana	En la mañana (de 7:00 a 1	Taxi / colectivo	224
Zona 1	Mujer	36-59	Rahue Alto	Ocio / recreación (jugar, d	Tres veces a la semana	En la mañana (de 7:00 a 1	Caminando	229
Zona 1	Mujer	26-35	Rahue Bajo	Ocio / recreación (jugar, d	Tres veces a la semana	En la mañana (de 7:00 a 1	Caminando	151
Zona 1	Mujer	18-25	Rahue Bajo	Estudiar	Tres veces a la semana	En la mañana (de 7:00 a 1	Micro	129
Zona 1	Mujer	18-25	Rahue Bajo	Trabajo	Tres veces a la semana	En la mañana (de 7:00 a 1	Taxi / colectivo	264
Zona 1	Hombre	18-25	Centro	Trabajo	Una vez a la semana	En la mañana (de 7:00 a 1	Taxi / colectivo	259
Zona 1	Hombre	36-59	Ninguno de los anteriore	Comprar	Una vez a la semana	En la mañana (de 7:00 a 1	Auto particular	146
Zona 1	Hombre	60-màs	Ninguno de los anteriore	Comprar	Una vez a la semana	En la mañana (de 7:00 a 1	Micro	237
Zona 1	Hombre	Hasta 17	Ninguno de los anteriore	Orar	Una vez a la semana	En la mañana (de 7:00 a 1	Micro	253
Zona 1	Hombre	18-25	Rahue Alto	Trabajo	Una vez a la semana	En la mañana (de 7:00 a 1	Caminando	258
Zona 1	Mujer	18-25	Ninguno de los anteriore	Trabajo	Una vez a la semana	En la mañana (de 7:00 a 1	Micro	256
Zona 1	Mujer	36-59	Ninguno de los anteriore	Orar	Una vez a la semana	En la mañana (de 7:00 a 1	Micro	252
Zona 1	Mujer	Hasta 17	Ninguno de los anteriore	Orar	Una vez a la semana	En la mañana (de 7:00 a 1	Micro	254
Zona 1	Mujer	Hasta 17	Ninguno de los anteriore	Comprar	Una vez a la semana	En la mañana (de 7:00 a 1	Caminando	152
Zona 1	Mujer	18-25	Rahue Alto	Otro (tramites administr	Una vez a la semana	En la mañana (de 7:00 a 1	Caminando	37
Zona 1	Mujer	18-25	Rahue Bajo	Otro (tramites administr	Una vez a la semana	En la mañana (de 7:00 a 1	Taxi / colectivo	243
Zona 1	Mujer	26-35	Rahue Bajo	Trabajo	Una vez a la semana	En la mañana (de 7:00 a 1	Taxi / colectivo	147
Zona 1	Hombre	18-25	Rahue Alto	Trabajo	Una vez al mes	En la mañana (de 7:00 a 1	Auto particular	134
Zona 1	Hombre	36-59	Rahue Bajo	Ocio / recreación (jugar, d	Una vez al mes	En la mañana (de 7:00 a 1	Auto particular	225
Zona 1	Hombre	18-25	Rahue Alto	Ocio / recreación (jugar, d	Una vez al mes	En la mañana (de 7:00 a 1	Caminando	227
Zona 1	Mujer	18-25	Ninguno de los anteriore	Comprar	Una vez al mes	En la mañana (de 7:00 a 1	Micro	251
Zona 1	Mujer	18-25	Ninguno de los anteriore	Ocio / recreación (jugar, d	Una vez al mes	En la mañana (de 7:00 a 1	Micro	255
Zona 1	Mujer	26-35	Ninguno de los anteriore	Trabajo	Una vez al mes	En la mañana (de 7:00 a 1	Micro	142
Zona 1	Mujer	36-59	Rahue Alto	Comprar	Una vez al mes	En la mañana (de 7:00 a 1	Micro	45
Zona 1	Hombre	36-59	Rahue Bajo	Ocio / recreación (jugar, d	Todos los días	En la noche (de 20:00 a 7	Caminando	219
Zona 1	Hombre	18-25	Rahue Alto	Estudiar	Todos los días	En la noche (de 20:00 a 7	Taxi / colectivo	133
Zona 1	Hombre	36-59	Ninguno de los anteriore	Otro (tramites administr	Dos veces a la semana	En la tarde (de 13:00 a 20	Micro	73
Zona 1	Mujer	26-35	Ninguno de los anteriore	Comprar	Dos veces a la semana	En la tarde (de 13:00 a 20	Micro	40
Zona 1	Mujer	26-35	Rahue Bajo	Trabajo	Dos veces a la semana	En la tarde (de 13:00 a 20	Caminando	244
Zona 1	Hombre	Hasta 17	Ninguno de los anteriore	Estudiar	Todos los días	En la tarde (de 13:00 a 20	Caminando	248
Zona 1	Hombre	18-25	Rahue Bajo	Trabajo	Todos los días	En la tarde (de 13:00 a 20	Caminando	42
Zona 1	Hombre	36-59	Rahue Bajo	Trabajo	Todos los días	En la tarde (de 13:00 a 20	Caminando	43
Zona 1	Hombre	26-35	Rahue Bajo	Ocio / recreación (jugar, d	Todos los días	En la tarde (de 13:00 a 20	Micro	130
Zona 1	Mujer	36-59	Ninguno de los anteriore	Trabajo	Todos los días	En la tarde (de 13:00 a 20	Micro	239
Zona 1	Mujer	18-25	Ninguno de los anteriore	Trabajo	Todos los días	En la tarde (de 13:00 a 20	Caminando	245
Zona 1	Mujer	26-35	Rahue Bajo	Ocio / recreación (jugar, d	Todos los días	En la tarde (de 13:00 a 20	Caminando	223
Zona 1	Hombre	36-59	Ninguno de los anteriore	Trabajo	Tres veces a la semana	En la tarde (de 13:00 a 20	Micro	41
Zona 1	Hombre	18-25	Rahue Alto	Otro (tramites administr	Tres veces a la semana	En la tarde (de 13:00 a 20	Caminando	47
Zona 1	Hombre	18-25	Rahue Alto	Estudiar	Tres veces a la semana	En la tarde (de 13:00 a 20	Micro	222
Zona 1	Mujer	18-25	Centro	Trabajo	Tres veces a la semana	En la tarde (de 13:00 a 20	Auto particular	131
Zona 1	Mujer	36-59	Rahue Bajo	Otro (tramites administr	Tres veces a la semana	En la tarde (de 13:00 a 20	Caminando	124
Zona 1	Hombre	Hasta 17	Ninguno de los anteriore	Otro (tramites administr	Una vez a la semana	En la tarde (de 13:00 a 20	Caminando	49
Zona 1	Mujer	26-35	Ninguno de los anteriore	Trabajo	Una vez a la semana	En la tarde (de 13:00 a 20	Auto particular	38
Zona 1	Mujer	26-35	Ninguno de los anteriore	Comprar	Una vez a la semana	En la tarde (de 13:00 a 20	Micro	242
Zona 1	Mujer	18-25	Rahue Alto	Comprar	Una vez a la semana	En la tarde (de 13:00 a 20	Caminando	241
Zona 1	Hombre	Hasta 17	Ninguno de los anteriore	Ocio / recreación (jugar, d	Una vez al mes	En la tarde (de 13:00 a 20	Micro	126
Zona 1	Hombre	18-25	Ninguno de los anteriore	Comprar	Dos veces a la semana	mañana y tarde	Bicicleta	74
Zona 1	Mujer	36-59	Rahue Bajo	Ocio / recreación (jugar, d	Dos veces a la semana	mañana y tarde	Caminando	231
Zona 1	Hombre	26-35	Ninguno de los anteriore	Trabajo	Todos los días	mañana y tarde	Caminando	235
Zona 1	Hombre	60-màs	Ninguno de los anteriore	Ocio / recreación (jugar, d	Todos los días	mañana y tarde	Caminando	236
Zona 1	Hombre	Hasta 17	Ninguno de los anteriore	Trabajo	Todos los días	mañana y tarde	Caminando	230
Zona 1	Hombre	26-35	Rahue Alto	Estudiar	Todos los días	mañana y tarde	Caminando	50
Zona 1	Hombre	18-25	Rahue Bajo	Ocio / recreación (jugar, d	Todos los días	mañana y tarde	Caminando	247
Zona 1	Hombre	18-25	Rahue Bajo	Trabajo	Todos los días	mañana y tarde	Caminando	260
Zona 1	Hombre	18-25	Ninguno de los anteriore	Trabajo	Todos los días	mañana y tarde	Micro	263
Zona 1	Hombre	Hasta 17	Ninguno de los anteriore	Trabajo	Todos los días	mañana y tarde	Taxi / colectivo	188
Zona 1	Hombre	36-59	Rahue Bajo	Trabajo	Todos los días	mañana y tarde	Caminando	234
Zona 1	Hombre	Hasta 17	Rahue Bajo	Ocio / recreación (jugar, d	Todos los días	mañana y tarde	Caminando	132
Zona 1	Hombre	18-25	Rahue Bajo	Estudiar	Todos los días	mañana y tarde	Micro	233
Zona 1	Hombre	36-59	Rahue Bajo	Otro (tramites administr	Todos los días	mañana y tarde	Micro	185
Zona 1	Mujer	26-35	Ninguno de los anteriore	Ocio / recreación (jugar, d	Todos los días	mañana y tarde	Micro	136
Zona 1	Mujer	26-35	Ninguno de los anteriore	Trabajo	Todos los días	mañana y tarde	Micro	123
Zona 1	Mujer	36-59	Ninguno de los anteriore	Estudiar	Todos los días	mañana y tarde	Micro	39
Zona 1	Mujer	26-35	Ninguno de los anteriore	Trabajo	Todos los días	mañana y tarde	Taxi / colectivo	25
Zona 1	Mujer	26-35	Ninguno de los anteriore	Trabajo	Todos los días	mañana y tarde	Taxi / colectivo	122
Zona 1	Mujer	18-25	Rahue Alto	Otro (tramites administr	Todos los días	mañana y tarde	Micro	44
Zona 1	Mujer	26-35	Rahue Alto	Estudiar	Todos los días	mañana y tarde	Micro	46
Zona 1	Mujer	26-35	Rahue Alto	Ocio / recreación (jugar, d	Todos los días	mañana y tarde	Micro	137
Zona 1	Mujer	26-35	Rahue Alto	Trabajo	Todos los días	mañana y tarde	Micro	72
Zona 1	Mujer	26-35	Rahue Alto	Ocio / recreación (jugar, d	Todos los días	mañana y tarde	Taxi / colectivo	138
Zona 1	Mujer	26-35	Rahue Alto	Trabajo	Todos los días	mañana y tarde	Taxi / colectivo	221
Zona 1	Mujer	36-59	Rahue Alto	Trabajo	Todos los días	mañana y tarde	Taxi / colectivo	153
Zona 1	Mujer	18-25	Rahue Bajo	Estudiar	Todos los días	mañana y tarde	Caminando	187
Zona 1	Mujer	18-25	Rahue Bajo	Trabajo	Todos los días	mañana y tarde	Caminando	266
Zona 1	Mujer	Hasta 17	Rahue Bajo	Otro (tramites administr	Todos los días	mañana y tarde	Micro	3
Zona 1	Mujer	26-35	Rahue Bajo	Estudiar	Todos los días	mañana y tarde	Taxi / colectivo	140
Zona 1	Hombre	36-59	Rahue Alto	Otro (tramites administr	Tres veces a la semana	mañana y tarde	Auto particular	135
Zona 1	Hombre	Hasta 17	Ninguno de los anteriore	Ocio / recreación (jugar, d	Tres veces a la semana	mañana y tarde	Caminando	240
Zona 1	Mujer	18-25	Rahue Alto	Estudiar	Tres veces a la semana	mañana y tarde	Micro	128
Zona 1	Mujer	18-25	Rahue Bajo	Comprar	Tres veces a la semana	mañana y tarde	Micro	232
Zona 1	Hombre	Hasta 17	Ninguno de los anteriore	Ocio / recreación (jugar, d	Una vez a la semana	mañana y tarde	Taxi / colectivo	127
Zona 1	Mujer	36-59	Ninguno de los anteriore	Comprar	Una vez al mes	mañana y tarde	Micro	218
Zona 1	Mujer	36-59	Ninguno de los anteriore	Ocio / recreación (jugar, d	Una vez al mes	mañana y tarde	Micro	238

Appendix D- 4: Raw data collected from survey questions in Node 2

Cual Zona?	¿Cuál es su género?	¿Qué edad tiene? (seleccione el rango de edad en el que se encuentra)	¿Dónde vive?	¿Cuál es la principal actividad que hace usted aquí?	¿Con qué frecuencia vienes a este lugar?	¿En qué horario viene a este lugar, por lo general?	¿Qué medio de transporte utiliza para llegar a este lugar?	_index
Zona 2	Hombre	60-màs	Rahue Alto	Comprar	Dos veces a la semana	En la mañana (de 7:00 a	Caminando	166
Zona 2	Mujer	36-59	Rahue Alto	Comprar	Dos veces a la semana	En la mañana (de 7:00 a	Caminando	159
Zona 2	Mujer	36-59	Rahue Bajo	Otro (tramites administr	Dos veces a la semana	En la mañana (de 7:00 a	Caminando	210
Zona 2	Mujer	60-màs	Rahue Bajo	Otro (tramites administr	Dos veces a la semana	En la mañana (de 7:00 a	Caminando	88
Zona 2	Hombre	36-59	Rahue Alto	Trabajo	Todos los días	En la mañana (de 7:00 a	Caminando	98
Zona 2	Hombre	36-59	Rahue Bajo	Trabajo	Todos los días	En la mañana (de 7:00 a	Caminando	160
Zona 2	Hombre	60-màs	Rahue Bajo	Comprar	Todos los días	En la mañana (de 7:00 a	Caminando	85
Zona 2	Hombre	60-màs	Rahue Alto	Otro (tramites administr	Todos los días	En la mañana (de 7:00 a	Caminando	90
Zona 2	Hombre	60-màs	Rahue Bajo	Otro (tramites administr	Todos los días	En la mañana (de 7:00 a	Caminando	95
Zona 2	Mujer	60-màs	Rahue Bajo	Comprar	Todos los días	En la mañana (de 7:00 a	Caminando	212
Zona 2	Mujer	36-59	Rahue Bajo	Orar	Todos los días	En la mañana (de 7:00 a	Micro	162
Zona 2	Hombre	60-màs	Rahue Alto	Otro (tramites administr	Tres veces a la semana	En la mañana (de 7:00 a	Caminando	170
Zona 2	Mujer	36-59	Rahue Bajo	Comprar	Tres veces a la semana	En la mañana (de 7:00 a	Caminando	169
Zona 2	Hombre	36-59	Rahue Bajo	Comprar	Una vez a la semana	En la mañana (de 7:00 a	Caminando	167
Zona 2	Hombre	36-59	Rahue Bajo	Trabajo	Una vez a la semana	En la mañana (de 7:00 a	Caminando	86
Zona 2	Hombre	36-59	Rahue Alto	Comprar	Una vez a la semana	En la mañana (de 7:00 a	Micro	91
Zona 2	Mujer	60-màs	Rahue Alto	Comprar	Una vez a la semana	En la mañana (de 7:00 a	Micro	89
Zona 2	Hombre	60-màs	Ninguno de los anteriore	Comprar	Una vez al mes	En la mañana (de 7:00 a	Micro	168
Zona 2	Mujer	36-59	Ninguno de los anteriore	Comprar	Una vez al mes	En la mañana (de 7:00 a	Micro	161
Zona 2	Hombre	36-59	Rahue Alto	Comprar	Dos veces a la semana	En la tarde (de 13:00 a 20	Taxi / colectivo	108
Zona 2	Mujer	60-màs	Rahue Bajo	Comprar	Dos veces a la semana	En la tarde (de 13:00 a 20	Taxi / colectivo	102
Zona 2	Hombre	36-59	Centro	Trabajo	Todos los días	En la tarde (de 13:00 a 20	Caminando	202
Zona 2	Hombre	36-59	Rahue Alto	Trabajo	Todos los días	En la tarde (de 13:00 a 20	Caminando	109
Zona 2	Hombre	36-59	Rahue Bajo	Comprar	Todos los días	En la tarde (de 13:00 a 20	Taxi / colectivo	111
Zona 2	Hombre	36-59	Rahue Alto	Trabajo	Todos los días	En la tarde (de 13:00 a 20	Taxi / colectivo	101
Zona 2	Mujer	36-59	Rahue Bajo	Comprar	Todos los días	En la tarde (de 13:00 a 20	Caminando	207
Zona 2	Mujer	60-màs	Rahue Alto	Trabajo	Todos los días	En la tarde (de 13:00 a 20	Caminando	103
Zona 2	Mujer	60-màs	Rahue Bajo	Trabajo	Todos los días	En la tarde (de 13:00 a 20	Taxi / colectivo	216
Zona 2	Hombre	36-59	Centro	Otro (tramites administr	Una vez a la semana	En la tarde (de 13:00 a 20	Caminando	206
Zona 2	Hombre	36-59	Ninguno de los anteriore	Trabajo	Una vez a la semana	En la tarde (de 13:00 a 20	Caminando	107
Zona 2	Mujer	36-59	Rahue Alto	Comprar	Una vez a la semana	En la tarde (de 13:00 a 20	Taxi / colectivo	115
Zona 2	Mujer	36-59	Ninguno de los anteriore	Comprar	Una vez al mes	En la tarde (de 13:00 a 20	Micro	100
Zona 2	Hombre	36-59	Rahue Bajo	Comprar	Dos veces a la semana	mañana y tarde	Taxi / colectivo	94
Zona 2	Mujer	60-màs	Rahue Bajo	Comprar	Dos veces a la semana	mañana y tarde	Caminando	204
Zona 2	Mujer	36-59	Ninguno de los anteriore	Comprar	Dos veces a la semana	mañana y tarde	Taxi / colectivo	156
Zona 2	Hombre	36-59	Rahue Bajo	Otro (tramites administr	Todos los días	mañana y tarde	Caminando	114
Zona 2	Hombre	60-màs	Rahue Bajo	Comprar	Todos los días	mañana y tarde	Caminando	157
Zona 2	Hombre	60-màs	Rahue Alto	Trabajo	Todos los días	mañana y tarde	Caminando	163
Zona 2	Hombre	60-màs	Rahue Bajo	Trabajo	Todos los días	mañana y tarde	Caminando	96
Zona 2	Hombre	Hasta 17	Rahue Bajo	Ocio / recreación (jugar,	Todos los días	mañana y tarde	Caminando	113
Zona 2	Hombre	Hasta 17	Rahue Alto	Otro (tramites administr	Todos los días	mañana y tarde	Caminando	112
Zona 2	Hombre	18-25	Rahue Bajo	Otro (tramites administr	Todos los días	mañana y tarde	Micro	110
Zona 2	Hombre	36-59	Rahue Bajo	Trabajo	Todos los días	mañana y tarde	Taxi / colectivo	104
Zona 2	Mujer	36-59	Rahue Alto	Comprar	Todos los días	mañana y tarde	Auto particular	208
Zona 2	Mujer	18-25	Rahue Alto	Otro (tramites administr	Todos los días	mañana y tarde	Caminando	106
Zona 2	Mujer	26-35	Rahue Bajo	Otro (tramites administr	Todos los días	mañana y tarde	Caminando	215
Zona 2	Mujer	36-59	Rahue Alto	Trabajo	Todos los días	mañana y tarde	Caminando	164
Zona 2	Mujer	36-59	Rahue Bajo	Trabajo	Todos los días	mañana y tarde	Caminando	92
Zona 2	Mujer	60-màs	Rahue Bajo	Comprar	Todos los días	mañana y tarde	Caminando	205
Zona 2	Mujer	60-màs	Rahue Alto	Orar	Todos los días	mañana y tarde	Caminando	99
Zona 2	Mujer	Hasta 17	Rahue Bajo	Otro (tramites administr	Todos los días	mañana y tarde	Micro	211
Zona 2	Mujer	36-59	Rahue Alto	Otro (tramites administr	Todos los días	mañana y tarde	Taxi / colectivo	93
Zona 2	Mujer	36-59	Centro	Trabajo	Todos los días	mañana y tarde	Taxi / colectivo	97
Zona 2	Hombre	60-màs	Rahue Alto	Comprar	Tres veces a la semana	mañana y tarde	Micro	84
Zona 2	Mujer	36-59	Rahue Alto	Comprar	Tres veces a la semana	mañana y tarde	Micro	87
Zona 2	Mujer	26-35	Rahue Alto	Comprar	Tres veces a la semana	mañana y tarde	Taxi / colectivo	105
Zona 2	Mujer	60-màs	Rahue Alto	Comprar	Una vez a la semana	mañana y tarde	Taxi / colectivo	203
Zona 2	Hombre	60-màs	Rahue Bajo	Trabajo	Una vez al mes	mañana y tarde	Micro	165
Zona 2	Mujer	60-màs	Rahue Alto	Comprar	Una vez al mes	mañana y tarde	Micro	158

Appendix D- 5: Raw data collected from survey questions in Node 3

Cual Zona?	¿Cuál es su género?	¿Qué edad tiene? (seleccione el rango de edad en el que se encuentra)	¿Dónde vive?	¿Cuál es la principal actividad que hace usted aquí?	¿Con qué frecuencia vienes a este lugar?	¿En qué horario viene a este lugar, por lo general?	¿Qué medio de transporte utiliza para llegar a este lugar?	_index
Zona 3	Hombre	18-25	Rahue Alto	Trabajo	Dos veces a la semana	En la mañana (de 7:00 a 1	Caminando	195
Zona 3	Hombre	18-25	Rahue Bajo	Trabajo	Dos veces a la semana	En la mañana (de 7:00 a 1	Caminando	177
Zona 3	Hombre	36-59	Rahue Bajo	Ocio / recreación (jugar, c	Dos veces a la semana	En la mañana (de 7:00 a 1	Caminando	19
Zona 3	Hombre	36-59	Ninguno de los anteriore	Trabajo	Dos veces a la semana	En la mañana (de 7:00 a 1	Caminando	16
Zona 3	Mujer	26-35	Ninguno de los anteriore	Trabajo	Dos veces a la semana	En la mañana (de 7:00 a 1	Caminando	175
Zona 3	Mujer	18-25	Rahue Alto	Trabajo	Dos veces a la semana	En la mañana (de 7:00 a 1	Micro	12
Zona 3	Mujer	36-59	Rahue Alto	Trabajo	Dos veces a la semana	En la mañana (de 7:00 a 1	Micro	15
Zona 3	Hombre	36-59	Ninguno de los anteriore	Comprar	Menos de una vez al mes	En la mañana (de 7:00 a 1	Micro	182
Zona 3	Mujer	18-25	Ninguno de los anteriore	Ocio / recreación (jugar, c	Menos de una vez al mes	En la mañana (de 7:00 a 1	Micro	9
Zona 3	Hombre	36-59	Rahue Alto	Comprar	Todos los días	En la mañana (de 7:00 a 1	Auto particular	13
Zona 3	Hombre	18-25	Ninguno de los anteriore	Trabajo	Todos los días	En la mañana (de 7:00 a 1	Bicicleta	197
Zona 3	Hombre	36-59	Rahue Bajo	Comprar	Todos los días	En la mañana (de 7:00 a 1	Caminando	119
Zona 3	Hombre	36-59	Rahue Bajo	Ocio / recreación (jugar, c	Todos los días	En la mañana (de 7:00 a 1	Caminando	171
Zona 3	Hombre	36-59	Ninguno de los anteriore	Trabajo	Todos los días	En la mañana (de 7:00 a 1	Taxi / colectivo	11
Zona 3	Mujer	26-35	Rahue Alto	Ocio / recreación (jugar, c	Todos los días	En la mañana (de 7:00 a 1	Auto particular	20
Zona 3	Mujer	36-59	Rahue Bajo	Trabajo	Todos los días	En la mañana (de 7:00 a 1	Caminando	21
Zona 3	Mujer	36-59	Rahue Bajo	Comprar	Tres veces a la semana	En la mañana (de 7:00 a 1	Caminando	18
Zona 3	Hombre	26-35	Rahue Alto	Comprar	Una vez a la semana	En la mañana (de 7:00 a 1	Micro	178
Zona 3	Hombre	36-59	Ninguno de los anteriore	Comprar	Una vez a la semana	En la mañana (de 7:00 a 1	Micro	183
Zona 3	Hombre	36-59	Ninguno de los anteriore	Comprar	Una vez a la semana	En la mañana (de 7:00 a 1	Taxi / colectivo	174
Zona 3	Mujer	18-25	Rahue Bajo	Estudiar	Una vez a la semana	En la mañana (de 7:00 a 1	Caminando	8
Zona 3	Mujer	36-59	Rahue Alto	Comprar	Una vez a la semana	En la mañana (de 7:00 a 1	Caminando	17
Zona 3	Mujer	36-59	Rahue Bajo	Trabajo	Una vez a la semana	En la mañana (de 7:00 a 1	Caminando	176
Zona 3	Mujer	36-59	Rahue Alto	Comprar	Una vez a la semana	En la mañana (de 7:00 a 1	Micro	249
Zona 3	Mujer	36-59	Rahue Alto	Comprar	Una vez a la semana	En la mañana (de 7:00 a 1	Taxi / colectivo	172
Zona 3	Mujer	26-35	Rahue Alto	Comprar	Una vez al mes	En la mañana (de 7:00 a 1	Micro	180
Zona 3	Mujer	36-59	Rahue Alto	Otro (tramites administr	Una vez al mes	En la mañana (de 7:00 a 1	Micro	120
Zona 3	Mujer	36-59	Rahue Alto	Ocio / recreación (jugar, c	Dos veces a la semana	En la tarde (de 13:00 a 20	Auto particular	51
Zona 3	Mujer	36-59	Rahue Alto	Ocio / recreación (jugar, c	Dos veces a la semana	En la tarde (de 13:00 a 20	Caminando	199
Zona 3	Mujer	36-59	Ninguno de los anteriore	Trabajo	Dos veces a la semana	En la tarde (de 13:00 a 20	Micro	14
Zona 3	Hombre	36-59	Rahue Alto	Comprar	Menos de una vez al mes	En la tarde (de 13:00 a 20	Taxi / colectivo	75
Zona 3	Hombre	18-25	Rahue Alto	Trabajo	Todos los días	En la tarde (de 13:00 a 20	Bicicleta	196
Zona 3	Hombre	26-35	Ninguno de los anteriore	Trabajo	Todos los días	En la tarde (de 13:00 a 20	Caminando	82
Zona 3	Hombre	Hasta 17	Rahue Bajo	Estudiar	Todos los días	En la tarde (de 13:00 a 20	Micro	194
Zona 3	Mujer	18-25	Rahue Bajo	Ocio / recreación (jugar, c	Todos los días	En la tarde (de 13:00 a 20	Caminando	57
Zona 3	Mujer	18-25	Ninguno de los anteriore	Otro (tramites administr	Todos los días	En la tarde (de 13:00 a 20	Micro	59
Zona 3	Mujer	36-59	Rahue Alto	Otro (tramites administr	Todos los días	En la tarde (de 13:00 a 20	Micro	79
Zona 3	Mujer	26-35	Rahue Alto	Trabajo	Una vez a la semana	En la tarde (de 13:00 a 20	Micro	64
Zona 3	Mujer	26-35	Rahue Alto	Trabajo	Una vez a la semana	En la tarde (de 13:00 a 20	Micro	76
Zona 3	Mujer	36-59	Ninguno de los anteriore	Comprar	Una vez a la semana	En la tarde (de 13:00 a 20	Taxi / colectivo	61
Zona 3	Mujer	26-35	Rahue Alto	Comprar	Una vez al mes	En la tarde (de 13:00 a 20	Micro	201
Zona 3	Mujer	36-59	Rahue Alto	Comprar	Una vez al mes	En la tarde (de 13:00 a 20	Micro	200
Zona 3	Mujer	36-59	Ninguno de los anteriore	Otro (tramites administr	Una vez al mes	En la tarde (de 13:00 a 20	Micro	54
Zona 3	Mujer	36-59	Rahue Bajo	Trabajo	Una vez al mes	En la tarde (de 13:00 a 20	Micro	7
Zona 3	Hombre	36-59	Rahue Alto	Trabajo	Dos veces a la semana	mañana y tarde	Taxi / colectivo	173
Zona 3	Mujer	36-59	Ninguno de los anteriore	Trabajo	Dos veces a la semana	mañana y tarde	Micro	55
Zona 3	Mujer	36-59	Rahue Alto	Trabajo	Menos de una vez al mes	mañana y tarde	Micro	56
Zona 3	Hombre	36-59	Rahue Alto	Trabajo	Todos los días	mañana y tarde	Bicicleta	78
Zona 3	Hombre	18-25	Rahue Alto	Estudiar	Todos los días	mañana y tarde	Caminando	52
Zona 3	Hombre	18-25	Rahue Bajo	Trabajo	Todos los días	mañana y tarde	Caminando	81
Zona 3	Hombre	36-59	Ninguno de los anteriore	Trabajo	Todos los días	mañana y tarde	Micro	198
Zona 3	Hombre	Hasta 17	Rahue Bajo	Estudiar	Todos los días	mañana y tarde	Micro	63
Zona 3	Hombre	26-35	Rahue Bajo	Trabajo	Todos los días	mañana y tarde	Taxi / colectivo	80
Zona 3	Hombre	60-màs	Rahue Alto	Trabajo	Todos los días	mañana y tarde	Taxi / colectivo	62
Zona 3	Mujer	18-25	Rahue Bajo	Estudiar	Todos los días	mañana y tarde	Micro	193
Zona 3	Mujer	18-25	Rahue Alto	Trabajo	Todos los días	mañana y tarde	Micro	58
Zona 3	Mujer	26-35	Rahue Alto	Trabajo	Todos los días	mañana y tarde	Micro	60
Zona 3	Mujer	26-35	Rahue Bajo	Trabajo	Todos los días	mañana y tarde	Micro	77
Zona 3	Mujer	26-35	Rahue Alto	Trabajo	Todos los días	mañana y tarde	Moto	181
Zona 3	Hombre	Hasta 17	Ninguno de los anteriore	Comprar	Tres veces a la semana	mañana y tarde	Taxi / colectivo	83
Zona 3	Mujer	18-25	Rahue Alto	Trabajo	Tres veces a la semana	mañana y tarde	Caminando	179
Zona 3	Mujer	36-59	Ninguno de los anteriore	Comprar	Tres veces a la semana	mañana y tarde	Taxi / colectivo	121
Zona 3	Hombre	18-25	Rahue Bajo	Ocio / recreación (jugar, c	Una vez a la semana	mañana y tarde	Moto	53

Appendix D- 6: Raw data collected from survey questions in Node 4

Cual Zona?	¿Cuál es su género?	¿Qué edad tiene? (seleccione el rango de edad en el que se encuentra)	¿Dónde vive?	¿Cuál es la principal actividad que hace usted aquí?	¿Con qué frecuencia vienes a este lugar?	¿En qué horario viene a este lugar, por lo general?	¿Qué medio de transporte utiliza para llegar a este lugar?	_index
Zona 4	Hombre	26-35	Centro	Comprar	Dos veces a la semana	En la mañana (de 7:00 a	Bicicleta	118
Zona 4	Mujer	36-59	Rahue Alto	Ocio / recreación (jugar, c	Dos veces a la semana	En la mañana (de 7:00 a	Caminando	117
Zona 4	Hombre	36-59	Centro	Ocio / recreación (jugar, c	Menos de una vez al mes	En la mañana (de 7:00 a	Caminando	28
Zona 4	Mujer	36-59	Rahue Alto	Trabajo	Todos los días	En la mañana (de 7:00 a	Caminando	2
Zona 4	Hombre	60-màs	Centro	Comprar	Tres veces a la semana	En la mañana (de 7:00 a	Caminando	116
Zona 4	Hombre	60-màs	Centro	Comprar	Una vez a la semana	En la mañana (de 7:00 a	Caminando	155
Zona 4	Hombre	18-25	Rahue Alto	Otro (tramites administr	Una vez al mes	En la mañana (de 7:00 a	Caminando	209
Zona 4	Mujer	18-25	Rahue Bajo	Ocio / recreación (jugar, c	Una vez al mes	En la noche (de 20:00 a 7	Caminando	271
Zona 4	Hombre	26-35	Rahue Bajo	Ocio / recreación (jugar, c	Dos veces a la semana	En la tarde (de 13:00 a 2(	Bicicleta	284
Zona 4	Hombre	26-35	Rahue Alto	Ocio / recreación (jugar, c	Dos veces a la semana	En la tarde (de 13:00 a 2(	Caminando	285
Zona 4	Hombre	Hasta 17	Rahue Alto	Ocio / recreación (jugar, c	Dos veces a la semana	En la tarde (de 13:00 a 2(	Micro	281
Zona 4	Mujer	26-35	Rahue Bajo	Ocio / recreación (jugar, c	Dos veces a la semana	En la tarde (de 13:00 a 2(	Caminando	275
Zona 4	Mujer	36-59	Ninguno de los anteriore	Ocio / recreación (jugar, c	Dos veces a la semana	En la tarde (de 13:00 a 2(	Caminando	272
Zona 4	Mujer	60-màs	Rahue Bajo	Ocio / recreación (jugar, c	Dos veces a la semana	En la tarde (de 13:00 a 2(	Caminando	6
Zona 4	Mujer	36-59	Rahue Bajo	Ocio / recreación (jugar, c	Menos de una vez al mes	En la tarde (de 13:00 a 2(	Caminando	277
Zona 4	Hombre	36-59	Centro	Ocio / recreación (jugar, c	Todos los días	En la tarde (de 13:00 a 2(	Bicicleta	268
Zona 4	Hombre	Hasta 17	Rahue Bajo	Ocio / recreación (jugar, c	Todos los días	En la tarde (de 13:00 a 2(	Caminando	192
Zona 4	Mujer	26-35	Centro	Ocio / recreación (jugar, c	Todos los días	En la tarde (de 13:00 a 2(	Caminando	191
Zona 4	Mujer	36-59	Rahue Bajo	Estudiar	Todos los días	En la tarde (de 13:00 a 2(	Caminando	184
Zona 4	Mujer	36-59	Rahue Bajo	Trabajo	Todos los días	En la tarde (de 13:00 a 2(	Caminando	10
Zona 4	Hombre	18-25	Centro	Ocio / recreación (jugar, c	Tres veces a la semana	En la tarde (de 13:00 a 2(	Bicicleta	214
Zona 4	Hombre	18-25	Ninguno de los anteriore	Ocio / recreación (jugar, c	Tres veces a la semana	En la tarde (de 13:00 a 2(	Bicicleta	273
Zona 4	Mujer	26-35	Centro	Ocio / recreación (jugar, c	Tres veces a la semana	En la tarde (de 13:00 a 2(	Auto particular	35
Zona 4	Mujer	36-59	Rahue Alto	Estudiar	Tres veces a la semana	En la tarde (de 13:00 a 2(	Caminando	5
Zona 4	Hombre	18-25	Ninguno de los anteriore	Ocio / recreación (jugar, c	Una vez a la semana	En la tarde (de 13:00 a 2(	Auto particular	279
Zona 4	Hombre	60-màs	Centro	Comprar	Una vez a la semana	En la tarde (de 13:00 a 2(	Bicicleta	65
Zona 4	Hombre	26-35	Rahue Alto	Ocio / recreación (jugar, c	Una vez a la semana	En la tarde (de 13:00 a 2(	Caminando	283
Zona 4	Hombre	36-59	Centro	Ocio / recreación (jugar, c	Una vez a la semana	En la tarde (de 13:00 a 2(	Caminando	278
Zona 4	Hombre	36-59	Rahue Alto	Ocio / recreación (jugar, c	Una vez a la semana	En la tarde (de 13:00 a 2(	Caminando	274
Zona 4	Hombre	Hasta 17	Centro	Ocio / recreación (jugar, c	Una vez a la semana	En la tarde (de 13:00 a 2(	Caminando	282
Zona 4	Mujer	36-59	Ninguno de los anteriore	Ocio / recreación (jugar, c	Una vez a la semana	En la tarde (de 13:00 a 2(	Auto particular	276
Zona 4	Mujer	26-35	Rahue Bajo	Ocio / recreación (jugar, c	Una vez a la semana	En la tarde (de 13:00 a 2(	Caminando	69
Zona 4	Mujer	36-59	Rahue Bajo	Ocio / recreación (jugar, c	Una vez a la semana	En la tarde (de 13:00 a 2(	Caminando	70
Zona 4	Mujer	18-25	Rahue Alto	Ocio / recreación (jugar, c	Una vez a la semana	En la tarde (de 13:00 a 2(	Micro	26
Zona 4	Hombre	36-59	Ninguno de los anteriore	Otro (tramites administr	Una vez al mes	En la tarde (de 13:00 a 2(	Caminando	27
Zona 4	Hombre	Hasta 17	Ninguno de los anteriore	Ocio / recreación (jugar, c	Una vez al mes	En la tarde (de 13:00 a 2(	Caminando	269
Zona 4	Hombre	18-25	Ninguno de los anteriore	Ocio / recreación (jugar, c	Una vez al mes	En la tarde (de 13:00 a 2(	Micro	270
Zona 4	Mujer	Hasta 17	Centro	Ocio / recreación (jugar, c	Una vez al mes	En la tarde (de 13:00 a 2(	Caminando	66
Zona 4	Mujer	Hasta 17	Ninguno de los anteriore	Ocio / recreación (jugar, c	Una vez al mes	En la tarde (de 13:00 a 2(	Micro	280
Zona 4	Hombre	Hasta 17	Rahue Alto	Ocio / recreación (jugar, c	Dos veces a la semana	mañana y tarde	Caminando	190
Zona 4	Mujer	18-25	Rahue Alto	Estudiar	Menos de una vez al mes	mañana y tarde	Caminando	30
Zona 4	Hombre	36-59	Rahue Alto	Trabajo	Todos los días	mañana y tarde	Bicicleta	154
Zona 4	Hombre	36-59	Centro	Trabajo	Todos los días	mañana y tarde	Caminando	68
Zona 4	Hombre	36-59	Rahue Alto	Trabajo	Todos los días	mañana y tarde	Caminando	1
Zona 4	Mujer	26-35	Centro	Trabajo	Todos los días	mañana y tarde	Bicicleta	67
Zona 4	Mujer	36-59	Rahue Bajo	Ocio / recreación (jugar, c	Todos los días	mañana y tarde	Caminando	267
Zona 4	Hombre	18-25	Ninguno de los anteriore	Ocio / recreación (jugar, c	Tres veces a la semana	mañana y tarde	Bicicleta	213
Zona 4	Hombre	60-màs	Centro	Comprar	Una vez a la semana	mañana y tarde	Caminando	250

Appendix D- 7: Data analysis for survey regarding the age group question in absolute numbers and percentages

Zones	Age group survey					Total
	< 17	18-25	26-35	36-59	> 60	
Zone 1	13	39	28	28	3	111
Zone 2	3	2	2	30	22	59
Zone 3	3	15	12	32	1	63
Zone 4	7	9	9	18	5	48
Total zones	26	65	51	108	31	281

Zones	Age group survey					Total
	< 17	18-25	26-35	36-59	> 60	
Zone 1	11.71%	35.14%	25.23%	25.23%	2.70%	1
Zone 2	5.08%	3.39%	3.39%	50.85%	37.29%	1
Zone 3	4.76%	23.81%	19.05%	50.79%	1.59%	1
Zone 4	14.58%	18.75%	18.75%	37.50%	10.42%	1
Total zones	9.25%	23.13%	18.15%	38.43%	11.03%	1

Appendix D- 8: Data analysis for survey regarding the resident's living area question in absolute numbers and percentages

Zones	Where do people live? (Frequency)				Total
	R. Bajo	R. Alto	Centre	Other	
Zona 1	31	33	3	44	111
Zona 2	27	24	3	5	59
Zona 3	17	29	0	17	63
Zona 4	11	13	15	9	48
Total	86	99	21	75	281

Zones	Where do people live?				% of all
	R. Bajo	R. Alto	Centre	Other	
Zona 1	27.9%	29.7%	2.7%	39.6%	39.5%
Zona 2	45.8%	40.7%	5.1%	8.5%	21.0%
Zona 3	27.0%	46.0%	0.0%	27.0%	22.4%
Zona 4	22.9%	27.1%	31.3%	18.8%	17.1%
Total zones	30.6%	35.2%	7.5%	26.7%	100.0%

Appendix D- 9: Data analysis for survey regarding the main activities question in absolute numbers and percentages

Zones /Activities	What is the main activity users do in space? (Frq.)						Total
	Shopping	Studying	Working	Others	Praying	Recreation	
Zone 1	14	15	41	15	3	23	111
Zone 2	27	0	16	13	2	1	59
Zone 3	17	5	29	4	0	8	63
Zone 4	6	3	6	0	0	34	49
Total	64	23	92	32	5	66	282
Zones /Activities	What is the main activity users do in space?						Total
	Shopping	Studying	Working	Admin/Others	Praying	Recreation	
Zone 1	12.6%	13.5%	36.9%	13.5%	2.7%	20.7%	39.36%
Zone 2	45.8%	0.0%	27.1%	22.0%	3.4%	1.7%	20.92%
Zone 3	27.0%	7.9%	46.0%	6.3%	0.0%	12.7%	22.34%
Zone 4	12.2%	6.1%	12.2%	0.0%	0.0%	69.4%	17.38%
Total zones	22.7%	8.2%	32.6%	11.3%	1.8%	23.4%	100.0%

Appendix D- 10: Sorting percentages in functional and communal activities

Zones /Activities	What is the main activity users do in space? %							
	Shopping	Studying	Working	Admin/Others	Total Fun.	% Functional Activity	Praying	Recreation
Zone 1	12.6%	13.5%	36.9%	13.5%	71	64.0%	2.7%	20.7%
Zone 2	45.8%	0.0%	27.1%	22.0%	29	49.2%	3.4%	1.7%
Zone 3	27.0%	7.9%	46.0%	6.3%	38	60.3%	0.0%	12.7%
Zone 4	12.2%	6.1%	12.2%	0.0%	9	18.4%	0.0%	69.4%

Appendix D- 11: Compilation of data from the activities question in three forms of Economic, functional and communal

Zones	Economical Activities	Functional Activities	Communal activities
Zone 1	12.6%	64.0%	23.4%
Zone 2	45.8%	49.2%	5.1%
Zone 3	27.0%	60.3%	12.7%
Zone 4	12.2%	18.4%	69.4%

Appendix D- 12: Data analysis for survey regarding the number of people concerning gender in absolute numbers and percentages

	GENDER		Total
Zones	Mujer	Hombre	
Zone 1	62	49	111
Zone 2	30	29	59
Zone 3	36	27	63
Zone 4	21	27	48
Total zones	149	132	281

	GENDER		Total
Zones	Mujer	Hombre	
Zone 1	55.9%	44.1%	1
Zone 2	50.8%	49.2%	1
Zone 3	57.1%	42.9%	1
Zone 4	43.8%	56.3%	1
Total zones	53.0%	47.0%	4

Appendix D- 13: Data analysis for survey regarding mode of transport in absolute numbers and percentages

Zones	Mode of Transport						Total
	Walking	Bici	Micro	Collectivo	Moto	Auto	
Zone 1	41	2	37	19	0	12	111
Zone 2	33	0	12	13	0	1	59
Zone 3	18	3	27	10	2	3	63
Zone 4	32	9	4	0	0	3	48
Total zones	124	14	80	42	2	19	281

Zones	Modes of Transport					
	Walking	Bici	Micro	Collectivo	Moto	Auto
Zone 1	36.9%	1.8%	33.3%	17.1%	0.0%	10.8%
Zone 2	55.9%	0.0%	20.3%	22.0%	0.0%	1.7%
Zone 3	28.6%	4.8%	42.9%	15.9%	3.2%	4.8%
Zone 4	66.7%	18.8%	8.3%	0.0%	0.0%	6.3%
Total zones	44.1%	5.0%	28.5%	14.9%	0.7%	6.8%

Appendix D- 14: Data analysis for survey regarding survey question in absolute numbers and percentages

	Frequency						Total
Zones	Daily	Weekly	Twice a week	Three times a week	Monthly	<Monthly	
Zone 1	52	17	11	18	10	3	111
Zone 2	32	8	9	5	5	0	59
Zone 3	25	12	12	4	6	4	63
Zone 4	11	12	9	6	7	3	48
Total zones	120	49	41	33	28	10	281

	Frequency						Total
Zones	Daily	Weekly	Twice a week	Three times a week	Monthly	<Monthly	
Zone 1	46.85%	15.32%	9.91%	16.22%	9.01%	2.70%	1
Zone 2	54.24%	13.56%	15.25%	8.47%	8.47%	0.00%	1
Zone 3	39.68%	19.05%	19.05%	6.35%	9.52%	6.35%	1
Zone 4	22.92%	25.00%	18.75%	12.50%	14.58%	6.25%	1
Total zones	42.70%	17.44%	14.59%	11.74%	9.96%	3.56%	4

Appendix D- 15: Data analysis for survey regarding intensity question in absolute numbers and percentages

	Intensity				Total
Zones	Morning	Afternoon	Morning&Afternoon	At night	
Zone 1	52	20	37	2	111
Zone 2	19	13	27	0	59
Zone 3	27	17	19	0	63
Zone 4	7	31	9	1	63
Total zones	105	81	92	3	296