Flood risk reduction and resilience building in flood-prone settlements: The case of Sitio Gulayan Community

PhD

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Declaration of original authorship

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged. It is being submitted for the Dual Degree of Doctor of Philosophy in Built Environment / Architecture at the University of Reading, UK and University of Santo Tomas, Manila, Philippines. This original work has not been submitted before to any other University for the award of any other degree or diploma.

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Abstract

This PhD thesis focuses on the issue of informal settlements in flood risk areas and sets out to contribute fresh insights and new knowledge in relation to flood risk reduction and resilience building. The case study is a floodplain settlement in the heart of Malabon City historically experiencing flood inundation during the typhoon season. The urbanised city situated in the northern sector of Mega Manila is renowned for flooding due to its geographical location. With the settlement's housing programme in an impasse and land scarcity hindering in-city relocation, this thesis aims to explore if the settlement can adapt to flood hazards in-situ. Sitio Gulayan community was investigated to address the research question, "Could informal floodplain settlements be technically adapted for resilience building and developed to form transitional settlements?" The conceptual model proposed by Pojani in 2018 to study the urban form and architecture of informal settlements was adapted in this study, to explain and give a broader understanding of the research problem. The methodology involved the design and administration of survey questionnaires to a sample of 150 residents, key informant interviews with 30 residents including 5 local authorities, and visual recordings from field observations. Data on historical flooding and flood damage were collected from the field, published literature, and reports from government agencies. The findings showed 6 housing typologies classified according to structural type and height classes. Most one- and two-storey concrete houses have already adapted to flood hazards, whilst the one-storey houses made of wood would still need to adapt technically in order to mitigate flood risks. The makeshift houses using salvaged materials particularly vulnerable to flood hazards, may well benefit from technical adaptation. The main findings indicate that the settlement can be technically adapted to develop into a transitional settlement over time, through the recommendations of elevated construction and floatable houses, in conjunction with resolving overcrowding in the community incrementally through reblocking.

Keywords

Flood risk; resilience building; floodplain settlement; Malabon City; transitional settlement; flood damage.

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Table of Contents

List of Tables

List of Figures

List of Appendices

1. Chapter 1 Introduction

The opening chapter begins with the background of the study to set the context of the research, and to introduce the research problem. It then presents the research questions, aims, and the objectives that will enable to address the research aims. This will be followed by the discussion on the significance of the study, together with the limitations of the study. The chapter will conclude with the structure of the thesis in an outline that briefly discusses each of the eight chapters.

1.1 Background

Flood as a hydrometeorological hazard has caused unprecedented damage in the Philippine urban setting. In its urban flood monitoring report, UN Climate Change declares flooding as a major challenge in the country that is being visited by an average of 20 typhoons annually (UNFCCC, 2020). In terms of economic and social impact, typhoons and floods according to the World Bank, are the most devastating in the 360 disasters that struck the country in the last 30 years. Both disasters combined, account for 80 percent of 33,000 total death toll, 90 percent of the 120 million total number of people affected, and 92 percent of the total economic impact (World Bank Group, 2017).

Absorbing the brunt of typhoons and flood disasters are the informal settlers not only in the Philippines, but in most countries in the Global South located in risk areas, particularly those in coastal and riverine settlements. With informality continuing to be a predominant source of affordable housing for the urban poor, these risk areas have not been spared (Davis, 2006) from the phenomenal growth of informal settlers which has now escalated to over 1 billion (UN Statistics Division, 2019).

To address this global problem, the UN 2030 agenda in its Sustainable Development Goal 11, aims toward making cities and human settlements inclusive, safe, resilient, and sustainable (UN, 2015). The goal provides the opportunity to make concerted efforts toward developing human rights-based, strategic, and globally aligned approaches geared to inclusive urban development (UN-Habitat, 2017). Amongst the SDG 11 targets, decreasing losses in water-related disasters, with a focus on protecting the poor and people in vulnerable situations, is essential for settlements in risk areas.

In the delivery of improved living conditions for informal settler families (ISFs), in-situ (on-site) upgrading is generally being pursued instead of relocation that deprives the settlers of job opportunities and social networks. However, in a wide study to investigate the objectives of slum upgrading by Olthuis, et al. (2015), it was noted that slums are perceived to be temporary which results to low incentive to invest in slums. This perception according to the study, prohibits their upgrading and pushes them into a negative spiral. It was also observed by some scholars, that the urban form and architecture of informal settlements remain largely unstudied

creating a research gap in the discipline (for example, Kellet and Napier, 1995; Alcazaren, et al. 2010; Kellett, 2011; Dovey and King, 2011; Ballegooijen & Rocco, 2013; Kamalipour, 2016; Pojani, 2018; Kamalipour and Dovey, 2020).

This research gap according to Pojani (2018, p. 294), is attributed by some commentators to the "…lingering concept of informal settlements as a pathology rather than as a permanent part of the housing supply". It may also be attributed to the observation of Jones (2017, p. 9), that "…mainstream planning and design theory has not embraced the dynamic form, complexity and understanding of urbanism that creates the communities living in informal settlements and slums".

In light of this gap, the research problem involves a flood-prone informal settlement provided by the government with a housing programme awarded to the established homeowners' association. Beset with formalisation issues due to the association's non-payment of its amortisation, the proposed redevelopment has ceased with the programme eventually reaching an impasse. Meanwhile, being located along the riverbanks and in the core of the city, the settlement is prone both to river and urban flooding with most of the dwellings unfit to mitigate flood hazards. In lieu of permanent formalised housing, the study will investigate the viability for the community to develop into a transitional settlement by examining the existing housing layout, form, and building materials used.

Transitional settlement according to USAID, is "…the improvement of existing neighbourhoods, including informal settlements, to permit provision of shelter and basic services, while reducing hazard risks and the need to relocate affected populations to new settlements" (USAID, 2017, p. 4). Associated with post-disaster events, the concept of transitional settlements will be adopted in this study to address the vulnerability of floodplain informal settlements to flood hazards via in-situ upgrading.

The rationale behind the proposition of the concept for this study is two-fold – first is the challenges in implementing in-city housing, and second, as an alternative approach to conventional upgrading. For the first part, the goal of the Philippine's Settlements Upgrading Programme under the National Housing Authority (NHA), is to address the security of tenure and infrastructure requirements of informal settlements on government land, and proclaimed or designated socialised housing sites (NHA, 2018). Ideally implemented via in-city, the programme covers survey and titling of individual lots for disposition to qualified occupants, infrastructure development, housing construction, and rehabilitation of existing project sites.

The challenges encountered in NHA's in-city housing against off-city relocation are: 1) high capital investment within the cities for including high cost of land in urban areas; 2) unsustainable off-city projects in the long term with the loss of livelihood; 3) lack of suitable lands for housing, and; 3) absence of a common subsidy framework to support socialised housing programmes across agencies. With these challenges, housing provision issues may

not be resolved in the near, and perhaps even in the distant future. As USAID Senior Advisor, Charles Setchell (2017, p. 18) argued, most official plans to address the problem of settlements, "…are aspirational, perhaps even inspirational, but not operational".

For the second part, the conventional approach to upgrading is the customary provision of basic services and infrastructure, with less or no consideration at all to the locational characteristics of the settlements. The response to the needs of the settlers, hence, is quite general and considered a one-size-fits-all solution, which could be attributed according to Olthuis et al. (2015), to the widely accepted and dominant definition of slums by UN-Habitat in 2003. The definition classifies the slums in terms of household and dwelling attributes, with the location or the nature of the place where it is situated being disregarded. Particularly for floodplain settlements, the existence of flood risk as further argued by Olthuis et al. (2015, p. 273), "…questions the effectiveness of broad and generic upgrading investments which mainly focus in improving basic infrastructure and basic service provision".

Against this backdrop, the concept of transitional settlements and shelters will be adopted in this study as an approach to frame the response to the housing challenges and conventional upgrading system. With the government's sluggish resettlement and upgrading programmes, hampered further by the community association's default, the integrated multi-sectoral planning and activities related to transitional settlements as an alternative approach, will be explored in this study. The viability of adaptation to flood hazards being prioritised even prior to the flood event, as opposed to the conventional post-event response, will likewise be investigated in the study.

Mainly associated with post disasters, the area-based principle of transitional settlements and shelters particularly in supporting post-event planning through capacity building efforts, and pre-event planning to configure and reconfigure risk-prone settlements (Setchell, 2017), will serve as a foundational concept to address the research problem.

1.2 Research questions, aims, and objectives

Whilst the local government is working to find ways to either formalise the settlement or relocate those along high-risk areas, the community could be developed by improving the dwellings to be technically adapted to flood hazards. The study will investigate if transitional housing as the typical response to post-disaster events, could be adopted to strengthen the community's resilience to flood hazards, whilst waiting to transition into more permanent dwellings.

The study will, therefore, address the main research question - "Could informal floodplain settlements be technically adapted for resilience building and developed to form transitional settlements?" The investigation will identify and evaluate the physical characteristics of informal housing within the context of the flood-prone community of Sitio Gulayan in Malabon City. The

potential for the study area to develop as a transitional settlement will be examined on the premise that technical adaptation will strengthen the community's resilience to flood hazards.

To answer the central research question, the study will identify the technical adaptation approaches being utilised by flood-prone communities initiated either by the government and disaster experts, or the dwellers of the self-build houses themselves. The upgrading programmes being adopted to mitigate flood hazards, particularly for informal settlements located along coastal or riverine areas, will be investigated as well to help address the main research question. Finally, with the consideration of transitional settlement as a probable resolution to flood-risk reduction and resilience building, transitional shelter and settlements will be explored to surmise its application to flood-prone settlements.

Given these considerations, the following sub-questions were formulated to address the main research question:

1. What are the technical adaptation approaches being applied by floodplain communities to address flood risk?

2. What are the upgrading programmes being adopted in informal floodplain settlements in mitigating flood hazards?

3. How can informal floodplain settlements be developed and managed to form transitional settlements?

This study aims to fill the research gap discussed above, by undertaking an analysis on the form and architecture of Sitio Gulayan community as an informal floodplain settlement. The intent is to assess the physical and spatial characteristics of the dwellings, which could determine the community's potential to form a transitional settlement. The urban form can be analysed by assessing the organisation of spaces within the community, which could be characterised by the spatial functions that serve both the residents and the community at large.

The dwellings can also be classified to establish the different types that could be observed in the settlement. By establishing a typology, the dwellings can be grouped together according to their characteristics to represent the entire settlement, which can then be judiciously assessed in terms of the technical adaptation that can be applied to each type. The adaptation can be based on the historical flooding scenarios, particularly the extreme events which could serve as the basis for the extent of technical adaptation necessary.

Through the historical flood events and other published works, the range of damage and impacts within the community could be observed and identified. This will enable the relationships between the housing type characteristics and the related flood impacts on the urban form of the community to be identified. The relationships will be the basis in the analysis of the flood mitigation approaches, that may be applicable to the existing urban form of Sitio Gulayan community.

The process to realise the research aims, starting from the assessment of the space organisation, to the analysis of the flood mitigation approaches as discussed above, is broken down to formulate the main objectives of the study as follows:

1. To characterise and assess the spatial organisation and urban form of the informal vulnerable community of Sitio Gulayan;
2. To form a classification of the dwelling units in Sitio Gulayan according to the typologies of urban form, and the building materials used and house design in terms of vulnerability;
3. To identify and evaluate a range of flooding scenarios, based on both the historic event record and other published work together with broad constructs for, i) key co-variables, and ii) the currently adopted indicators for a range of damage and impacts within the community;
4. To express the relationships between designs (in objective 2) and related flood impacts (in objective 3) on the community and urban form;
5. To analyse current flood mitigation approaches that could apply to the existing urban form of Sitio Gulayan community.

With these objectives, the data needed in the study can be identified together with the appropriate methods to be used in collecting the data and the sources of data. This will be presented in chapter 4, *Research design and methods,* in tabulated form to illustrate their relationship with the research objectives.

1.3 Significance and limitations of the study

The housing challenges confronting both the government and the urban poor, allow for informal settlements to proliferate even in “no-build zone” areas prohibited by law. With nowhere to go and whilst waiting for government intervention, this study will explore pragmatic approaches for the existing settlements along bodies of water, to contend with flood hazards in the context of resilience building. This study will, therefore, benefit firstly the informal settlers, and secondly the local government with an alternative means of improving the living conditions of their constituents residing in risk areas.

The significance of this study lies in contributing and furthering studies on the urban form and architecture of informal settlements. The phenomenon of informal settlements, as opposed to the earlier cited study in 2015 by Olthuis, et al., has persisted seemingly into a permanent fixture in urbanism, particularly in the Global South. Moreover, no two informal settlements are alike (Fernandez, 2011), where the findings on the urban form and architecture in one study, may not necessarily apply to another. Conducting more studies, therefore, would help in generating new insights, references, and theories, in addressing the diverse and multiple issues related with this phenomenon. The results and findings in this study, hence, could benefit future researchers as well.

Another significance in this study is the attempt to explore and apply the concept of transitional settlements in pre-disaster conditions, as opposed to its general application in the aftermath of disasters. With the lived experiences and local knowledge of the settlers as references to the extent of damage brought about by previous flood events, improving their living conditions even before the next disaster strikes through the process of transitional housing, may serve as an alternative concept to relocation, resettlement, or even the long-winded formalisation.

In terms of the limitations in the study, the main challenge which resulted to a limitation was the COVID-19 pandemic, particularly in the data gathering stage of the study. One instance is the imposed lockdowns and restrictions for the residents to go out during the survey and interview stages, which resulted to unbalanced participation of residents in terms of the targeted number of respondents in the pre-assigned zones. There are other related limitations which will be discussed in detail in chapter 4, *Research design and methods*, and chapter 7, *Results and study findings*.

Other limitations include the typhoon and flood issues in the case study area of Sitio Gulayan community, which will only be reviewed in terms of magnitude, extent, impacts, and perceptions of flooding. Flood modelling will not be conducted in this study considering the data available on the two extreme flood events used as the bases for the flood damage analysis. For future flood events, flood hazard maps will be utilised indicating the 5-, 25-, and 100-year return periods in the city and the community itself, which will be presented in chapter 5, *Study area*.

Finally, with the limited time to work on the research study, a comprehensive discussion on the current legal, political, and socio-economic issues facing floodplain informal settlements will not be explored. The complexities of politics and land tenure issues (Kamalipour and Dovey, 2020) beleaguering most informal settlements including the study area are thus, beyond the scope of this study.

1.4 Thesis structure

Starting with this chapter, the thesis is structured into eight chapters which will be briefly described in this last section. Chapter 1, *Introduction*, comprise of four main sections with the background to the topic (Section 1.1) identifying the broader research problem, and indicating the limited studies in the topic of interest. The research questions, aims, and objectives (Section 1.2) are included in the chapter, discussing the process on how the central and sub-questions were formulated. Similarly, the process on how the objectives were developed was also discussed with their link to the data requirements mentioned. Prior to this last section 1.4, the third section presents the significance and limitations of the study (Section 1.3), stating the conceivable contributions including those who will benefit in this research study.

Chapter 2, *Literature review*, presents the relevant published works from the more general to the more specific information, engaging primarily with those that the research study directly

builds on. The intent is to present and bring together the similar and different perspectives gleaned from the current body of knowledge, tensioning the diverse viewpoints against each other to eventually bring them into a synthesis. The chapter consists of twelve main sections starting off with the introduction on informal settlements as being characterised with poverty (Section 2.1). It clarifies how the study is set out to investigate informality being one of the causes of vulnerability, but could also be an enabler in countering it.

With the settlement as the main object of the study, its two key features are urban flooding (Section 2.2) and urban informality (Section 2.7), discussed in the succeeding sections and explored through the concepts of risk (Section 2.3) and resilience (Section 2.4) under their respective sub-sections. The flooding scenario in Metro Manila is presented through the extreme flood events of Tropical Storm *Ondoy* in 2009 and the Southwest Monsoon (*Habagat*) in 2013 (Section 2.5), followed by a review on the flood damage assessment (Section 2.6). The state of informal settlements in the metropolis (Section 2.8) is presented in the succeeding section with the literature on in-situ upgrading for informal settlements (Section 2.9), technical adaptation approaches (Section 2.10), and transitional settlements (Section 2.11) presented in the latter part of the chapter. The chapter is concluded with the summary to tie up all the sections together (Section 2.12). The overall intent of the chapter is to set out the foundation for the arguments that will be developed later on in the study.

Chapter 3, *Conceptual model*, has three main sections with the first discussing the rationale behind choosing to utilise a conceptual model that comes from existing views synthesised from theoretical and empirical findings (Section 3.1). The adopted conceptual model is then presented in the succeeding main section, discussing its original application to the vernacular architecture of informal settlements, to its adaptation and application to the urban form and architecture of informal settlements (Section 3.2). The use of the model or framework and its appropriateness for the study is further discussed, justifying its applicability to the diverse setting of informal settlements.

The tabulated elements and constructs in the conceptual model are then presented with the additional element that was added in adapting the model discussed. Each of the key elements are presented in the succeeding sub-sections at the last part of the chapter, discussing in detail each of the sub-elements under the key elements. A brief summary concluded the chapter (Section 3.3), clarifying the application of the conceptual model to the community under study that will be presented in chapter 6, *Data Analysis*. The entire chapter sets the scene for the rest of the work where it is underpinned intellectually, from the data collection and analysis approaches, to the data and insights that will be gathered in the study.

Chapter 4, *Research design and methods*, sets out the methodological approach used in the study to deliver the research objectives. Consisting of six sections, the introduction briefly describes the study area as a preface to the possible research approaches that can be applied

based on the research focus and problem (Section 4.1). The case study design and mixed method approach as the chosen approaches for the study, are then justified and presented together with the tabulation linking the research objectives with the data required, collection methods, and sources of data (Section 4.2).

The succeeding sections present the qualitative and quantitative methods, with the respective data collection methods to be utilised in the study (Sections 4.3 & 4.4). The line of questioning for both the interview protocol and survey questionnaire is discussed and justified, by linking the related reviewed literature in chapter 2 with the questions formulated for the residents and officials from the community, Barangay, and city government. Both the survey and interview protocols were included in the Appendices for referencing. The section ends with the discussion on the process for the flood damage assessment, as one of the data collection methods employed under the quantitative approach. The penultimate section (4.5) discussed the main ethical issues related to the research methods, together with the execution of the standard forms for ethics review, and the addition of the data collection protocol for COVID-19. The chapter concludes with a brief summary in the final section (4.6).

Chapter 5, *Study area*, comprise of three main sections starting out with an overview of Sitio Gulayan community (Section 5.1). The section initially presented the location of the community within the barangay and the city, including the motivation behind choosing the settlement as the single case in the research study. The administrative division from the city down to the community with their respective local officials is presented next, followed by the location and a brief historical development of the city leading to the physical features of the community. The section ended with the socio-economic and hazard feature presentation from the city level down to the community level.

The second section presents the flood risk management in the city by discussing first, the flood types inherent in the city and the community (Section 5.2). The magnitude and flooding impacts were presented next followed by the prevention and mitigation programmes in the regional level, which involves the city of Malabon and its related programmes implemented down to the Barangays. The last part of the section discusses the preparedness and response to flood hazards from the city, to the barangay and community levels. The section on the flood risk management from the city level down to the community level, is deemed to help identify the possible technical adaptations appropriate for the community, in relation to its potential to develop and transform into a transitional settlement. The chapter closes with the last section briefly summarising the two main sections (Section 5.3).

Chapter 6, *Data analysis*, has three main sections presenting the analysis of data qualitatively (Section 6.1), and quantitatively (Section 6.2). The first section discusses the breadth of data to be collected, and the justification in the use of thematic analysis for the qualitative data. The development of themes from the interviews conducted is presented subsequently, discussing

the three main themes established and complemented by thematic maps developing from broad to specific, which ultimately lead to the final themes and their sub-themes. The coding process made use of *NVivo* as a sorting tool only, so as not to constrain the researcher in generating themes, and not lose sight of the important points that inevitably came across very strongly from all the interviews carried out, whilst being guided by the framework used.

In presenting the qualitative data from the interviews, three approaches were utilised: 1) weaving in direct quotations within the flow of the sentence, making a point as a general consensus amongst those taking part on a particular issue, from one another or another participant; 2) using the different points of view which could be presented with similar and different views as separate stand-out quotations to support a point being made in a paragraph, with the quotations indented underneath, and; 3) tabulating unique responses from participants, where important points can be captured from. These variety of approaches will help in presenting the qualitative data clearly and effectively from a reading perspective.

The second section presents the quantitative data analysis discussing the twofold usage of the survey protocol: 1) establishing the structural classification of dwellings, and; 2) flood damage assessment on the dwellings. The structural classification is presented with the bar charts indicating the building materials of the major components of the houses. Whilst the survey questionnaire contains qualitative questions, there are questions included that by their nature are essentially quantitative, which can be measured to help generate the flood damage assessment. The section concludes with the flood damage assessment discussing the stage-damage curve, with the bar charts indicating the flood damage cost on the houses from the two extreme flood events. The last section summarises the entire chapter (Section 6.3).

Chapter 7, *Results and study findings*, presents the detailed findings discussed initially in the previous chapter. Consisting of five main sections, the introduction (Section 7.1) reflects on the survey protocol as a prelude to the survey results, starting with the demographics presented in bar charts. This was followed by the survey results on the house features presenting the established house types (Section 7.2), similarly consolidated and summarised through bar charts. The results are complemented with visual recordings and the flood damage results to differentiate the typologies, with the flood damage results presented using the damage fraction tabulation, and the stage-damage curve plots for each typology.

The succeeding section presents the state or condition of basic services provision resulting from the survey and interviews conducted (Section 7.3). The presentation correspondingly made use of photos and bar charts to complement and support the discussion. The ensuing section presents the findings on the three main themes (Section 7.4), as a result of the analysis in the previous chapter. Finally, the last section summarises the entire chapter (Section 7.5), bringing together all the sections that will serve as a preface to the ensuing final chapter 8, *Discussion and conclusion*.

Chapter 8, *Discussion and conclusion*, is structured with the overlapping discussion and conclusion sections grouped together into this final chapter. Comprising of five main sections, it explores the relevance and meanings of the findings in the study by relating the results with the body of knowledge in the existing published literature. The introduction (Section 8.1) breaks down the composition of the main sections with the discussions (Section 8.2) interpreting the findings in relation to the four sub-sections of conceptual model key elements, transitional settlement development, flood projections, and research questions.

The sub-sections were then followed by the conclusion (Section 8.3) with the asserted arguments in the previous chapters serving as the foundations of the study's conclusion. The recommendation (Section 8.4) ensued presenting a two-part guidance drawn from the encountered limitations in the study. This was followed by the proposed future directions for research included in the penultimate section. Finally, the chapter and the study concluded with the research contribution (Section 8.5) presenting both the foreseen and apparent uses of the study for future research works both in the study area, and in informal settlements in general.

2. Chapter 2 Literature Review

The chapter reflects on the concepts, theories, and approaches of the relevant literatures associated with the research question. Urban flooding as a key feature in the study, is initially presented with its drivers and consequence through the concepts of urban flood risk and urban flood resilience. The chapter addresses the discourse on the dichotomy of 'formal' versus 'informal', as a preface to discussing the concepts of risk and resilience in the context of urban informality, as the other key feature in the study. Technical adaptation approaches and the concept of transitional settlements and shelters, are subsequently discussed to help address and elaborate the main research question. The chapter is summarised at the end to restate the research question and as a prelude to the conceptual model, discussed in the succeeding chapter 3.

2.1 Introduction

The main research question in this study enquires about the potential of floodplain settlements, to adapt technically to flood hazards and develop to form a transitional settlement. The study focuses on informal settlements where poverty is inherent and aggravates vulnerability, by gradually exhausting the people's ability to cope and recover from disasters (Zevenbergen et al., 2010). This study sets out to investigate informality as a contributory cause of vulnerability on one hand, and an enabler in countering vulnerability on the other hand, through resilience building to endure disasters. The next section starts off by discussing urban flooding, as the main cause of the inundation in the floodplain settlement being investigated.

2.2 Urban flooding

Our urban landscape is replete with disasters that highlight the diverse connections between the built environment and water, "…whether there is too much or too little of this precious resource" (Ryan et al., 2010. p.12). Floods along with windstorms according to Zevenbergen et al. (2010), are the most common and widespread of all-natural disasters where floods in the past decades, caused more than half of the deaths instigated by natural catastrophes.

There are several types of flooding in urban areas that can be described according to velocity/intensity, geography, or cause of flooding, such as flash floods, coastal floods, or river floods (FLOODsite, 2008). Another specific type is urban flooding which according to Weber (2019), is a lesser-recognised threat caused by unmanaged or non-absorption of rainfall. It is specific because it is not uniquely flooding that occurs in an urban area.

Unlike flooding in urban areas due to a river overflowing its banks, or a storm surge driven by a hurricane across a coastal neighbourhood, urban flooding is caused instead by excessive runoff with water having nowhere else to go (Weber, 2019). Particularly in more densely populated areas, it is inundation caused by rain falling on increased amounts of impervious surfaces overwhelming the capacity of drainage systems (FEMA, 2010).

In their natural form, floodplains serve to reduce flooding by providing an increased area for the storage and slow movement of water (Watson and Adams, 2011). When altered into urban environments, however, local water balance is disrupted and water resource quality is diminished. This often leads to increased flooding frequency and severity in urban landscapes, furthering the need for implementation of mitigation measures. In the absence of these measures, floodplain communities typically can be inundated either by precipitation leading to excessive runoff, or by river flooding.

Cities or urban areas are special cases as the world becomes predominantly urban (Lavell, 2020), with the multiple ways in which urban development can increase disaster risk (Burayidi et al., 2020). Currently, 54 percent of the world's population reside in urban areas with UN projecting the proportion of urban residents to grow to 68 percent of the world's 6.4 billion population in 2050. This will add 2.5 billion people to the urban population (UN Population Division, 2018), who could be exposed to disaster risks if urban development is not properly managed.

Distinguishing the Asian region in particular, Zevenbergen et al. (2010) posited that the massive migration of people to the urban centres for employment, increase the flood risk as they settle in high-density urban slums or along riverbanks. The high demand for urban land to accommodate development will continue to prompt alterations in land use and result to increased urban flooding when combined with increased precipitation (Watson and Adams, 2011).

In the Philippines, the National Capital Region (NCR) also known as Metro Manila, is the most urbanised agglomeration with a 100 percent level of urbanisation (UN-Habitat, 2016). The World Bank Group (2017) estimates that populations living in cities will double close to 102 million by 2050 thereby, increasing the potential exposure of people, their possessions, and economic activities to urban floods. The combination of these two increasingly obvious trends - rapid urbanisation and frequent natural disasters - will substantially increase the risk of flood (Correa, 2011).

Interventions can help minimise the risk, but those that disrupt economic activity and social networks, often compound instead of resolve the problem. Bottom-up interventions aimed at enhancing resilience and adaptation should be recognised by planning authorities who favour top-down interventions (e.g. formalisation or resettlement), but fail to consider livelihood enhancements. The inevitable risk the informal settlers will continue to encounter as discussed in the succeeding section, can be better understood when explored and investigated in the context of informality, which will be further discussed in the later sections.

2.3 Urban flood risk

Throughout history, the preferred human settlement locations are along bodies of water despite the cost of an increased flood risk for such favourable locations (APFM, 2008). The alarming

numbers presented above can thus, result to the starker increase in the population of urban settlers who will be additionally exposed to flood risk. The causes and impacts of this risk can be examined by distinguishing clearly between its integral components identified by APFM (2008) as hazard, exposure, and vulnerability.

Flood risk according to Jha et al. (2011, p.4), is "…commonly described as a function of the probability of the flood hazard, of exposure to the flood hazard, and of the vulnerability to the flood hazard of receptors" (i.e. people, buildings, infrastructure, agriculture, open recreational space and the natural world [RIBA, n.d.]). It is created by the occurrence of an extreme flood event (hazard), and the presence of somebody or something (exposure) at risk (vulnerability).

The compounding effect of the three components can be considered as directly proportional to flood risk, in which Crichton (1999) posited, that if any of these three elements in risk increase or decrease, then the risk increases or decreases respectively. As Jha et al. (2011, p.16) expounded, "…increases in impacts from flooding can result from increases in hazard, in the exposure of populations and their assets, or in the vulnerability of these exposed populations and assets to flooding".

Increase in exposure in the context of stability, however, is not entirely negative. Although stable condition enables greater efficiency according to Wenger (2017, p.3), it leads to an increasingly narrow operating space, where it forfeits the ability of communities to function outside this condition, thereby increasing their vulnerability to large-scale events. Exposure prevention, she adds, "…lowers risk awareness and response capacity, inhibiting the use of construction standards that are flexible enough to cope with flood" (i.e. other than levees and flood mitigation dams).

The analysis of flood risk is vital in investigating informal floodplain settlements as the object of this study. Analysis according to Badilla et al. (2016), involves the combination of information from the three components: 1) flood hazard information describing the likelihood and intensity of a flood event; 2) exposure information, which describes the distribution of people or elements 'at-risk' to a flood event; and, 3) vulnerability information describing how the exposed elements would be affected if subject to a given intensity of flooding.

Flood risks in built environments can be considered as the consequence of both natural and man-made factors. Anthropogenic or human factors further exacerbate urban flood risks particularly with unplanned urban growth. The area where floods can overflow naturally (APFM, 2008) for instance, when replaced with impervious surfaces like concrete and asphalt paving lessens the absorption capacity of the area (Ramirez, 2011). If unplanned growth aggravates flood risk, more so will unauthorised development substantially intensify urban flood risk. Floodplain settlements on no-build zone areas for example, are apparently exposed to far more risk that those along the authorised buildable areas.

Apart from the human factors, rainfall patterns become more uncertain under climate change scenarios and as urban populations increase, flood risks according to Butler et al. (2014), become more complicated. In the same vein, Oliver-Smith (2009) argued that as a major effect of global climate change, increased intensity and frequency of climate-based natural disasters, will lead to displacement and resettlement. Others argue, however, that resettlement should be the last resort after exhausting all efforts to explore in-situ development and climate change adaptation.

The World Bank (2011, p. ix) for example, pointed out in their housing projects that resettlement is a "…complex, multidimensional process with potentially very high negative impact if not properly planned and implemented". Ramirez (2011) correspondingly argues, that resettlement is more relevant where it is not possible to technically mitigate the risk, similar to what this study sets out to investigate, which is the technical adaptability of settlements to mitigate flood risk.

Flood as a natural event, makes the risks inherent and particularly unavoidable in vulnerable areas like floodplain settlements. APFM (2008) argued that aiming to avoid or absolutely control floods, often proves to be an unrealistic endeavour. Burayidi et al. (2020) recognised the problem not with the lack of information about disaster, but about how urban areas can more appropriately mitigate disasters and adapt to their new environments following a disaster. Appropriately, the aim of managing flood risks is to mitigate and not to eliminate risks.

In the end, flood on the one hand becomes a disaster risk because of the way we build upon areas susceptible to flooding (Watson and Adams, 2011). On the other hand, identifying, assessing, and reducing the exposure of people to hazard along with their vulnerability, will help in managing flood risk by building resilience to prevent flood disasters. Increasing people's resilience to floods as will be further explored in the next section, may enable them to live with floods in the urban environment.

2.4 Urban flood resilience

The discussion above on flood risk leads in the conversations on disturbances and preparedness, which are discourses fundamentally on resilience. As a component of resilience, preparedness relates to steps taken by the government, communities and individuals to mitigate the impact of hazards (Bollettino et al, 2018). The concept of resilience according to Kuhlicke, et al. (2020), accepts potential disturbances and catastrophic events as inevitable by preparing for such events, whilst learning relevant lessons in order to reduce the respective consequences. Holling in 1973, was the first to introduce resilience in the field of ecology and since then, it found popularity in the fields of social science, psychology and disaster management (McClymont et al., 2019).

The application of resilience falls under at least three different characterisations: 1) engineering; 2) ecological; and, 3) socio-ecological, or adaptive resilience (Zevenbergen et al., 2020). The

terms “resist”, “withstand”, and “rapid recovery”, are often reflected in engineering resilience (Wenger, 2017) and as pointed out by Zevenbergen et al. (2020), applied in planning, architecture and building technology with focus on flood hazard mitigation. The application they added, involves deployment of flood resilient design and technologies to adapt or construct buildings in reducing the probability of failure, the consequence during failure and, the recovery time after failure by flood water.

Building engineering resilience according to Zevenbergen et al. (2020, p.1), “…involves a static approach, with a fixed time horizon and a set of robust measures designed for specific future conditions or scenarios”. The key features of engineering resilience are the speed of return to equilibrium (Fenner, 2020) and resistance to disturbance and change, to conserve what you have (Folke, 2006). However, with these systems not designed for failure, the impacts of extreme flood events as a consequence may be disastrous (Zevenbergen et al., 2020), such as when a dyke is breached.

Ecological resilience on the other hand, similarly resists disturbance and focuses on persistence, change, unpredictability (Holling,1996), and robustness in multiple equilibria (Folke, 2006). It has the “…ability to absorb change and disturbances and still maintain the same relationships”, or maintain existence of function (i.e. persistence) (Zevenbergen et al., 2020, p4). Existence of function in the context of flood risk management, may imply withstanding the flood wave or quick recovery after being exposed to flood water (ibid.).

In the third approach, socio-ecological or adaptive resilience, focuses on adaptive capacity, transformability, learning, and innovation (Folke, 2006). Resilience in this sense, according to Smit and Wandel (2006) as cited by Folke (2006, p.259), “…provides adaptive capacity that allow for continuous development similar to a dynamic adaptive interplay between sustaining and developing with change”. In a social–ecological system, adaptability is referred to as the capacity of people to build resilience through collective action (Folke, 2006).

The significant difference of socio-ecological with ecological resilience is that it enables the human component of the system to prosper as Wenger (2017, p.1) puts it, which means “…maintaining human stability in the face of variable conditions”. Human stability may refer to population numbers, health, infrastructure, resource base, network, and social institutions (Wenger, 2017). Zevenbergen et al. (2020, p. 4) similarly pointed out , that socio-ecological resilience “…reflects the degree to which complex adaptive systems (e.g. communities) are capable of self-organization and to which these systems can build capacity for learning and adaptation”.

The sequence of resilience concepts from the narrower interpretation to the broader social ecological context (Folke, 2006), presents a more holistic systems approach moving from a reactive to proactive resilience. Reactive being aligned with the ability to resist and recover, can be exemplified by structural flood mitigation measures such as levees or dykes, whilst proactive

resilience which refers to the ability to adapt and transform, could be illustrated by elevating the dyke in response to sea level rise (Zevenbergen et al., 2020, p. 4).

Adaptation and transformation involve preparing for disturbances and applying relevant lessons learnt in similar future events, which can help to reduce risk substantially and increase resilience to prevent flood damages and losses. Understanding the construct of probable flood damages can help determine preparations and preventive actions to take, in mitigating these likely damages (APFM, 2008).

Flood losses and damages can be categorised into tangible or intangible losses, and direct or indirect damages (Penning-Roswell et al., 2005; Zevenbergen et al., 2010). Both direct and tangible losses result from the physical contact of flood water with damageable property and its contents (Penning-Roswell et al., 2005), whilst indirect and intangible losses result from the event, but not from its direct impact (APFM, 2008). In the urban setting, flood damages and losses are more intense and costly with the much higher concentration of population (Jha et al., 2011). Losses, however, can be deterred when damages are averted, typically by applying the appropriate measures.

Preventive measures could at times be as simple as providing the "missing nail" in a roof sheathing as cited by FEMA (2010), where a multiplier effect from one missing fastener could result to loss of the entire roof and possibly, the structure. It could also be as technical as retrofitting flood-prone residential structures, which may include elevating the building in place, relocating the building, constructing barriers, dry floodproofing and wet floodproofing (FEMA, 2011) as further discussed in section 2.10, *Technical adaptation approaches*.

Whether simple or complex, measures could be based on the technical feasibility appropriate to the historical flood events in the area. Similar future disasters can then be anticipated with feasible precautionary measures set in place. As Zevenbergen et al. (2010, p.156) argued, anticipation and precaution are the two pillars that underpin a resilience-focused approach to flood risks which will "…require cultural changes in regimes, institutions, decision-makers and professional actors".

A resilience-focused approach means preparing by designing and building structures for extreme storms and flooding. More broadly, the approach focuses on "…creating buildings, communities, and regions that restore and improve water resources and mitigate threats of extreme weather and climate change" (Watson and Adams, 2011, p. xvi). APFM (2008) in the same context, refers to a holistic paradigm in urban flood risk management combining spatial, technical and organisational measures for an effective management. A shift in flood risk response, therefore, should be initiated for adaptation to increase the resilience of both natural and human systems to current and future impacts or disturbances (Zevenbergen et al., 2010).

The effects of disturbances that can affect urban systems, can be potentially reduced by urban resilience as presented in this section, whilst considering disturbances as opportunities for a more sustainable urban development (Serre et al., 2012). As Folke (2006) argued, disturbance has the potential to create opportunity for doing new things, for innovation, and for development, in a resilient social ecological system. With flooding as one of its major disturbances, Metro Manila may be far from becoming such a "system". To provide a glimpse, flooding together with its drivers in this National Capital Region (NCR), will be presented in the next section.

2.5 Flooding in Metro Manila

In terms of urban flood resilience discussed above, the situation in Metro Manila can be understood and appreciated with a brief historical introduction on the drivers of flood risk in the Philippines. The country's geographic and topographic features play critical roles in its vulnerability to flood hazards, typically exacerbated as mentioned earlier, by the anthropogenic factors. The natural features, however, can likewise be seen as opportunities and usable resources that can add to the quality of urban areas (Ashley et al., 2020), in achieving urban flood resilience.

With the archipelagic country located along the typhoon belt in the western North Pacific Basin where about 33 tropical cyclones originate, the islands have been visited by an average number of 20 typhoons annually since the late 1800s when it was first recorded by the Jesuit meteorologists (Warren, 2016). Disasters back then were already frequent that both Spanish and American reports, repeatedly highlighted the devastation caused by typhoons on agriculture as the major means of livelihood of the locals during the period.

The frequency of events and the number of affected people steadily increased as human-caused activities such as deforestation, overgrazing and urbanisation exacerbate environmental conditions (Bankoff, 2003a). What is ultimately suggested as Bankoff (2003b) pointed out, is that societies in the Philippines have come to terms with hazard in such a way that disasters are not regarded as abnormal situations, but as quite the reverse - as a constant feature of life.

Considering the long history of disasters, which for many have already become a way of life, it can be argued that the locals should have been more resilient by now. However, constraints typical of a developing country such as rapid urbanisation, population growth, and poverty in particular, restrain people's ability to cope and recover from disaster. Without the means to live in formal neighbourhoods, they would often settle in unauthorised urban areas like the undeveloped lands along bodies of water where they are exposed to flood hazards. In Metro Manila or NCR alone for instance, there are eight major waterways identified as risk areas (DPWH, 2014).

Aside from the proliferation of unauthorised settlements, the geographical feature of NCR has further increased flood risk in the region. The highly urbanised Metro Manila is located in very

low land susceptible to floods and landslides brought about by heavy rains and other related weather systems such as monsoon and intertropical convergence zone (JICA, 2015). Characterised by a complex and rapidly changing physical environment, the NCR is very vulnerable to extreme weather events (IRIACC, 2017).

With an area of just over 630 km^2 and a population of 13.4 million (PSA, 2020), Metro Manila is located in the southwest region of Luzon Island surrounded by Manila Bay to the west, Sierra Madre Mountain range to the west and northeast, Laguna de Bay to the southeast, and the plain of Central Luzon to the north (Bagtasa, 2019). Along the western slopes of the Sierra Madre is the Marikina River Basin which flows southward to Laguna de Bay (Abon et al., 2011).

Pasig River traverses Metro Manila which channels water from Laguna de Bay out to Manila Bay with interconnected channels and creeks that make Metro Manila susceptible to flooding (Bagtasa, 2019). In addition, the outdated existing modified natural channels (esteros) and canals constructed during both the Spanish and American periods, have been rendered inadequate (Bankoff, 2003a).

DPWH (2014) identified three causes of major flooding occurrences in Metro Manila: 1) huge volume of water coming from Sierra Madre; 2) drainage capacity constraints in core area of NCR; and, 3) low-lying communities around Manila Bay and Laguna Lake. Aside from the human factors, flooding can be mainly attributed to natural causes such as flat terrain, rainfall intensity, and high tides in Manila Bay (Bankoff, 2003a).

Flooding in NCR is further enhanced due to subsidence and sea level rise. The land fringing Manila Bay according to Bankoff (2003a), consists of sediments that underlie the river delta with a high-water content that gets compressed by the weight of succeeding deposits. This process of subsidence is accelerated when groundwater is extracted faster than it can be replenished by natural recharge from rain.

Sea level rise as an added concern, reached a staggering rate of about three centimetres by 1991 from about a rise of just two millimetres a year between 1902 and early 1960s (Bankoff, 2003a). Global mean sea level further increased to 3.7 millimetres between 2006 to 2018, which IPCC (2021) reported was *very likely* due to human influence, mainly driving the increases since at least 1971.

In the Manila Bay area, CSLR-Phil reported that the sea is rising by about four times the global average at 12.13 millimetres (Enano, 2021). With the land around Manila Bay sinking and the level of the sea rising, flooding has become more prevalent not only in Metro Manila, but in its neighbouring provinces as well (Siringan and Rodolfo, 2002). IRIACC (2017, p.6) concludes in its technical report that in a future warmer climate, Metro Manila's vulnerability to flooding "…may increase due to: torrential rainfall projected to be more frequent; increasing sea levels; and, changes in land cover and urbanisation".

Flooding in Metro Manila has indeed become a way of life not only for the informal, but for the formal residents alike. The apparent difference with previous events, however, are the extent of devastation caused by the recent flood events. Two of these disastrous events occurred in 2009 from Tropical Storm 'Ondoy', and in 2013 brought about by the Southwest Monsoon (Habagat), which are both recounted in the succeeding sections.

2.5.1 Tropical Storm 'Ondoy' flooding

The effects of the "future" warmer climate may have come sooner than expected, as observed in the recent flood events that devastated the metropolis. To provide a glimpse on how these floods have impacted NCR, particularly the informal settlements similar to the case study, it is noteworthy to narrate the unprecedented events. Two such events may qualify with the first presented in this section, followed by the second in the subsequent section.

On September 26, 2009, Tropical Storm (TS) Ondoy (international code name Ketsana), made landfall at 9:00 AM in Central Luzon highlighting the Philippine Atmospheric Geophysical Astronomical Services Administration's (PAGASA) warning on the occurrence of flash floods and landslides (NDCC, 2009). An equivalent of a Category I storm, PAGASA reported that during the first 24 hours, Ondoy dropped 455 mm of rain in Manila (figure 1).

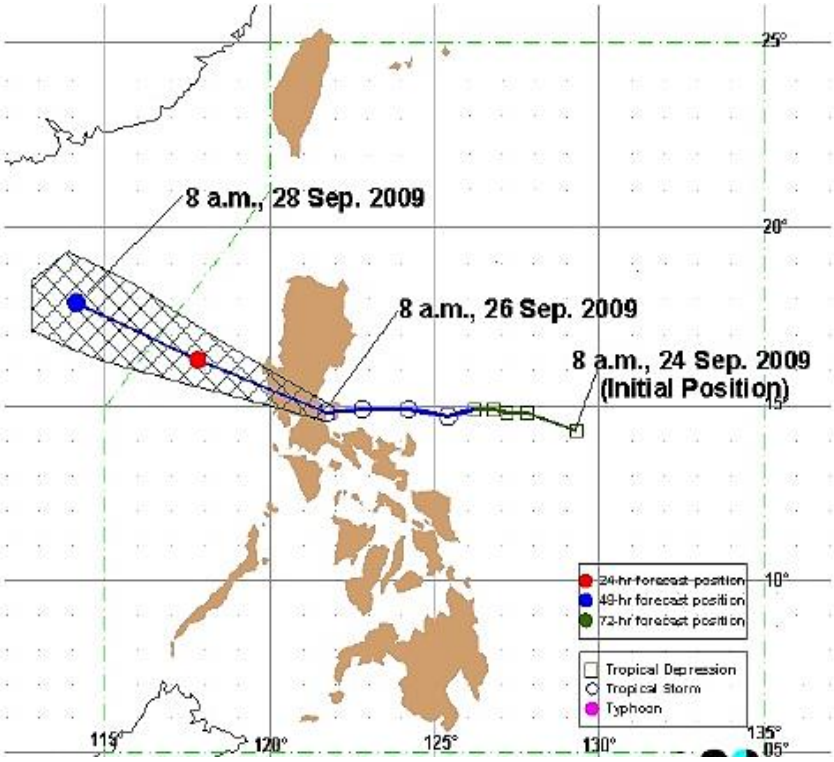


Figure 1 TS Ondoy (Ketsana) track map. Source: PAGASA (2009)

According to Gutro (2009) of NASA, a record 13.43 inches (341 mm) of rain fell in the six hours between 8 AM and 2 PM equivalent to about a month's worth of rain for the area. The reason for the enhanced rainfall as the storm approached according to NASA's Lang (2009), was the

interaction between Ondoy's low-level circulation and the seasonal Southwest Monsoon locally known as "Habagat" [1].

In the National Disaster Coordinating Council's (NDCC) final report, the enhanced southwest monsoon brought about by Ondoy caused widespread flooding in almost all parts of Metro Manila, Central and Southern Luzon as well as some parts of Visayas and Mindanao. There were 1,786 barangays flooded in 172 municipalities and 16 cities in the country. In Metro Manila, NDCC (2009) reported that a total of 239 barangays were flooded with the most heavily affected ranging from knee/neck to roof top deep.

NDCC further adds that the estimated cost of damage to infrastructure and agriculture amounted to Php 11 billion with a total of 185,004 damaged houses. As a result, 993,227 families or a total of 4,901,234 people were affected causing 464 deaths, 529 injuries, with 37 missing (Table 1).

Table 1 Affected People and Casualties (Source: NDCC, Situation Report as of November 20, 2009)

Affected	TS Ondoy
Families / Persons	993,227 families or 4,901,234 persons
Provinces	26
Cities	16
Municipalities	172
Families / Persons in Evacuation Centres	15,798 / 70,124 persons in 244 centres
Casualties	1,030
Deaths	464
Injured	529
Missing	37

The World Bank (2010) in its post analysis report, showed that anthropogenic factors exacerbated the impacts of torrential rains which include: 1) a decrease in river channel capacity through encroachment of houses; 2) siltation from deforestation, and garbage; 3) disappearance of 21 kilometres of small river channels; 4) urbanisation accelerating runoff concentration and reducing infiltration losses; 5) loss of natural retention areas, and; 6) land subsidence. Flooding after 'Ondoy' in many areas receded within one or two weeks, whilst in other areas particularly around the Laguna de Bay, waters remained for a number of months (AIIB, 2017).

The unprecedented event in the NCR prompted the government to renew its focus on improving flood management. Responding to 'Ondoy' and other disasters, Congress enacted the Philippine Climate Change Act of 2009 which created a Climate Change Commission, and

[1] 'Habagat' (Southwest Monsoon) occurs when warm moist winds from the southwest cause rains over the western portion of the country from May to September. It confirms the onset of the rainy season over the western part of the country (PAGASA).

passed the Disaster Risk Reduction and Management Act in 2010 (UN-Habitat, 2016). Any positive changes expected from these statutes have yet to be realised as four years after, another extreme flood event brought about by 'Habagat', devastated NCR yet again.

2.5.2 'Habagat' (Southwest Monsoon) flooding

In the middle of August 2013, the NCR experienced three days of non-stop rain caused by the Southwest Monsoon locally known as "Habagat" (Boquet, 2015). Enhanced by the proximity of Tropical Storm Maring (international code name Trami), Metro Manila was placed in a state of calamity due to widespread flooding. As shown in table 2 below, the flood event caused Php 1.645 billion in damages, affecting 3.1 million people, which resulted to 32 deaths (NDRRMC, 2013).

NDRRMC (2013) in its final report showed that TS Maring started as a Low Pressure Area (LPA) in the northeast of the country that developed into a Tropical Depression (TD). Maintaining its strength as it moved in an eastward direction (figure 2), it further intensified into a Tropical Storm (TS). The estimated rainfall amount was 10 to 25 millimetres per hour (heavy to intense) and reached up to 40 millimetres per hour (torrential) whilst the Southwest Monsoon continued to affect the islands of Luzon and Visayas.

Table 2 Affected People and Casualties (Source: NDRRMC Final Report, August 2013)

Affected	Habagat 2013
Families / Persons	697,263 families or 3,110,165 persons
Provinces	19
Cities	37
Municipalities	160
Families / Persons in Evacuation Centres	86,729 / 396,872 persons in 1,216 centres
Casualties	65
Deaths	32
Injured	30
Missing	3

Although Tropical Storm Maring did not make landfall nor affected the country directly, its presence induced the monsoonal rains. The rains dumped by Habagat over Metro Manila and other parts of Luzon surpassed the rainfall amount of TS Ondoy in 2009 and the Southwest Monsoon in 2012 (Philstar, 2013). Lagmay of Project NOAH, stated that the rainfall amount for August 18 was 600 millimetres in 24 hours compared with Ondoy's 455 millimetres and 2012 Habagat's 472 millimetres of rainfall (ibid.).

The total cost of Php1.645 billion in damages consisted of Php 860 million damages to infrastructures, and Php 784 million worth of damages to agriculture. In terms of damaged houses, a total of 2,641 were damaged with 654 totally, and 1,987 partially destroyed (NDRRMC, 2013). The worst flooding in the 2013 Habagat event was recorded in some

barangays in the province of Laguna (south of NCR), which went under six to seven feet deep floodwaters (Philstar, 2013).

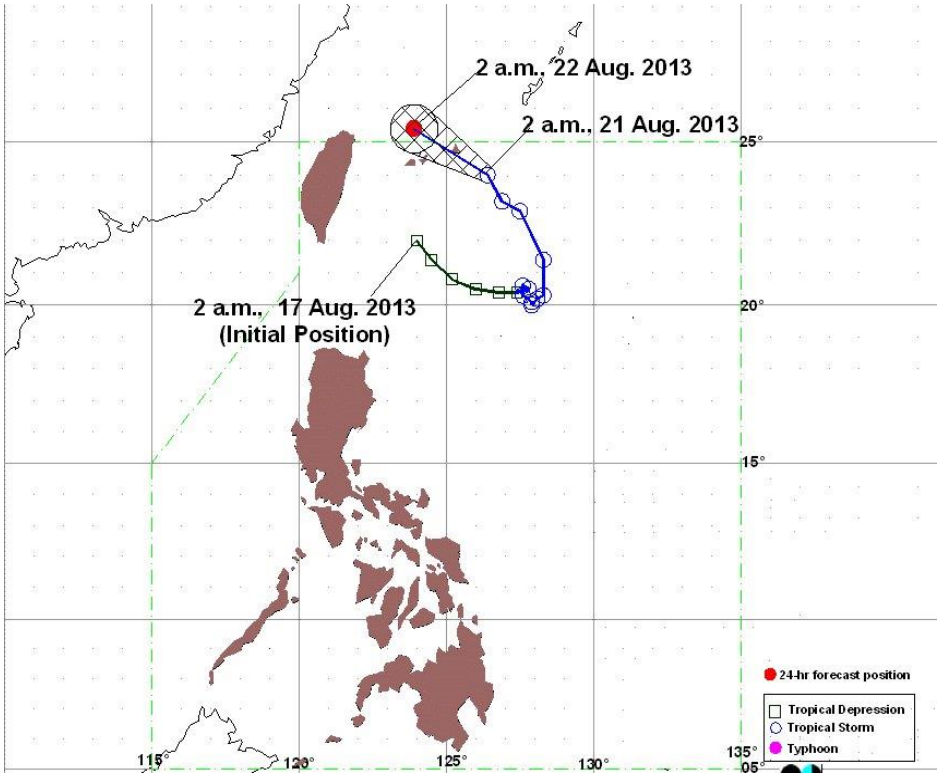


Figure 2 TS Maring (Trami) track map. (Source: PAGASA, August 2013)

Floodwaters in the three lakeshore barangays in the city of Sta. Rosa, Laguna, remained for two to three months due to heavy rainfall that caused the overflow of water from the Laguna de Bay (santarosacity.gov.ph). Most affected similar to the other cities in NCR, are the informal neighbourhoods located along the waterways with their makeshift structures bearing the brunt of Habagat and other extreme flood events. These damages incurred by the settlements from the effects of flood is important in this study to assess and determine the extent and cost of damages. How these can be identified and determined, will be discussed in the immediate section.

2.6 Flood damage assessment

From the extreme flood events discussed in the above sections, this section will present the approaches on assessing flood damage which will be useful in identifying the extent of destruction on the dwellings in the study area. The assessment will help in distinguishing the vulnerability of the different types of dwellings to the extreme flood events, that will enable to identify the technical adaptation measures appropriate for its development into a transitional settlement. The approaches that will be reviewed in this study will focus mainly on those applied in residential buildings, mostly found in developing countries where there is a large variation in construction types in the building stock (Englhardt, et al., 2019).

In performing flood damage assessments, Merz, et al. (2010) distinguishes three different spatial scales: 1) micro-scale based on single elements at risk or affected object such as building or infrastructure object; 2) meso-scale based on spatial aggregations like residential areas with the size magnitude of one hectare to one square kilometre; and, 3) macro-scale based on large-scale units like municipalities, regions, or even countries. The community in this study, would fall under the micro-scale level where the damage in case of a certain flood event, can be estimated by calculating the damages for each affected building or infrastructure object.

Considering the types of flooding being experienced in the study area, the damage assessment to be reviewed in this section will be limited to the flood effects of inland or urban flooding, and riverine flooding on dwellings for which according to Marvi (2020), the effect of wind forces and wave is negligible. Correspondingly, flood damage to residential buildings according to Merz et al., (2010), is strongly dependent on the flood water depth. The water depth, thus, represents the physical vulnerability in relation to the potential damage of the exposed elements for the different levels of hazard.

Exposed elements according to Englhardt, et al. (2019), refer to different structural factors such as building type, quality, height, and materials used. Based on these structural factors, the buildings being assessed can be categorized and divided into different types in which the similarities in factors mean similar responses to flood and damages to structure (Davis and Skaggs, 1992). Estimating these damages can help identify the effects of flood to the structure, which can be quantified in monetary terms with the damage cost compared against the overall building cost to determine the extent and magnitude of damage. The procedure on estimating these damages will be presented in the ensuing paragraphs.

2.6.1 Flood damage estimation

The estimation of direct flood damage to buildings according to Pistrika, et al. (2014), consists of two related steps – analysis of the structural damage caused by the flood effects, and economic estimates on the physical damages. They noted that the physical structural damage can be converted to economic estimates of damage percentage, through the required insight in both the pre-disaster market value and the replacement cost of each building. This can often be accomplished by applying the method of depth-damage function, as further noted by Pistrika, et al. (2014, p. 555), "…that relates flood characteristics directly to the economic value of damage without investigating the physical mechanisms that cause the structural damage".

The depth-damage function according to Davis and Skaggs (1992, p. 2), "…is a mathematical relationship between the depth of flood water above or below the first floor of a building, and the amount of damage that can be attributed to that water". It denotes according to Huizinga, et al. (2017, p. 2), "…the flood damage that would occur at specific water depths per asset or per land-use class". Davis and Skaggs (1992, p. 2), add that the relationships of depth-damage are "…based on the premise that water height, and its relationship to structure height (elevation), is

the most important variable in determining the expected value of damage to buildings". Aside from flood depth, other flooding factors may influence the extent and severity of damage to buildings such as flow velocity, flood duration, sediment load, and contamination, but flood damage models hardly include all these other factors (Merz et al., 2010; Pistrika et al., 2014).

The kind of information used in the analysis, distinguishes two types of flood depth-damage function - those that use real data and empirical models (Merz, et al., 2010; Marvi, 2020), and those which use synthetic or what-if analysis and analytical methods (Penning-Rowsell et al., 2005; Merz, et al., 2010; Marvi, 2020). The advantages and disadvantages between these two types of functions will help identify which may be more applicable and appropriate for the study area.

Real data and empirical methods

Empirical approaches use damage data collected after flood events from post-flood survey data or insurance claims data (Marvi, 2020). In the study and analysis of informal settlements, post-flood survey may be the preferred source over insurance data, particularly in developing regions where insurance claims do not normally apply. Post-flood data for specific events can also be collected from the various government agencies. However, in most developing countries like the Philippines, Shreshta, et al., (2014) noted in their study that baseline data and appropriate flood damages estimation method are lacking. Damages are mainly estimated as Shreshta, et al. further noted, in terms of partially or totally damaged after-flood events.

Empirical methods are favoured over synthetic approaches, with the information on actual damage being more accurate than the what-if analysis (Merz et al., 2010). Davis and Skaggs (1992) in their USACE (US Army Corps of Engineers) report suggests that the most precise method of gathering residential depth-damage information is through interviews of recent flood victims. Although post-flood damage analysis can be the most accurate method of calculating depth-damage relationships, it can be time-consuming and expensive.

The building characteristics that are commonly collected by surveys consist of wall height, floor height, number of stories, opening conditions (doors and windows), configuration of the components, exterior perimeter, and materials used (Marvi, 2020). Davis and Skaggs (1992) also noted the limitations of post-flood damage analysis in terms of its dependence on recent flood occurrences, and difficulties in acquiring resources or personnel for a complete survey when a flood does occur.

What-if analysis and analytical methods

When flood damage data is not available, or the available data is insufficient to explain the response of a structure to a flood event, what-if analyses and analytical models are the preferred approaches. Based on synthetic data (i.e. from a synthesis of many data items) of

potential flood damage to a structure, data is collected from interviews, surveys, or from experts in flood damage assessment (Merz, et al., 2010; Marvi, 2020).

Synthetic estimates are necessary in the absence of recent flooding. Compared with post-flood surveys, this method is generally less time-consuming and less expensive. Davis and Skaggs (1992), however, note that the disadvantage of synthetic damage estimates is the hypothetical nature of the assumptions which may require a good deal of skill from the analyst, and cooperation and acceptance from the interviewees or survey participants. Synthetic method is the preferred method in developing flood-damage function for developing countries with limited history or actual flood damage data (Romali, et al., 2015). The damage information for various flood levels can also be retrieved, and with the approach not relying on actual flood event information, it can be applied to any other area (Merz et al., 2010)

In analytical models, simulation models are used to study the interaction between water and the building materials. The models are based on structural analysis and simulation of water-structure interaction (Marvi, 2020). Aside from being expensive, the simulation takes time to provide similar environments with real flooding conditions. The exact building characteristics have to be replicated with the rising and receding flood waters, and the duration of the flooding event.

For this study, the information to be collected will come from the flood events that occurred in the 2009 TS 'Ondoy' and 2013 'Habagat' event. Ideally, the post-event flood interview according to Davis and Skaggs (1992, p. 11), "…should occur soon enough after the event for the damages to be remembered and records to still be available, but long enough after the event for the great proportion of damage to occur and be discovered". The information for this study therefore, will be collected from a synthesis of data items through survey questionnaire, interviews, and any existing damages observed from the two extreme flood events. To compensate for the long after-event-interview time period, the questions on the survey will be comprehensive with the responses to be confirmed during the interviews and field observations.

Relative and absolute functions

The depth-damage analysis can also be distinguished between relative and absolute functions. Relative functions according to Pistrika, et al. (2014), express the flood damage as a percentage of the total replacement value of a flood-affected property, using ratios of the absolute monetary amounts of damage to the value of assets. This absolute cost according to Merz et al. (2010, p. 5), can be divided by the total value of the structure with the result in percentage which, "...indicates the cost of structural damage relative to the total value of the structure, thus named relative cost" (Scawthorn et al., 2006). Relative damage functions are applicable for different purposes and simpler in terms of data sources readily available on the value of properties (Merz et al., 2010).

Absolute on the other hand, uses "… the absolute monetary amounts of damage per element at risk, and thus, their period of validity is short" (Pistrika, et al., 2014, p. 556). Damage is thus, reported in a total monetary cost for a structure in any currencies, reported in an absolute value (Penning-Rowsell et al., 2005). Object asset values are not necessary, as Merz et al., (2010) noted, with the estimated monetary damaged due to a given flood event results directly.

The choice between relative or absolute functions, therefore, may depend on the kind of data that is available and for this study, the relative function will be utilised being the more appropriate and applicable approach with the data to be collected. The damage incurred in the sample dwellings, will be gathered with the estimated cost relative to the total cost of the dwelling expressed in percentage. The details on the application of the flood depth-damage function, will be further discussed in the subsequent section.

2.6.2 Flood depth-damage function

As briefly discussed above, the depth of flooding is the one variable that is mostly used in flood assessment procedures, with the depth-damage function as the primary relationship used in flood damage estimation. As Marvi (2020) noted, the damage functions generated based on the flood depth and damage incurred refer to depth-damage function. Estimation could either be generalised that is computed for a country, region, state, or project, or it can also be developed as a new depth-damage relationship (Davis and Skaggs, 1992).

The US Army Corps of Engineers (USACE) for instance, generated their damage functions based on their survey data, which have been updated over time using their own method (Marvi, 2020). The cost according to Davis and Skaggs (1992), is estimated using data or cost manual from other entities, with the average cost of damage to structure divided by the average value of the structure. The result is then reported to construct the depth-damage functions for the different types of residential buildings, by connecting with a line the average relative damage at each depth (Marvi, 2020). An example is shown in figure 3 below indicating the damage ratio relative to the flood depth for a one-storey without basement, residential structure from USACE.

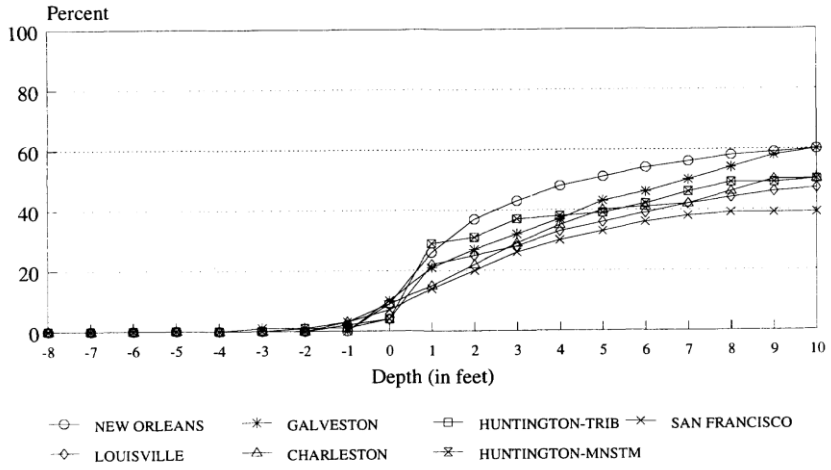


Figure 3. Percent Damage to Structure Value for One-story without basement. (Source: Davis and Skaggs, 1992).

Aside from generalised estimation, a new depth-damage relationship can be developed in the analysis. In a study by Shrestha, et al. (2015) on flood damage assessment in the province of Pampanga, Philippines, a methodology for household damage estimation was developed which includes field investigations and survey, based on the flood and household assets and building characteristics. To estimate flood damages, relative damage function or percentage damage approach was used. The houses in the study area were categorised into different types, and the damage rate was calculated as the ratio of the damaged value of house to the total value of house (ibid.).

In another study by Guarin, et al. (2004) on flood risk assessment in Guatemala, they conducted a survey using traditional paper questionnaires on the technical description of the building and an interview with the inhabitants. Information was gathered based on three main topics: characteristics of the building and its contents, socio-economic aspects, and information on the magnitude and damage of historic flood events obtained through a questionnaire. In this study, the household assets or contents will not be included in the estimation, with the focus mainly on the physical structural damage on the dwellings. The damage to be estimated will assign a value between 0, as no damage, to 1 as total destruction (Guarin, et al., 2004), adopted from the magnitude scale used by UNDRO (1980), from the occurrence of a natural phenomenon expressed on a scale of 0 (no damage) to 1 (total loss). The application to the study area of the functions discussed in this section will be presented in chapter 4, *Research design and methods*, in section 4.4.2, *Flood damage assessment approach*.

In the proposition of transitional settlement development in the community, flood projections are vital to identify the appropriate technical adaptation measures, and the probable length in number of years of the development and adaptation's useability relative to future flood levels. For this study, the flood levels in the community from the two extreme flood events presented earlier will be collected from the survey and interview protocols, and will be compared with the flood hazard maps from government agencies. The maps from the city level to the community level will be presented in chapter 5, *Study area* to identify future flood levels. The impacts of climate change are also important in the future flood projections which will be presented in the succeeding paragraphs.

2.6.3 Future climate change impacts

In the published literature reviewed, flood projections and climate change impacts are commonly estimated for the next 30 years (for example, IPCC, 2001; DOST-PAGASA, 2011; Muto, M. et al., 2012; Johnson, B. et al., 2021). Accordingly, this study will present local projections for the impacts of climate change for year 2050. Similar to the comparison of the historical and future flood events discussed above, the 2050 projections will be included in the analysis to come up with the worst-case flooding scenario. This will help ascertain the feasibility

of the proposition in the study which will be presented in the final chapter 8, *Discussion and conclusion*.

In the study *Climate Change in the Philippines*, conducted by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), the report presented projected changes in precipitation, temperature, intensity of tropical cyclones and extreme weather event frequency. The report noted that in dealing with the impacts of climate change, considerable efforts to prepare the Philippines would be required on the different climate-sensitive sector, and that "Adaptation will be an integral part of our response to the threats of climate change" (DOST-PAGASA, 2011, p. v).

The report highlighted the then present (observed baseline from 1971 to 2000) climates, the key finding of the 2020 climates, and future climates in the country in 2050. The key findings are presented in terms of temperature increase, rainfall change by seasons, and changes in frequency of daily extreme events in graphs and tables. Thus, the main outputs of the simulations are the – projected changes in seasonal and annual mean temperature; projected changes in minimum and maximum temperatures; projected changes in seasonal rainfall; and, projected frequency of extreme events. The climate scenario outputs according to the report, could be useful to – illustrate projected climate change in a given administrative region/province; provide data for impact adaptation assessment studies; communicate potential consequences of climate change; and, strategic planning.

The simulations were conducted for all three emission scenarios – high-range; mid-range; and, low-range where the projections for up to 2050 indicate little variation between these three, and therefore, the mid-range emission scenario outputs are the ones presented in the report in detail. The mid-range emission scenario as noted in the report, "…indicates a future world of very rapid economic growth, with the global population peaking in mid-century and declining thereafter, and there is rapid introduction of new and more efficient technologies with energy generation balanced across all sources" (DOST-PAGASA, 2011, p. 7).

There were also four seasonal variations used in climate scenario outputs (tables 3a & 3b): 1) the DJF season (December, January, February or northeast monsoon locally known as *Amihan*); 2) the MAM season (March, April, May or summer); 3) the JJA season (June, July, August or southwest monsoon season, or *Habagat*); and, 4) the SON season (September, October, November or transition from southwest to northeast monsoon).

The extreme events referred to in the outputs (table 3c), are defined as: extreme temperature (assessed as number of days with maximum temperature greater than 35 °C, following the threshold values used in other countries in the Asia Pacific region); dry days (assessed as number of dry days or day with rainfall equal or less than 2.5mm/day, following the World Meteorological Organization standard definition of dry days used in a number of countries); and, extreme rainfall (assessed as number of days with daily rainfall greater than 300mm, which for

wet tropical areas, like the Philippines, is considerably intense that could trigger disastrous events).

The tables below show the final report output for the present and future climate projections in the National Capital Region (NCR) on seasonal temperature increases, rainfall change, and frequency of extreme events.

Table 3a. Seasonal temperature increases (°C) in 2020 and 2050 in NCR (Source: DOST-PAGASA, 2011)

	Observed baseline (1971 to 2000)				Change in 2020				Change in 2050			
NCR	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
	26.1	28.8	28.0	27.4	1.0	1.1	0.9	1.0	2.0	2.1	1.8	1.9

Table 3b. Seasonal rainfall change (%) in 2020 and 2050 in NCR (Source: DOST-PAGASA, 2011)

	Observed baseline (1971 to 2000)				Change in 2020				Change in 2050			
NCR	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
	107.5	198.5	1170.2	758.7	-12.8	-33.3	8.5	0.0	-17.3	-38.5	21.3	3.7

Table 3c. Frequency of extreme events in NCR (Source: DOST-PAGASA, 2011)

NCR	No. of days w/ Tmax >35°C			No. dry days			No. of days w/ rainfall >300mm		
Port Area values for Malabon	OBS	2020	2050	OBS	2020	2050	OBS	2020	2050
	299	1176	2118	7380	6445	6382	12	12	13

In using the tables to arrive at values of seasonal mean temperature and seasonal rainfall in 2050, the projections are added to the observed values. Using the JJA or southwest monsoon season which is the rainiest season, the projected values are:

- JJA mean temperature = (28 °C + 1.8 °C) = 30.6 °C;
- JJA rainfall = 1170.2 (21.3%) = 249.3mm + 1170.2 = 1419.5mm;
- number of days with Tmax >35 °C in Malabon City during the 2036-2065 period (centred at 2050) = 2,118;
- number of dry days in Malabon City during the 2036-2065 period (centred at 2050) = 6,382; and
- number of days with rainfall >300mm in Malabon City during the 2036-2065 period (centred at 2050) = 13.

Referring back to the previous section 2.5.2, *'Habagat' (Southwest monsoon) flooding*, it is noteworthy that the rainfall amount in 24 hours for the August 18 Habagat flood event was 600 millimetres, 455mm in 'Ondoy', and 472mm in 2012 Habagat. These figures are greater in comparison with the 300mm projected rainfall for 13 days in 2050 above.

In another local study, *Insurance Mechanism for Incentivizing Disaster Resilient Public Infrastructures in Metro Manila*, the goal is to estimate loss and damages of select facilities in Metro Manila. Conducted by the Japan International Cooperation Agency (JICA), the study was commissioned to the Diliman Technology Laboratories, Inc. in 2016, to develop a detailed flood risk analysis in the metropolis by producing flood inundation maps for 19 rain return periods. Two main open bodies of water were considered in the flood inundation and discharge modelling study – Manila Bay and Laguna de Bay. The data and methods used involved: 1) data gathering; 2) data pre-processing; 3) development of hydrological model; 4) and, hydraulic modelling, flood routing and flood mapping (Paringit, E., 2016).

For this study, the results of the model from Manila Bay will be useful considering that one of the Manila Bay outlets used to measure its tide variation was the Tullahan River outlet. The tidal variation used in JICA's study was set to the actual tide level during the TS 'Ondoy' event with the highest at 0.91 metre above sea level. To complement PAGASA's report discussed earlier, the return period for 'Ondoy' can be used from JICA's study. Return periods for 5, 25, and 100 years can also be used to compare with the available flood hazard maps from other government agencies which will be presented in chapter 5, *Study area*.

The results show the time of arrival of peak inflow for these different return periods at the Tullahan River outlet as shown in the table below. In comparison, the time of arrival of peak inflow is fastest in the 'Ondoy' return period, which indicates that the highest flood level projection that can be used amongst the chosen return periods for this study is from the 'Ondoy' flood event.

Table 4. List of time of arrival peak of inflow for various return periods
(Source: Paringit, E., 2016)

Return Period	Time of arrival of peak inflow (in hours)
5-year	17.83
25-year	15.67
100-year	14.50
Ondoy	9.17

Complementing the results on the table above is the peak rainfall for the 'Ondoy' event recorded in 10 minutes at 229mm with a total precipitation of 344mm. This was recorded from the Science Garden and Boso-boso rainfall stations respectively which were used to model the discharge from Tullahan River. As shown in the simulated hydrograph in figure 4 below, the results indicate that the peak flow was recorded at 330cms which occurred at 9:20 in the morning of September 26. Referencing the results in the table above, the peak inflow at the Tullahan River outlet occurred 9 hours later.

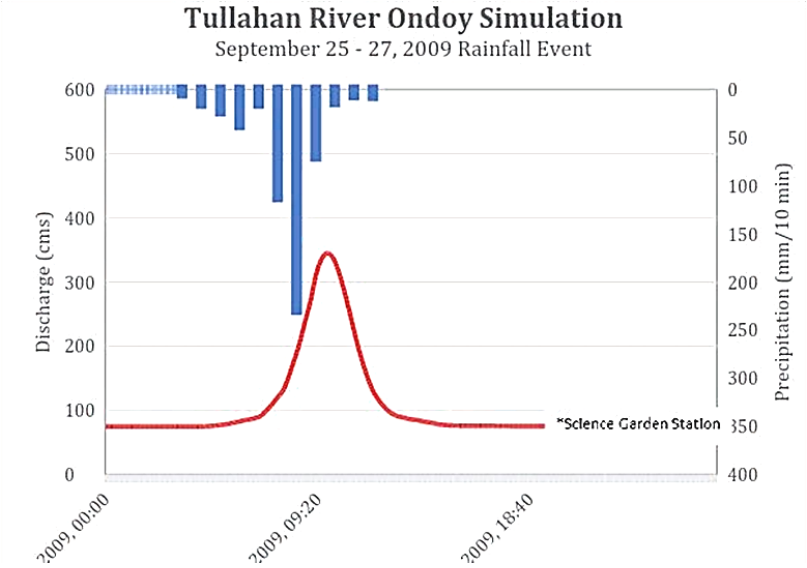


Figure 4. Simulated hydrograph of Tullahan River from 2009 Ondoy rainfall event (Source: Paringit, E., 2016)

The findings and results from both studies of PAGASA and JICA as presented in this section, indicate that in projecting the flood levels for 2050 period in this study, using the 'Ondoy' event return would be valid in comparison with the other return periods presented above. The generated flood map corresponding to the return period of 'Ondoy' indicate that the area of Sitio Gulayan community will "…likely to experience 1.01 to 2.00 metre (waist to person's height) occurring within 24 hours" and, "Likely to occur in topographic lows and along banks of major active river channels and meanders" […], "2.01 to 5.00 metres (person's height to 2-storey high) and durations of less than 24 hours". (Paringit, 2016, p. O-41). As earlier mentioned, these results will be further compared with the flood hazard maps generated by the government agencies which will be presented in chapter 5, *Study area*.

As presented in section 2.5.1, *TS Ondoy flooding*, the informal settlement dwellings bore the brunt of the devastation caused by the event, and as discussed in section 2.6, *Flood damage assessment*, the building characteristics is one of the bases for assessing flood damage. Hence, it is important to explore the character and nature of informal neighbourhoods objectively and conscientiously from the perspective of "informality". The immediate section will discuss the origins of the term - how, and why informality is perceived in the negative sense, particularly in the urban context.

2.7 Urban informality

With informal settlements as the object of this study, it is pertinent to present the origin and evolution of "informality" as a background, which could elucidate the plight of the urban informal settlers particularly during flood events. This section briefly discusses the genesis of the construct and its connection to urban planning, followed by the dichotomy of the "formal" and "informal" in the ensuing section.

Informality as a term used in urbanism is a relatively new concept derived from its origins in 1960s when it was first used in debates on employment and the economic aspects connected with it (Lutzoni, 2016). It is often viewed as a product of urban modernity and economic liberalisation, both assumed to be the domains of the "formal" (McFarlane, 2012), hence, the negative connotation on the "informal". Labour categorisations for instance, introduced the terms *informal labour* (McFarlane, 2012), *informal employment* and *informal income* (Lutzoni, 2016).

Its adoption can be traced back in particular from British economic anthropologist Keith Hart, when he coined the term "informal sector" in his 1971 study of low-income activities among unskilled migrants from Northern Ghana to the capital city of Accra, who could not find wage employment (Chen, 2012). The terminology gained widespread acceptance after the International Labour Office Organisation (ILO) used it to analyse economic activities in Kenya for an ILO Employment mission in 1972 (ILO, 2013).

Between the 1970s to 1990s, there was a concentration of theoretical studies which according to Lutzoni (2016), modified the approach to urban informality whilst debates were on-going on informal economy in developing countries. At the heart of which according to Chen (2012), is the question of whether or how to formalise informal economy. The debates paused in the 1990s (Ballegooijen and Rocco, 2013; Lutzoni, 2016), but regained interest in recent years (Roy, 2005; Chen, 2012).

Whilst there was a renewed interest in informality, its link with urban planning became apparent with "…institutional biases that work against informal enterprises and workers" (Chen, 2012). These include as Chen (2012, p. 19) elaborated, undermining or destruction of existing employment opportunities, where places of work of the urban informal work force are being demolished due to urban renewal, and failure in urban planning to incorporate urban informal livelihoods in city plans.

The question of formalisation is similarly being discussed in urbanism. Dovey (2019) for example, views slum upgrading as a kind of formalisation which can be achieved by harnessing the informality that has produced and sustained the self-built cities. He argues that informality is a form of urbanity that emerges outside formal urban planning frameworks, and not a condition of poverty or lack of tenure, but a means of managing poverty. AlSayyad (2004) comparably,

describes urban informality as a way of life already in existence prior to the introduction of formality to organise urban society in the 19th century. He argued that what requires explanation is not so much about informality as a way of life, as does formality as a "new mode" of urbanism.

Roy (2012) echoing AlSayyad, added that it is an alternative urban order that is opposed to the planned and formal city. Both scholars previously argued, that urban informality is a mode of the production of space and a practice of planning (Roy and AlSayyad, 2004). To further justify its existence in the formal city, Roy (2005, p. 141) posited that "…once associated with poor squatter settlements, informality is now seen as a generalised mode of metropolitan urbanism". Recognising urban informality in this mode can shift traditional thinking from dismantling informal settlements, to being integrated into the city.

As a similar stance in this study, what is clear in these contemporary arguments is their departure from the dualist approach of informality as a sphere separated from formal processes which according to Lutzoni (2016), encouraged the emergence of a dichotomous perspective between the formal and informal, devoid of any relationship between the two spheres. This binary system of conceptualisation Lutzoni (p. 7) added, shows an inability to define adequate perspectives for the contemporary urban condition with the view of "…informality as the unregulated, uncontrolled, untidy and inefficient use of space compared with the formal as tidy, regulated and planned sphere".

Examining the assumptions on informality in the literature as discussed above, can help in this study's data gathering and analysis in terms of determining the appropriate approach in flood management that will prioritise local knowledge and the lived experience of the community under study. This section also clarified the assumptions made in the literature review that were problematised, particularly the negative perception on informality, with the use of the binary of "formal" versus "informal" being unreflectively pitted against each other, which will be further discussed in the next section.

2.7.1 Formal versus informal

The debate on the formal versus the informal started with the inception of the *informal economy* where for different reasons, some observers view it in positive terms, whilst others in negative terms to which WIEGO (n.d., p. 48) claims, "…tended to generate more heat than light" on the issue. Already a field of study in its own right, informal economy according to Chen (2012), has drawn scholars from multiple disciplines including urban planning.

The discourse, however, is not new and as old as the debate on the informal economy as demonstrated in the seminal works of John Turner (1965, 1967) on Lima's *barriadas*. Using "squatter settlements" to describe the present-day informal settlements, he argued that "…the

standards required by the authorities (and practised by institutional and capitalist enterprise) conflict with the demands of the mass of urban settlers" (Turner, 1967, p. 168).

Turner presented the significance of the cultural change that takes place over time in a *barriada* location, which points to the different priorities and demands of the low-wage earner and of the high-wage earner. He then concludes that with the modern minimum standard concept acting as a barrier to development by attempting to prohibit the intermediate stages, a concept which uses standards as guides toward the progressive achievements of minimum goals should be introduced (Turner, 1967).

Other prolific scholars like Charles Abrams and William Mangin together with Turner, were regarded to have inverted established thinking and suggested that such settlements, far from being a problem on the one hand, were in fact a solution (Kellet and Napier, 1995). On the other hand, Burgess (1978) in his critique of Turner's housing policy views, argued that the housing problem in the Third World societies can be best understood as the product of the general conditions of capitalist development, rather than the product of particular technological or organisational systems as theorised by Turner.

Capitalist development nevertheless, was included in Turner's argument albeit briefly, focusing mainly on the authorities who directly allow "instant development" and disallow "progressive development". The argument regained momentum in recent years with De Soto's legalist approach in his work *The Other Path* (1989), where he noted that the inefficiency of the formal economy is the origin of informality.

Other critics like Ward (1982) and Huque (1982) argue that Turner's self-help housing concept rationalises and romanticises the substandard housing of the poor on environments reflecting not freedom nor ingenuity, but structural constraints, injustice, and exploitation of the poor (Kellet and Napier, 1995). The solution according to them lies in the "…fundamental structural changes that would address the uneven distribution of power and resources throughout the society" (p. 9). The argument reflective of the legalist approach, does not consider the relationship between the formal and informal, with an inaccurate description of informality that does not help comprehend its complexity (Lutzoni, 2016).

Giving earnest consideration on environmental hazard mitigation, this study is sympathetic to the plight of the informal settlers, taking a similar stance with Turner on the authorities' imposition of minimum standards on urban housing. In a developing or transitional economy, this imposition as Turner (1967, p. 168) directly articulated, "…is an assault on the traditional function of housing as a source of social and economic security and mobility". In a similar direction, Abrams (1966) noted that the squatters are more worried about where they will build than what they will build, and more concerned about initial layout than initial standards.

Contemporary scholars are building on similar arguments in the context of modern-day issues such as globalisation, rapid urbanisation, and urban governance (for example De Soto, 1989 & De Soto 2000; AlSayyad, 2004; Roy, 2005 & Roy, 2012; McFarlane, 2012; Chen, 2012; Ballegooijen & Rocco, 2013; Pojani, 2018; and, Kamalipour & Dovey, 2020). Building on capitalist development for instance, De Soto (1989) as cited earlier, presented the informal sector as grassroots uprising against the bureaucracy of state planning (Roy, 2012). In his *Mystery of the Capital* (2000), he further argued that the poor are declassed not because of their lack of assets, but in the ownership and use of such assets which he referred to as "legal apartheid".

Legalisation in De Soto's framework will hence, integrate the informal with the formal sector allowing them to trade their assets in the formal system of capitalism. Roy (2005, p. 148), however, seeing many problematic corollary propositions in the framework, argued that informality against the dichotomy of the formal and informal sector, "…is not a separate sector but a series of transactions that connect different economies and spaces to one another". Thus, her thesis on informality rather than being a sector, but as a mode - manner, form, or method - a generalised mode of metropolitan urbanisation.

With a better understanding of informal settlement as a mode of spatial production, most with few exceptions as Kamalipour and Dovey (2020) noted, can be upgraded incrementally on the same site to avoid displacement. Incremental upgrading, however, should take into consideration risk mitigation, particularly in areas where most settlers occasionally contend with the forces of nature, favouring the risks of informality over resettling outside the city, remote from their sources of livelihood, and deprived of their social connections.

This section explored the unreflective binary system of formal and informal providing a deeper understanding on informal settlement as a mode of spatial production. The position taken in this study from the reviewed literature, is incremental upgrading for this mode of urbanisation with considerations on risk mitigation. The connection between informality and vulnerability to flood risk which is key to risk mitigation, will be further explored in the subsequent section.

2.7.2 Informality as risk

Contending with nature is an encounter that seems all-too-familiar with informal settling in the urban areas. Unauthorised lands for habitation exposed to environmental hazards, are often the location where informal settlements thrive. The geographical definition of the squatter settlement as Davis (2006, p. 121) pointed out, is a hazardous, health-threatening location where the settlers "…trade physical safety and public health for a few square metres of land and some security against eviction."

Dangerous sites being unattractive to developers, give settlers a higher chance of avoiding eviction (Satterthwaite et al., 2020), which include floodplains, river banks, estuaries, hillsides,

landfill, and railroad sidings in the city. Vulnerable areas and the way we build upon them as earlier mentioned, make the risks inherent and particularly unavoidable. Risk areas intrinsically pose a threat to the inhabitants even in the absence of hydrological (flooding) and meteorological (hurricanes or typhoons) phenomena. Heightened by the effects of climate change, the occurrence of these events in risk areas if not mitigated, could only result to disaster.

Risk mitigation measures in vulnerable settlements are crucial in building the community's adaptive capacity as they seek ways to cope with various hazards. Common to most informal settlements, Satterthwaite et al. (2018) note that this makes building resilience for the billion urban dwellers, one of the greatest challenges for climate change adaptation. Their lack of finances impeding their capacity to invest in structural mitigation measures (Abunyewah, et al., 2018), makes them the most vulnerable residents and the least equipped to recover from disasters.

Flooding accounts for the majority of these disasters with Asia, regionally suffering the most (Jayawardena, 2013), and where the frequency is expected to increase due to climate change, affecting more people with population growth. As projected by UN, urban population growth in less developed regions by 2050, will be over two billion wherein close to 90 percent of the increase will be in Asia and Africa. Asian megacities are of particular interest because these cities according to Shatkin (2019, p. 209), "…are at the vanguard of the contradictions between pressures of rapid urbanisation, climate change and the hydrological conditions of river deltas".

In Metro Manila, the pressure of rapid urbanisation resulting to the proliferation of informal settlements, substantially contributes to unparalleled flood devastations. The high rate of city migration has put enormous pressure on housing needs and infrastructure, that many of these settlements are located on floodplains and shorelines exposed to natural and other hazards (World Bank, 2017). The 'no build zone' policy in high-risk areas according to UNDRR (2019, p. 23), "…is yet to be fully applied, with strong enforcement of land administrations and sustainable options for incorporating social, economic and cultural considerations of the affected communities."

The lack of basic services particularly in solid waste management, aggravates the flooding problem with floodplains, river banks, and natural waterways becoming dumping areas. The use of sub-standard building materials and poor construction in these settlements exacerbate the problem, with recycled materials put together by unskilled workers as the preferred construction material and mode in terms of affordability and insecurity of tenure. Houses are also often built incrementally rendering them prone to damage when caught in a heavy storm.

Overall, the lack of effective interaction amongst the socio-economic forces that shaped the settlement patterns of the city (i.e., land use, infrastructural development, building practices, urban development policies and programmes), has heightened the risks to the residents and

reduced their potential for adaptation and resilience (Porio, 2011). Notwithstanding all these concerns, the settlers somehow find ways to survive the devastations and are able to adapt by rebuilding from meagre resources.

Experiences from previous disasters are added to their local knowledge enabling them to become more resilient. The environmental context interacts in complex ways with the patterns of human activities as Porio (2011) has pointed out, giving rise to patterns of survival strategies amongst the residents. Adjustments are made for instance, on household routines and work patterns according to the demands of the rains and floods. Thus, in the context of informality as risk, adaptation through resilience could very well be the key to survival.

The informal can be better understood as earlier noted, if explored objectively and conscientiously. Similarly, as Kamalipour and Dovey (2020) argued, a more sophisticated understanding of how the incremental production of buildings and public space works, can harness the productive capacities of informality. With this section presenting the risks inherent in the informal production of space, the resilience that may be similarly inherent as demonstrated by the settlers in the above discussions, will be further explored in the following section.

2.7.3 Informality as resilience

In contrast with *informality as risk*, this section will review literature that represent resilience with informality (Weakley, 2013), focusing mostly on the community being the main object of this study. Communities in general are complex and dynamic (Twigg, 2009; IFRC, 2019), which make the vulnerabilities that challenge them similarly complex (IFRC, 2019). Add to this, the complexity of informality as widely discussed in the earlier sections.

To understand this complexity, the characteristics of a community has to be learned as suggested by IFRC (2019, p.10). Providing a general set of characteristics, they define community as "…a group of people who may or may not live within the same area, village or neighbourhood, share a similar culture, habits and resources […], are groups of people also exposed to the same threats and risks such as disease, political and economic issues and natural disasters." Arguably, the latter part of this definition describes most accurately, the intrinsic characteristics of informal settlements.

According to the World Bank (2008, p.20), several overlapping forces are seen as the physical manifestation of these settlements, "…they are the manifestation of deep poverty, unrealistic regulatory frameworks, ill-conceived policies, inadequate urban planning, weak institutional capacity, and larger macroeconomic factors". Notwithstanding these challenges, they are also "…a manifestation of the ingenuity and resilience", organising themselves despite extreme deprivation (ibid.). Resilience similar to risk, can thus be argued, as intrinsic to informality.

One of the distinctive elements in the transitions associated with resilience as discussed in the *Urban resilience* section, is the concept of "shared responsibility" between the authorities and those who live in hazardous areas (UNISDR, 2015). From being victims (vulnerable), the people are transformed to actors in control of their own destiny (resilient) reducing government responsibility, whilst empowering the people to cope with setback (Wenger, 2017). Although this may be true for those who seldom experience disasters, it can be argued that informal settlers who associate disaster as a way of life, often cope on their own and as a community.

Informality has forced the settlers to simultaneously learn being both the victim and actor in times of disaster, looking after themselves with or without government aid in order to survive. As exemplified in a study by Porio (2011) on marginal riverine communities in Metro Manila, recurring flooding experiences have led the settlers to craft particular adaptive strategies such as raising their floors, devising raised platforms for appliances and furniture, building makeshift bridges, storing food supplies, and preparing things they would need to evacuate including their makeshift rafts.

Moving to a neighbour's house is also a common practice showing the significance of social capital and networks in these communities as components of adaptive capacity. These networks according to Morin et al. (2016), can have vertical associations between community, NGOs, government, or horizontal associations between individuals within a community. Having a wide network of relatives, neighbours, friends, and access to aid from formal institutions (Porio, 2015) thus, strengthen a household's adaptive capacity making them more resilient.

Vertical associations in UNDRR's 2019 Status Report on the country's Disaster Risk Reduction (DRR), were identified to come from the government, private sectors, NGOs and CBOs, with their concerted actions in disaster risk reduction programmes helping to improve the delivery of services in the country. The same report indicated that the private sector's investments drive development in the country that could reconfigure the nation's disaster risk, whilst the NGOs and CBOs including their media partners, assist in emergency response, early warning system, and emergency broadcast system both on the national and regional levels (UNDRR, 2019).

Interactions between horizontal associations on the other hand, take place before, during, and after disaster occurs in marginalised communities. Neighbours and kin help each other in house building, offer lodgings for those who need to evacuate, and assist in rebuilding damaged houses in the aftermath of a disaster. These interactions exemplify "resilience" as described by IFRC (2019, p.6), "…as a process of adaptation before, during and after an adverse event".

The support from the vertical to the horizontal associations, however, could better enhance resilience building in these communities such as involving them and their leaders in the official DRR. As Twigg (2009, p. 9) argues, aside from its own capacities, the level of a community's resilience is also influenced by outside capacities, particularly "…by emergency management

services, by other social and administrative services, public infrastructure and a web of socio-economic and political linkages with the wider world".

Community flood resilience is defined by FRA (2019, p.5) as, "The ability of a community to pursue its development and growth objectives, whilst managing its flood risk over time in a mutually reinforcing way". In the face of the challenges of informality as mentioned earlier, a typical informal community's development and growth objectives may only be realised if support is provided particularly in managing its flood risk. The synergistic actions between the network associations are thus, vital for the actualisation of intended aspirations for future resilience in informal communities (UNDRR, 2019).

Informality as resilience inherent in marginalised communities, was presented in this section contrasting the previous on the construct of risk in informality. The discussions above on community characteristics vis-à-vis the challenges of informality in the local context, will be presented in the next section via the informal settlements found in Metro Manila. The literature categorising the typology of informal floodplain settlements as the main focus of this study, will then be reviewed in the ensuing section. These sections are important as a prelude to the discussion about the study area in Chapter 5.

2.8 Informal settlements in Metro Manila

The origin and evolution of informality presented in the earlier section, will be complemented in the brief introduction of the history of the local informal settling in this section. Informal settlements interestingly, were as old as the disasters that have disturbed the archipelago dating back to the Spanish colonial period, which were influenced apparently, by the colonisers themselves.

Informal settlements have been in existence in Manila since the late 16th century, when Manila residents were either living inside *Intramuros*[2], or in the communities located outside the walled city (*extramuros*). In many ways, the design of Intramuros marked the origin of many of the formal and informal distinctions that can be seen in Metro Manila today (Gray and Ocampo, 2017). With the Spanish elite living "inside the city walls," and the Chinese, Japanese, and Filipinos living "outside the city walls", these were clear and deliberate physical, social, and class distinctions between the formal and informal (Alcazaren et al., 2010).

Urban settlements today are described by the GMMA Exposure Database Framework in 2014, as settlement areas within a barangay that contain the main residential and small commercial land uses. These can be further divided into: *Formal Settlements* - areas where approved planning and land development has occurred for a mixture of residential and light commercial

[2] Intramuros, Spanish for "within the walls", is the historic walled area within the modern city of Manila, the capital of the Philippines. Other towns and arrabales (suburbs) located beyond the walls are referred to as "extramuros", the Spanish for "outside the walls". Intramuros was considered the colonial capital and the original Manila.

purposes; and, *Informal Settlements* - where urban development has occurred without formal planning and development approval (Jakab, et al, 2014, p. 17).

The Philippine urban population living in informal settlements are estimated by World Bank (2017) in 2012 at 2.2 million persons or 5.4 percent and out of this, 1.3 million or 59 percent were in Metro Manila. In terms of families, the National Economic Development Authority (NEDA) puts the number of Informal Settler Families (ISFs), both in urban and rural areas at 1.5 million, with Metro Manila as the region with the highest percentage at 39 percent or 584,425 families. Estimates also show that 18 percent of the ISFs live in government lands, 25 percent in privately-owned lands, and 51 percent or 778,458 families live in danger areas (HUDCC, 2016).

Informal settlements typically involve the illegal construction of buildings using either regular or improvised materials (Jakab et al., 2014). In Metro Manila, ISF dwellings are commonly patterned after the quintessential vernacular *bahay kubo* (nipa hut) from the rural origins of the migrant settlers (Ferrer, 2010). Urban shanties as a descendant of this provincial dwelling, are built by their own inhabitants with no blueprints and using materials in the immediate environment like the traditional dwelling (Lico, 2008).

The elevated cube-shaped house using climate-responsive organic materials available in the rural areas, have been replaced with salvaged or recycled materials in the urban setting. Despite the adaptive change in materials, Ferrer (2010, p. 131) argues that "…the social structure, associational behaviour, and community life invariably linked to define the nature, character, and values of the *bahay kubo*", have been preserved in the informal urban milieu. Albeit incremental makeshift construction, Kamalipour and Dovey (2020) argue that there is always a spatial logic and often significant levels of design ingenuity as different forms of livelihood are supported through design and construction.

The design, layout, and hierarchy of spaces in the organic urban pattern of informal settlements, were influenced by the Spanish coloniser's urban form known as the "plaza complex" (Barretto-Tesoro, 2015), codified in the *Laws of the Indies,* as a Royal Ordinance on guidelines for the founding and building of Hispanic colonial towns (Lico, 2008). The main square or *plaza* serving as the focal public space (Hart, 1955), is surrounded by the symbols of power such as the church and government buildings with the surrounding area organized in a grid pattern to accommodate the residential area. The elites (*Peninsulares, Insulares,* and *Filipinos*)[3] resided near the plaza with the social statuses of the residents diminishing gradually as one move away from the centre (Arcilla, 1998).

[3] At the top of the Philippines' Colonial Social System, were the Iberian-born *peninsulares*, then the '*insulares* or Philippine-born Spaniards. After them were the "Filipinos," Spanish-Indio *mestizos* (the educated Filipino *mestizos* among this class were referred to as "*ilustrados*"); then the Chinese *mestizos* and the Chinese; and, lastly, the darker-skinned natives, the *indios* (Rodriguez, 2006).

The informal community today adopts the plaza concept, but with the original pattern obscured and modified by its branch-like organic growth (Ferrer, 2010). A basketball court commonly found inside informal settlements, serves as the open plaza typically surrounded by the barangay centre and community chapel. This public space is key to the social structure of the community that binds the settlers together with the ruling local political leaders, credited for the installation of the court. Aside from its function as a sports facility, it is used as congregation and assembly area for community meetings, entertainment, political campaigns, and celebratory events.

With the recurring disasters that are commonly catastrophic in these settlements, its utility as refuge area is an indispensable function of the open space. Typically characterised by congestion, the makeshift dwellings are prone to fire, destruction from earthquakes and flood inundation, with the open space serving as sanctuary for the settlers. Considering the utilitarian and socio-cultural value of the emulated and inherited concept, the plaza will remain to be an essential part of the informal spatial urban pattern.

The urban form is created by the settlers with the incremental process of building their private and public spaces as an expression of their community life and activities. Understanding the production of space means analysing the forms of social action and organisation (AlSayyad, 2004). A better understanding of this spatial production as argued by Kamalipour and Dovey (2020), is where the most effective knowledge base for upgrading practices lies, which will benefit this study in terms of identifying the appropriate upgrading approaches for the community being investigated.

This section presented as a background for the study area, informal settlements in the local context. The specific typology of informal settlements located in the floodplains, will be discussed in the next section for a comprehensive understanding of their spatial production. This comprehension will help determine the technical adaptation approaches suitable to the study area, which will be presented in the subsequent section.

2.8.1 Informal floodplain settlements

In this section, the origin of floodplain settlements will be briefly discussed to present how the settlements along the historical Pasig River, have turned full circle from the period they were established, up to their current urban form in the metropolis today. Starting with the typology, Dovey and King (2011) refer to those located on marginal land between the formal city and the water (river, canal, lake, or harbour frontage) as “waterfront” settlements.

In the local context, these are referred to according to Alcazaren et al. (2010), as either *tabing-ilog* (by the river) or *tabing-dagat* (by the sea). Similar types can be observed in other Southeast Asian countries- along the *khlongs* (canals) of Bangkok (Berquist, et al. 2015), Chau Doc canals and rivers in Vietnam (Liao et al., 2016), and Surabaya River in Indonesia (Das, 2017).

In Metro Manila, the cultural and political contexts play a key role in the past and current urban form and housing characteristics of informal floodplain settlements. The typology of *tabing-ilog* (by the river) can be traced back to the 16th century Spanish period, when the colonial capital was established by force from an original settlement at the mouth of Pasig River (Alcazaren, et al., 2010). Manila as the capital back then, witnessed the establishment of the seat of power alongside this river and as mentioned earlier, in the walled city of Intramuros.

Half a millennium after, informal settlements in the Manila port area brought the evolution of the city a full cycle back to the mouth of the same river, with almost the same amenities and social structure as the original barangays (Alcazaren, et al., 2010). Pasig River and its tributaries today, accommodate the majority of the estimated 104,219 ISFs living in danger areas in Metro Manila. Some of these waterfront settlements at high-risk areas owe to their economic connection to water (Dovey and King, 2011), like in the coastal areas of the metropolis where the urban fishermen occasionally battle it out with storm surges and strong winds during the typhoon season.

With the proliferation of settlements in these risk areas, there is a growing literature on resettlement and in-situ upgrading for risk area settlement. As Doberstein and Stager (2012, p. 31) have argued, in instances where the location of the settlements is inherently risky, "…no amount of in-situ upgrading can eliminate completely the life-threatening vulnerabilities […], and in-situ housing upgrading actually may increase vulnerabilities". Tipple (2005) similarly recommended, that governments in developing countries should clearly delineate hazardous land as off-limits for informal settlement, whilst making available alternative safer lands.

Alternative lands at affordable prices for the low-income residents arguably, are either hard to find, or non-existent with the scarce urban land. Poor access to in-city land accordingly, remains a key obstacle to socialised housing programmes (Patino, 2016; Galuszka, 2018), like in the local *People's Plan*[4], which has yet to be fully realised in most qualified communities. Comparably, pocket infill sites close to the settlements can rarely be found. Resettlement to support Doberstein and Stager's argument does not work either with available land being remote from the residents' employment areas, driving the settlers to revert to squatting. Basic services and infrastructure are also often unavailable including community facilities, either due to the urgency of resettling, or the slow development operating under constrained budgets. Other than the non-availability of services and economic activity disruption, access to urban amenities and existing social networks are also disrupted (Correa et al., 2011).

A technical report by IRIACC (2017, p. 10) on building adaptive capacity in Metro Manila, argued that existing principles of good practice for resettlement have been developed

[4] The People's Plan is an alternative shelter planning approach, which integrates principles of bottom-up planning and positions the concerned communities as a leading stakeholder in the delivery of a variety of functions within the resettlement process (Galuszka, 2018).

"…providing significant guidance to not destabilise or impact negatively the informal settlements". The report however, concludes that further research "…is required in order to merge resettlement with livelihood enhancement and poverty reduction". Moreover, although the conventional resettlement approach may initially involve lower costs, Ballesteros and Egana (2012) correspondingly argue, that it fails to secure the welfare of the beneficiaries compared with alternative incremental and in-city approaches.

In this light, the proposition of this study is to adopt in-situ upgrading with considerations on the risks inherent in the settlement location. The goal is to minimise the vulnerabilities giving consideration as well to the above argument, that upgrading on risk areas cannot totally eliminate life-threatening vulnerabilities. The ensuing section will discuss and present the different upgrading programmes being implemented on-site for informal settlements.

2.9 Informal settlement in-situ upgrading

A brief evolution of informal settlement upgrading will be discussed in this section together with the previous and current upgrading approaches, to identify which may apply to the case of Sitio Gulayan community. The focus of interest will be on in-situ upgrading with the study's proposition for the community to be developed into a transitional settlement. Informal settlements in general will be considered, but more attention will be given to floodplain settlements or those with flood control and drainage system schemes. Examples of these slum upgrading projects will be presented at the end of this section.

Slum upgrading

In-situ upgrading as a response to solving the housing issues, started in the 1980s as an approach following the others that have not been successful such as eradication, relocation, public housing, and sites and services schemes (Greene, 2010; UN-Habitat, 2014). Referred to as "slum upgrading", it became the new trend that addresses the importance of retaining the socio-economic life of the residents, and considered the importance of land tenure (UN-Habitat, 2014). The approach encouraged the settlers to invest in their homes and community with the guarantee of not being displaced.

Deemed to be more successful as a housing strategy, UN-Habitat (2014) sees slum upgrading as the most socially appropriate approach, albeit a greater amount of financing involved in providing infrastructure to existing settlements as compared to new ones. Moreover, the legal vulnerabilities to overcome for securing land proved to be similarly costly, allowing the strategy to be more successful in small-scale projects only, without really addressing the huge housing backlogs. Some of the bigger projects started out to be promising, but ended up either falling short of expectation, or rectified using previous strategies.

With the leading global organisations like UN-Habitat and the World Bank, spearheading and touting the newfound strategy, huge projects were implemented and with not much success,

garnered a lot of flak from the critics. One example is the case in the Philippines with the Tondo Foreshore in the capital city Manila, where all the original dwellers in the model project in Pasig left within five years with their lots sold to the wealthy families (Davis, 2006). Similar cases occurred in Mumbai where according to O'Hare, et al. (1998) as cited by Davis (2006), the slum upgrading scheme had only 9 percent of the recipients belonging to the low-income groups, falling well short of the expectation.

Writing and editing *The Urban Edge* from 1977 to 1983, Werlin (1999) similarly critiqued the strategy referencing back from the *Freedom to Build* literature by Turner (1972) and his observations in Peru, as mainly influencing slum upgrading. He argued that the 'minimal state' advocacy of Turner where the role of the government is simply to expand human aspirations, whilst the settlers are entrusted with the maintenance of the infrastructure provided, was unable to address the problems via slum upgrading.

The physically-led approach to slum upgrading from 1970 to 1990, resulted to extremely encouraging results in some of the pioneering programmes like the Kampung Improvement Programme (KIP) in Jakarta, and the aforementioned Tondo Foreshore in Manila. However, in later years, maintenance indeed became a major issue with both the government and the community not taking responsibility (UN-Habitat, 2014). Thus, conditions became wretched with water supply and sanitation falling into disrepair, water systems getting contaminated, and solid waste not being collected.

The failures of public housing and sites and services in terms of unmet loans by the settlers, lack of basic services, and gentrification, were also the same symptoms detected in slum upgrading. As pointed out by Greene (2010, p. 10), the basic lesson learned from the experience was that, "…upgrading is a process", where not everything needs to be done at the same time, "…but basic infrastructure, services and land security are fundamental blocks". Adding another lesson as pointed out by Cities Alliance in 2003 as cited by Greene (2010), is the value of decentralisation and working with the community.

On the part of UN-Habitat (2014), the four key lessons learned were: 1) participation of dwellers and community organisations is critical with projects designed from the 'bottom-up'; 2) the level of service to be designed should be affordable both to the community and the local government; 3) upgrading programmes must be integrated with city level and country policies, programmes and strategies, to achieve synergies with other supporting interventions, and; 4) upgrading programmes should be led by the municipal authority implemented at the community level through a set of intermediaries including CBOs, NGO, and UN agencies.

Learning from past failures, successful projects were eventually realised often under state sponsorship and state-community partnerships (Corburn and Sverdlik, 2017). Much of the success according to Huchzermeyer in 1999 as cited by Abbott (2002), can be traced to the strong commitment to community-driven development with the general preference for NGO-

driven approaches. In this line, two approaches came out as promoted by the World Bank - adaptive approach, and proactive approach. Although these were not expected to entirely address the wide-ranging challenges and complexities of urban informality, the adaptive measures were created according to the World Bank (2008, p. 21), "…to unlock the productivity of the urban poor, creating a powerful upward spiral that strengthens both urban and national economies". The proactive measures on the other hand, were designed to create conditions to help the future urban poor "…to find affordable housing and not be forced to settle in slums".

Generally, these approaches according to the World Bank (2008), involves the level of urban services upgrading in terms of the physical, social, and economic including solutions for the issues of land and tenure security. The physical could include provision of basic services like supply for water, electricity, sanitation, and basic infrastructure such as footpaths, roads, drains, street lighting, as well as land readjustment. The physical services can be further categorised as: on-plot, or those used by the households privately; on-site, or those used collectively by the settlers, and; off-site, or those used not only by the settlers, but the city as well.

The social services may include infrastructure facilities like health, education, recreation, day-care, and other community facilities. These are vital initiatives in upgrading often contributing "...to increased economic growth, reduced crime, and better education and awareness" (World Bank, 2008 p. 26). As a way to revitalise the economy in the community, economic services are provided to create employment through assistance in job training and placement, technical and credit assistance to small enterprises whether privately or community owned, opportunities for microfinance, and loan assistance for housing.

Infrastructure under the social services, could also support environmental protection which is seldom included in the upgrading initiatives. As Olthuis et al. (2015) pointed out in their study, the upgrading measures seemed to be generic and dominantly focusing on basic conditions improvement without considerations on the locational attributes. The flooding measures for example, often become a priority only in post-disaster upgrading, when it should be considered even prior to the disastrous event occurring.

Participatory slum upgrading

On the part of UN-Habitat, two programmes were established – Slum Upgrading Facility in 2000, and Participatory Slum Upgrading Programme (PSUP) launched in 2008. In consideration of the environmental management with the physical, social, and economic services provision, participatory slum upgrading according to UN-Habitat, has been identified as the preferred solution. UN-Habitat (2003, p. 165) states that, "…it has come to be regarded as best practice in dealing with the problems of existing slums, [...] conducted not as technical exercise, but as a political, social and organisational plan". For the initiative to be sustainable and replicable, it is advised that the upgrading be undertaken within a framework that is inclusive and responsive to local conditions that involve the slum dwellers and their representative organisations. It is further

advised that participatory slum upgrading must be broad and conducted as part of a city and national plan. However, there are also successful projects that were able to address the immediate needs of the community from the household scale to the community and city.

In the study of Dobson, et al. (2015, p. 611), the National Slum Dwellers Federation of Uganda (NSDFU), were able to create savings groups, settlement profiling and enumeration, and conducted activities contributing to low-carbon development and resilience building through "…efforts to move from small projects to programmes of work that generate benefits at the community and city scales". For this study, the focus similarly will be on community-scale projects only, distinguished from the other levels according to UN-Habitat (2014), as being project-based which may not, but should be linked to wider planning processes, and tailor-made to the needs and priorities of the settlement. Some of the case studies comparable to this study either in scale or scope, including the aforementioned NSDFU project, are presented in the tabulation below.

Table 5. Participatory Slum Upgrading Projects (source: Dobson et al., 2015; Olthuis et al., 2015; UN-Habitat, 2003; World Bank, 2008)

Participatory Slum Upgrading Project	Location	Project start	Project objectives	Project results
PRIMED, Medellin, Colombia	Medellin, Colombia	1993	Access roads; footpaths and public stairways; stabilisation of slopes; drainage; public spaces and facilities; water and sanitation; improved housing and land title provisions	Improved quality of life with home improvements, public spaces. Tenure legalisation and transport access; better incorporation into the city with streets and paths
NSDFU Project	Kampala, Uganda	2002	Create savings groups; profiling and enumeration of settlements; building materials workshop; clean water and improved drainage	Formed savings groups networked at the settlement and municipal levels; communities are supported to profile and enumerate their settlements; drainage and water projects
Baan Mankong, Thailand	Thailand	2003	Create savings groups; physical services as part of social and political development; collective land ownership or lease; in-situ upgrading with options for reblocking and relocation	80% of projects accounted for in-situ upgrading; low-interest loans permitted to savings groups only; universities, NGOs, religious bodies provided technical assistance
PSUP, Ismalia	Ismalia, Egypt	2004	Water; sewage network; paved roads; electricity networks	Participated in by working groups consisting of NGOs, CBOs, women, youth, associations and community leaders; facilities and services upgraded
VN Urban Upgrading Project	Vietnam	2009	Water; sanitation; sewerage; electricity; lighting; roads; flooding (drainage); housing; capacity building	Improved service coverage; reduced flooding; change in property values

Vertical resettlement

Another slum upgrading model that has been quite successful in Mumbai, being the most populous city in India, is the densification through vertical resettlement. In a paper authored by Gill and Bhide (2012), they described how the model has provided housing at no cost to the poor or to the government, whilst supplying land for the physical infrastructure in the city. As an offshoot of in-situ upgrading (Doberstein, 2019), this concept took shape as a scheme in 1991 and refined with the passage of the Slum Rehabilitation Act (SRA) in 1995. It allows legal entitlement to rehabilitation for the slum dwellers with the dwellers moved into a structure constructed by a private developer "…at the behest of the government and no cost to the slum dweller". (Rao, 2019). This is in lieu of preferential development rights in other higher-end residential and commercial zones of the city.

The existing slums are demolished with the dwellers moved to a transition shelter while high-rise buildings are being built in place, all at the expense of the developer. In lieu of these costs, the city of Mumbai provides the developer an additional Floor Space Index (FSI) or Floor Area Ratio (FAR) of up to 2.5 for the development of properties either on site or onto other sites as air rights. The cost of constructing high-rise apartments for slum dwellers, according to Gill and Bhide (2012), is more than recovered by the private developers through the value of the commercial buildings. Three main factors make this model successful in Mumbai – 1) high cost of land occupied by slums; 2) the extensive social mobilization efforts that were made with the community organizations; and, 3) the design of the program influenced by consultation with potential beneficiaries (ibid., p. 7).

According to the World Bank (2004), more than 50,000 people were resettled under the program and have expressed high levels of satisfaction with the program. The success was evident from the early indicators - no defaults on the loan components of housing assistance; residents worked together to form cooperative societies for maintenance and other activities; maintenance fees and utility tariffs have been paid regularly; women-led savings and loans' groups have been established in every building; and, settlers have adapted to living in high-rise buildings quite well.

However, not all of the sites have the same sentiments. Rao (2019) noted that the new buildings represent a desire for producing mass social housing, "…while at same time building contempt for those very people they intend to resettle". This is evident in the two housing typologies created by the program which Rao further elaborated. First is the dismal contrast between the dwellers packed building and the adjacent high-priced towering private building, which Rao describes as "…producing a distance that is built into the future of this neighbourhood and the lives of its residents". This could be seen in one of the developments in *Sewri neighbourhood* where three socialised housing buildings were constructed right beside a twenty-four private apartment tower.

The other typology according to Rao (2019), is the rehabilitation colony where large number of clustered buildings are built closely together separated by narrow alleys with the majority not having any access to direct sunlight. The buildings were also poorly designed lacking in open spaces, ventilation, and sanitation that after only fifteen years, the buildings are already in an advanced state of decay. Many residents have sold their units and went back to informal settling. An example of this is in *Lallubhai Compound* in northeast Mumbai.

Vertical settlement as an innovative model, should consider foremost the welfare of the settlers to whom the program was originally designed for. The development started out with the objectives geared toward the improvement of the living conditions of the urban poor, but has gradually shifted favouring the high-income generating private tower buildings. Relaxing minimum standards in the building code is also an innovative measure to complement the model, but has been abused favouring the towers with maximum air rights and in contrast, disfavouring the resettlements with less than the minimum required living and common spaces.

Whilst the design of the facility is different for each of the sites, general standards perhaps should be established based on the previous projects that have earned high levels of satisfaction from the people. If this would be implemented, the benefits of the model may be truly realized in housing the populace it was designed for originally. In comparison to the discussed housing approach, the Philippine's take on in-situ and in-city housing will be presented in the succeeding paragraphs.

People's plan / People's proposal

In the local context, the government formulated a programme deemed to complement on-site or in-city relocation programmes. The Oplan LIKAS Project was approved in 2010 by then President Benigno Aquino III for the implementation of a five-year ISF programme, to provide on-site or in-city housing for more than 100,000 families living on or near danger zones. The *Oplan Lumikas para Iwas Kalamidad at Sakit* (LIKAS) or Operation Plan Evacuate to Avoid Calamities or Sickness, is in line with a 2008 Supreme Court writ of mandamus, requiring the reservation of a three-meter easement zone along the waterways and the resettlement of ISFs (Galuszka, 2018). The court set a deadline of 31 December 2015 for the complete removal of all informal settlers in areas subject to the jurisdiction of the mandamus. This provided an opportunity for the ISFs to develop their People's Plan for housing and resettlement within or near the city (Patino, 2016). Together with the "in-city relocation" advocacy of the urban poor, these two became the key advocacy points of the urban poor and civil society agenda (Galuszka, 2018).

The People's Plan also known as People's Proposal, refers to the plan formulated by the beneficiary-association which shall contain a site development plan including community health, sanitation and security plans. The plan also includes non-physical development components such as self-help housing cooperative, livelihood, self-help development, capability building

trainings, and a system of allocation of socialized housing units (R.A. 11201, pp. 3-4). As an alternative shelter planning approach, Galuszka (2018, p. 2) notes that it "…integrates principles of bottom-up planning and positions the concerned communities as a leading stakeholder in the delivery of a variety of functions within the resettlement process". The functions are all-encompassing covering community profiling, land acquisition and development, site development, involvement in architectural and engineering design, financing, management, and as discussed above, community development plans.

The programme also guided the implementation of specific programmes such as the High-Density Housing (HDH) of the Social Housing Finance Corporation established in 2013, and the Micro-Medium-Rise Building established in 2015 by DILG. Both programmes promote the development of in-city multi-storey housing, and given the scarcity of land with their high prices in the metropolis, medium- or high-rise buildings can be a better option for on-site or in-city relocation programmes. From the time the People's Plan was launched in 2011, the first project that was approved was in January 2014 which started construction in September 2014 (Patino, 2016). The delay was due to the payment terms with the landowner and securing construction-related permits and clearances from the different local government agencies.

Based on the actual implementation of the programme, the foundations as originally conceptualised were not translated into practice. Galuszka (2018) points out two dimensions of the programme as the cause – implementation logic of the program, and delivery record. The implementation logic of the program promoted rapid and mass delivery of uniform housing product as related to the way the Php50 billion budget was released on a yearly basis at Php10 billion each year. With the difficulties in identifying in-city land, National Housing Authority (NHA) was the recipient of the first tranches of the fund to be able to spend the money fast. The agency, however, opted to adopt the off-city relocation with the HDH and MRB as discussed above, established only at a later date.

In terms of delivery, Galuszka's study show that Php32 billion of the Php50 billion fund was utilized by NHA on mass production of standardised housing units, again in locations mostly off-city. The overall target number of units is at- 101,210 for NHA; 19,658 for SHFC; and, 2,966 for DILG. Completed units as of 2018 were at- 85,063 for NHA; 3,729 for SHFC; and, 434 for DILG. The deficit can be attributed first to the conflicting policies, agendas and interests in the policy formulation of the programme (Patino, 2016).

Second is the issue on the Disbursement Acceleration Program (DAP), a stimulus package designed to fast-track public spending which is mainly the source of the ISF housing programme. It was put in a controversial situation when a disbursement from the DAP to the senators were identified, thus, delaying the processing and approval of People's Plan. Another reason for the shortfall was the difficulties the community associations went through to

collaboratively engage with the government and comply with all the legal and documentary requirements.

The People's Plan is an alternative programme that departs from the government's forced evictions and off-city resettlement (Patino, 2016). It allowed the urban poor to engage government in recognizing their right to decent shelter and security of tenure. There are a number of takeaways from the gained experiences from the programme. For one, compliance by the communities to the complex procedures of different agencies (Patino, 2016), should be simplified given their limited resources, time and effort. It is also essential for agencies to initiate new and innovative programs such as the SHCF's high-density housing, in contrast to NHA's bias toward conventional solutions (Galuszka, 2018), which have already been disproved to resolving the housing problem. Overall, the programme as originally designed, should fulfil its promise of translating the progressive foundations into practice, and strengthen the role of communities who are the key stakeholder in the programme (Galuszka, 2018).

Building on the literature reviewed in this section, would enable this study to take a position on the slum upgrading initiatives appropriate for the study area. In consideration of the locational attributes in upgrading discussed above, the technical adaptation for flood mitigation will be presented in the next section. The existing approaches currently being practised in the metropolis, will be discussed in comparison with the other regions, to help identify and evaluate the alternative approaches that can be appropriately applied to the study area.

2.10 Technical adaptation approaches

With both the general and specific characteristics including the challenges in the upgrading of informal settlements presented above, literature on the technical adaptation applied in general, will be reviewed next in this section. A systematic review was conducted to gather literature that represent significant and current hazard adaptation approaches, globally in this section and locally, particularly those adopted by informal settlements in Metro Manila, in the subsequent section. This section starts off with reference to resilience-focused approach discussed in the *Urban Flood Resilience* in section 2.4.

The responses for the resilience-approach to flood risk include both structural and non-structural measures, which can be grouped further into locational sectors such as coastal or inland flooding, and into physical, regulatory, or behavioural measures (Zevebergen et al., 2010). The measures could range from urban drainage systems and technology, to flood proofing, to the management of land use, and urban planning and recovery, where publications and guidance according to Zevebergen et al. (2010), approach responses based on their particular vision or context.

In the context of the study area, the technical adaptation approaches should consider both structural and non-structural measures, with focus on inland flooding that covers the physical

and regulatory aspects. Structural measures according to UNDDR, are any physical construction to reduce or avoid possible impacts of hazards, or the application of engineering techniques or technology to achieve hazard resistance and resilience in structures or systems. Non-structural measures on the other hand, are measures not involving physical construction which use knowledge, practice or agreement to reduce disaster risks and impacts, in particular through policies and laws, public awareness raising, training and education (Correa et al., 2011).

In the reviewed literature, the key issues above were contained within four environmental hazard adaptation approaches. The first three broad approaches - *protect*, *accommodate*, and *retreat* - were identified by the Coastal Zone Management Subgroup (CZMS) in its 1990 IPCC Response Strategies Working Group Report (Gilbert and Vellinga, 1990). Practitioners and researchers working on climate change-related sea level rise, added *avoid* as another approach and collectively, these were coined by Doberstein et al. (2018) as "PARA" framework.

The framework was first developed for use by coastal communities for adaptation to sea level rise (IPCC 2014), but can also be useful for flood risk reduction and flood resilience, despite significant differences between the mechanics of sea level rise and riverine or pluvial flooding (Doberstein et al., 2018). The categories are commonly used either separately or jointly (e.g. USAID, 2012; AGP+AI, 2013; Rogers et al., 2020), and exploring these independently in the study will help identify the measures being practised or applied in the floodplain settlement. This will also help determine which amongst the measures are efficient and sufficiently applied (or otherwise) in protecting the households and the community as a whole.

Protect approach

The *protect* approach support the concept of "fighting the water" (McClymont et al., 2019) with engineered structural flood protection or revegetation (Doberstein et al., 2020). Protection according to Gilbert and Vellinga (1990), involves protecting the land so that existing land uses can continue. It includes hard structures such as seawalls, dykes, and groynes, as well as soft solutions like dunes and vegetation. *Protect* is a reactive strategy that is typically the first response considered to protect people, property and infrastructure (AGP+AI, 2013).

The strategy according to the Sea Level Rise Primer Guide in 2013, has been the traditional approach, but could be prohibitively expensive with limited long-term effectiveness in highly vulnerable locations. The strategy is attractive if the government bears the protection costs and if land use is not managed by the local government with a long-term perspective (AGP+AI, 2013). There are also non-structural measures under the *protect* approach such as beach nourishment and coastal wetland restoration and creation (ibid.) which may also complement the structural measures.

In the EU flood directive's 3Ps (Zevenbergen et al., 2010)- prevention, protection, and preparedness- *protection* is described as taking measures, both structural and non-structural, to reduce the likelihood of floods and/or the impact of floods in a specific location as noted in the 2007 European Parliament, Council of the European Union. The approaches particularly under the Habitats Regulations Assessment in 2015, are mostly non-structural which include - maintenance of the existing drainage and flood defence network; new flood alleviation schemes; and, catchment-based management.

Considering the prohibitive costs involved in structural measures, maintenance and management of the existing measures, would be the more pragmatic non-structural *protection* approach. In terms of urban flooding, the activities may involve maintenance of all drainage, public sewer, and flood defence assets (Rivers Agency, 2015). Structural measures associated with *protect* strategy and aligned with "fighting the water" as being "…largely considered to be a top-down, technocratic strategy" (McClymont et al., 2019), should be integrated with the bottom-up opposing principle of "living with floods" that is more aligned with "accommodating", instead of resisting the floodwaters.

Accommodate approach

Accommodate approach in the SLR Primer is utilised to allow continued occupation of coastal or riverine areas through changes made to human activities or buildings and infrastructure (e.g. infrastructure retrofits, or land use planning adjustments). As an adaptive strategy used to improve resilience to occasional flooding, it can involve retrofitting a building, use of structural fill to raise elevation, restricting building areas subject to flooding to non-habitable uses, and increasing setbacks from watercourses (AGP+AI, 2013).

Often used in conjunction with protect strategy, *accommodate* according to Tyler (2015), provides a secondary line of defence which could include wet flood proofing, floatable or elevated homes, and flood storage areas. Wet flood proofing is the use of flood-damage-resistant materials and construction techniques to minimise flood damage to areas intentionally allowed to flood, below the flood level of a structure (FEMA, 2013, p. 1-2). It is generally used to allow water to enter and exit the house with the areas in contact with water protected from flood damage.

The principle of elevated homes is similarly utilised to allow water into the premises and pass through under the house, but not to enclosures below elevated structures. Examples are the stilt houses or its modern form, *pilotis architecture* which are buildings according to Liao et al. (2016), supported by columns at the ground level. The ground area is an open space that can be used during the dry season, and allowed to be inundated during the flooding season. It is a lifestyle of tolerating flood based on flood adaptation at the property level (Liao et al., 2016), hence, the principle of "living with floods". In the local context, the traditional "bahay-kubo" is considered a stilt house on land, whilst the *Badjao* house found along the coastal areas of Tawi-

Tawi, Sulu, Basilan, and some coastal municipalities of Zamboanga del Sur, is built on water for the seaborne lifestyle of the residents (Lico, 2008).

Raised structures or elevated construction using stilts are not just confined to single housing units, but are already being adopted even in multi-dwelling apartment buildings, office buildings, showrooms, and other building typologies, using a variety of materials such as concrete, steel, and aluminium. In the United States, one of the government-promoted strategies for protecting buildings from floods is elevating buildings on vertical structural supports to a height above the projected 100-year flood level. This is referred to as permanent static elevation (PSE) (English et al., 2016).

In UK, elevation is usually recommended to above a probabilistic baseline flood such as 1 in 100 years plus climate change adjustment (Proverbs and Lammond, 2017). There are, however, concomitant disadvantages of exposing a structure to higher wind forces according to English et al. (2016) when adopting stilts or PSE. They argue that if a coastal community is required to elevate their homes high above the ground, the homes are likely to be exposed to significantly higher wind speeds which may have significant impacts on building damage.

Floatable homes on the other hand, are structures allowed to float on the surface of the rising floodwater instead of being inundated. Also known as *amphibious architecture*, it vertically moves through a buoyancy system under the house that displaces water to provide floatation with a vertical guide system, allowing the structure to rise and fall at the same exact place (English et al., 2016). Floatable structures have been traditionally adopted in the floating villages of Cambodia's Tonle Sap River, Peru's Lake Titicaca, and Vietnam's Ha Long Bay.

Modern version of amphibious houses can be found in countries like the Netherlands (e.g. Maasbbommel project), UK (Baca Architects), USA (Old River Landing; Make it Right Foundation), and Thailand (Site Specific Company), with other projects under development in France and Canada (English et al., 2016). More affordable amphibious solutions have also been explored in: Bangladesh with Prithula Prosun's *LIFT House* design; Nigeria with architect Kunlé Adeyemi's *Makoko Floating School*; and, Vietnam's Mekong Delta houses with amphibious retrofitting. These projects are relatively inexpensive and applicable to low-cost housing with the use of more traditional building materials on new structures, and preserving those in the existing structures when retrofitting.

Comparing the PSE system with amphibious construction, English et al. (2016) cites a number of disadvantages in using PSE. Aside from being subjected to higher wind speeds and pressures making it more vulnerable to wind damage, retrofitting with PSE is roughly twice the cost of an amphibious retrofit. Detailed cost comparisons indicate that on average, amphibious retrofits range from 1/3 to 1/2 of the cost of PSE. Unlike amphibious houses, PSE is unable to accommodate varying levels of floodwater as it is limited to a fixed level. PSE, English et al. adds, is also disruptive to resident's activities requiring long flights of stairs and removing them

from the street level. In terms of aesthetics, PSE disrupts the visual coherence of the neighbourhood if not all the houses are elevated. It also creates voids at street level disrupting the original character of the neighbourhood as well. In general, amphibious construction performs better with more social and economic benefits over PSE (ibid.).

Given the technical adaptation measures for the *accommodate approach* presented above, what is crucial is the consideration for the local capacities which include both knowledge and materials. In a recent study on providing design guidelines for upgrading the living conditions in floodplain settlements, Olthuis, et al. (2020) used Dhaka, Bangladesh as their case study. The goal of the study is to match the basic services level (such as electricity, water, sanitation, schools, and clinics) in the formal dwellings surrounding the slum under study, eventually connecting the informal with the rest of the city. They identified first the specific issues and concerns by the dwellers and second, the stakeholders' position and demands toward the proposed upgrading.

Their findings were used to establish eight constraint requirements (CRs) that need to be addressed with the upgrading proposition. These are: 1) geographic location; 2) flood proof ability; 3) flexibility; 4) transportability; 5) standardisation; 6) affordability; 7) safety; and, 8) legality. The approach and guideline will be ultimately used to develop a small-scale project proposition which they refer to as 'City App'.

Applying the eight CRs in the study, the results show a design guideline with a system providing all the basic services lacking in the floodplain location of the settlement (CR1), to be built on a floating support (CR2) that is modular and flexible (CR3). It should be based on prefabricated, transportable components permitting it to move to a new plot if required (CR4), and standardised (CR5) to be easily replicable. These components should be reusable (CR6) and resist water-related disasters (C7) allowing it to run throughout the year. The system also has to comply with the local laws and regulations (CR8).

As a result of the case study, refurbished shipping containers appeared to be the best match for these constraint requirements. The installation of the system in the targeted floodplain settlement in Dhaka, has to be accepted and validated by local authorities and must follow existing local regulations and laws. This will allow a common validation for the standardised system according to the study, that could be used in the entire city and deployed in a short response time. Finally, the transportable elements of the system must be certified according to the international transport regulations.

What was not considered as part of the constraint requirements (CRs) in the study, however, was the local knowledge and materials which comprise the local capacities. Often invisible to outsiders, these need to be recognised and strengthened for shelter response to improve assessment and be included in reporting systems (particularly in post-disaster). Locally driven approaches as noted by Sharma (2018, p. 19), "…are methods that are sensitive to the local

context, including culture, materials, knowledge and systems". It is common for people to reconstruct or repair their homes after a disaster (Schofield and Flinn, 2018), and rather than pushing remotely conceived designs and prototypes onto them, Sharma (2018) argues that working with the local people is a huge opportunity for the humanitarian shelter sector. In the same vein, the Sphere Association (2018, p. 241) noted, that "Regardless of the form of support provided, it is important to always respect existing community structures and promote social cohesion".

Retreat approach

Planned or managed retreat strategy includes withdrawal, relocation or abandonment of land and structures at risk due to coastal or riverine hazards. It involves relocating infrastructure or resettling residents in low-lying cities, particularly in areas which do not have the resources to invest in long-term protection or accommodation strategies (Abel et al., 2011). Relocation could also be temporary according to seasonal river fluctuations (Doberstein et al., 2019).

Retreat limits the use of structural or engineered protection, discourages the development in risk areas, and plans for the relocation of building and infrastructure to areas with lesser or no risk (AGP+AI, 2013). Managed retreat could either be small-scaled involving a few structures, or large scale which may include the entire community as a planned relocation or "managed resettlement" (Doberstein, et al., 2019).

Reflecting back on the argumentation in the literature contending that resettlement should be the last resort, the retreat approach may only be favoured for structures along the 'no build zone'. Similarly, in a CDKN funded research project - *Reducing Relocation Risk in Urban Areas* - which looked across several case studies from 2015 to 2017, stated in its first key finding that "…resettlement and relocation may reduce people's exposure to hazards, but experience shows that in most cases, it leaves people worse off overall in social and economic terms that they were before" (CDKN, 2017, p. 1).

The practice of resettlement and relocation to reduce risk in the form of 'managed retreat', according to Johnson, et al. (2021, p. 311), is widespread both across the global South and North, but with no clear estimate of the number of people affected. This in effect, "…prevents a cohesive advocacy in search of alternative approaches for risk reduction and climate adaptation". Wilkinson (2021) also suggested that the benefits should be weighed against the loss of livelihoods in terms of reducing disaster risk on tourism and local economies, where managed retreat's impact could be enormous.

Retreat as an adaptive strategy would benefit relocation more than resettlement. Relocation in UN's definition is the non-systematic movement of people from hazard-prone locations to nearby areas which involves less disturbance in terms of access to work and social networks. Resettlement on the other hand, involves new housing and services, new social and economic

relations, and new challenges such as access to work and social cohesion. It is a major integrated, comprehensive movement of people, which normally involves significant distance between the original and new locations (Ferris, 2014).

Retreat via resettlement should only take place either when no means of technical adaptation can mitigate the flood risk in the settlement, or when the land being occupied encroaches the required easement. As CDKN (2017) argues, people have always lived in risk areas and the settlers may just be willing to accept certain risks based on the opportunities offered by the location and the value they place on it. Government, communities, and other stakeholders, should discuss alternatives to resettlement and relocation including potential options for risk reduction and in-situ upgrading or rebuilding (CDKN, 2017), but when these alternatives fail, avoiding the risk area should be the final course of action.

Avoid approach

The strategy of avoidance may involve identifying future "no build" areas such as restriction on future development within local government planning (Tyler, 2015; McClymont et al., 2019) through land acquisition, land trust, or transfer of development rights (Tyler, 2015). Mostly dealing with regulatory measures, planning may involve the designation of lands or zoning for non-habitable or limited functions (AGP+AI, 2013), discouraging development even in areas where the risk is presently low, but over time will increase.

Avoid approaches according to Doberstein et al. (2018), have been used traditionally to reduce the risks of riverine flooding, but efforts to avoid pluvial flooding in urban areas outside of riverine floodplain through urban design are also increasing. The application of this approach is closely linked with the previous *retreat* approach where the development and its inhabitants or users, should be relocated or resettled in a safer or non-risk area.

The avoid approach is the equivalent of the *prevention* measure in the EU flood directives with the objective of avoiding construction of houses and industries in flood-prone areas. This can be executed according to the Habitats Regulations Assessment, by adapting future developments to the risk of flooding and by promoting appropriate land use, agricultural and forestry practices (Rivers Agency, 2015). To fulfil the objective of the measure, the approaches include: keeping new development outside flood risk areas; ensuring that new development when permitted in exceptional circumstances is suitably constructed; and, surface water management.

In terms of new development, the avoidance strategies incorporating planning legislation according to Proverbs and Lamond (2017, p. 2), is moving forward with appreciation "…from combining strategies and property level measures, and incorporating water resistant and resilient materials". This essentially refers to the *accommodate* approach as discussed earlier, particularly wet flood proofing measure where water is allowed into non-habitable areas that were built with flood resilient materials.

The combination or integration of strategies is generally being encouraged by the sources and authors of the varied literature reviewed in the four approaches presented above. Doberstein et al, (2018) for instance, contend that when taken alone, no single flood risk reduction approach would be capable of delivering resilience. McClymont et al. (2019) in parallel, proposes a "fluid frontier" between top-down and bottom-up flood risk management with technocratic approaches benefitting from bottom-up approaches and vice-versa.

The SLR Primer similarly stated that the four strategies are not mutually exclusive or "pure" approaches, providing a "combinations and compatibility" section in their toolkit with a matrix indicating that several tools are interdependent and should be used in combination to produce hybrid protection systems (AGP+AI, 2013). The EU flood directives did not only advise for the combination of approaches, but advocates green infrastructure as well which combines the restoration of ecosystem functioning with the provision of a service, particularly for climate change adaptation and disaster prevention. Finally, the CDKN project recommends to combine grey-green-blue infrastructure to reduce the impacts of flooding in already risk-exposed informal settlements, as a better option to resettlement.

The general adaptation approaches presented in this section will be compared and evaluated with the local adaptations applied in Metro Manila which will be reviewed in the next section. The evaluation will help the study in determining the more practical and feasible approaches that could be adopted by the community under study, in its potential to technically adapt and develop to a transitional settlement. This will be finalised and discussed in the *Discussion and conclusion* chapter 8.

2.10.1 Adaptation measures in Metro Manila's Informal Settlements

The four broad adaptation measures discussed above are being practised in Metro Manila starting during the post-war period, mostly with the top-down approaches (protect, retreat, and avoid) and partly with the bottom-up approaches (accommodate). *Protect* started with the High Modernist movement prevalent in the late 1950s and 1960s which saw the rise of imperialistic state planning, and operated on the premise that with Western countries being the most developed, the rest of the world who were still under traditional and pre-modern economies, would need to follow suit in flood adaptation measures for them to advance beyond the outdated state (Scott, 1998).

Informal settlers in post-war Manila were frequently blamed for floods as being "…part of the greater perceived evil that is, unplanned urban development" (Loh and Pante, 2015, p. 38). This prompted the government to evict squatters (*retreat*) settling along waterways (*avoid*) whilst implementing the much-needed structural measures. Notable flood mitigation projects during the period were the Php1.8 million construction of the interceptor in Blumentritt to prevent floods in the district of Sampaloc in Manila, and the Php 800,000 Sampaloc *estero* (modified natural channels*)* improvement (Loh and Pante, 2015).

The 1970s saw huge structural projects such as the raising of the Pasig River walls to accommodate 14-metre-high water level (Zoleta-Nantes, 2000), and the Greater Manila three-phase drainage and sewerage expansion megaproject programme (Loh and Pante, 2015). Community participation in flood mitigation was initiated by the local NGOs in the 1980s in line with slum upgrading as land tenure was revealed then as a major societal issue (HUDCC, 2014). The period saw the start of community-based disaster management which according to (Loh and Pante, 2015), combined technical expertise and local knowledge in drawing up hazard maps, forming flood warnings, rescue teams, and evacuation efforts.

Civil society and NGO involvement gained more strength in the succeeding decades, increasing community participation together with the government's integration of climate change resiliency and disaster risk reduction and management (DRRM) features into the local shelter plans. Socialised housing programmes such as the Community Mortgage Program (CMP) and Localised CMP (LCMP) were introduced with the primary objective of assisting residents of blighted or depressed areas, to either own the lots they occupy or where they choose to relocate, and eventually improve their neighbourhood to the extent of their affordable limits (HUDCC, 2014).

As discussed in the previous sections, resettlement of ISFs along waterways and danger areas also introduced the government's High-Density Program and Medium Rise Housing which are in-city housing programmes that involves the construction of two to five-storey buildings to serve the needs of the resettling families. Formulated through the 2011 Oplan LIKAS Project to resettle ISFs along the waterways in Metro Manila, the implementation however, "…has been slow due to land acquisition, site development, and relocation issues and bottlenecks" (NEDA, 2017, p. 183). The general situation for these programmes according to (HUDCC, 2014), is the limited resources and inefficient recovery of government investments in the production of housing provision. The National Housing Agency (NHA) for instance, suffers a low 20 to 30 percent collection efficiency in its projects.

Whilst the government is lagging behind the housing needs in the cities, the ISFs in danger areas craft their own adaptation measure mostly aligned with the *accommodate* approach. In the riverine communities in Metro Manila, Porio (2011) noted the "water-based" lifestyle of residents employing interventions as earlier discussed, such as increasing number of floors in their dwellings, building makeshift bridges amongst households, water diversion, and devising platforms to raise appliances or furniture.

Without permanent intervention, these efforts may only protect the residents in the short-term, and notwithstanding the unpredictable hazards and more severe consequences of climate change, the need for alternative strategies for the long-term should be considered in the upgrading initiatives of vulnerable communities. The strategies may be developed to hold the

settlers at bay from flood risks initially, whilst awaiting government intervention programmes which could lead to more permanent housing solutions.

The technical adaptations in the local context presented in this section provided a glimpse on the current approaches practiced in the metropolis in comparison with the general approaches reviewed in the previous section. These reviews can guide the study in investigating the potential for the floodplain community to develop to a transitional settlement. As an introductory guide, the concept of transitional settlements and shelters will be discussed in the next section, followed by the presentation of significant programmes on the concept implemented in the country.

2.11 Transitional settlements and shelters

This section briefly introduces the housing issues and constraints in the country, resulting to the proliferation of informal settlements in the highly urbanised National Capital Region. It will be followed by the rationale behind the concept of transitional settlements and shelters, and will conclude with the various approaches to the concept, as practised by the more established humanitarian organisation advocates.

In its mission to provide adequate and affordable housing to low-income families, the Philippine National Housing Authority's (NHA) projected 2017 to 2022 housing needs, is at 6.57 million units accumulated for socialised, economic, low-cost and the open market (NHA, 2018). In the National Economic Development Authority's (NEDA) projections, the government sector must put up at least 1.5 million housing units with NHA contributing more than a third of the government target at 552,755 units for the five-year period. In the past six to seven years, the government has only been able to build on average, 192,000 units annually.

With the housing supply challenges in the country, this study will explore the viability of transitional settlement development in lieu of relocation or resettlement. The approach will be adopted in consideration of the transitional settlement and reconstruction principles in UN's guidelines that are closely related, with two inextricably linked to the study: 1) avoid relocation or resettlement unless it is essential for reasons of safety; and, 2) minimise duration and distance, when displacement is essential. Principles closely related to the study are: a) support settlement and reconstruction for all those affected; b) ensure rights and secure tenure for all those affected; c) ensure that vulnerability to disasters is not rebuilt; and, d) undertake contingency planning (Corsellis and Vitale, 2008).

Each humanitarian agency dealing with post-disaster shelter assistance has their own definition of transitional settlements and for this study, USAID's description being closely related to the study's context, will be adopted. It is thus, reiterated as "…the improvement of existing neighbourhoods, including informal settlements, to permit provision of shelter and basic services whilst reducing hazard risks and the need to relocate affected populations to new

settlements" (USAID, 2017, p. 4). Transitional shelters similarly, have varied descriptions and using IFRC's (2013, p. 8) definition, they are described as "…rapid, post disaster household shelters made from materials that can be upgraded or re-used in more permanent structures, or that can be relocated from temporary sites to permanent locations".

There are three main approaches to transitional shelter that were introduced and being practised by humanitarian organisations namely, 1) the UN Shelter Centre; 2) International Federation of Red Cross (IFRC); and, 3) the U.S. Agency for International Development (USAID). These approaches incorporate disaster risk reduction measures to reduce the vulnerability of households to future natural disasters (Rohwerder, 2016).

Shelter Centre's approach considers transitional shelter as "…an incremental process which supports the shelter of families affected by conflicts and disasters, as they seek to maintain alternative options for their recovery" (Shelter Centre, 2013, p. 2). It has become a common term used as noted in its *Transitional Shelter Guidelines* (2012), since the Indian Ocean tsunami of 2004. The guideline identifies five characteristics of transitional shelter: 1) upgraded into part of a permanent house; 2) reused for another purpose; 3) relocated from a temporary site to a permanent location; 4) resold, to generate income to aid with recovery; and, 5) recycled for reconstruction.

IFRC considers these characteristics particularly on relocation to a permanent location, helpful in solving land tenure issues by providing additional options for beneficiaries such as physical relocation of shelters. IFRC (2013, p. 8) in its *Post-disaster shelter: Ten designs* study, described its approach as designed to facilitate the transition by affected populations to more durable shelter, that respond to the fact that post disaster shelter is often undertaken by the affected population themselves, thus, the support for resourcefulness and self-management.

USAID (2017) on the other hand, describes its transitional shelter approach as the provision of inputs- sometimes including salvaged materials - construction, technical advice, and oversight - needed to create shelter in compliance with the minimum *Sphere Project*[5] metrics for living space, where conditions permit. Their transitional shelter and settlements assistance is intended to address the short to medium-term needs of disaster-affected households up to three years, with the area-based interventions serving as platforms for subsequent recovery and reconstruction as well.

Transitional settlement and shelter approach offers practical guidelines that can be used to facilitate the implementation of more effective programmes, together with a compilation of prototype designs developed by shelter manufacturers in collaboration with the humanitarian

[5] The Sphere Minimum Standards for Shelter and Settlement are a practical expression of the right to adequate housing in humanitarian contexts. The standards are grounded in the beliefs, principles, duties and broader rights declared in the Humanitarian Charter. These include the right to life with dignity, the right to protection and security, and the right to receive humanitarian assistance on the basis of need (Sphere Association, 2018).

community (Shelter Centre, 2009). In IFRC's study discussed above for example, shelter solutions from different leading humanitarian agencies, identified the preferred designs that were successfully used in past disasters and established a working group of technical representatives to oversee the engineering review and guidance in selecting the schemes. The ten schemes selected according to the study (IFRC, 2013, p. 4), "…reflect a range of disaster contexts and climatic conditions, differing materials and building technologies, and different approaches to the process of sheltering".

In the shelter design, IFRC advises to first develop a design brief which is a document defining the performance of the shelter that will allow the design to be verified against key criteria such as safety, cost and durability. Developed through consultation with the residents, "the design brief should also be developed in consultation with the government", and "reference existing building codes and standards" […], "to balance the ideal building from a structural perspective with constraints such as limited time and budgets" (IFRC, 2013, p. 14). For the design checks on the shelter schemes, IFRC used the International Building Code (IBC) 2009 and other available and appropriate building codes.

It is further advised by the organisation that the shelters should be well located to reduce hazard exposure with the dwelling layout and orientation adapted to the local culture. The design should consider the financial capacity of the households to maintain and upgrade their dwellings, and the technical support necessary through construction and maintenance trainings. Thus, the shelters should be designed to be upgradeable with the components repairable. In the Philippines, there were two transitional shelters included in the ten designs and the one most appropriate for the case study will be presented in the succeeding section, together with the various programmes in the country initiated by the humanitarian community in responding to the settlers' emergency needs.

Transitional settlements and shelters in the Philippines

Building resilience that will reduce or mitigate the impacts of environmental hazards as discussed earlier, is critical to settlements located in risk areas. With the frequency of devastating typhoons visiting the archipelago, post-disaster assistance from international humanitarian agencies have been extended a number of times to the country. One such agency is UN's International Organisation for Migration (IOM) which established its office in the country back in 1975 and in 1996, located one of its first regional IOM offices in Manila (philippines.iom.int). Long established in the country, it has a wide-range of programmes from knowledge transfer and delivery of technical trainings on DRR measures, to transitional shelters.

IOM's transitional shelter programme in the 2013 Super Typhoon Yolanda (Haiyan), was credited for providing 5,690 transitional shelters either built on relocation sites or place of origin (figure 5). Amongst its considerations in the programme are: 1) shelter design based on local

construction typologies, local materials and improved construction techniques; 2) support in land tenure and land issues amongst beneficiary household; and, 3) partnering with other organisations to ensure basic services provision (IOM, 2014).

Figure 5. Transitional Shelters being constructed for affected families by typhoon Haiyan, Kananga, Western Leyte. (Source: IOM, 2014).

The programme also created an opportunity to train more labourers and improve construction practices through DRR features introduction, enhancing resilience in the communities to future disaster events. Moreover, the process enabled the provision of financial support into the communities by engaging local labourers through the organisation's Cash for Work programme. In line with emergency employment (figure 5a), IOM also provides technical trainings to builders and carpenters to better equip them in setting up their own businesses in the construction sector (IOM, 2014).

Figure 5a. Transitional Shelters being constructed for victims of typhoon Haiyan, San Isidro, Tacloban, (Source: IOM, 2014).

Another organisation, Catholic Relief Services (CRS) is the official humanitarian agency of the Catholic community in the United States founded in 1943. It has been supporting the Philippines since 1945 with its programmes ranging from emergency response to disaster preparedness, agro-enterprise and peacebuilding (crs.org). In 2011, it implemented an urban transitional settlement programme in response to the devastation caused by TS Sendong (Washi) in

Cagayan de Oro, the provincial capital of the province of Misamis Oriental in Northern Mindanao.

The catastrophic destruction damaged 18,436 houses with 5,801 totally destroyed and 12,635 partially damaged, directly affecting 228,728 people as reported by the Cagayan de Oro Department of Social Welfare and Development (CDO-DSWD) in 2012. Working with IOM, CRS launched a transitional settlement programme to provide the affected population with more than 1,300 shelters, whilst the settlers wait for their places within the on-going permanent housing programme by the government Adopting a three-phase sheltering process- emergency to transitional to permanent, the transitional shelters were designed using traditional local materials (figure 6) that can be moved or used to extend, or improve future permanent houses (Hirano, 2012).

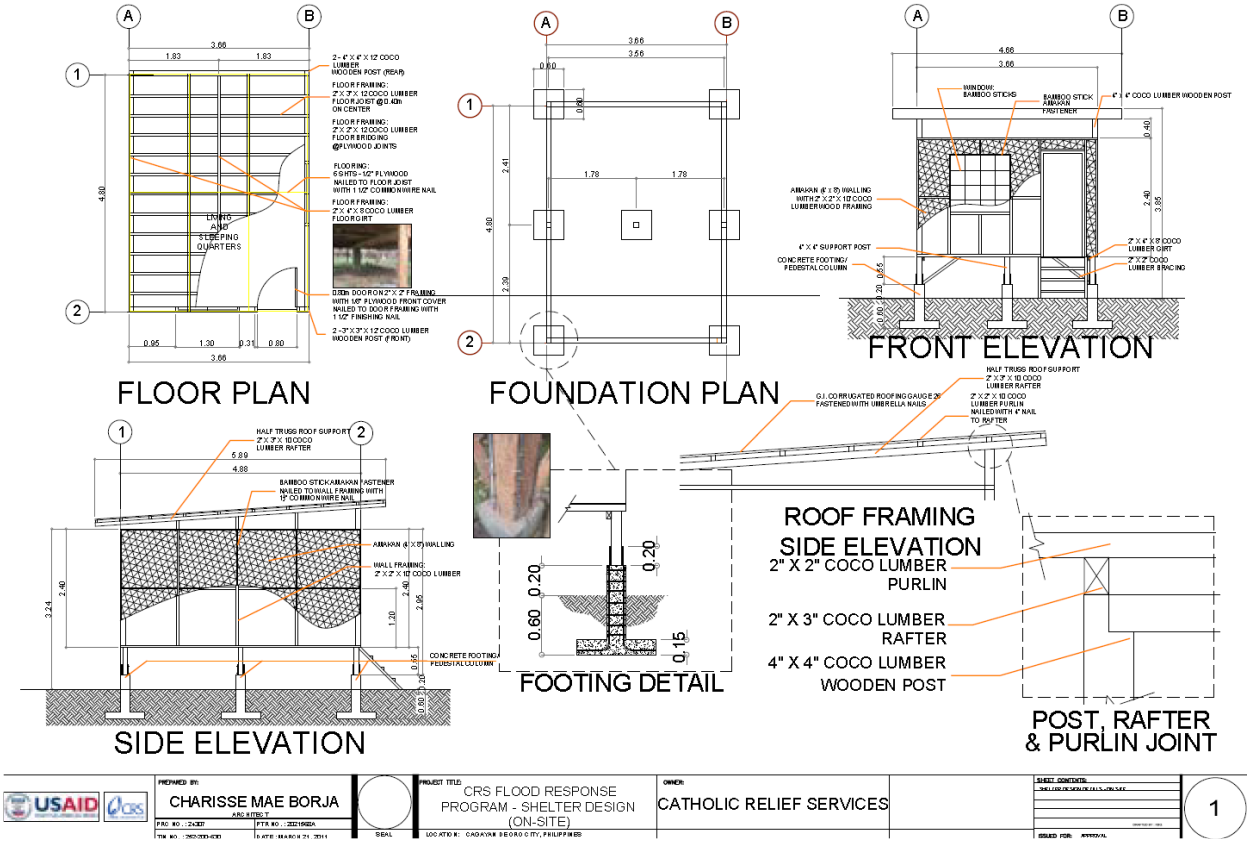


Figure 6. Architectural construction details of onsite transitional shelters. (Source: Charisse Mae Borja / CRS, 2012).

The transitional shelter is one of the two from IFRC's ten designs as discussed in the previous section. The houses were built on both the relocation sites and in the original neighbourhood, with WASH (water, sanitation, and hygiene) facilities and permanent septic tanks. The shelter was inspired by the traditional "bahay-kubo" predominantly made out of *amakan* (bamboo or palm oil leaf weave) for the walls, with coco lumber for the structural framing built on stilts for flood and vermin protection (figures 7 & 8). The footings were made out of concrete with the floors out of plywood and corrugated G.I. sheet for roofs. The design parameters according to

Hirano (2012) that were significant in the programme are: 1) culturally appropriate; 2) re-locatable; 3) speed of construction; 4) economical; 5) flexible; and, 6) upgradeable.

Figures 7 & 8 Culturally appropriate and re-locatable transitional shelter with the local architect and engineer who designed and oversaw the shelter construction. (Source: Charisse Mae Borja / CRS, 2012).

According to IFRC, the shelter has a covered floor area of 4.80 x 8.70 metres supported on concrete piers and footings with the first floor raised from the ground by about 750mm. There is only one door and two windows and with the light materials used, the shelter can be lifted and moved to a different location by a few people. In terms of durability and lifespan, IFRC notes that the concrete piers are very durable, but the coconut wood and plywood should be treated to resist fungal and insect attacks. The wall panel construction is also not that durable to resist strong storm events. With five people in the construction team, it took them five days to finish the build and the anticipated lifespan added IFRC, is at five years.

In the performance analysis on earthquakes, the shelter should be able to withstand seismic events with little to no damage given the light weight of the shelter. For the wind loads during strong storms, the collapse of the shelter is not expected, but localised damage in some frame members should be expected. In terms of flooding, the shelter offers protection from flood waters with the raised floor and proper anchorage to the concrete piers. Finally, the light materials used are not resistant to fire and the shelters should thus, be separated when laid out on the site to reduce fire spread.

In integrating the shelters and WASH (water, sanitation, and hygiene), the transitional site was provided with two toilets, two showers and laundry area for every ten households, with a 1,250-litre water storage that supplied the needed water for the facility. Other basic services like power, solid waste management, separate drainage for rainwater and waste water were also provided, as well as roads and pathways for the transitional site. CRS noted in their experience in implementing the urban transitional settlement and shelter programme, the significance of close coordination, cooperation, and partnering with multiple stakeholders for the effective delivery of emergency and early recovery shelter operations.

Housing, land and property issues were on top of their list in terms of delays experienced in implementing the programme, with the three sheltering phases of emergency, transitional, and permanent housing requiring land allocations (Hirano, 2012). In the end, the programme has proven to have effectively delivered safe, secure, and dignified living conditions rapidly, to those affected who have transitioned over time to permanent housing.

The concept of transitional settlements and shelters can be applied in the context of in-situ upgrading of informal settlements in hazard-prone areas, considering the incremental long-term process of housing development, typical of the housing process practised by informal settlers. The utility of the approach to response and recovery with its integrated multi-sectoral planning, encompasses promoting disaster risk reduction, health, and protection, with the process of transition that links relief and developmental concerns from temporary to permanent shelter. Integrating traditional and local knowledge with the humanitarian community's post-disaster expertise, may enable the government to work with the settlers, in dealing with the seemingly insurmountable housing issues, and its related risk reduction challenges.

2.12 Summary

The literature reviewed in the chapter presented the concepts, theories, and approaches related mainly to the object of the study, the informal floodplain settlement, and partly to the key features of the study namely, informality and flooding. Urban flooding as the main cause of inundation in the study area, served as the chapter opening presenting its unique features compared with the other flood types in terms of its drivers and effects in the urban landscape, particularly in marginalised communities. This was followed by the two extreme flood events experienced in the country with the flood damage assessment and future climate change impacts.

Informality as the other key feature in the study, was widely presented discussing its origins, evolution, and linkage to urban planning, that influenced the unreflective binary system of the "formal" and "informal". The dichotomy was further presented in the section, *Formal versus Informal*, bringing together similar and different perspectives from published literature, to provide a detailed synthesis and present the study's position in the conversation. The section also served as a prelude to the concepts of risk and resilience under the sections *Informality as Risk*, and *Informality as Resilience*, respectively.

The two sections presented the inherent "risk" associated with informality, and contrasted with the similarly intrinsic "resilience" demonstrated by the responses of the settlers and communities to flood events in the literature reviewed. These were followed by the presentation of informal settlements in the local context that funnelled through floodplain settlements, as the typology of specific interest in the study. The general and specific characteristics and challenges of these settlements were further discussed as an interlude to the literature on technical adaptation approaches. The purpose of this section is to determine the appropriate

approaches that will underpin the concept of transitional settlements and shelters, as a potential direction for development in the community being investigated.

The chapter ended with the section on transitional settlements and shelters as the foundational concept in the study, where the responses to the challenges on the issues of housing and related flood risk will be framed, as formulated in the main research question, “Could informal floodplain settlements be technically adapted for resilience building and develop to form transitional settlements?” In addressing the question, the synthesis of the published literature in this chapter will help explain the phenomenon being investigated, through the conceptual model or framework utilised in the study.

With the knowledge gathered from the different perspectives in the reviewed literature, and the author’s knowledge based on observations, the actions required in the course of the study can then be mapped out in the course of the investigation. The variables needed will be identified, whilst comprehending their interconnections to be able to pursue the investigation. This comprehension will constitute the *Conceptual model* presented in the following chapter.

3 Chapter 3 Conceptual model

The chapter introduces the rationale in utilising a conceptual model in the study, followed by the adopted model from Pojani on the urban form and architecture of informal settlements, drawn from an earlier work of Kellett and Napier. The development of the model or framework, starting from the vernacular architecture of informal settlements, building on to the urban design and architectural aspects, to its adaptation for this study will be presented thereafter. Finally, the key elements in the model, including the basic services added for this study, will be discussed at the end of the chapter.

3.1 Introduction

The diversity and complexity of human settlements, according to Kropf (2009, p. 105), is reflected in the range of ways we try to understand them and "…the challenge raised by the diversity is not how to select between the different views, but how to combine and coordinate them". Informal settlements as one of the more diverse and perhaps the most complex of these human settlements, have grown into an extensive phenomenon that to engage in its study as Pojani (2018) opined, will involve making generalisations whilst missing some contextual nuance in the interest of synthesising theory.

In studying the urban form and architecture of informal settlements, the problem may not be researched meaningfully in reference to only one theory, or concepts resident within one theory (Imenda, 2014). Thus, the synthesis of existing views in the literature, both from theoretical and empirical findings may be necessary. Bringing the related concepts together to explain and give a broader understanding of the research problem, resulted to the conceptual model adapted to provide a larger map of possible relationships (ibid.), that will enable to view the research problem in an integrated manner.

3.2 Conceptual model development

The study will investigate as earlier mentioned, the potential of an informal floodplain settlement to form and develop as transitional settlement by being technically adapted to flood hazards. Identifying and evaluating the physical characteristics of the dwellings will be the essential approach to determine this potentiality. The housing characteristics will be used to classify the dwellings into structural typologies to determine their performance to flood hazards. These characteristics can be observed from the urban form of the community through the settlement itself, the houses within, and the dwellers of these self-build houses. The study's focus is on investigating these elements.

Kellett and Napier (1995) examined the built form of informal settlements by creating a framework to gain a more comprehensive and balanced understanding of both the product and process dynamics of informal settlements, and of the people who create and inhabit them. It seeks "…to integrate an understanding of the built form along with process and use

characteristics, as well as accommodate the structural contexts in which such environments develop" (p. 8).

Frameworks designed for vernacular architecture compared with informal settlements according to Kellett and Napier (1995), have reached maturity stage. It has also been long argued according to Kamalipour (2016, p. 61), that "…informal settlements can be considered as modern vernacular environments". With the many descriptions of vernacular which have the potential to include informal settlements and allow for a better understanding of the settlements, the frameworks for the vernacular architecture instead of informal settlements, were thus, applied in Kellett and Napier's study.

Their designed framework aims to possibly locate the various characteristics of a dwelling or groups of dwellings (or settlements) at a point in time within the framework. If longitudinal data are available and applied, Kellett and Napier (1995) claim it should be further possible to plot change over time. The key elements considered in creating the framework were "…the residents (households); the dwelling and how it is used; the process through which the dwellers shape it; and, the context (setting) in which these actions take place" (p. 16).

The multidimensional feature of the framework makes it distinct from previous unidimensional approaches. It combines for instance, the concepts of Stea and Turan (conditions of existence) with that of Turner's (typology of settlements), to locate the various characteristics of a dwelling at a point in time within the framework. The transition for example, from starting as a temporary to permanent dwelling and the resultant change in its physical characteristics can be plotted in the framework.

The framework, however, lacks the specifics of form needed to determine the capacity of both the dwellings and settlement in flood hazard adaptation, which this study intends to establish. Details necessary for the study are those that make up built-up areas such as the layout, density, and public space for the settlement, and building technology for the dwellings. Despite the breadth of the framework which includes visual appearances, process and use of the dwelling, and an added plotting of change over time, it may not adequately apply to the diverse setting of today's informal settlements particularly those in risk areas.

Drawing from Kellett and Napier's approach, Pojani (2018, p. 295) proposed a conceptual framework to study the urban form and architecture of informal settlements. It "…considers the context in which informality takes place; the settlement itself; the houses in the settlement; the dwellers; and the process through which a settlement is originally formed and transformed over time". The proposed framework aims to be similarly comprehensive, but flexible to be applied across diverse settings, with the approach drawn from literature on the urban design and architectural aspects of informal settlements. It adapted the key elements in the previous work and provided the specifics of the urban form in its elements both for the dwellings and settlement.

Kellet and Napier's (1995) framework is presented in a simple circular diagram (figure 9) that can be extended to represent the varied points in time (figure 10), whilst in Pojani's, the diagram was transformed into a tabulated form with the specifics identified under each of the elements in the table.

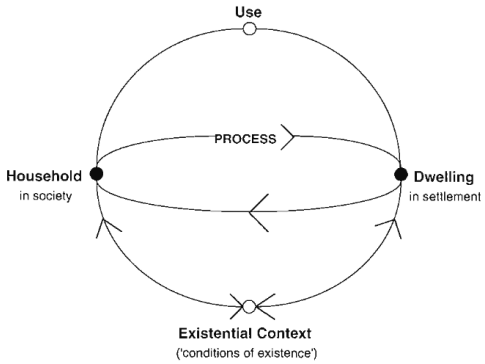


Figure 9 Household and dwelling: key elements and relationships (unidimensional)

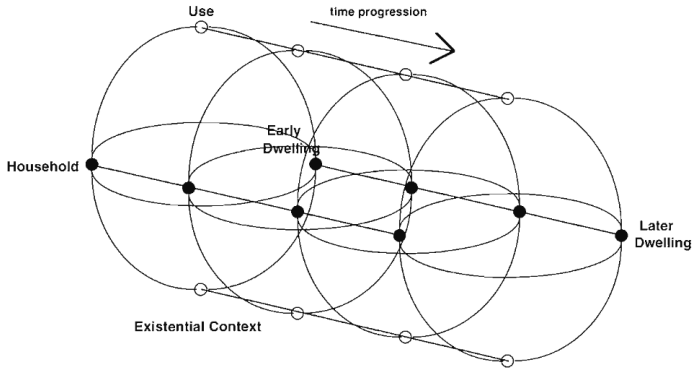


Figure 10 House and dwelling relationships through time (multidimensional)

Building on the previous approach, Pojani's framework is more flexible and can be applied to the diverse setting of informal settlements. The framework can be appropriately applied in this study to investigate the physical characteristics of informal settlements in establishing its potential to be technically adapted and developed into a transitional settlement.

The table form provided the flexibility in applying the framework with the option of using, replacing, or modifying the characteristics under each key element to suit the setting of the study area. It did not consider, however, the value of the adapted framework's distinct feature to plot change over time. Particularly useful for applying in studies with longitudinal data as noted earlier, changes on housing characteristics can be located and plotted over time.

This study, being more cross-sectional in nature, involves collecting data at a single point in time as opposed to longitudinal, where data is collected over an extended period of time. The need to plot change over time, therefore, is not critical in the current study. Should studies, however, be conducted in the future with the same dwellings and dwellers, longitudinal methods will be particularly useful in studying the development and the changes over time.

Considering the provision of basic services in transitional settlements, this will be added in the framework under the key element of "settlement". Aside from the settlement's vulnerability to flood hazards, the lack of basic services adds to their concerns particularly during flood events. Table 6 below shows the adapted conceptual framework, including the additional feature of basic services.

Each of the key elements will be explored to discuss their application to the study. The focus in this chapter will be on the local context, mainly with informal settlements in Metro Manila with the general introduction previously discussed in Chapter 2. The discussion will complement the

earlier section in 2.8, *Informal settlements in Metro Manila*, with more detail probing into each of the key elements as indicated in the tabulated model. The characteristics under each key element meanwhile, will be discussed briefly as a prelude to Chapter 6, *Data Analysis*, where each of the characteristics will be applied specifically to the community under study.

Table 6. Conceptual framework for housing characteristics adapted from Pojani, 2018 (Author's addition [a])

Context (social, economic, cultural, political, institutional- national and local)			
Settlement	**House**	**Dwellers**	**Process**
• Size and location • Layout and density • Land use • Public space • Image and identity • Basic services[a]	• Architecture and symbolism • Materials and technology	• Conditions of existence • Place attachment	• Origins • Consolidation • Gentrification • Redevelopment

3.2.1 Context

Informal settlements have been largely studied within the anthropological, sociological, economic, legal, and political frameworks, but to a lesser extent in terms of urban form and architecture as earlier articulated (Kellett, 2011; Dovey and King, 2011; Ballegooijen & Rocco, 2013; Kamalipour, 2016; Pojani, 2018; Kamalipour and Dovey, 2020). In investigating this research gap, the context in which informality takes place will be considered to guide the research.

The context of informal housing as Pojani (2018) has pointed out, has been framed in two different ways: "emancipatory" frame where bottom-up democratic practices and political participation are made possible in informality; and, as a product of the adverse effects of informality like inequality, poverty, exclusion, and vulnerability to catastrophes. In terms of adaptation and coping capacity from this study's perspective, "resilience" as another contextual framing may be added.

In the midst of poverty, social and political exclusion that repress the settlers' rights, their coping system somehow enable them to bounce back. The persistence and proliferation of these settlements despite being the product of informality constraints, demonstrate the coping capacity of the households and their settlements in surviving disasters. As one of the key elements in the model, *Settlements* will be discussed in the next section including the corresponding characteristics of informal settlements necessary in establishing the urban form and morphology of the community.

Pausing briefly, it is noteworthy to discuss the nomenclature of *informal settlements* in this study. Informal settlements according to Dovey (2013), are defined as “informal” because with the limited choice the settlers have, they transgress the formal rules in terms of land tenure, urban planning, design and construction. The label as Dovey added, is also used to avoid the terms ‘slum’ and ‘squatter’, which it is partially synonymous with. In this study, these terms have been used interchangeably, albeit not casually, based on the terminology used by the published literature cited.

3.2.2 Settlement

Exploring the various features of the settlements will help identify and establish the urban form of the community being studied. With the study’s focus on the informal settlement’s development and with their existence being premised as permanent, the prospects of any appropriate development will depend on a deeper understanding of their morphologies (Dovey and King, 2012). Urban morphology refers to the shape of the city, including its architecture, layout of streets, and different densities of habitation (Calhoun, 2002). This can also be applied to informal settlements in a microcosmic manner that similarly considers the settlement’s size, shape, architecture, layout, and density.

In the local context, the National Housing Authority (NHA) has classified informal settlements in the country into five types according to their location or type of area. These are: 1) private lands/ properties; 2) government owned lands; 3) danger areas; 4) government infrastructure project areas; and, 5) other areas. The ‘other areas’ could include those residing in areas for priority development (APDs) or resettlement areas needing upgrading (HUDCC, 2014). The study’s interest is on the danger areas particularly on the waterfronts or those *tabing-ilog* (by the river) as earlier mentioned.

In terms of *size*, the extent of these settlements varies depending on the number of years they have been established, and the available land for expansion considering the *laissez-faire* attitude of the government. It has implications for what is possible or not possible according to UN-Habitat (2003), in terms of social organisation, community cohesion and future intervention, from which the scale and size of these settlements are distinguished as large, medium-sized, and small settlements.

In Metro Manila, the rapid urban growth has resulted in the explosion in number and size of informal settlements over the decades (HUDCC, 2014), that in all of the 16 cities and one municipality in the NCR, informal settlements are present. One of the largest is Baseco Compound in Manila, situated in a 50-hectare reclaimed land in a low coastal zone that is home to about 60,000 settlers (Valenzuela et al., 2020).

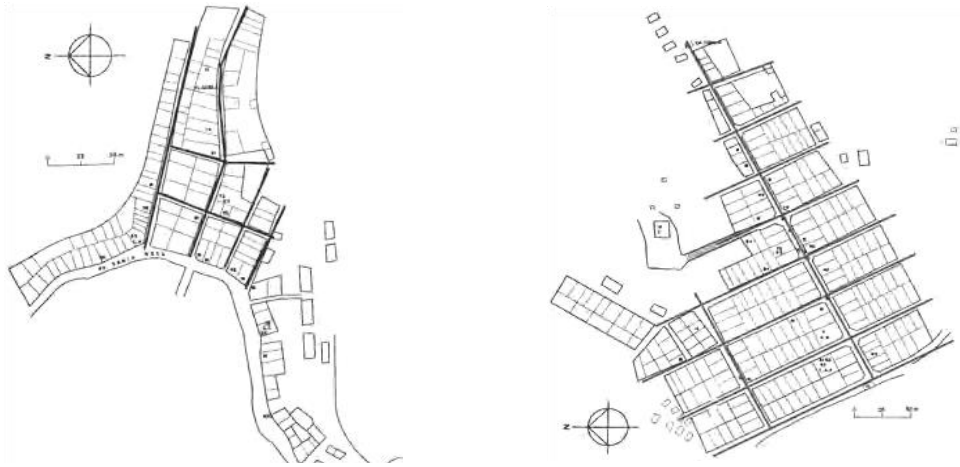
In and around the city, medium-sized or neighbourhood-sized slums according to UN-Habitat (2003), are the most common on lands that have been undeveloped or abandoned as being

difficult or impossible to develop. These settlements are quite effective as UN-Habitat adds, in resisting demolition or relocation because of a formed cohesive community, that supports internal leadership ensuring enough voting power to gain external political support. In the NCR, most medium-sized settlements would have around 2,000 to 3,000 families, or about 10,000 to 15,000 settlers with a third, more or less as voters.

There are also the small pocket-sized slums which are usually scattered throughout the cities containing eight to ten dwellings only, surrounded by formal housing (UN-Habitat, 2003). These are commonly tolerated by the neighbouring residents with the settlers often working as either domestic staff or employees of the formal residents. Depending on available space and government interference, these small settlements could grow into medium size over time.

Related to the *location* is the configuration or *layout* of the settlements. Often seen as chaotic, unorganised and irregular, the configurations may have some similarities, but finding two informal settlements with the same physical and spatial layout is impossible (Fernandez, 2011). Newly developed slums according to UN-Habitat (2003), often used the grid-iron layout for the following beneficial reasons: it is easy to layout; stronger likelihood of obtaining recognition and basic services if settlement is found orderly; and, likely to be fewer disruptions and demolitions when services are installed.

On flat lands, settlements according to Matos (1977) are usually in the form of checkerboard or grid with parallel and transversal street of nearly uniform dimensions (figures 11 & 12). Those on steep slopes as Matos added, are usually configured in an orthogonal type adapted to a radial type of topography with a central corridor in the shape of terraces.



Figures 11 & 12 Grid and orthogonal framed form adopted in a planned occupation. (Source: Matos, M., 1977 as cited by Fernandez, R.A., 2011)

Settlements in Metro Manila would typically start out in a grid-iron pattern and evolve into a convoluted organic form with the infills being invaded by new settlers, extended family, or the succeeding generation. There are those, however, that occupy long narrow spaces making

them linear in nature which are usually found along the creeks, utility rights-of-way, and along the rails (Alcazaren et. Al, 2010).

Irregularly shaped settlements in grid form can be found on both rugged and flat lands (Fernandez, 2011). The streets and corridors within these settlements are developed and determined by topographic features of the terrain for the passage needs of settlers (figure 13). Characterised by winding and tangled corridors, the labyrinthine layout is commonly impervious to outsiders.

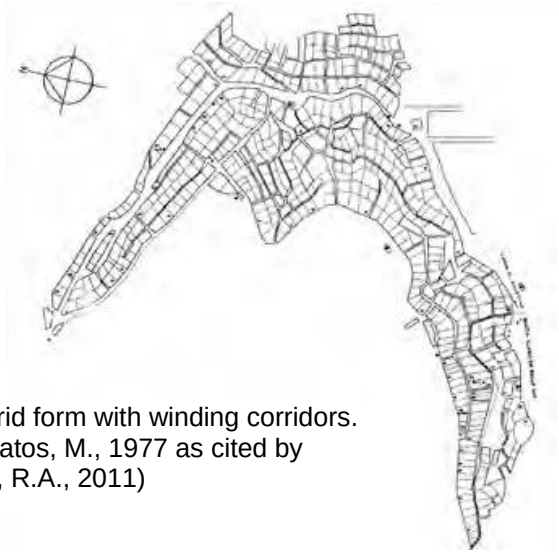


Figure 13 Irregular grid form with winding corridors. (Source: Matos, M., 1977 as cited by Fernandez, R.A., 2011)

With regards to *density*, informal settlements are relatively high density and overcrowded making them walkable, transit-oriented and car-free (Dovey, 2017). Neighbourhoods in close proximity to the urban economic activities, infrastructure, and employment sources, often have a very high population density (Fernandez, 2011), with many housing units often with five or more people sharing a one-room unit (UN-Habitat, 2003). In extreme cases in Mumbai, Mukhija (2001) observed lots ranging between nine and eleven square metres. Similarly in Metro Manila, small lots are subdivided to accommodate extended family in highly dense settlements.

In terms of *land use*, the modifications in the city's landscape are manifested significantly in the changes in the use of land (UN-Habitat, 2003), most of which through urbanisation have been converted either formally or informally. Informal spaces, however, are not always claimed by the poor, but at times by the State itself. Citing Ghertner, Roy (2012) argues that much of the construction in Delhi for instance, can be viewed as unauthorised, violating some planning or building by-laws. With the high value of land, its informal acquisition is not exclusive to the squatters only.

The land use function of informal settlements is typically mixed-use, with residential areas interspersed with commercial and institutional areas. Settlements in Metro Manila typically have small-scale industries mixed with the dwellings such as junk shops, repair shops, bakeries, and the ubiquitous *sari-sari* (variety) store, that can be found in every block of the settlement. Institutional structures like day care centres and places of worship, can also be found inside the

settlements intermingling with the dwelling areas. Commercial activities could be vast helping generate income not only for the community, but for the city itself. Dharavi in Mumbai, for example, as the centre of small-scale industries with its dwellers manufacturing products for global markets (Roy, 2005), is reported to turnover US $665 million annually (Roy, 2011).

For the *public spaces*, open areas such as pathways, alleys, and vacant lots serve as the public space in the community where residents congregate. As mentioned earlier, the basketball court is an essential public space in informal settlements. The settlers make use of public open space in their immediate surroundings as social spaces which allow them to build relations in the community. Streets and alleys being the only available open space within the community, are also utilised as play areas by the children.

In the context of *image and identity*, informal settlements have been generally viewed as a visual and social pollution that is a blight upon the city and state (Kellett and Napier, 1995; Lico, 2008; Kellett, 2011; Dovey and King, 2011). Comparing informal urban environments with traditional vernacular architecture, Kellet (2011) argues that studies have frequently produced analyses that are naïve focusing on visual appearances independently of social structures and economic conditions.

The popular view today remains to be that “blight upon the city” which according to Dovey (2017), is linked to squatting, corruption and poverty - the very reason why governments make these settlements invisible and disconnected from the formal city. The negative view on this built form, Kellett (2011) adds, should be examined alongside process aspects where the ideological and economic contexts in the production of such environments are accommodated.

The chaotic image, however, may just be the opposite of what the settlers themselves perceive with what Lynch (1960) described as *Legibility* in his seminal work *The Image of the City*. The districts, landmarks, and pathways can be easily identified and grouped into an over-all pattern only by those who created and live in them, whilst outsiders may find the community “illegible”, that is, not being able to recognise the symbols nor visually grasp the elements as related patterns. Lynch argues that there may be little in the real object that is ordered, but with its mental picture gaining identity and organisation through long familiarity, it provides for the coherence of the image.

The *identity* of the informal settlement has been established in contrast with the formal communities. As Kellett and Napier (1995) argue, their identity has been achieved by comparing with the formal, what they do not have, and what they are not. Their definition Kellett (2011) adds, have been traditionally in negative terms in relationship to the formal aspects of the city such as - absence of legality, substandard space and infrastructure, and absence of permanent materials.

In terms of *basic services*, the delivery of services such as water, electricity, sanitation, and waste management as a core function of the government, is characteristically lacking in informal settlements. Correlating closely with the health and well-being of the residents, insufficient basic services also hinder their efforts to overcome vulnerability where they spend more time and resources according to Avis (2006), seeking alternative provision which are often of poorer quality and higher cost.

Constraints to service delivery in developing countries are further exacerbated by the pace and scale of urbanisation (Avis, 2006), which Duflo et al. (2012) categorised in three ways: 1) *supply constraints*; 2) *demand constraints*; 3) and, *institutional constraints*. Supply constraint could typically be the prohibitive cost of providing services given the technical complexity on the existing urban form of informal communities. Demand constraints would be the inability of the residents to pay for the basic services forcing them to purchase informally, whilst institutional constraints would be the challenges of managing the services effectively by the local government.

Without the basic infrastructure in the community, services will remain unaffordable for the residents. In the NCR, services are often accessed informally through neighbours with legitimate utility connections or lines from service providers. Power and water consumption is also metered with the buyers providing their own “sub-meters”, paying the sellers more than what the service providers charge for profit.

The community’s lack of basic services and infrastructure is a distinct characteristic of informal settlements (UN, 2015). This characteristic together with the others discussed above under the first key element of *Settlement*, will help identify in the local context the urban form and morphology of the informal community. This will then be applied to the case of the community under study, to help determine its potential to be technically adapted and develop to form a transitional settlement. The houses that constitute the settlement, will be explored and discussed in the next section.

3.2.3 House

As the second key element in the conceptual model, the houses that individually constitute the settlement, collectively make up the urban form and architecture of the community. The house will serve as the unit of analysis in this research investigation, which will help establish the dwelling typologies in the settlement. The typologies could be determined by exploring the dwelling architecture including the symbols it elicits, as well as the materials and technology utilised to create the dwelling. The housing types will then be used to evaluate their respective behaviour to flood events, which will help establish their technical adaptability in potentially developing to form a transitional settlement.

Informal settlements can be referred to as *vernacular architecture* in the urban context using available materials in the vicinity to build a makeshift house or shanty with one's own hands. This method according to Lico (2008, p. 21), is the essence of the vernacular mode which can be described in the local context, "…as a term broadly applied to symbolise indigenous, folk, tribal, ethnic or traditional architecture found amongst the different ethnolinguistic communities in the Philippines". Its architecture according to Ghisleni (2020), is related to its context strongly influenced by the geographic features and cultural aspects of its surroundings.

A typical shanty can be traced back to the quintessential rural dwelling known as the 'bahay kubo' (nipa hut) as discussed previously. Constructed from available indigenous materials like bamboo, wood, rattan, and nipa (as the predominant material used, hence, its name), the nipa hut is the epitome of domestic vernacular architecture in the Philippines (figure 14). Elevated by stilts with the lower area used as storage area or as domestic animal pen, the upper floor serves as the main dwelling area. The dwelling is usually without partitions and used multi-functionally as living, dining, and kitchen area at daytime, and sleeping area at night.

Figure 14 A typical bahay-kubo (nipa hut). (Source: Lico, G., 2008).

In the urban milieu where code-compliant dwellings are the norm, urbanised nipa huts *symbolise* the poverty and daily struggles of its residents. These settlements in the local context can be broadly classified by construction or building material type: a) temporary shelter made from salvaged materials; b) semi-permanent made from a combination of second-hand durable material; and, c) permanent shelter made of concrete, hollow blocks, and galvanised iron sheets (UN-Habitat, 2003; Lico, 2008).

The shanty as a temporary shelter, makes use of *materials* available in the immediate environment similar to the traditional nipa hut dwelling. This could range from recycled wood, plyboard, roof sheets, canvass, tarpaulins, and plastics. The original form of the nipa hut, can be discerned in most informal dwellings with the use of "light materials, raised floors, multi-

function spaces, and nuclear families" (Alcazaren et al., 2010). The houses are usually built on stilts as defence for floods, particularly those along the river and coasts.

The *technology* adopted from the nipa hut by the urban dwellings according to Lico (2008, p.24, 58), "…is sustained through independent evolution and the accumulation of local wisdom", with its architecture as "…an interesting case of a genuinely adaptive application of the vernacular mode in an urban environment". Built incrementally depending on the availability of materials, the dwelling layout is flexible to changes to accommodate growing or extended family.

Without giving attention to social and economic functions nor to planned aesthetic values, these dwellings according to Lico (2008), represent the creativity and ingenuity of the dwellers to spontaneously build sustainable shelters. Out of poverty, the designer, builder, and dweller who reinvented the "shanty", as "…a degraded vernacular architecture mode" (ibid., p. 59), will be discussed in the succeeding section.

3.2.4 Dwellers

In Metro Manila, formal housing was made inaccessible to the poor according to Davis (2006), by land inflation. As Bankoff (2003a) reported, the 1980s land prices rose from between 35 to a whopping 2000 times in some cities in the metropolis, continuing on in 1986 where the central business district (CBD), increased by 50 percent annually whilst those in the peripheral areas, rose by about 25 percent. In the context of declining formal employment, land inflation as Davis (2006, p. 92) argued, "…has been the piston driving this compression of people".

These people will be the subject of this section as the *Dwellers* in the conceptual model, with its features of *conditions of existence*, and *place attachment*. Playing the roles of both the designer and builder, they are responsible for the urban form and architecture of the community. The dwellers who built the houses and the community in essence, are the primary source of information in this study.

The settlers are mainly migrants either rural to urban or urban to urban (Lico, 2008), who are low-income wage earners employed informally. Commonly employed in the city serving the formal communities, they serve as domestic helpers, drivers, gardeners, cooks, or nannies, who according to Alcazaren et al. (2010), make up "…this veritable army of help who did not live with their 'masters', but live nearby". Others land formal jobs in factories or manufacturing firms, earning minimum wage.

Not all informal settlers, however, are poor either having worked their way out of poverty, or out of their parents' or guardians' grit, earn college degrees and become professionals landing a better paying job here or abroad. Job promotion or family growth are some of the incremental changes in a household's "conditions of existence" (Pojani, 2018). Stea and Turan (1990) refer to *conditions of existence* as material conditions and cultural conditions taken together, and accompanied by conditions of change coming from outside of society. These changes are

usually reflected in house design such as alterations or improvements which according to Pojani (2018), are accommodated by making the most of the home which is the dweller's main or sole asset.

Learning the material and cultural conditions from the dwellers will help to better understand the self-built urban form and architecture of the community. The local culture of extended family for instance, as widely practised in the region, could substantially affect the *Settlement* features of *size, layout and density*. The culture of "bayanihan" (community spirit) commonly being practised as well, would have markedly effects on the *Dweller* feature of *place attachment*.

Described as an affective link between individuals and their environments, Altman and Low (1992) defined place attachment as a positive emotional bond between individuals and groups and their environment. Place attachment is amongst the three place constructs together with place dependence and place identity, that make up the sense of place - the meaning attached to a spatial setting by a person or group (Jorgensen and Stedman, 2001). Long-term interactions with a place create memories and this accumulation of experience and memories according to Manzo (2005), create place meaning.

Designers and planners may learn lessons from the dwellers on how to design and plan spaces in informal settlements with every available space maximised for practical use. The design goes through a process from its *origins* to the *consolidation* of dwellings, *gentrification* in some cases, as well as *redevelopment*. This key element of *Process* with its four mentioned features, will be explored in the ensuing section.

3.2.5 Process

The process behind the origin of informal settlements and the development of their urban morphology, to the prospects of their redevelopment, are essential in identifying its urban form and architecture. In terms of their origin in the metropolis, settlements near formal villages, "…sprouted first with the construction of the sprawling bungalows […], where labourers would eventually end up as help, their wives as domestics, and relatives – for other roles necessary to keep these enclaves running" (Alcazaren et al., 2010, p. 53).

With regard to *consolidation* in the household level, family growth determines the expansion of the house where additional rooms are provided either horizontally or vertically to accommodate new family members. When members opt to move out particularly married children starting their own families, vacated rooms can be leased out for additional household income, or converted to commercial spaces to accommodate micro-enterprises such as *sari-sari* (variety) stores, *carinderias* (eateries), or workshops.

On the community level, *consolidation* of commercial and institutional with the residential function, eventually evolve as a microcosm of a city, where the basic physical and spiritual needs are made available. This process may involve the feature of *gentrification* where

outsiders could either rent or buy out houses for *redevelopment*, and establish commercial or residential areas unaffordable for the original dwellers, forcing them to move out or relocate.

Through government intervention, formal *redevelopment* in Metro Manila happens through an on-site housing development programme. The NHA after acquiring occupied lands, will provide on-site improvement through the introduction of roads or alleys and basic services (HUDCC, 2014). The process of on-site development, however, is often hindered with the legalities of land ownership and the availability of temporary relocation sites whilst redevelopment is on-going. These challenges make informal urbanisation, the pragmatic solution to the housing issues hounding the metropolis.

3.3 Summary

The conceptual model adapted to study the urban form and architecture of informal settlements, was discussed at the outset of the chapter, justifying its application in this study. The model's development was presented from the original concept, to its adaptation by Pojani in table form that leads to its adoption in this study. The key elements and their characteristics synthesised from existing views in the literature, were presented in the local context through the settlements in Metro Manila.

Building on the model, basic services as a requirement in transitional settlement development, was added to address the general issue on its inadequacy or non-delivery in informal settlements. This addition will serve as a prelude to the investigation on the condition of services in the study area in terms of availability and delivery. The adapted conceptual model will be applied to the community, discussing the characteristics of the settlement and their interrelationships to help address the main research question.

As earlier mentioned, this study subscribes to the idea of legitimising illegal tenures and permitting temporary structures, but in the context of planned development where the environment and social vulnerabilities will be taken into consideration. Alternative urban designs involving planners and designers in public housing, could consider the innovativeness and creativity involved in self-building both houses and community, through local knowledge as presented in this chapter. The methodology of collecting this information from Sitio Gulayan community, will be the subject of discussion in the ensuing Chapter 4 – *Research design and methods*.

4 Chapter 4 Research Design and Methods

The chosen methodological approach is set out in this chapter discussing with some justification and rationale the different techniques employed, making reference to some recognised methodological textbooks. The chapter begins with the summary explanation of the study itself, and takes a step back to consider the different elements and approaches that could have been incorporated into the research design, before finally justifying the appropriateness of the chosen approach for the study. The chapter then presents in detail, the various data collection methods employed in the study.

4.1 Introduction

The community of Sitio Gulayan is located along one of the eight declared priority major waterways in Metro Manila, Tullahan River, which ranks third in terms of the number of informal settler families (ISFs) occupying its banks. The research focus is to develop a thorough description and analysis of the community which will provide a comprehensive understanding of the study area, whilst the research problem involves the investigation of the community's technical adaptation for resilience building and development to form a transitional settlement.

Possible research approaches that can be employed in this type of study from methodological references, are phenomenological research, grounded theory research, ethnographic research, and case study research. Based on the research needs in terms of research focus and research problem, Creswell and Poth (2018), distinguished the possible applicable approaches in the adapted flowchart in figure 15 below.

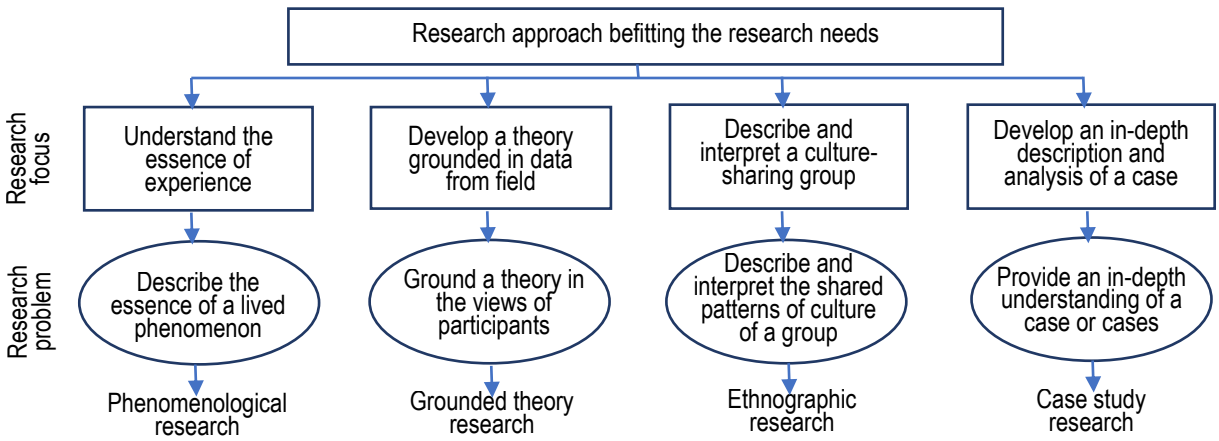


Figure 15. Flowchart for assessing research approach fit with research needs (adapted from Creswell and Poth, 2018)

Considering the study's particular research focus and problem, together with the research question seeking to explain the contemporary circumstance of flood hazard adaptation that requires an extensive and in-depth description, the case study research was the clear methodological path to follow (Yin, 2018), amongst the reviewed approaches.

4.2 Case study design and mixed method approach

Case study research according to Creswell and Poth (2018), is a type of design in qualitative research on the one hand, which involves the exploration of a real-life, contemporary bounded (within specific place and timeframe) system over time, through the detailed data collection from multiple sources of information. Yin (2014) on the other hand, advocates both qualitative and quantitative approaches to case study development.

With Sitio Gulayan community as the object of study or the case, the inquiry approach was able to meet the study's research needs where the dwellings in the community served as the units of analysis and the household members, particularly the head of the family or the decision-maker in the household, as the primary source of information. The research design also allowed to retain a holistic and real-world perspective in studying the residents' behaviour and changes in the neighbourhood (Yin, 2018).

Sitio Gulayan community was utilised as a specific case illustration to explore the problem of flood risk reduction and resilience building in flood-prone settlements. The researcher was able to report a case description and the case themes, through the detailed data collection and integration of multiple forms of data. Varied sources of information were gathered from documents, survey, interviews, observations, and visual recordings, with the utilisation of the mixed method approach as discussed in the succeeding sections.

The study employed the mixed approach of quantitative and qualitative methodologies, with Sitio Gulayan being studied and examined to understand the community's urban form and architecture as a floodplain settlement. The mixed method adopted the explanatory sequential design (Creswell and Clark, 2010) with the quantitative data collection and analysis initially conducted, followed up with qualitative data collection and analysis, leading to the interpretation process (figure 16).

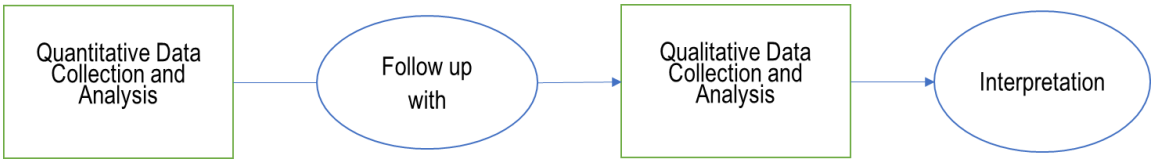


Figure 16. Mixed method explanatory sequential design
(adopted from Creswell and Plano Clark, 2010)

The data gathering for this study was divided into two parts. The first part was the data collection from the survey questionnaire that established the housing typologies and the housing characteristics, whilst the second was the data collection from the interviews and observations, that were related and influenced by the first part of data collection. The extensive scale of data required for the research project as indicated in table 7, was the prodigious

challenge in this study. The data required with the proposed collection methods, sources, and analyses, in relation to the research objectives are shown in the table below.

Table 7. Data requirement, collection method, source, and analysis

	No.	Research Objectives	Data required	Data Collection Methods	Data Source and Analysis
Housing and settlement characteristics	1.0	To characterize and assess the spatial organization and urban form of the informal vulnerable community of Sitio Gulayan	Settlement characteristics • Size and location • Layout and density • Public space • Basic services ○ Water, electricity, and sanitation	• Document review • Survey questionnaire • Interviews • Urban mapping	• Government agencies (PSA, DENR, NWRB, MWSS, Maynilad, MERALCO, and DOE) • Satellite imagery from Google Earth ○ Historical imagery
	2.0	To form a classification of the dwelling units in Sitio Gulayan according to the typologies of urban form, and the building materials used and house design in terms of vulnerability	Housing characteristics • Materials: floor, wall, roof, and plinth • Measurements: size (floor area), ground floor height (ground clearance) • No. of storeys	• Document review • Survey questionnaire • Interviews • Field observation with visual recording	• GMMA Exposure Database • Other published work ○ Typology based on building materials used
Flood damage assessment	3.0	To identify and evaluate a range of flooding scenarios, based on both the historic event record and other published work together with broad constructs for, i) key co-variables, and ii) the currently adopted indicators for a range of damage and impacts within the community	Historical flood events • Highest flood events ○ Typhoon Ondoy (Ketsana) 2009 ○ Habagat (SW monsoon) 2013	• Document review • Survey questionnaire • Interviews • Field observation with visual recording	• NDRRMC, PAGASA, and UP-NOAH ○ Comparative assessment on flood impacts ○ Flood damage assessment
	4.0	To express the relationships between designs (in objective 2) and related flood impacts (in objective 3) on the community and urban form.	Damage information • Flood height/depth • Duration (days) • Damage extent (floor, walls, roof) • Repair cost	• Document review • Survey questionnaire • Interviews • Field observation with visual recording	• NDRRMC, PAGASA UP-NOAH, and GMMA RAP ○ Vulnerability curves on depth-damage relationships
	5.0	To analyse current flood mitigation approaches that could apply to the exiting urban form of Sitio Gulayan	• Structural measures for flood mitigation	• Document review • Field observation with visual recording	• Other published work

(PSA- *Philippine Statistics Authority;* DENR- *Dept, of Environment and Natural resources;* NWRB- *National Water Resources Board;* MWSS- *Metropolitan Waterworks and Sewerage System;* Maynilad- *Maynilad Water Services, Inc.;* MERALCO- *Manila Electric Company;* DOE- *Department of Energy;* NDRRMC- *National Disaster Risk and Reduction Management Commission;* PAGASA- *Philippine Atmospheric, Geophysical and Astronomical Services Administration;* UP-NOAH- *University of the Philippines Nationwide Operational Assessment of Hazards*)

The researcher dealt with the breadth of information that were collected and analysed to address the objectives and aim of the study, which ultimately provided the answers to the main research question. In dealing with the qualitative data collection, the methods utilised were, document review, semi-structured interviews, observations with visual recordings, and urban mapping. For the quantitative method, the data collection employed was the survey questionnaire that was distributed and retrieved door-to-door from the participants.

The mixed method approach provided the synergy amongst the different data collection methods, particularly the survey questionnaire responses that influenced the interview questions crossing over the field observations. The flood damage assessment was also confirmed by the field observations conducted, with the visual recordings documenting the building materials used and flood height levels in the dwellings. Figure 17 below shows the linkages between the different data collection methods.

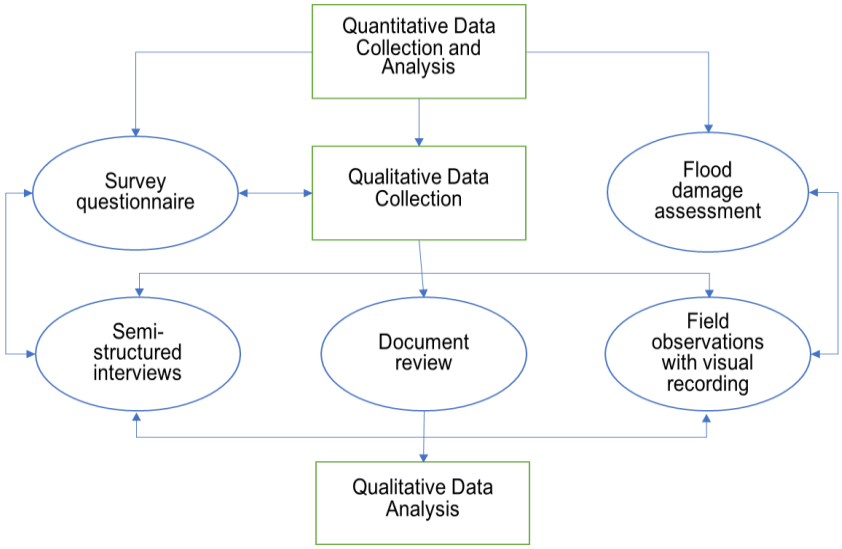


Figure 17. Mixed method data collection linkages (by author)

4.3 Qualitative method

The research problem in this study should address the meaning individuals or groups attribute to a particular social or human problem. To study this problem, Creswell (2013) recommends the use of qualitative approach to inquiry, the collection of data in a natural setting sensitive to the people and place under study, and data analysis that is both inductive and deductive to establish patterns or themes.

Under the qualitative approach in this study, various methods were employed to collect data as discussed in the succeeding sections and through the integration of these methods, the final presentation of the study will include the voices of participants, the researcher's reflexivity, a complex description and interpretation of the problem, and ultimately, the study's contribution to the literature (Creswell, 2013).

4.3.1 Document review

Studying documents related to the research problem was the first method in data gathering for this study. Information was collected from multiple sources such as newspapers, books, journal articles and other published works, reports from international organisations like UN - Habitat, USAID, ADB, and The World Bank Group, as well as local reports on urban flooding and informal settlements.

Pertinent information pertaining to local historical flooding and flood damage was also collected from government agencies such as the *National Disaster Risk Reduction and Management Council* (NDRRMC), *Philippine Atmospheric, Geophysical and Astronomical Services Administration* (PAGASA), and *University of the Philippines Nationwide Operational Assessment of Hazards* (UP-NOAH).

For r\esidential depth-damage information, references were gathered from government projects such as the *Greater Metropolitan Manila Area Risk Analysis Project* (GMMA RAP) and similar published works. The information collected was used in the flood assessment damage to address the study's objective of expressing the relationships between dwelling designs and the related flood impacts (see table 7, no. 4).

The building classification schema from the *GMMA Exposure Database* was also utilised as reference for the structural classification of buildings, together with published case studies and theses on informal settlements in the Philippines. The schema broadly grouped buildings into four main categories: wood; masonry; concrete; and, steel. The data gathered were used as reference on the descriptive information of the buildings that were converted into numerical values for every specific level of damage.

The descriptive information addressed the study's objective of forming a classification of the dwelling units to propose an initial ranking of materials and design in terms of vulnerability (table 7, no. 2). Vulnerability according to UNDRO (1980), is the degree of loss to a given element at risk or set of such elements resulting from the occurrence of a natural phenomenon of a given magnitude and expressed on a scale of 0 (no damage) to 1 (total loss). The damage function in this study, similarly, estimated the damage as a value between 0 to 1 with the following scales adapted from *GMMA RAP*: 0 = no damage; 0.2 = slight damage; 0.4 = moderate damage; 0. 6= heavy damage; 0.8 = severe damage; and, 1.0 = total damage.

4.3.2 Semi-structured interviews

The principal uses of case study according to Stake (1995), are to obtain the descriptions and interpretations of others. Discovering and portraying the multiple views of the case can be attained through interview which Stake (1995, p. 64) argues, "…is the main road to multiple realities". In this study, sets of questions exclusive to each of the different group participants based on the reviewed literature, were formulated for the semi-structured interview engagement.

Semi-structured interview was adopted to collect new and exploratory data, where other data sources can be triangulated. It was also utilised for its applicability in working with complex issues where probes and impromptu questions can be used to explore, understand, and clarify answers to questions (Wilson, 2014). With the mixed methods approach, interviews were used in the qualitative phase of the study to explore new concepts and to explain results from the quantitative phase (DeJonckherre and Vaughn, 2019).

The interview participants consisted of the residents of the community (n=30), former and current community officials who are also residents of the community (n=4), and the Barangay officials (n=3). For the local government unit, a staff from the Housing Department, who is also an official in the organisation for the urban poor of the city was interviewed. Majority of the key informants were interviewed inside the covered basketball court in the Barangay Centre, to follow the health protocols required amidst the COVID-19 pandemic.

The 30 residents interviewed were chosen from the complement of survey respondents to represent the 6 housing typologies identified from the survey results, with 5 participants for each typology. Preliminary investigation gave rise to identification of 6 housing types and in discussion with the Supervisory team, it was decided that having a representative number from each of those different housing types would make a coherent sampling approach for the purposes of the interview phase. Each of the interviews with the residents lasted between half an hour to an hour. The community officials were interviewed after concluding the resident interviews, purposely to include the insights from the residents as part of the interview. Similarly, the interview with the Barangay officials was conducted subsequently, to include in the discussion the insights of the residents and the community officials. The Barangay officials were composed of administrative personnel and an official involved in the Disaster Risk Reduction and Management (DRMM) in the city. The interviews with the community and Barangay officials lasted for about an hour and a half.

The sample size for the interview between 30 to 60 was the targeted number to obtain data that will sufficiently describe the housing characteristics and flood impacts to address the research aims and questions. The larger target number of participants, however, was not achieved with the resultant restrictions from the on-going pandemic during the data collection phase in the study. The numbers achieved nonetheless, were able to attain saturation based on the initial analysis, where additional participants to the study did not result to any new information or perspectives.

Interview questions aside from being influenced by the responses in the survey protocol, were drawn from the literature with those for the resident participant group revolving around pre-flood and post-flood events, and perceptions on these events in relation to physical adaptation, design approaches and building technology. For the officials of the community, barangay, and city government, questions involved disaster risk reduction management (DRMM) programmes, community mortgage programme (CMP), structural and non-structural measures on flood mitigation, and basic services including infrastructure facilities delivery (see Appendix A).

Interview protocol for residents (Appendix A.1)

In formulating the interview questions for the residents, three sections were included- *General Information* related to the socio-demographic variables to gather the participant background; *Housing and Settlement* to probe about the characteristics of the dwellings and the community;

and, *Adaptive Capacity and Damage Assessment* to learn and understand the lived experiences of the participants during flood events and how they were able to cope.

Housing and Settlement were further subdivided with the first two questions under *Housing* related to the participant's migration background and ethnicity to conclude the socio-demographic line of inquiry from the first section. The succeeding questions pertained to the security of tenure and livelihood sources, informed and influenced by the issues discussed in the article *Climate Change Vulnerability and Adaptation in Metro Manila*, where it was argued that the vulnerability of the metropolis is heightened by "…the large portion of its population that does not have security of tenure in their housing, jobs, and livelihood sources" (Porio, 2014 p. 84).

Under S*ettlement*, the line of questioning in the first two inquiries involved the state of basic services in the community related to land security, as one of the major issues raised by Morrow (1999) and Cutter et al. (2003) cited by See and Porio (2015) under their article section *Correlates of Social Vulnerability.* The authors asserted that those with no land security tend to not have adequate access to electrical, water, and sewerage services, and may also lack access to information about disaster and aid during recovery.

The ensuing five questions probe the community and the dwelling location in relation to flood frequency and susceptibility followed by the last question, probing about the prospects of relocation given the state of the community's vulnerability to flood hazards. These were influenced by the issues raised in resettlement where Oliver-Smith (1991) posited, that a very high percentage of cases of resettlement have evoked a response of active resistance.

The line of questioning was also informed by the functions of sense of place, with place attachment as one of its concepts in mitigating flood experiences. In the literature by Anacio et al. (2016), it was inferred that seen as a functional mechanism, sense of place allows residents in a flood-prone community in Los Baños, Laguna, to adapt and maintain their residency within the community. They further suggested that in addition to other environmental and social variables, "…sense of place should be incorporated for interpreting the rationale of residents living in flood-prone areas" (p. 108).

The interview questions in the last section, *Adaptive Capacity and Damage Assessment*, focused on the line of questioning related to physical adaptation and damage sustained from the two experienced extreme flood events. Under physical adaptation, the first two questions referred to the preparations being practised by the residents in anticipation of flood events, and modifications effected on the dwellings, including the costs incurred for flood resiliency.

These questions were informed by the findings from a 2018 nationwide household survey in the Philippines, addressing disaster resilience and preparedness. The report of the *Harvard Humanitarian Initiative* (HHI) under the section *Barriers and Opportunities*, found out that one-

third of Filipinos reported spending money on household preparedness in the last year, and stated that if they had more money and resources, they would have invested in emergency supplies and strengthening the house (Bollettino et al., 2018).

Another influence in the line of inquiry for the remaining questions under physical adaptation, were the findings in the study by Lopez-Marrero and Tschakert (2011), about enhancing community resilience in a flood-prone municipality in Puerto Rico. The findings in their *Discussion* section suggested that, "…increasing resilience to floods in these communities, requires promoting social learning by building on existing knowledge about floods which refers to combining different types of knowledge, with explicit recognition of local knowledge" (p, 244).

For the last part of the section under *Damage Assessment*, questions related to the lived experiences of the residents from the extreme flood events and the damaged caused, including the estimated costs in the aftermath of the events were queried. This line of inquiry was informed by the reviewed literature of a research project by the *Asia-Pacific Network for Global Change Research* (APN) in measuring the physical, economic and social losses in the case study cities which included Manila. The findings are expected to improve the understanding of adaptation interventions coming from both the government and the communities.

In the APN's Manila case study on TS 'Ondoy' damage in terms of losing household assets, almost half or 45 percent of the surveyed households reported having lost severely, whilst 30 percent lost mildly and 16 percent had negligible losses. In terms of spending for the affected residents, those mostly in low- and middle-income households, spent at an average of Php12,000 pesos to repair their damaged homes and appliances (Porio, 2011).

The report finally highlighted the huge monetary burden of the flood impacts borne by the community, especially by the poor and vulnerable informal sectors that are often unaccounted for in usual damage impact assessment study. It concluded that integrated and coordinated efforts from all agencies including local government, planners, public utilities and community at large, is key to working towards greater adaptation to future climate risks for the city (Patankar et al., 2011).

Interview protocol for community, barangay, and city officials (Appendices A.2 & A.3)

In the interview questions formulated for the officials, three sections were similarly created with *General Information* for the background of the participants; *Settlement and Housing* to probe on the various roles of the officials on land appropriation and dwelling construction; and, concluded by *Housing Programme and Future Plans* to investigate and learn about the past, current, and any future plans and programmes for the community.

Under *Settlement and Housing*, the initial question was about the land ownership in the community followed by the total number of residents including building rules and regulations. These questions were influenced by the approved site development plan of Sitio Gulayan in

1992 as part of the community mortgage programme (CMP), where there were 804 individual lots allotted for the homeowners of the community. The current situation, however, showed that the population more than tripled from the original planned development, and that practically no construction rules and regulations are being imposed by the Homeowners' association (HoA) except for the lot encroachment.

The succeeding questions on the second section were related to the basic services delivery and those mainly affected during flood events. The line of questioning was informed again by the national survey conducted by *HHI* (Bollettino et al., 2018), where the results in chapter 2 section 2.4, *Access to Basic Services and Transportation*, indicated that in Metro Manila more than half of the respondents reported to have "good" or "very good" access to healthcare facilities (64%), transportation (68%), safe drinking water (82%), and access to an evacuation centre (54%).

The first four questions in the last section, *Housing Programmes and Future Plans,* relate to the current housing programme (CMP) and other future programmes, if any, for the community. The line of inquiry was influenced by the *Philippine Institute for Development Studies* (PIDS) report on the assessment of CMPs in 2015, where it was found out that the programme has been slow to respond to the demand it created and needs to be improved with regards to service delivery and programme organisation.

The report also revealed that the mechanisms of the programme's service delivery tend to exclude the poor from participation due to: the cost of land in the city; inclusion of non-resident households in community associations for both on-site and off-site communities; and, effects of substitution where the poor may actually be the ones defaulting in payment and getting substituted in the programme (Ballesteros et al., 2015).

The remaining questions for the section involved flood mitigation and response to calamities and hazards informed again by the article *Climate Change Vulnerability and Adaptation in Metro Manila.* The findings in the survey indicated that an overwhelming majority (70%) of respondents identified the barangay or city LGU as responsible for preventing and responding to hazards and calamities, whilst others identified family (17%), the civil society (8%), and the private sector (5%) as being responsible (Porio, 2014).

The same study finally, identified the glaring absence of a regular systematic training and capability programme for the staff of the agencies responsible for disaster risk reduction, and more significantly, for the flood-prone communities and residents. Only 25 percent of the respondents were also aware of the existence of the disaster risk reduction and management council (DRRMC) in their city and barangays, resulting to a very low (less than 10%) response rate on suggestions for a more efficient service from their DRRMC.

4.3.3 Observations and visual recording

To complement the interviews, field observations were conducted to validate the responses of the participants particularly those pertaining to the physical characteristics of the dwellings and the urban form of the settlement. Observations in unplanned settlements like Sitio Gulayan, helped to understand spatial attributes and utilisation, as Gehl and Svarre (2013) cited for instance, in addressing why some spaces are used, and others are not.

Field observations were conducted on the overall setting of the settlement and the physical conditions of the dwellings and its surroundings. The activity was carried out with the guidance of the assigned Research Assistants (n=6) headed by a Barangay Health Worker, who are all residents of the community and, therefore, familiar with the people and the place. Courtesy visits to the office of the Barangay Chairman and the house of the HoA President were initially conducted to secure access and permission, before proceeding with the key informant interviews.

The data collected from the field observations, supplemented the answers from the detailed questions queried relating to housing characteristics such as the building materials used and the number of storeys, to help establish the structural classification of dwellings. Other data variables such as floor and wall heights, ground clearances, including post-flood level depths, were also collected through field measurements to calculate and develop depth-damage curves for the assigned building types.

The effects of interaction between water and the building materials were observed with the extent of building damage from post-flood events documented by photographs. With both the verbal and written consents from the participants, photos of the dwelling owners were also taken pointing or demonstrating the level of flood in their houses, and the damages incurred from the past extreme flood events.

On the whole, the visual recordings to support and complement the data collected from observations, have been vital in filling the possible gaps of direct observation (Peimani and Kamalipour, 2016), assisting to analyse the situation more closely (Kamalipour, 2016), and in sharpening the gaze of the observer (Gehl and Svarre, 2013).

4.3.4 Urban mapping

The study involved exploring and identifying the urban form of the settlement. Mapping as a technique, whilst useful according to Kamalipour (2016), at the city scale spatial concentration, access network, and construction materials, was also suitable at the neighbourhood scale for the same reasons, and additionally, to determine the urban form and morphology of the community.

The spatial distribution and growth pattern of Sitio Gulayan community, were investigated with the aid of satellite imagery from *Google Earth Engine* using the historical imagery feature in the

geospatial analysis platform. The historical imageries were useful in determining the spatial growth and evolution of the study area from the imagery acquisition dates in the years 2001 and 2020 as provided in the images below (figures 18a and 18b).

Figures 18a & 18b. Sitio Gulayan historical imagery with acquisition dates on June 2001 and January 2020 (source: Google Earth)

It can be noted from the images that Sitio Gulayan community in 2001, followed an almost gridiron pattern that has evolved into an organic form occupying available open spaces in 2020. The images also provided the basis for a spatially referenced housing typology and infrastructure databases (Abbott, 2002) in this study, as discussed in the succeeding sections.

4.4 Quantitative method

Adopting an exploratory sequential design mixed method, quantitative data were collected primarily through a survey questionnaire distributed door-to-door and retrieved from a sample size of 150 residents. Roughly 10 percent of the originally estimated total number of families at 1500, the number equated to a confidence level of 95% and confidence interval (margin of error) of 8% for a population of 7500 (1500 x 5 members).

However, during the collection of qualitative data, the population estimates turned out to vary between 2500 (from a community official) to 3000 (from a barangay official) families. Typical of an informal settlement, population figures are not being monitored nor can accurately be determined either by the local government or the community itself. From the initial analyses of both the quantitative and qualitative data, it was observed nonetheless, that additional participants to satisfy the 10 percent sampling size with the respective confidence level and confidence interval, will not in any way change the findings significantly.

The community of Sitio Gulayan was divided into five main zones to distribute the survey forms to 30 respondents in each zone for a total of 150 participants. The map below (figure 19) shows

the different zones divided further into sub-zones, that will be used as identification code for the anonymity of the survey respondents. The survey forms were assigned control numbers for proper distribution and retrieval as discussed in detail in the next section.

Figure 19. Map of Sitio Gulayan with the five main zones showing the assigned participant House I.D. and Block I.D

4.4.1 Survey protocol

The survey respondents were mainly the household heads or members authorized by the head to maintain gender balance (Dangol and Carrasco, 2019). The family head in this study is the decision-maker and/or provider in the household, who is the ideal representative sample being in the foremost position to respond to the survey protocol about housing characteristics, history, and related future housing plans (see Appendix B). With the survey questionnaire singly distributed and retrieved door-to-door, the 150 target respondents were able to return all their accomplished forms. For those who are not willing to participate, the forms were just taken back and given to the other willing participants.

The survey forms were assigned control numbers to identify both the respondents and the assigned Research Assistants (RAs) in increments of 25 for each group assigned. The six RAs are thus, identified as: 1) B1-1-25; 2) B1-26-50; 3) B2-1-25; 4) B2-26-50; 5) B3-1-25, and; 6) B3-26-50. The 150 respondents were identified in relation to their assigned RA in six groups as: 1) 1A-1 to 1A-25; 2) 1B-26 to 1B-50; 3) 2A-1 to 2A-25; 4) 2B-26 to 2B-50; 5) 3A-1 to 3A-25, and; 6) 3B-26 to 3B-50. The first respondent for instance, assigned to the first RA will be identified as “B-1-25/1A-1”.

The survey questionnaire was divided into three parts starting with the *General Information* for the respondent's background, followed by the section, *Housing and Settlement Characteristics*, to elicit from the participants the physical description, location, and upgrades effected on their dwellings. Included in this section were the availability and quality of basic services in the household.

The third and final section, *Flood Assessment and Physical Adaptation*, enquired about the participant's experience on the two extreme flood events in 2009 and 2013, the extent of damage including the cost incurred from the damages in their dwellings, course of action during and after the events, and their aspirations in improving their dwellings.

The first three items in the second section inquired about the available basic services in the household, were influenced by UN-Habitat's definition of what constitutes a slum, identifying lack of basic services, particularly access to improved water and improved sanitation facilities (UN-Habitat, 2006). The line of inquiry was also informed by a report from PIDS in 2009, about the local service delivery of public goods and services which concluded that, "…improving local services delivery is a function of the triangulation of policy, institutions, and finance within value-based and principle-oriented governance framework" (Layug, 2009 p. 1).

The succeeding items in the section referred to the age, location, and physical features of the house including the improvements made. This inquiry was informed by the questions raised in the literature reviewed from Alcazaren et al. (2010), in chapter 4 under the section *Iskwater Planning: Incremental Formality*, asking "How do informal settlers plan their communities?" and "How do these informal patterns of physical development affect their personal and communal lives?".

The response in the section's succeeding paragraph asserted that, "The mystery of informal settlement community building lies, not where architects and planners expect it- on understanding abstract concepts of physical forms and spaces- but in understanding and learning from the informal process that created them" (Ferrer, 2010 p. 141). The previous book section, *Steps to Building an Informal Dwelling*, also suggested that "Analysing dimensions of informal dwellings can provide valuable insight into creating viable adaptations for cramped spaces" (p. 140).

The last section in the survey, *Flood Assessment and Physical Adaptation*, probed about the respondent's experience on the extreme flood events, the extent of damage and cost incurred, and the actions taken during and after the events. This line of inquiry was informed by the literature reviewed from Abon et al. (2011), reporting the extent of damages to property and infrastructure caused by TS 'Ondoy'.

The report pointed out that aside from the anthropogenic factors, the damage brought by the floods can be attributed to the lack of preparedness of the populace. The article further claimed

that early warning systems that can issue rapid flood forecasts do not yet exist, and that flood hazard maps produced by the authorities, citing the *Marikina River Basin* as an example, "…failed to include areas adjacent to river channels that experience flash flooding as soon as the capacity of the channels are exceeded" (Abon et al., 2011, p. 1283).

The line of inquiry regarding flood damage was specifically informed by the study conducted by *GMMA Risk Analysis Project* in 2016, using a stage-damage curve that described the ratio of damage to building replacement value or the damage fraction, applied for a range of different building types. The same damage ratio was used in this study, based on the responses from the participants in the last section of the survey questionnaire.

The same responses also addressed the research objective (table 7, no. 3) of identifying and evaluating a range of flooding scenarios, based on both the historic event records and other published works. On the items that pertained to the adaptation measures being practiced and the resident's perceptions on further enhancing their resilience to flood hazards, the responses helped address the objective (table 7, no. 5) to analyse current flood mitigation approaches that could apply to the existing urban form of the community.

Finally, the items in the survey related to the housing characteristics in terms of layout, size, materials, and technology, addressed the objective (table 7, no. 2) of forming a classification of the dwelling units according to the typologies of the urban form. By identifying these characteristics, variables such as the typology of dwellings and the number of storeys, were determined to establish the urban form of the community. The survey protocol being the first activity in gathering data, is seen to have influences in formulating the interview questions which demonstrated the link between the qualitative and quantitative methods.

4.4.2 Flood damage assessment approach

The synthesis of data items collected from survey, interviews, and field observations, were used to analyse the interaction between water and the building materials. The degree of potential damage to structure was measured through stage-damage curves, which measured damage fractions at different hazard intensity levels. The damage calculations involved integrating outputs from the exposure information with vulnerability models, in the form of stage-damage curves that were patterned after figure 20 shown below.

The figure as adopted in GMMA RAP in 2016, describes the damage fraction (i.e., ratio of damage to building replacement value) as a function of the 'peak flood depth minus the floor height', for a range of different building types. Damage ratios for this study were calculated and plotted from responses on the survey regarding house asset value and repair costs to show the relationship between inundation height and house damage from the various dwelling types.

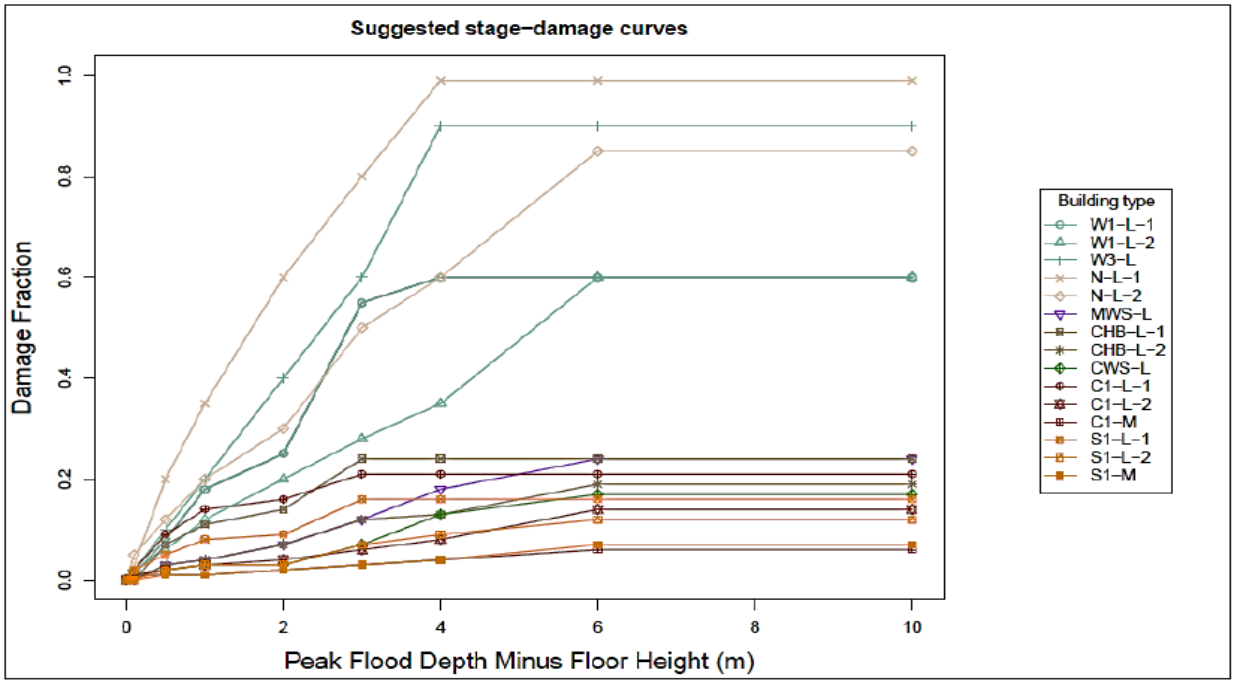


Figure 20. Depth-damage curve for different building types adapted from GMMA RAP, 2016

House structural values were based on the estimated building costs per square meter for different combinations of building types for informal settlements developed by *GMMA Risk Analysis Project* (Jakab, et al., 2014). The estimates as shown in table 8 below created in 2010 and 2011, were useful in applying the highest flood events both in 2009 (Typhoon Ondoy / Ketsana), and 2013 (Habagat/ SW monsoon).

Table 8. Estimated building costs per m2 (Phil. Peso), for different combinations of building type for informal settlements (estimates are based on DL & SI, 2010 and Muto et al., 2011) adapted from GMMA RAP, 2016.

L4 USE (level 4 land use)	L5 USE (level 5 land use)	Building Types / Building Costs per M2					
		W1 (wood, light frame)	**W2** (wood, comm'l. & indus'l.)	**N** (make-shift)	**CHB** (concrete hollow blocks)	**MWS** (chb with wood or light - metal)	**CWS** (reinf. concrete moment frames with wood or light metal)
Informal Settlements	Mixed Informal Settlements	4000	-	1200	3000	5200	7800

4.5 Ethical considerations

The main ethical issues related to the research methods discussed above, will be summarised in this section. This will include potential harms and risks that may arise from the study,

explaining how these have been addressed in the succeeding sub-sections. The required Application for Approval of Research Ethics, and Project/Activity Risk Assessment forms submitted to the Ethics Committee, together with the Data Collection Protocol for COVID-19, will be briefly discussed in the last part of the section.

4.5.1 Main ethical issues

Informed consent

A detailed information about the nature, purpose, and scope of the research at the onset have been provided to the participants together with a written consent. The expected benefits of the study both to the participant and to the field of study by gaining new knowledge were made known to the subject as well. Included in the participant consent form was a disclaimer, stating that participation is entirely voluntary and without detriment should the participant choose to withdraw from the project anytime.

The participants were also informed about the nature of the study during the introductions by the participants to the researcher through the gatekeepers or community leaders. An information sheet about the study was provided to the participant stating the purpose and methods of the research, together with the contact details of the researcher and Supervisor with the signed copy provided to the participant. If the participant is willing, a written consent form was also provided and discussed with the respondent, who in turn was asked to sign the consent form that will be retained by the researcher together with the collected data.

Respect for confidentiality, privacy, and anonymity-

In dealing with the potential issues on confidentiality, privacy, and anonymity, the researcher personally conducted all the interviews with the aims and methodology initially discussed with the prospective subjects. It was made clear at the onset, that the participants will be anonymised and where possible, make use of pseudonyms or initials and change other identifying details in the reports. The involvement of the research assistants was limited to the distribution and retrieval of the survey forms and coordination, in terms of interview schedules and venues. The procedures were thoroughly explained together with their coordination responsibilities in all stages of the study.

Controversial and sensitive research topic-

The residents of informal settlements living in danger areas may possibly be resettled or relocated at any time by the local government which is considered a sensitive issue for the settlers. This issue was dealt with by being open to the participants beforehand, informing them of the type of data and information that will be gathered, and informing them that the study is purely for academic purposes and non-political in nature. The researcher also engaged in reflectivity whilst responding sensitively to the participants' needs.

Vulnerable groups

In this study, the principal exclusion were the residents or representatives below the age of 21 and above 80. Vulnerable groups such as those who are sick and mentally incapable were excluded as well. Persons with disabilities (PWDs) however, were allowed to participate if they are mentally competent, within the age-bracket, and willing to participate. The elderly was included to provide historical information on the settlement, particularly those who have lived in the community for long periods and were chosen according to their physical and mental competence. Their inclusion, however, became limited with the onset of the restrictions imposed in the community for senior citizens during the community lockdowns due to the COVID-19 pandemic.

Data protection

Survey questionnaire were administered manually in paper form, whilst interviews were voice recorded with the consent of the participant, securely stored in a password-protected recording device. The study made use of anonymisation for the survey questionnaire, and pseudonymisation for the interviews where each participant will be assigned a pseudonym ID to differentiate one from the others, restricting its use to identify any participant in the working dataset. Personal data were only collected where it is necessary for the purposes of the research study. For example, instead of asking for the birth date of the participants, only the age bracket or age in years were asked minimising the personal data collected. In terms of housing addresses, partial addresses that coded or assigned a unique reference in the report were used instead.

Personal data were kept in a form which permits identification of data subjects for no longer than is necessary, for the purposes for which the personal data are processed. 'Truly anonymous' data, however, that do not relate to any identifiable individuals will be retained indefinitely. Copies of personal data will be kept to a minimum where unnecessary copies will be deleted. All data were stored electronically on the researcher's password protected laptop and password protected external drive as backup, whilst the hard copies will be stored at a secured University storage. Individual files and folders containing digital personal data will be provided with password protection access control. Cloud services other than the University One Drive where an equivalent level of protection for personal data is not provided, were not used to store data.

Recruitment process

The recruitment was coursed through the Barangay office via a letter submitted to the Barangay Chairman asking permission to conduct the research in the community stating the purpose, objectives of the study, and the assistance required from the Barangay office. The assistance included - introducing the researcher to the community leaders, organizations, and residents;

Barangay officers and community leaders to accompany the researcher in conducting interviews and field observations; and, the use of Barangay facilities such as the barangay hall, basketball court, and meeting rooms to hold interviews and surveys.

For the government officials in the city, a letter addressed to the department heads were submitted beforehand, similarly stating the purpose, objectives of the study, and the assistance required from the City Government. The assistance included - introductions to the various department heads or representatives involved in the housing, planning, engineering, and disaster risk management in the city; interviews with the department heads or their representatives; and, access to pertinent public documents related to the study.

Principal inclusion in the community were the household heads or member authorised by the head of the family. As earlier discussed, the family head will be the decision-maker and/or provider in the household. Community leaders, representatives from community organizations, and other organisations, were also included as participants.

4.5.2 Risk assessment and data collection protocol

Aside from the standard Application for Approval of Research Ethics form approved by the Ethics Committee, a Project/Activity Risk Assessment form stipulating the various activities assessed in terms of hazard, specific persons at risk, existing control, and additional controls required, was also submitted and approved. The main activities reported consist of field observation, survey administering, and interviews. An emergency escape route of Sitio Gulayan community was included in the form indicating three escape routes leading to their respective refuge areas, whilst photos of the covered basketball court inside the Barangay Centre were also included as the main venue for the interview protocol.

Finally, with the restrictions imposed during the data gathering phase at the height of the COVID-19 pandemic, a data collection protocol was similarly submitted stating how the pandemic challenges will be addressed. The protocol was created to identify the necessary precautions that will be applied to all involved in the study, based on the national and local regulations and measures. The key intent is to protect the researcher and all participants in the research study from contracting the virus. All the activities undertaken by the researcher in the study area were coordinated with the Barangay Chairman’s office for evaluation, approval, and monitoring. Updates from the LGU and Barangay Office on the status of COVID-19 cases in the city, barangay, and study area, were regularly checked by the researcher for the Supervisors guidance and reference.

4.6 Summary

The chapter presented the focus and problem of the research to assess the applicable approaches that will be appropriate for the study. With the research focus aimed at developing an in-depth description and analysis of the case, and the problem dealing with the in-depth

understanding of the case, the case study was chosen out of the four possible approaches. Making reference to recognised methodological literature, both qualitative and quantitative approaches were also applied as a mixed method to the development of the case study.

The mixed method adopted the explanatory sequential design with the quantitative method initially conducted followed by the qualitative method, leading to the interpretation process. A tabulation was formulated to elucidate the link between the research objectives with the required data, the methods of collecting the data, and the sources of data. Considering the varied methods of collecting data, a diagram indicating the linkages of these methods were also formulated and presented to guide the study.

The methods under the qualitative approach were then each presented to justify their suitability to the study. In the interview method, the formulation of questions for the residents and officials drawn from the literature, were discussed in detail per section with the questionnaires included in the Appendices for referencing. The quantitative method section presented the process and limitations in collecting the data, where a map of the community was used to indicate the zones created for the division and distribution of the participants, that would represent the entire community.

The consolidation and synthesis of the data gathered from the various methods, were presented as the source of analysing the interaction of the building materials with the floodwaters, to establish the degree of potential damage to the structures. Measured through the stage-damage curve, it described the function of the damage fraction for the different building types adopted from the GMMA Risk Analysis Project. The building costs for the different types correspondingly, were taken from the GMMA RAP.

In relation to the central research question, the research design presented in this chapter was justified, with the appropriateness of the research methods selected, to be further justified by the detailed description of the case study. This in-depth description will be presented in the succeeding chapter 5, *Study area*. Lastly, the main ethical issues related to the research methodology were summarised, including the execution, submission, and approval of the standard forms and procedures, required by the University in conducting research work.

5 Chapter 5 Study area

The informal floodplain settlement of Sitio Gulayan as the single case in the study, will be discussed in this chapter. The settlement overview will be presented initially, followed by the administrative division and the settlement's location in the city and within the barangay. The settlement characteristics including the hazard features will then be discussed, to help identify and evaluate the worst-case flooding scenario. The chapter will conclude discussing the flood risk management from the city level down to the community level, to help determine the possible technical adaptation appropriate for the community, in relation to its potential to develop and transform into a transitional settlement.

5.1 Sitio Gulayan overview

In evaluating the urban form and architecture of informal floodplain settlements, the focus will be on one of the risk settlements in the city of Malabon, in Barangay[6] Catmon, called Sitio[7] Gulayan. The settlement as the single case in this study, was chosen for the following motives: 1) the community's proximity to one of the major waterways in Metro Manila; 2) it is one of the oldest informal settlements in the city, and was nominated as the first community to undertake the Community Mortgage Programme (CMP[8]); and, 3) the settlement's ideal size and location for this research study.

As mentioned earlier, the community is located along one of the eight declared priority major waterways in Metro Manila, Tullahan River, which ranks third in terms of the number of informal settler families (ISFs) occupying its banks as assessed by the Department of Public Works and Highways (DPWH). The settlement is home to approximately 2,300 households occupying an 8.0-hectare land. As one of the oldest informal settlements in the city, it was nominated to undertake the CMP housing project back in 1992, which did not materialise then with the demise of the city mayor who initiated the project. The community nonetheless, undertook the programme, but currently needs to settle issues on non-payment of amortisation by the association, hampering the programme's progress to date.

To protect the settlement from the river (or vice versa), a concrete dike was constructed by the local government which also serves as a backdoor pathway that leads to the interstices of the community. During extreme weather conditions, the dike can be breached inundating the entire community like in the 2009 Tropical Storm "Ondoy", and 2013 "Habagat" flood events as presented in Chapter 2. To better understand the settlement location and features, the

[6] A barangay is the smallest administrative division in the Philippines and is the native Filipino term for a village, district, or ward.

[7] A sitio in the Philippines is a territorial enclave that forms part of a barangay.

[8] Under R.A. No. 7279, the CMP through the Social Housing Finance Corporation (SHFC), shall assist organized community associations to acquire tenure and ownership of the land they are presently occupying adverse against the interests of landowners. Financing at very low interest rate is granted to beneficiaries to purchase the land as a whole and to improve the sites.

administrative division of Malabon City with Sitio Gulayan's origin and characteristics, will be discussed in the succeeding sections.

5.1.1 Administrative division

This section will present the division of the city into barangays and sitios, including their physical features to identify the geographical location and geophysical characteristics of the study area. Identifying the location and physical features will help explain the vulnerability of Sitio Gulayan community to flood hazards. The local officials chosen by the electorate to govern the city down to the barangay, will also be discussed at the end of the section to present the link between the community and the local government unit.

Out of the 17 local government units (16 cities and 1 municipality), Malabon is one of the cities that comprise Metro Manila or the National Capital Region. The city is a coastal town teeming with rivers and waterways vital in transporting goods during the 1800's Spanish period (CPPD, 2017). Classified as a first class highly urbanised city, it is part of the third district or the Northern Manila District of NCR, together with three neighbouring cities collectively known as CAMANAVA (*Ca*loocan, *Ma*labon, *Na*votas, *Va*lenzuela). The cities and municipalities are made up of barangays with Malabon City having a total of 21 barangays (figure 21).

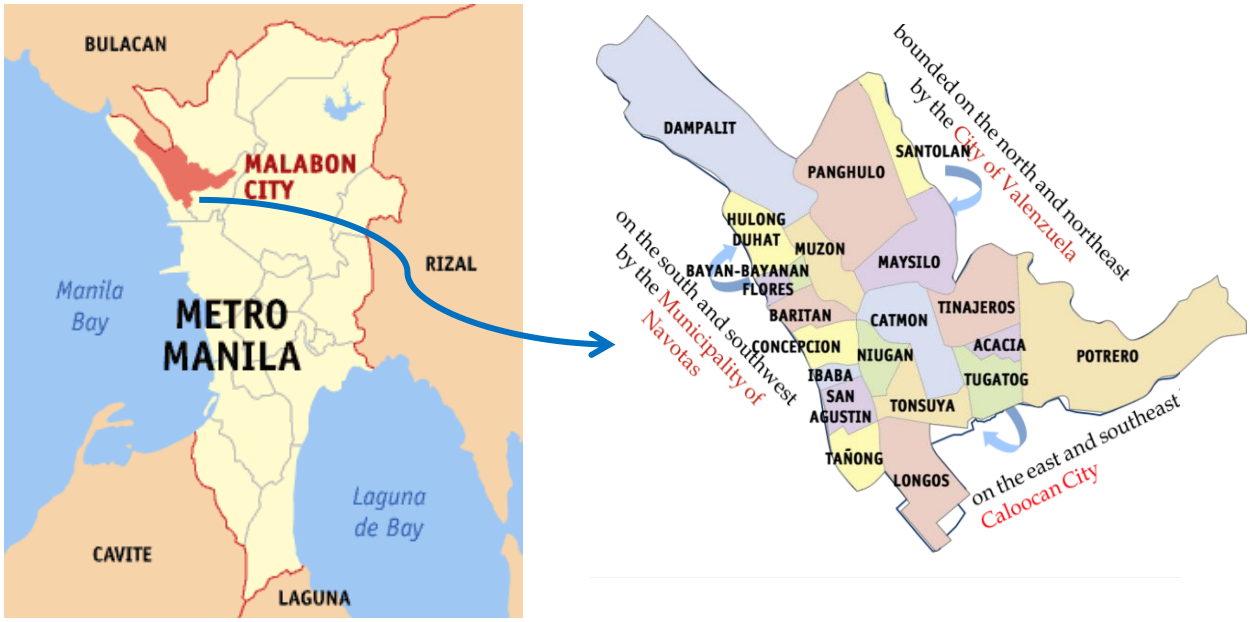


Figure 21. Map of Metro Manila and location of Malabon City (source: Villar 2003), with political map of Malabon City (source: Malabon.gov.ph and Balingit).

The city represents 2.5% of Metro Manila's total land area or 15.71 square kilometres out of the NCR's 619.54 square kilometre land area (PSA, 2020). It has a population of 380,522 (PSA, 2020) at a growth rate of 0.42% (CPPD, 2017). The city's major rivers influence its physical features (figure 22) with fishponds extending inland from Manila Bay (CPPD, 2017). With the

city's generally flat topography, rivers, and waterways, it is one of the low-lying cities in NCR ranging from 0-1.5 meters only above sea level (Serizawa, 2014).

Its physical features and pronounced wet season contribute to the city being highly prone to flooding. Due to year-long floods and gradual sinking, Malabon City has been tagged as the 'local Venice' in the metropolis (Rajib et. al, 2010; CDP, 2015). The city together with its neighbouring cities, have been prone to flooding even during high tides without any rain. These features make it more challenging for informal settlers, particularly those located along the waterways.

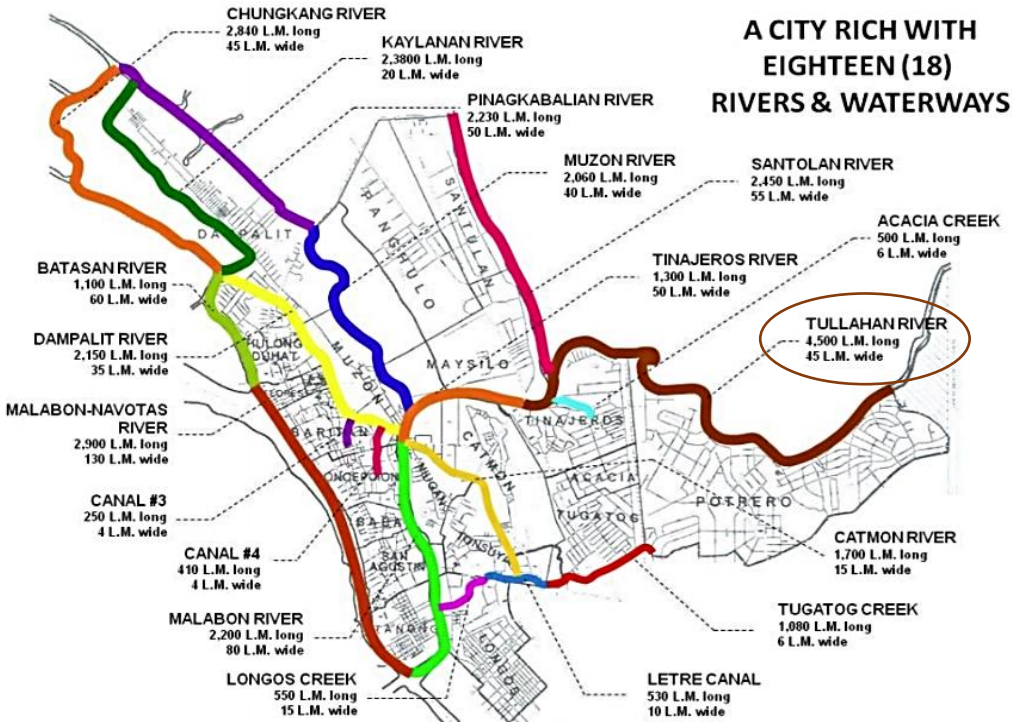


Figure 22. Map of Malabon City rivers and waterways. Source: Malabon.gov.ph (2017)

In terms of land use, the total city land area of 1,367.46 hectares is mostly residential at 37.67% or 515.15 hectares, and industrial at 22.37% or 305.85 hectares (figure 23). Socialised housing accounts for 4.07% or 55.63 hectares only contributing arguably, to the proliferation of informal settlements (CPDD, 2018). On the ISF population, a study by Human Cities Coalition (HCC) in 2017, indicate that there is a total of 23,310 informal settlers in the city of which 30.82% are in danger areas like waterways (3,216) and right of ways (3,968).

Those along the waterways are mostly found in barangays along Tullahan River (figure 24), whilst the remaining are in private lots (56.21% or 13,102) and government lots (12.97% or 3,024). The HCC study further reports that most of the ISFs in Malabon City work as labourers, construction workers, tricycle drivers, vendors, or are engaged in other low-paying jobs in the informal economy (HCC, 2017).

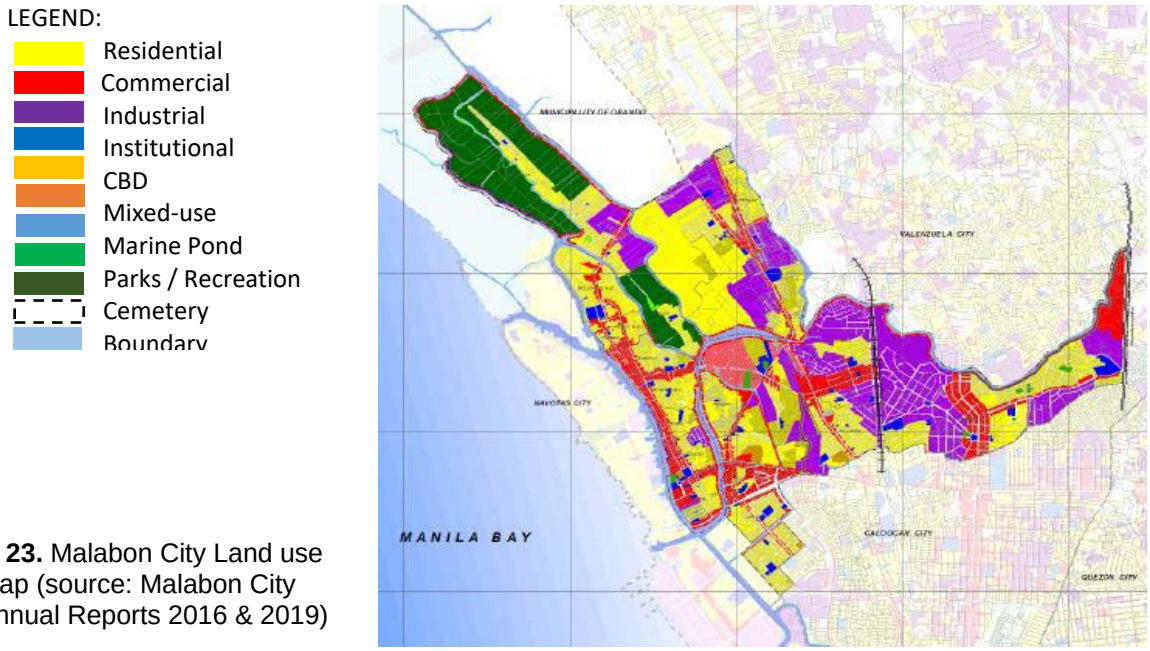


Figure 23. Malabon City Land use map (source: Malabon City Annual Reports 2016 & 2019)

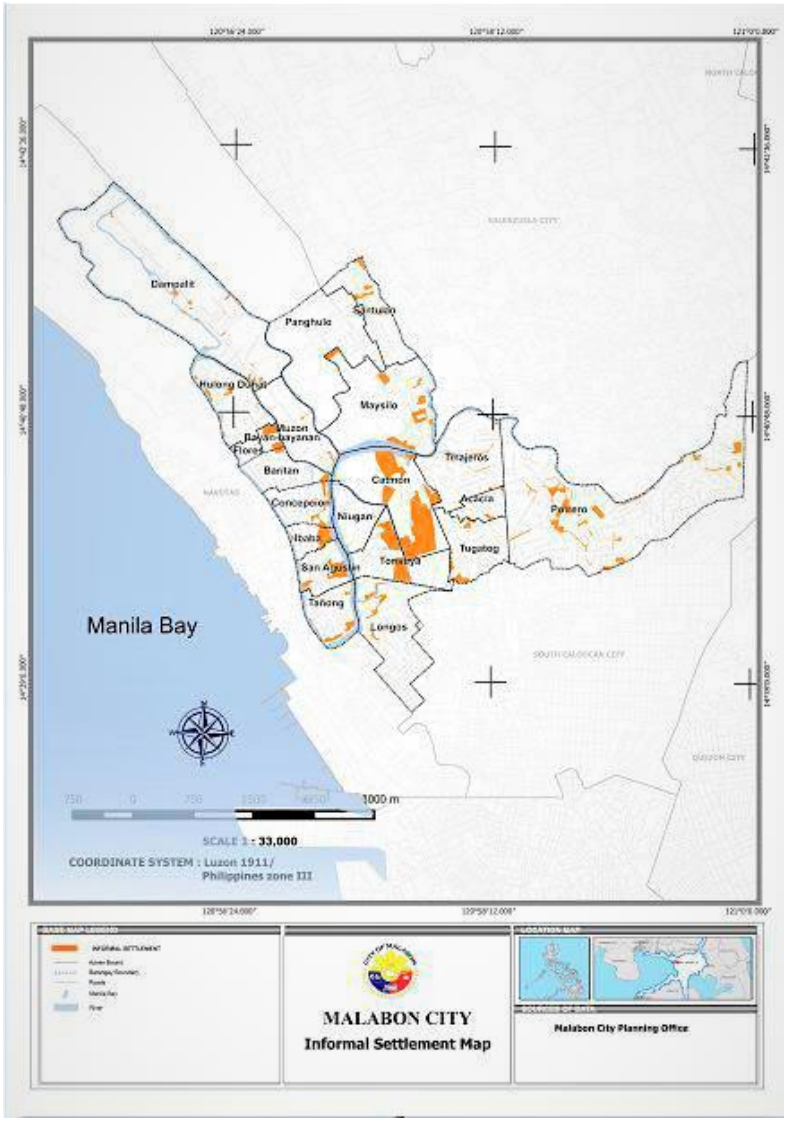


Figure 24. Malabon City Informal Settlement map (source: City Planning and Development Office, 2014)

The local government administrating the population is headed by the City Mayor, a Vice Mayor, 12 Councillors (six for each of the two districts), and a Congressman, all chosen by an electorate of 222,350 voters. Each barangay on the other hand, is headed by a Barangay Chairman (Punong Barangay) with seven Barangay Council (Sangguniang Barangay) members, the Youth Council (Sangguniang Kabataan) chairman, a Barangay Secretary, and a Barangay treasurer. One of the highly populated barangays, Barangay Catmon, is where Sitio Gulayan community can be found. The barangay located at the heart of the city, where the sattelite government offices and facilities are strategically located, will be discussed in the next section.

5.1.2 Location and historical development

This section will present the location and features of Barangay Catmon, relative to Malabon City and Sitio Gulayan community. The origins of the community will also be discussed to determine its beginnings and how it evolved into the largest informal floodplain settlement in the barangay. The size in terms of the population and density, including the inherent characteristics of the community will then be discussed in the subsequent section.

Ranking second highest in the city's barangay population, Barangay Catmon has a total of 44,868 residents representing 11.79% of the total city population (PSA, 2020). The population denotes a positive growth rate of 2.74%, or an increase of 5,402 residents from the previous population census of 39,466 in 2015. The household population in 2015 was 38,470 comprising of 8,830 households, or an average of 4.36 members per household. In 2018, the local government records indicate that there are 2,644 informal settler families (ISFs) in the barangay.

In the study by Human Cities Coalition on socialised housing in Barangay Catmon, the estimated land size of 197,363 square metres comprises of 21% or 41,446 square metres of government-owned land and 79% as privately owned. The study also reported that there were 27 ISF communities, with 23 occupying government-owned and 4 privately owned lands. Out of the 27 communities, there are 14 under the CMP housing programme. The ISF total population in the barangay was estimated at 31,137 consisting of 5,000 households or 6.2 members per household. Figure 25 below shows the ISF communities in Barangay Catmon including landownership.

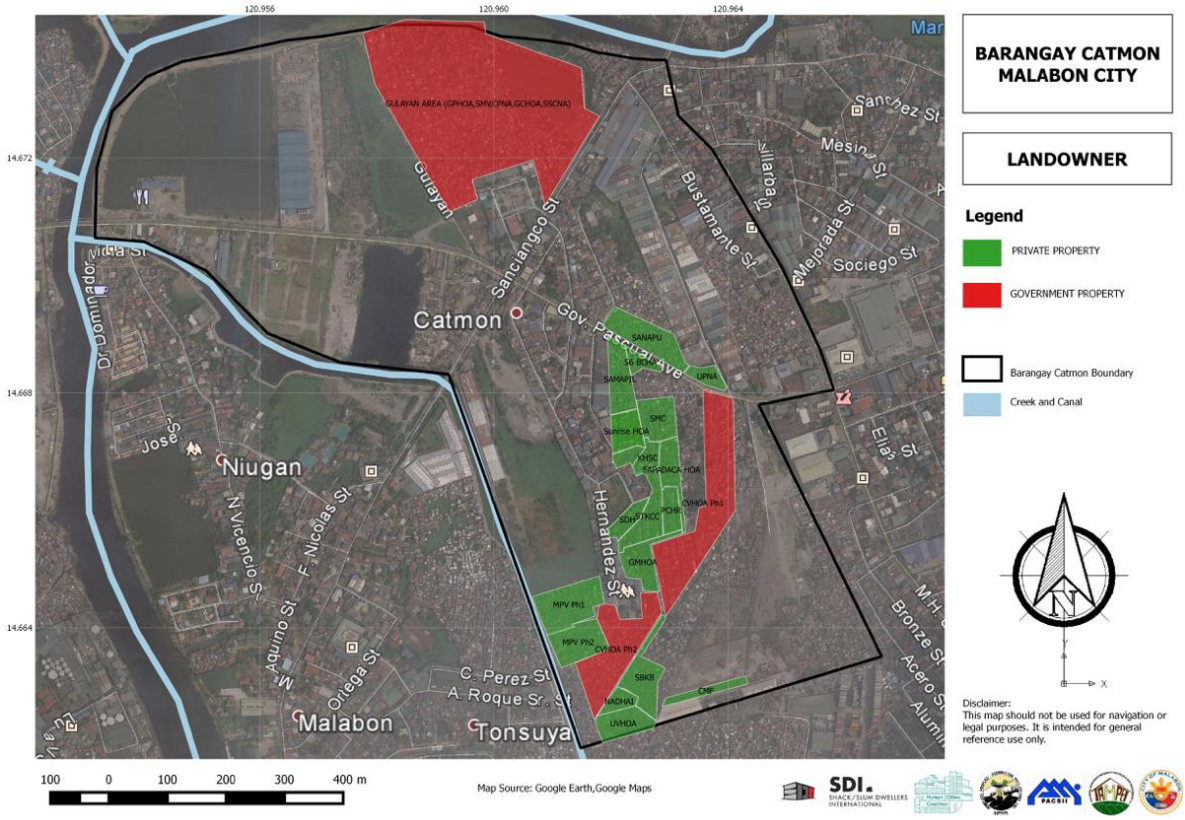


Figure 25. Barangay Catmon Informal Settlement map (source: HCC, 2017)

Bounded by rivers in the north (Tinajeros/Tullahan) and west (Malabon), Barangay Catmon is home to some of the floodplain settlements in the city with Sitio Gulayan being the largest. Often considered risky for settlement due to flooding, there is an ecological and/or economic connection to the water (Dovey and King, 2012). In the case of Sitio Gulayan, however, early settlers relied primarily on the land where vegetables are farmed earning the community its name ("gulay" is the local term for vegetable and "gulayan" means vegetable farm).

Pioneer residents refer to the location of Sitio Gulayan as a vegetable farmland beside a fishpond, with only three dwellings found in the farmland back in the early 1940s. One of the dwellers is the caretaker of the farmland, whilst the other resident was the patriarch of a renowned clan in Malabon, with some of its members still residing in the city. The fishpond and farmland are still partly reflected in the soil map of the city (figure 26) with the soil classification having an influence on the city's physical infrastructure.

There are three soil classifications namely: 1) *hydrosol series*, found in the central portion of the city developed from former tidal flats and conglomeration of clay materials and organic matters from the decay of marshy growth; 2) *prensa series*, in the eastern portion of the city formed from residual soils underlain with volcanic stuff, and; 3) *obando series*, found in the western portion of the city formed from recent coastal deposits with subsoil as gray sand mixed with marine shells. The soil types also have influence on the socio-economic activities in the city, which will be discussed in the next section.

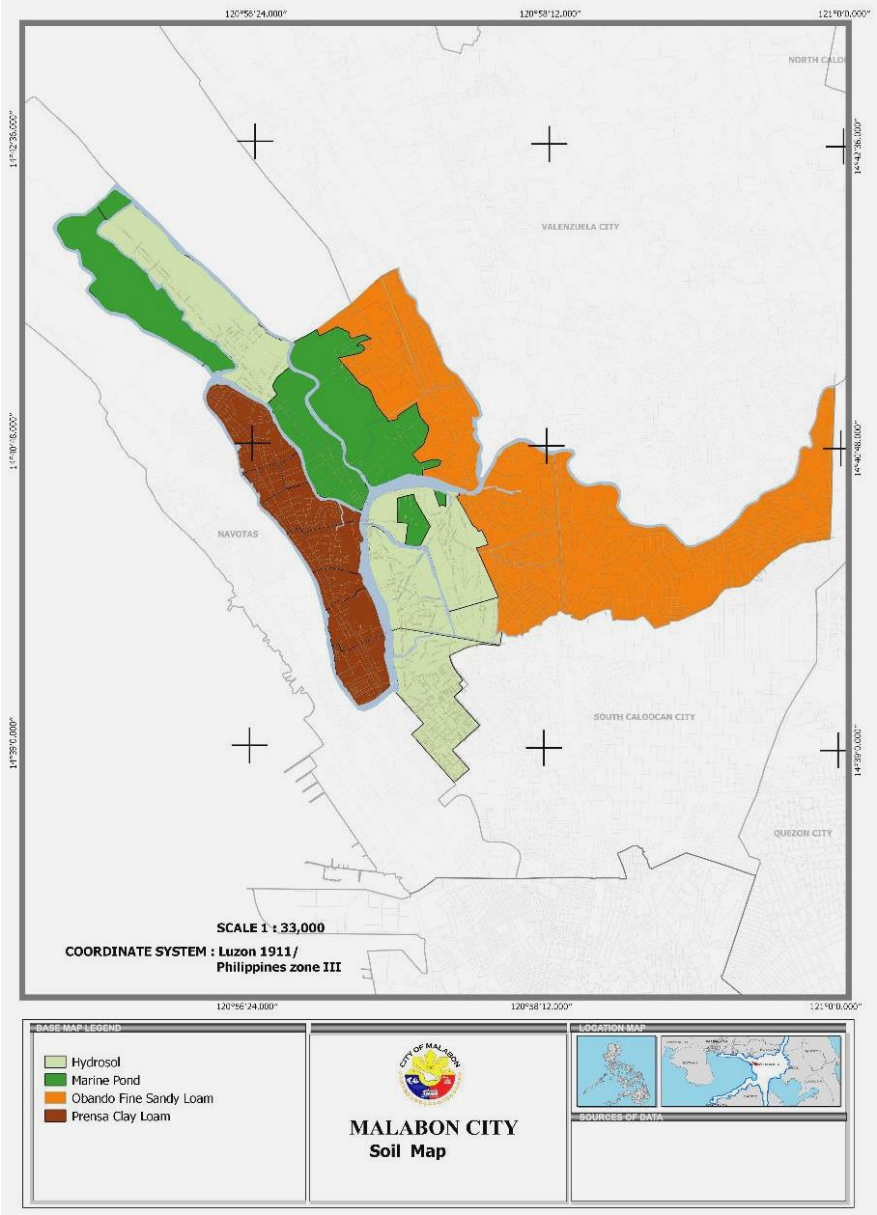


Figure 26. Malabon City Soil Classification map (source: CPDD, 2018)

During the 1950s, the settlers of Sitio Gulayan community were the farmers and their families until the town became industrialised and started to accommodate factory workers coming from the rural areas (Magno, 1993). The environmental landscape of Malabon was significantly altered in the 1970s, by the transformation of fishponds into slums and simultaneously, into middle class subdivisions (ibid.). The factories located along the riverbanks, however, were sustained with the migrant workers building their dwellings near the riverbanks. At present, some factories are still operating along the riverbanks of Tullahan River manufacturing paper, dye, and plastic, with some of the workers residing in Sitio Gulayan community.

The factories with their industrial effluents polluting the body of water, gradually ruined the natural habitat. The city's river system used to be wider, deeper, cleaner, navigable, and an important food source for the residents being a traditionally fishing community (CDP, 2015). The settlers themselves, whose roots may have relied economically on the riches of the river (figures 27 & 28), have been contributory in polluting the river with their household wastes.

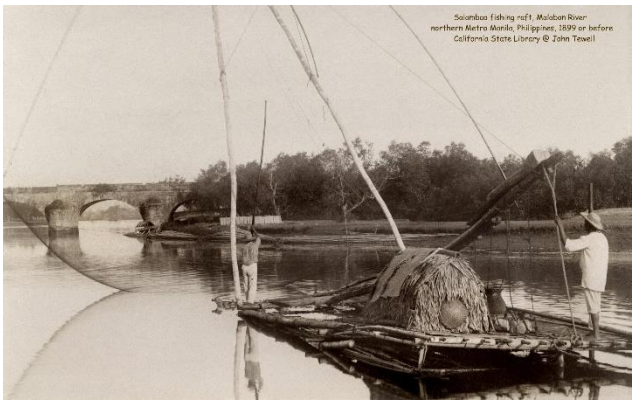


Figure 27. 'Salambao' fishing raft, Malabon River, 1899 or before. (Source: John Tewell, Califiornia State Library).

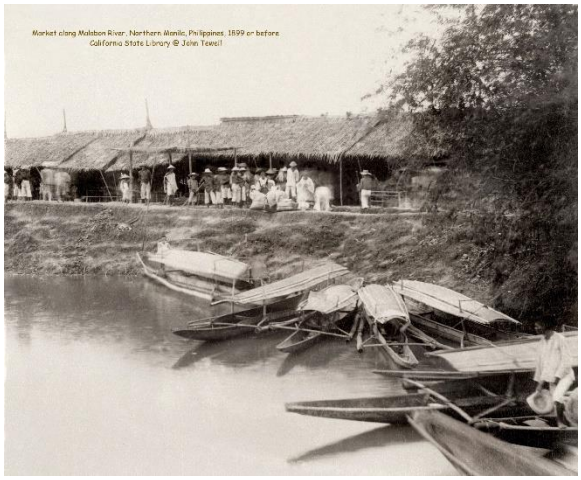


Figure 28. Market along Malabon River, 1899 or before. (Source: John Tewell, California State Library).

In terms of land use, Barangay Catmon is classified under *Mixed-use* that is mostly residential with portions that are commercial, industrial, and institutional (CPDD, 2018). Sitio Gulayan is classified under Residential that is adjacent to an Institutional area and Parks/Recreation area. The institutional area is the Justice Compound that houses the Barangay Centre, Police Headquarters, City Jail, and the Justice Hall itself. In the middle of the compound is the parks/recreation area which is called the People's Park (figures 29 & 30).

Figure 29. The police headquarters at the foreground and the city jail at the background.

Figure 30. In the middle of the People's Park is a children's playground.

Protecting Sitio Gulayan from riverine flooding is a concrete dike built in 2009, which also serves as a backdoor accessway to the community. The settlement can be accessed from three entry points: 1) the main access along the major road of Gov. Pascual Ave.; 2) an alley from the

minor road of Sanciangco St.; 3) and, the concrete dike along the same minor road. These three major routes are interconnected with pathways branching out to the irregular interior layout of the community (figure 31).

The layout helps to integrate the community tightly (Mills, 1992) with the unacquainted outsiders seemingly being discouraged to explore the interiors of the community. This mechanism according to Mills (1992), serves for cutting the community off from its wider urban context. The irregular layout has its disadvantages as well for the community. For one, it does not allow any road provisions inside the community for motor vehicles and more importantly, for fire trucks. Fire incidents are often devastating in the community with the fire trucks unable to reach the community core.

Labour costs for housing improvements can also be prohibitive doubling in price with the material hauling being done manually. With the high density, open spaces have also become scarce with only a basketball court serving as a refuge area inside the community. Whilst there are open spaces and a covered basketball court outside and adjacent to the community which serve as refuge areas, those living in the core have a difficult time reaching these areas compared to those along the community edges (figure 32). Similar challenges can be attributed to the inherent features of the settlement which will be presented in the ensuing sections.

Figure 31. Sitio Gulayan entry points from Gov. Pascual Ave. and Sanciangco St. (source: Google earth)

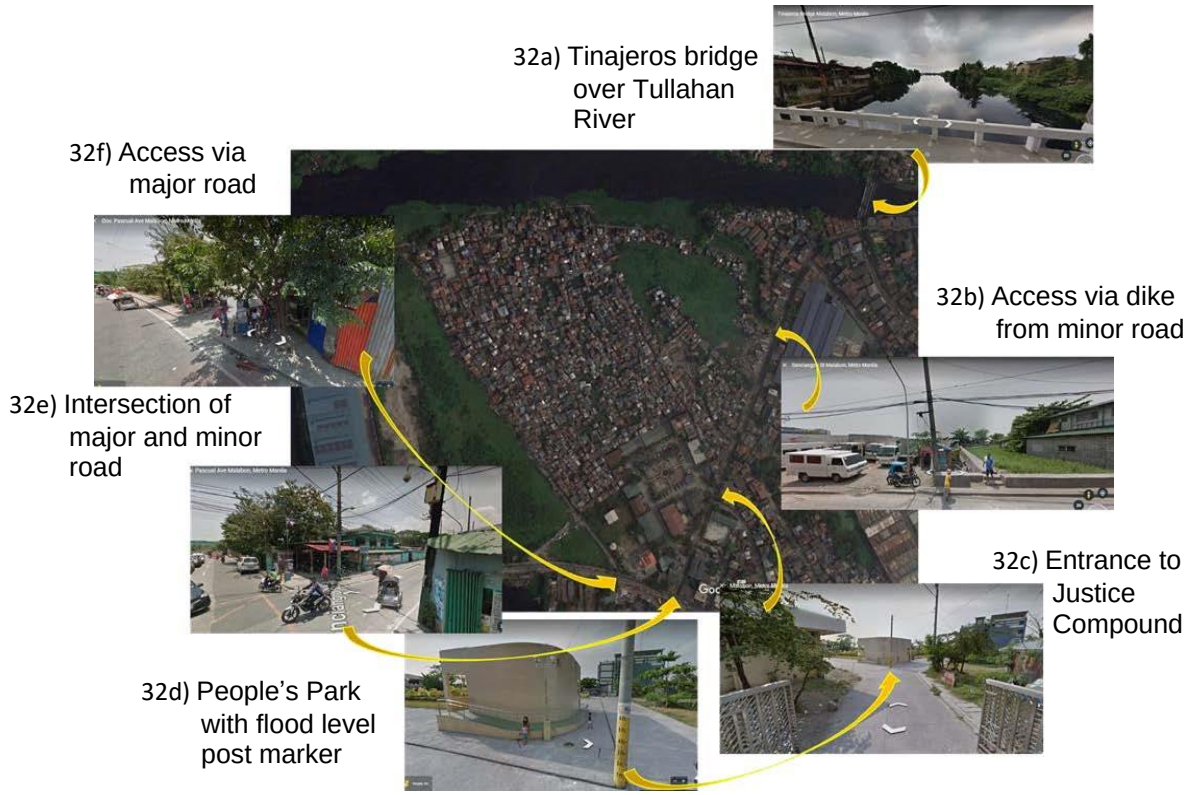


Figure 32. Sitio Gulayan surroundings (source: Google maps and author)

5.1.3 Settlement characteristics and population

In this section, the size of the community in terms of household numbers and estimated population will be discussed. These figures will help determine the other features of the settlement such as the urban form and density of the community. In terms of size, Sitio Gulayan started out from just a few dwellings on what used to be a farmland and a fishpond. The community has since grown into a larger informal settlement that is now typically subject to major upgrading and "formalising" schemes (Dovey and King, 2012).

Household estimates vary and according to the homeowners' association, the total number of families run between 2,000 to 2,300 typical of a medium-sized settlement. This population comprise about 25% of the total 8,830 households in the 2015 census in Barangay Catmon. At an average of 4.3 members per household, total population should be between 8,600 to 9,890 residents.

New dwellings are still being added in the community as indicated in the historical imagery maps shown below (figure 33 and 34). Figure 33 taken in 2001, shows the almost iron grid layout of the settlement with the green pond (not officially part of Sitio Gulayan under the CMP) on the upper right hand still unoccupied. In comparison, figure 34 taken after almost 20 years, shows the settlement evolving into an irregular form with the infills being occupied, including half of the green pond with the influx emanating from the perimeter.

Figure 33. Historical imagery taken on June 2001 (source: Google maps).

Figure 34. Historical imagery taken on January 2020 (source: Google earth).

Based on another set of historical imageries (figure 35 & 36), Sitio Gulayan appears to be regularly laid out up until 2007, when the dwellings have started to fill in voids creating an intricate pattern of dwelling clusters. What used to be a grid layout, has now become organic and chaotic, creating meandering alleys and pathways that lead to the core of the settlement as shown in figure 36. A visitor could easily get lost (as experienced firsthand) inside the community with its series of labyrinthine pathways.

Figure 35. Historical Imagery dated March 2007 (source: Google maps).

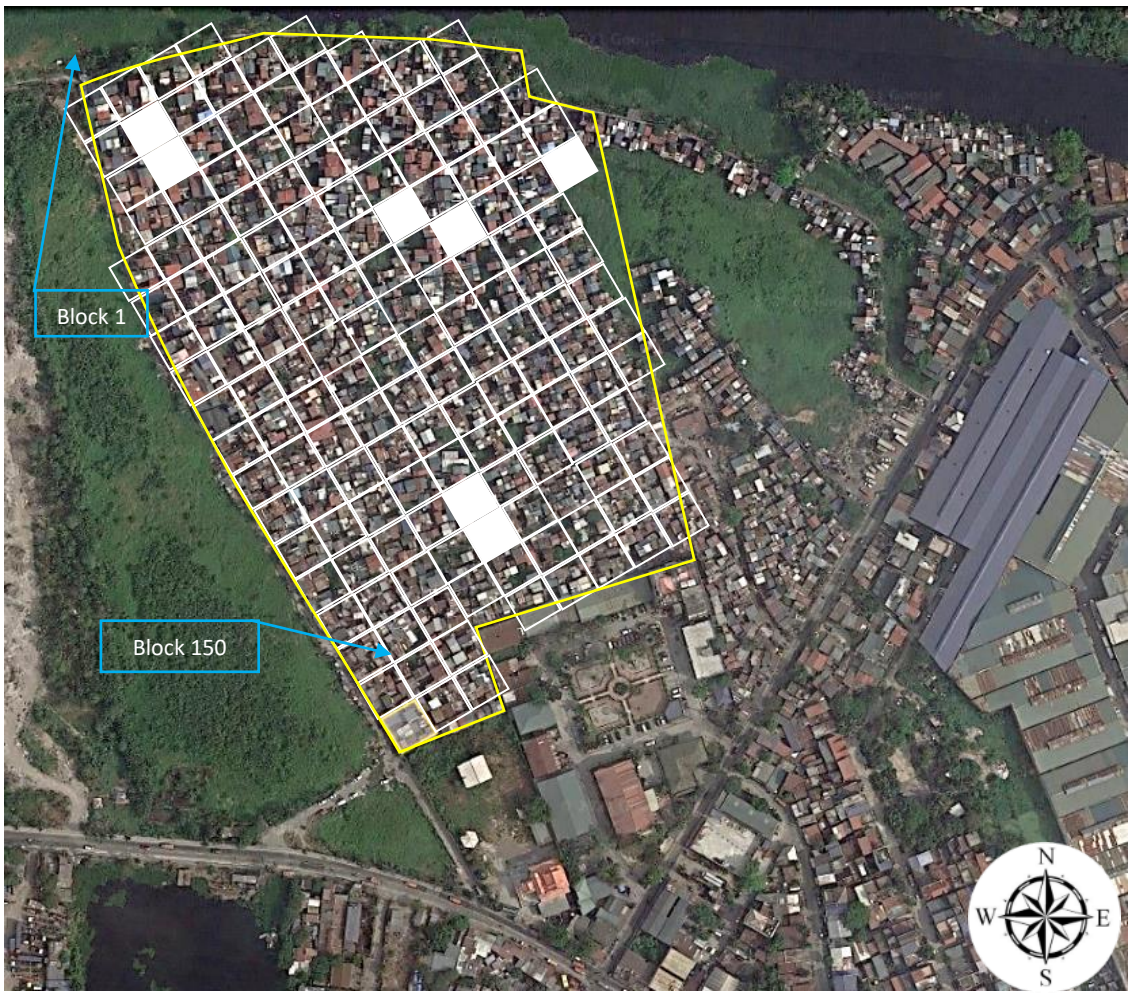
Figure 36. Historical Imagery dated Jan. 2020 with the main pathway (source: Google earth)

In terms of residential density, there are approximately 2,250 dwellings inside the 0.0722 square kilometre plot of land resulting in a gross neighbourhood density[9] of 31,163 dwelling units. The estimate was made by dividing the settlement into 20 x 20-metre blocks with one block

[9] Gross neighbourhood density measures the number of dwelling units or residents divided by the total area of the neighbourhood with no exclusions made (Forsyth et al., 2016).

containing an average of 15 houses (as observed in the field). With a total of 150 blocks, the approximate number of dwellings is at 2,250 units (figure 37), confirming the estimates of the homeowners' association. Comparing the existing form and community layout with the approved site development plan for the proposed CMP project in August 1992 (figure 38), there are only 804 lots allotted for the same site. This will result to a gross neighbourhood density of 11,136 dwelling units, which is almost three times lower in comparison with the current density figure. This means that in strictly implementing the original plan, about 1,500 households will be displaced.

This section presented the inherent features of Sitio Gulayan community in terms of estimated population size and density. It also showed the original site development plan approved for upgrading, which indicates that implementing the CMP project will be a challenge to the stakeholders (i.e. homeowners' association, residents, and the local government). In the next section, the socio-economic features of the city and barangay will be discussed.



Legend:
-Sitio Gulayan Community property line
-20 x 20-meter block at 15 houses/block (15 x 150= 2,250 houses)
-20 x 20-meter void block

Figure 37. Residential density block estimates (source: Google earth, 2020)

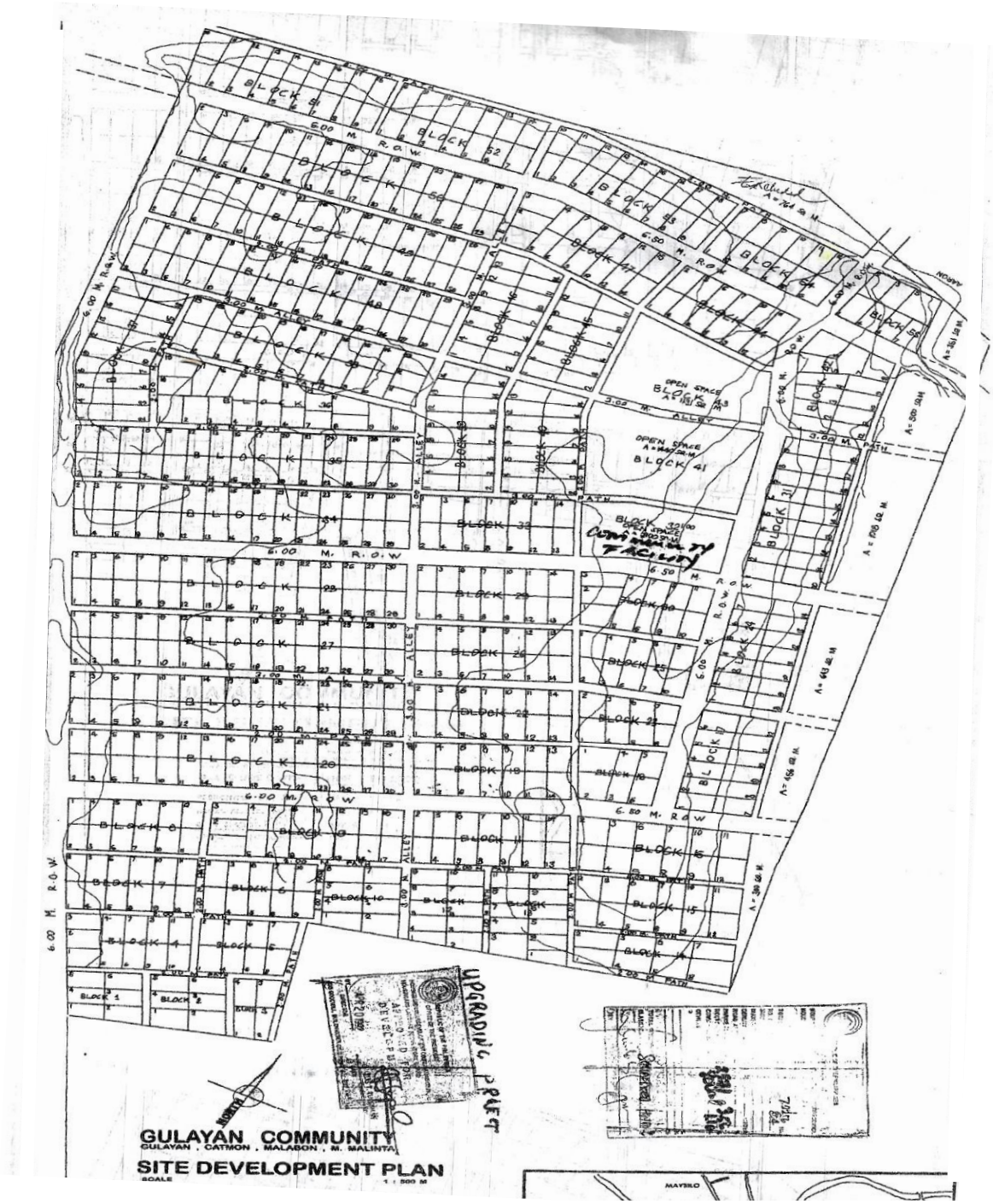


Figure 38. Site Development Plan with 804 lots approved in 1992 (source: GC-HOA, 2020)

5.1.4 Socio-economic features

The employment and livelihood of the population in the city down to the barangay, will be discussed in this section. This will help determine the available job opportunities in the city, which can then be compared with the livelihood means of the community at large, and the research participants in particular, from the data collected. The means of generating income by the city will also be discussed, to identify the economic activities being conducted to enhance its revenue generation.

The local government in the city established the Public Employment Service Office (PESO), to provide assistance on employment and income opportunities to the city's constituents. Part of its mandate is the regular conduct of employment facilitation through job fairs, career coaching orientation, labour education for graduating students, and related activities (CPDD, 2019), to assist job seekers and maintain a high employment rating.

In terms of the labour force, the 2018 pre-pandemic (COVID-19) records show, that 60.6% of the total population in the city belongs to the labour force. Almost 95% of which are employed including the 13.3% considered as underemployed, whilst those unemployed comprise of 5.1%. The most in-demand occupations from the 2019 PESO records, indicate the *office clerk/staff* at the top, followed by *production/factory worker* 2nd, *service crew* at 3rd, *sales clerk* at 4th, and lastly for the position of *cashier*. In the labour-supply demand profile, PESO records also show that the *service workers and shop market sales workers* accounted for the highest percentage of applicants at 57.96%. This was followed by *clerks* with 13.37%, and *labourer and unskilled workers* at 8.09%. The table below shows the complete listing of the major occupational groups (CPDD, 2019).

Table 9. Labour-supply demand by major occupational group (source: PESO, 2019)

Occupational Group	Male	Female	Total	% to Total
Special occupation	425	406	831	4.40%
Professional	584	567	1151	6.10%
Technician and associate professional	496	272	768	4.07%
Clerks	1258	1265	2523	13.37%
Service workers and shop market sales workers	6459	4479	10938	57.96%
Trade and related workers	835	116	951	5.04%
Plant and machine operator assemblers	179	5	184	0.97%
Labourer and unskilled workers	829	698	1527	8.09%
Total	11065	7808	18873	100.00%

In terms of businesses and enterprises, majority in the city belong to the micro, small and medium enterprises (MSMEs). According to the city's Business Permit and Licensing Office records, those registered were classified based on the asset of the business comprising of eight hundred (800) micro, twenty three (23) small and seven (7) medium enterprises (CPDD, 2019).

For the income of the city, the audited 2019 records from the Commission on Audit (COA), indicate that the city was not able to generate the projected revenues for CY 2019 totalling PHP1.90 billion as shown by the substantial shortfall of PHP108.112 million in actual income realised for the year. This indicates that the estimates may not have been based on reasonable and/or realistic figures submitted by the Local Finance Committee. Presented below are the financial highlights of the city of Malabon for CYs 2019 and 2018 – table 10 for the financial performance, and table 11 for the sources of income.

Table 10. Financial Performance for 2019 and 2018

	2019	2018	Increase (Decrease)
Income	P 1,792,062,922	P 1,686,086,967	P 105,975,955
Expenses	1,495,546,293	1,382,999,092	112,547,201
Transfer, Assistance and Subsidy To (Net)	60,454,412	47,451,231	13,003,181
Surplus for the period	236,062,217	255,636,644	(19,574,427)

Table 11. Sources of Income for 2019 and 2018

	2019	2018	Increase (Decrease)
Tax Revenue	P 691,175,973	P 662,201,910	P 28,974,063
Share from Internal Revenue Collections	832,646,874	762,824,864	69,822,010
Other Share from National Taxes	-	3,026,730	(3,026,730)
Service and Business Income	264,382,464	253,327,972	11,054,492
Shares, Grants and Donations	2,907,163	3,549,643	(642,480)
Other Income	950,448	1,155,848	(205,400)
Total	**P 1,792,062,922**	**P 1,686,086,967**	**P 105,975,955**

The city's financial highlights, employment and livelihood were presented in this section. The available officially audited figures were from 2018 and 2019 only, considering the delay in releasing the official figures for the succeeding and current years as a result of the pandemic. Figures specific to the barangay and Sitio Gulayan community are not available as well. The employment and livelihood of the residents, however, will be presented in the ensuing Chapter 6, *Data Analysis* from the data gathered. The next section will discuss the hazard features of the city, barangay, and the community, as a prelude to the succeeding flood management main section.

5.1.5 Hazard features

This section will identify the hazards in the city and discuss the climate and extreme weather events. The focus will be on the geological and hydro-meteorological hazard with both flooding and storms perennially experienced in the city. As mentioned, this section will serve as an introduction to the succeeding main section where the flood risk management in the city will be presented.

Malabon City's climate is classified as Type 1 in the Corona's classification being used by the Philippine Atmospheric, Geophysical & Astronomical Services Administration (PAGASA). It is characterised by two pronounced seasons – dry season from January to April, and rainy season from May to October. Temperature is hot and humid all year round with an average relative

humidity of 82%, but generally cooler between November and February. It is usually hottest in May with temperatures reaching up to 38 degrees Celsius. Rainy season starts in June until October, but with the changes in climate, it could extend until the yearend. The approximate average rainfall is 2000 mm with a peak of at least 400mm in August, usually the rainiest month, and a low of 4 mm in March. From the data recorded by PAGASA, table 12 below shows the summary of climate changes projected and its effect on the seasonal patterns. The climate data indicate projections for 2020 and 2050 under the medium-range emission scenario for Metro Manila. According to CPDD (2018), the climate change data derived from the tables are the seasonal temperature increase (in ºC), the seasonal rainfall change (in %), and the frequency of extreme events (Port Area data).

Table 12. Extreme Weather Events Summary in Metro Manila (source: CPDD, 2018)

Climate Variable	General Changes Expected in Climate Variables	Specific Change Expected and Reference Period	Information about seasonal patterns of change
Temperature	Increase	+0.9 to 1.1ºC (2020) +1.8 to 2.1ºC (2050) compared to OBS	Slightly warmer temperatures all throughout the year especially in the summer (MAM)
Rainfall	Seasonal increase or decrease	Amount of Rainfall (mm.) Season OBS 2020 2050 DJF 107.5 93.74 88.90 MAM 198.5 132.40 122.08 JJA 1170.2 1269.67 1419.4 SON 758.7 758.70 786.77	Decrease of rainfall from December to May (during Amihan) Increase of rainfall from June to November (during Habagat)
Extreme events	Increasing number of hot days (exceeding 35ºC)	1984 days exceeding 35ºC in years 2006-2035 3126 days exceeding 35ºC in years 2036-2065 From OBS of 1095 days	
	Decreasing number of dry days (<2.5 mm. of rain)	6302 dry days in years 2006-2035 6220 dry days in years 2036-2065 From OBS of 7476 days	
	Slight increase of number of days with heavy rainfall (>200 mm.)	13 days with heavy rainfall 17 days with heavy rainfall From OBS of 9 days	

The city's location and soil type make it prone to geological hazards such as ground shaking, liquefaction and tsunami, and hydro-meteorological such as flood, storm surge, and strong wind. With the exception of Barangays Acacia and Potrero, all of the 21 barangays including Barangay Catmon are susceptible to these hazards. Barangay Acacia is only partly susceptible to liquefaction, whilst Potrero is partly susceptible to both liquefaction and tsunami.

Hazard maps

Amongst the five hazards, Malabon City as discussed in Chapter 2, is mostly prone to floods due to typhoon and monsoon rains. The safest barangays being located on higher elevation are

Barangays Potrero, Acacia and Tugatog. The hazard maps in Metro Manila for *landslide* (figure 39), *liquefaction* (figure 40), *tsunami* (figure 41), and *flooding* are presented below highlighting the city of Malabon (figures 42a, 42b, & 42c) and Sitio Gulayan community (figures 43a, 43b, & 43c).

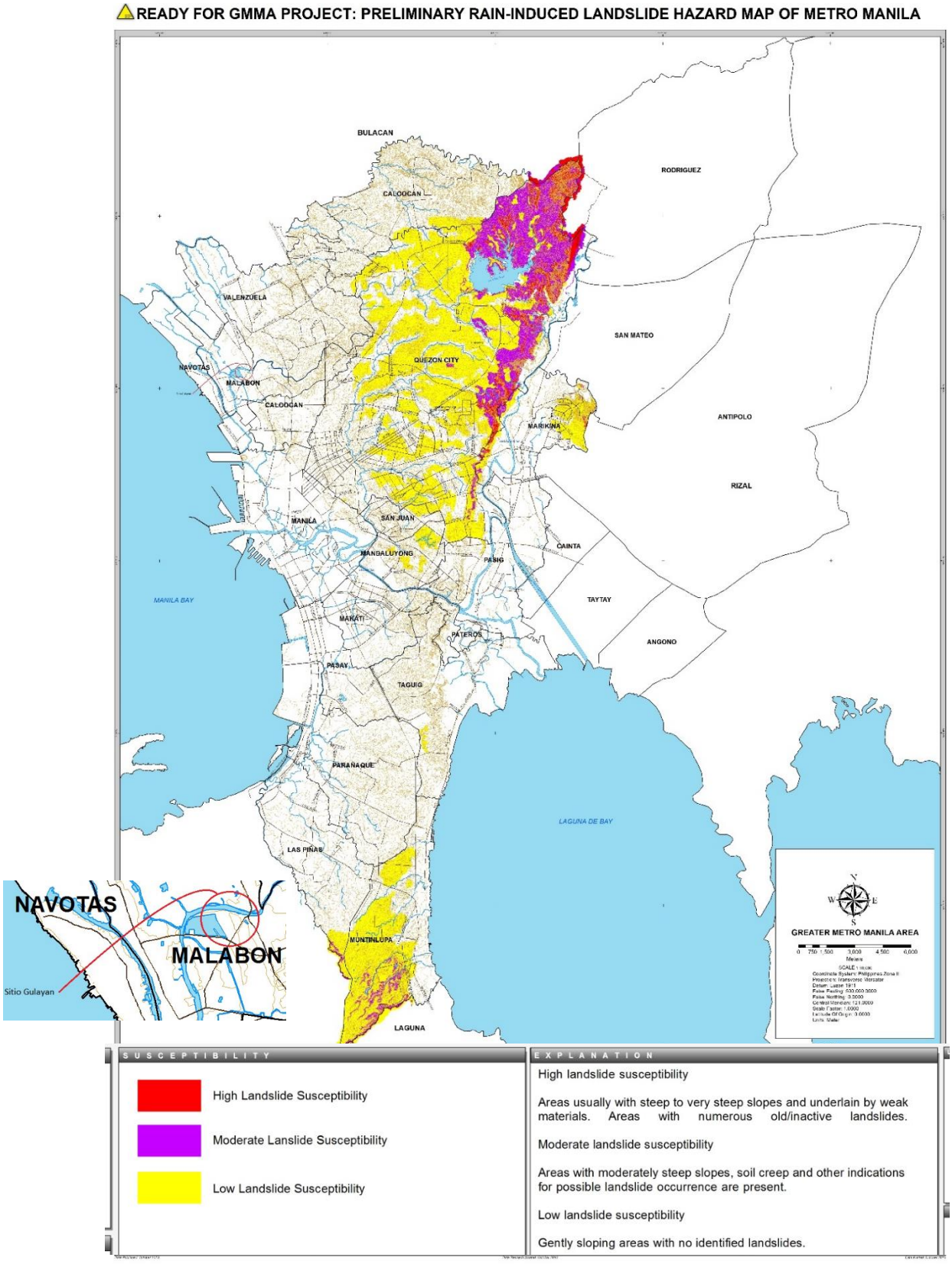


Figure 39. Metro Manila Rain-induced Landslide Hazard Map (source: GMMA RAP, 2013)

In the rain-induced landslide map (figure 39), Malabon City is shown to be insusceptible to landslide whilst in terms of liquefaction (figure 40), half of the area is highly susceptible with the other half moderately susceptible to liquefaction. The tsunami hazard map (figure 41) indicates that the entire city is susceptible to inundation based on the current physical conditions.

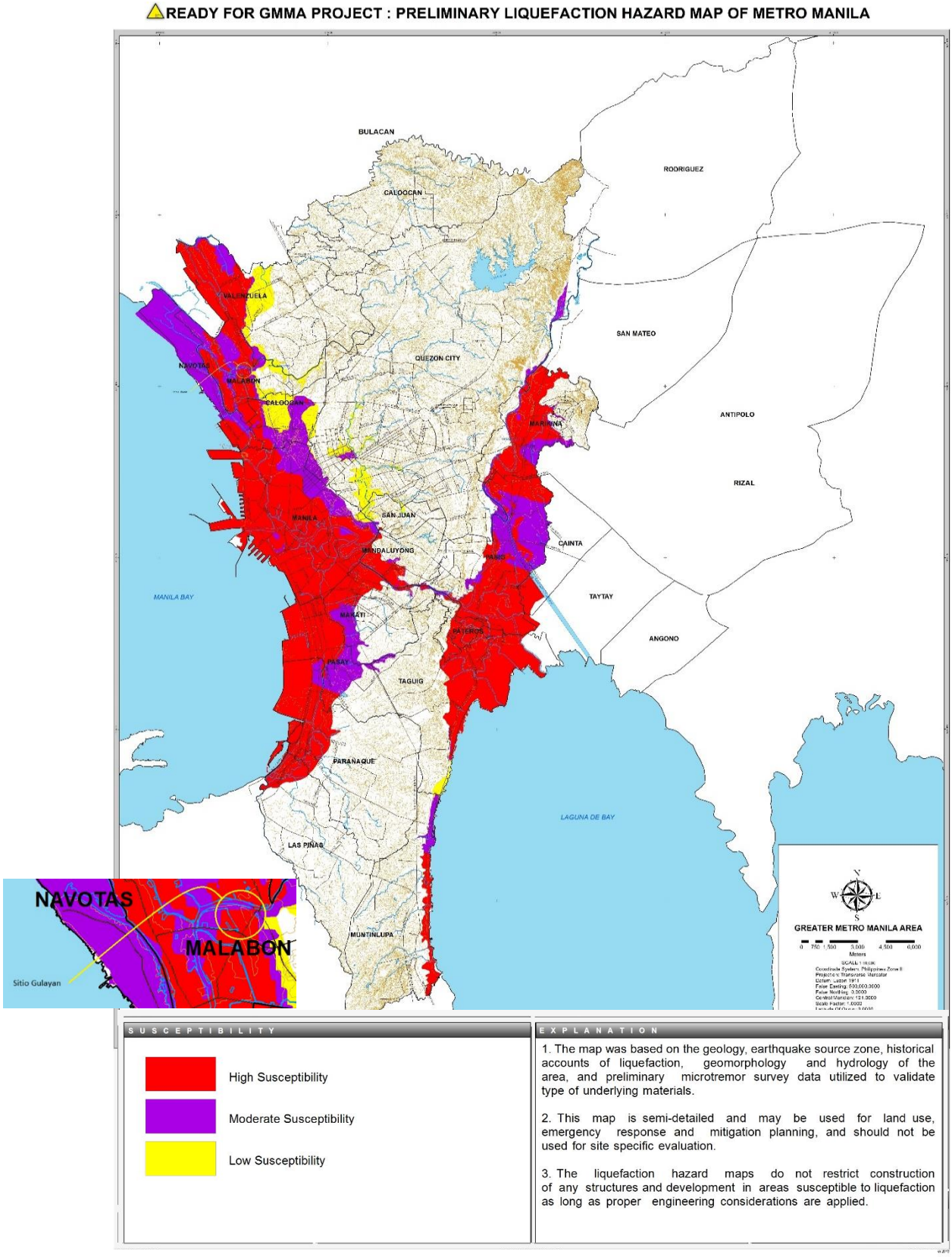


Figure 40. Metro Manila Liquefaction Hazard Map (source: GMMA RAP, 2013)

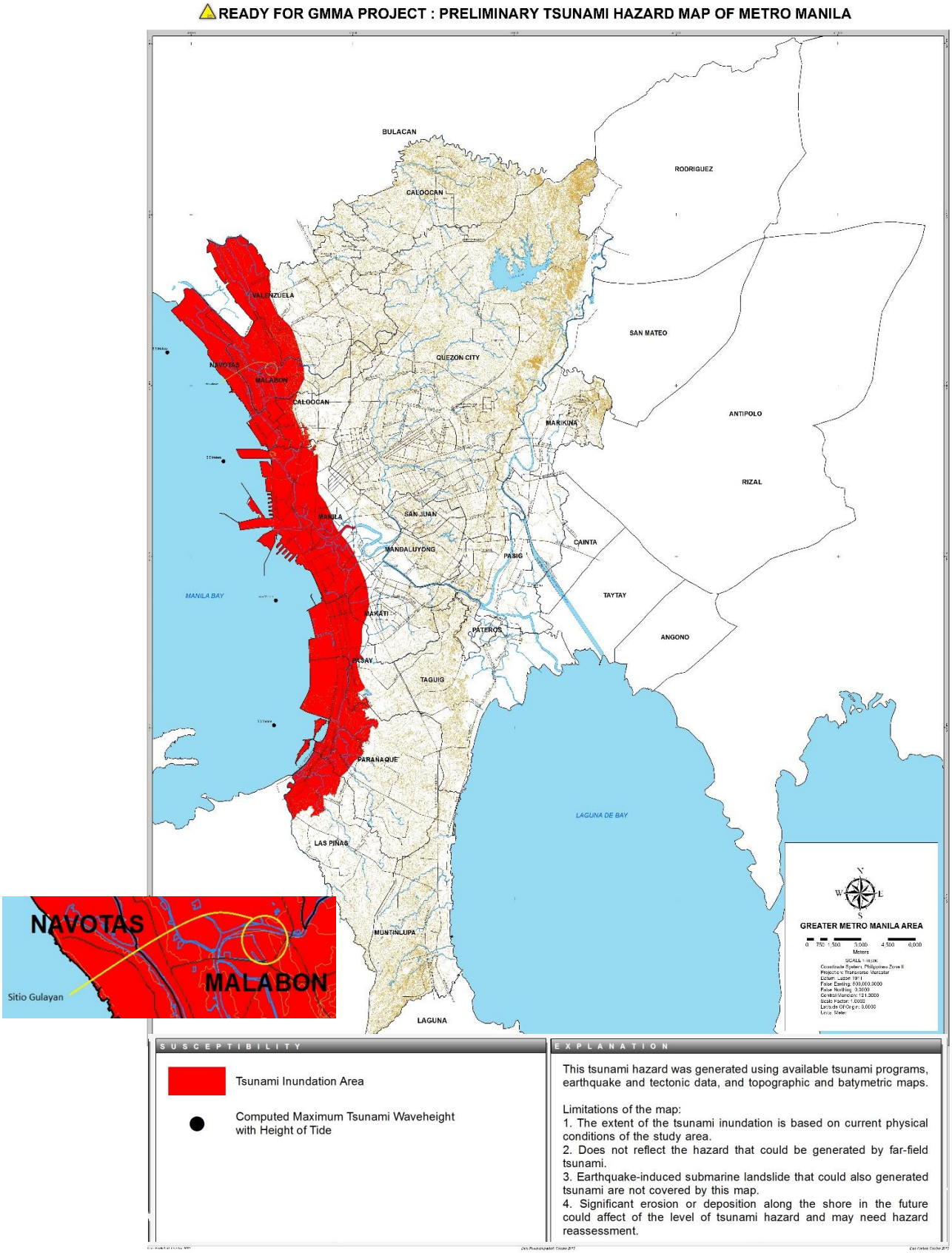


Figure 41. Metro Manila Tsunami Hazard Map (source: GMMA RAP, 2013)

City Of Malabon, Metropolitan Manila 5 Year Flood Hazard Map

Abstract

This shapefile, with a resolution of 10 meters, illustrates the inundation extents in the area if the actual amount of rain exceeds that of a 5 year-rain return period.

Note: There is a 1/5 (20%) probability of a flood with 5 year return period occurring in a single year. The Rainfall Intesity Duration Frequency is 243.100mm.

3 levels of hazard:
Low Hazard (YELLOW)
Height: 0.1m-0.5m

Medium Hazard (ORANGE)
Height: 0.5m-1.5m

High Hazard (RED)
Height: beyond 1.5m

Purpose

The flood hazard map may be used by the local government for appropriate land use planning in flood-prone areas and for disaster risk reduction and management, such as identifying areas at risk of flooding and proper planning of evacuation.

Legend

- Municipal Boundary
- Low
- Medium
- High
- Area Assessed
- Area Not Assessed

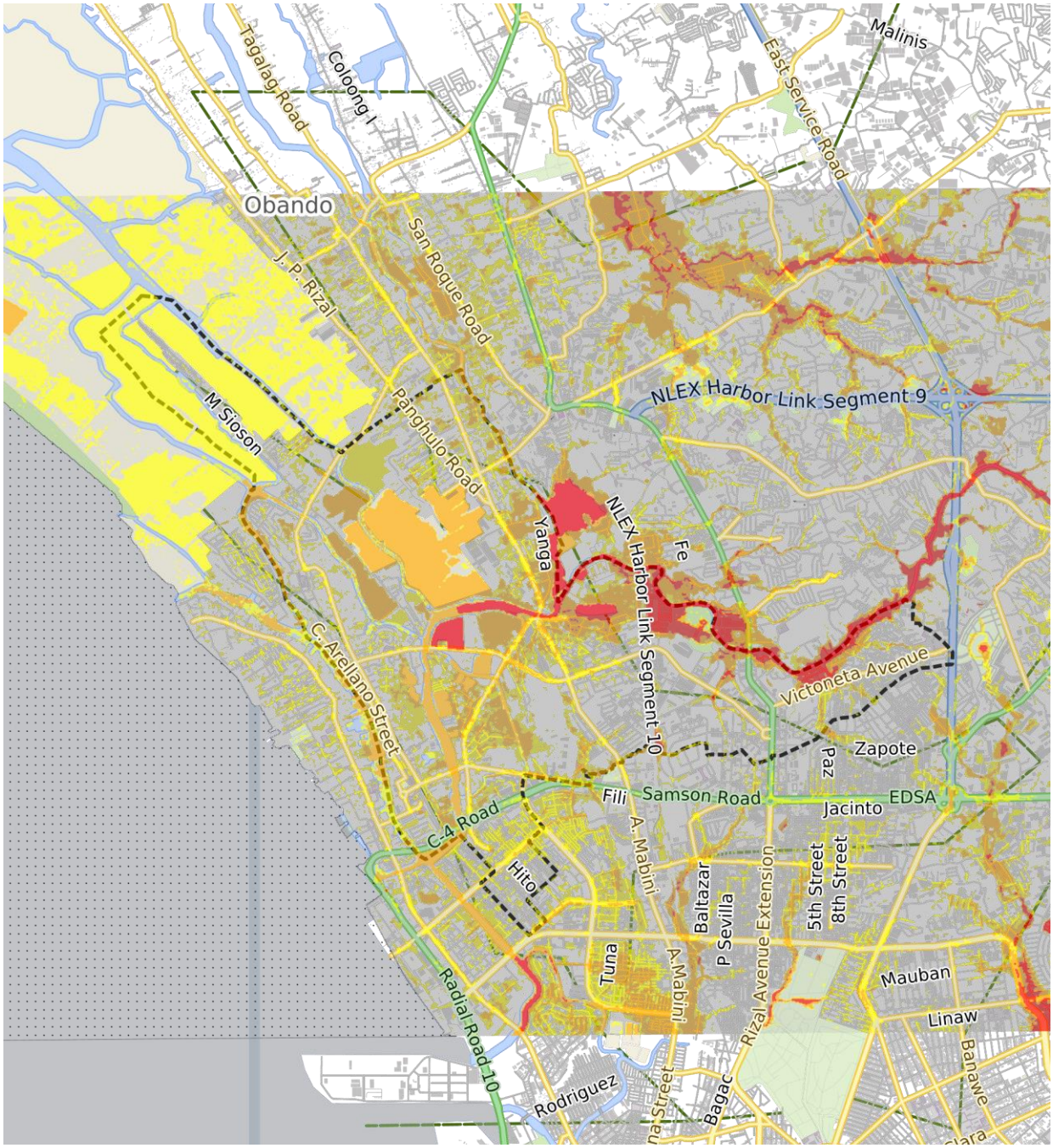


Figure 42a. Malabon City 5-year Flood Hazard Map (source: DOST-UP DREAM and Phil-LiDAR Program, 2017)

In the flood hazard maps, the 5-year map (figures 42a & 43a) shows that the northern portion of the city has low hazard level (0.10 to 0.50 metre) with the middle and southern areas having medium hazard level (0.50 to 1.50 metres) including Sitio Gulayan. Portions of Tullahan River and an existing fishpond is shown to have a high hazard level (beyond 1.50 metres).

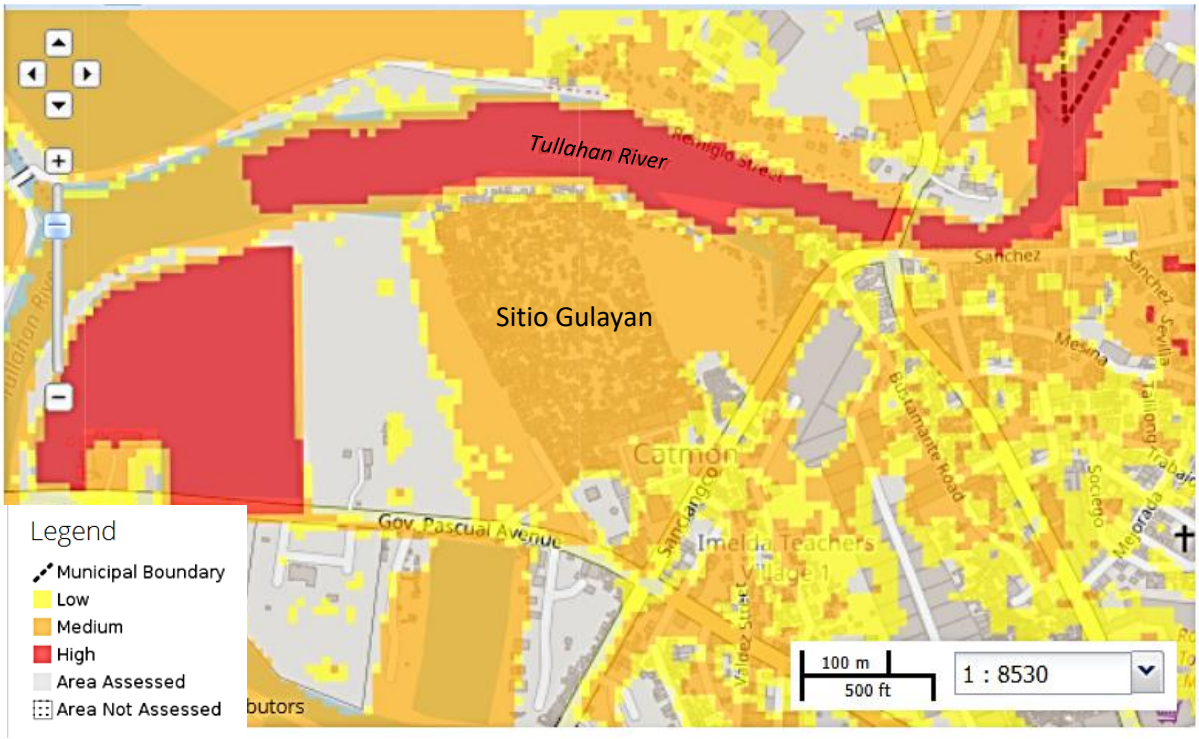


Figure 43a. Sitio Gulayan 5-year Flood Hazard Map (source: DOST-UP DREAM and Phil-LiDAR Program, 2017)

City Of Malabon, Metropolitan Manila 25 Year Flood Hazard Map

Abstract
This shapefile, with a resolution of 10 meters, illustrates the inundation extents in the area if the actual amount of rain exceeds that of a 25 year-rain return period.

Note: There is a 1/25 (4%) probability of a flood with 25 year return period occurring in a single year. The Rainfall Intesity Duration Frequency is 373.600mm.

3 levels of hazard:
Low Hazard (YELLOW)
Height: 0.1m-0.5m

Medium Hazard (ORANGE)
Height: 0.5m-1.5m

High Hazard (RED)
Height: beyond 1.5m

Purpose
The flood hazard map may be used by the local government for appropriate land use planning in flood-prone areas and for disaster risk reduction and management, such as identifying areas at risk of flooding and proper planning of evacuation.

Legend
- Municipal Boundary
- Low
- Medium
- High
- Area Assessed
- Area Not Assessed

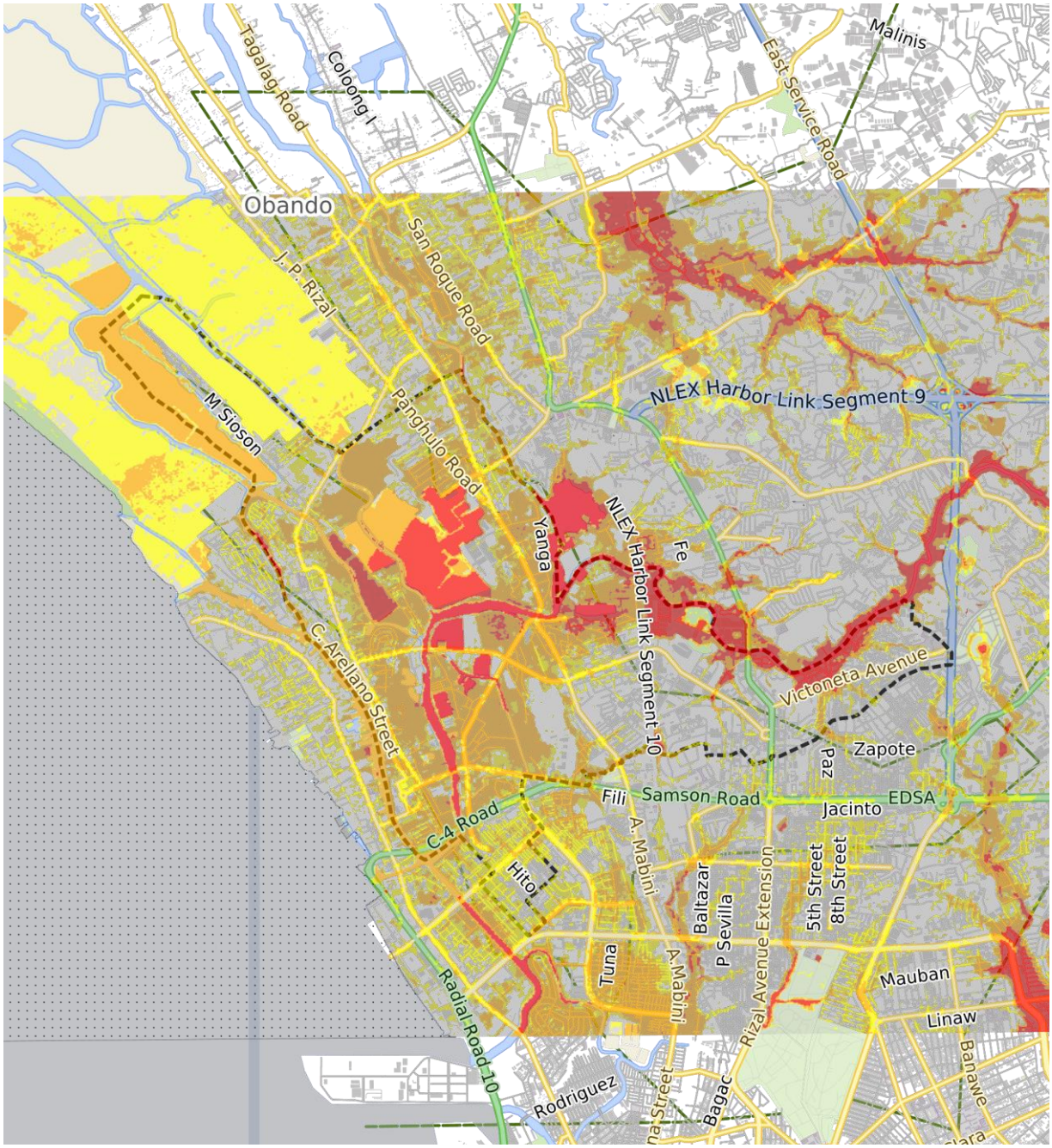


Figure 42b. Malabon City 25-year Flood Hazard Map (source: DOST-UP DREAM and Phil-LiDAR Program, 2017)

For the 25-year flood hazard map (figures 42b & 43b), the northern portion is divided into low (0.10 to 0.50 metre) and medium hazard level (0.50 to 1.50 metres) with the middle and lower portions mixed between medium and high level (beyond 1.50 metres). The core of the community of Sitio Gulayan is shown to be high with the perimeter at medium level hazard.

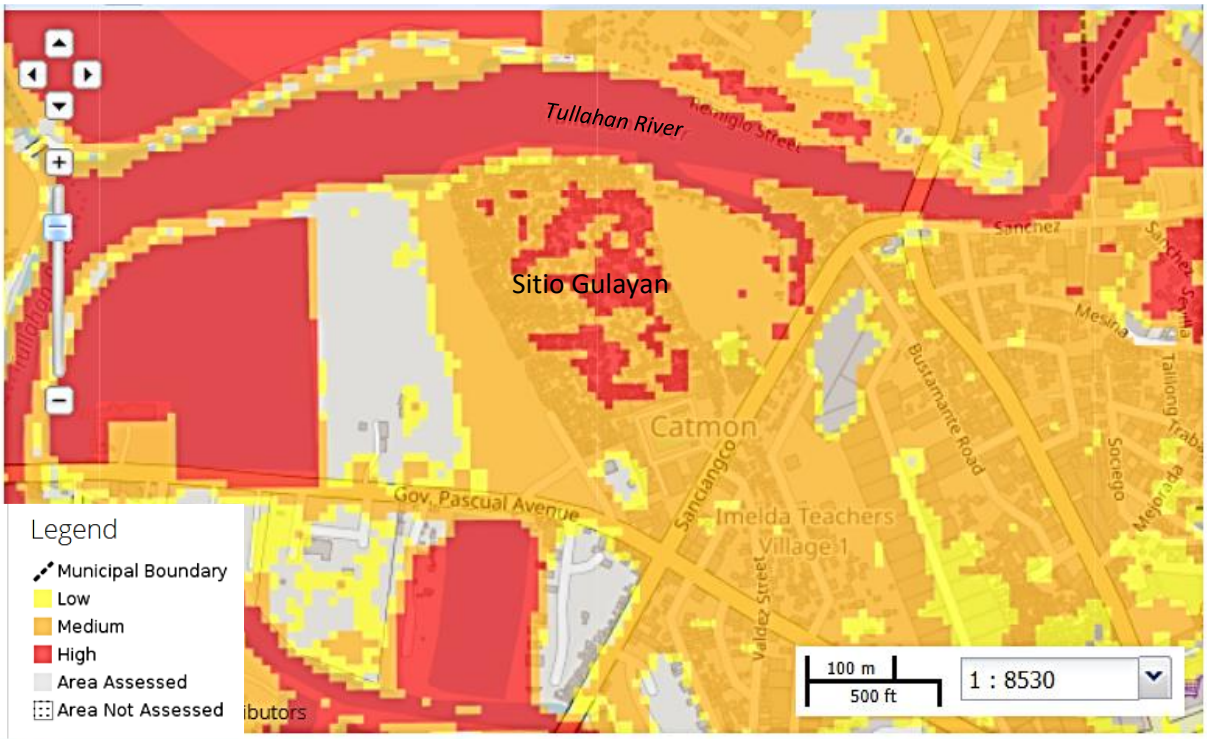


Figure 43b. Sitio Gulayan 25-year Flood Hazard Map (source: DOST-UP DREAM and Phil-LiDAR Program, 2017)

City Of Malabon, Metropolitan Manila 100 Year Flood Hazard Map

Abstract
This shapefile, with a resolution of 10 meters, illustrates the inundation extents in the area if the actual amount of rain exceeds that of a 100 year-rain return period.

Note: There is a 1/100 (1%) probability of a flood with 100 year return period occurring in a single year. The Rainfall Intesity Duration Frequency is 481.200mm.

3 levels of hazard:
Low Hazard (YELLOW)
Height: 0.1m-0.5m

Medium Hazard (ORANGE)
Height: 0.5m-1.5m

Purpose
The flood hazard map may be used by the local government for appropriate land use planning in flood-prone areas and for disaster risk reduction and management, such as identifying areas at risk of flooding and proper planning of evacuation.

Legend
Municipal Boundary
Low
Medium
High
Area Assessed
Area Not Assessed

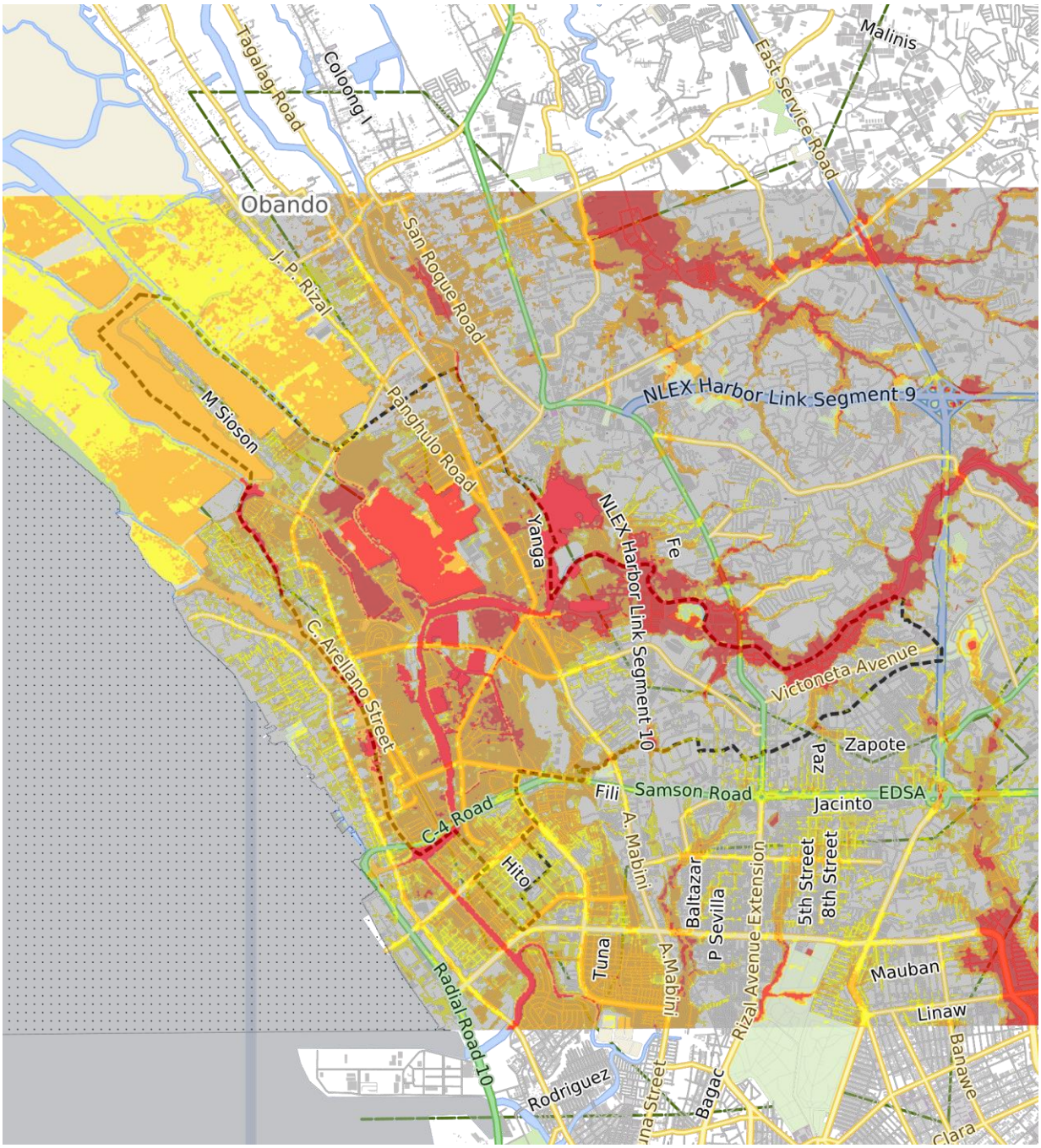


Figure 42c. Malabon City 100-year Flood Hazard Map (source: DOST-UP DREAM and Phil-LiDAR Program, 2017)

The 100-year hazard map (figures 42c & 43c) indicates the northern portion to be mostly medium level (0.50 to 1.50 metres) with the middle and lower portions largely high level (beyond 1.50 metres), particularly in the core with the exterior areas at medium hazard level. Sitio Gulayan, however, is shown to be totally at a high hazard level except for the concrete dike and exterior portions along the major and minor roads. This means that the entire settlement could be inundated beyond 1.50-metre-high floods.

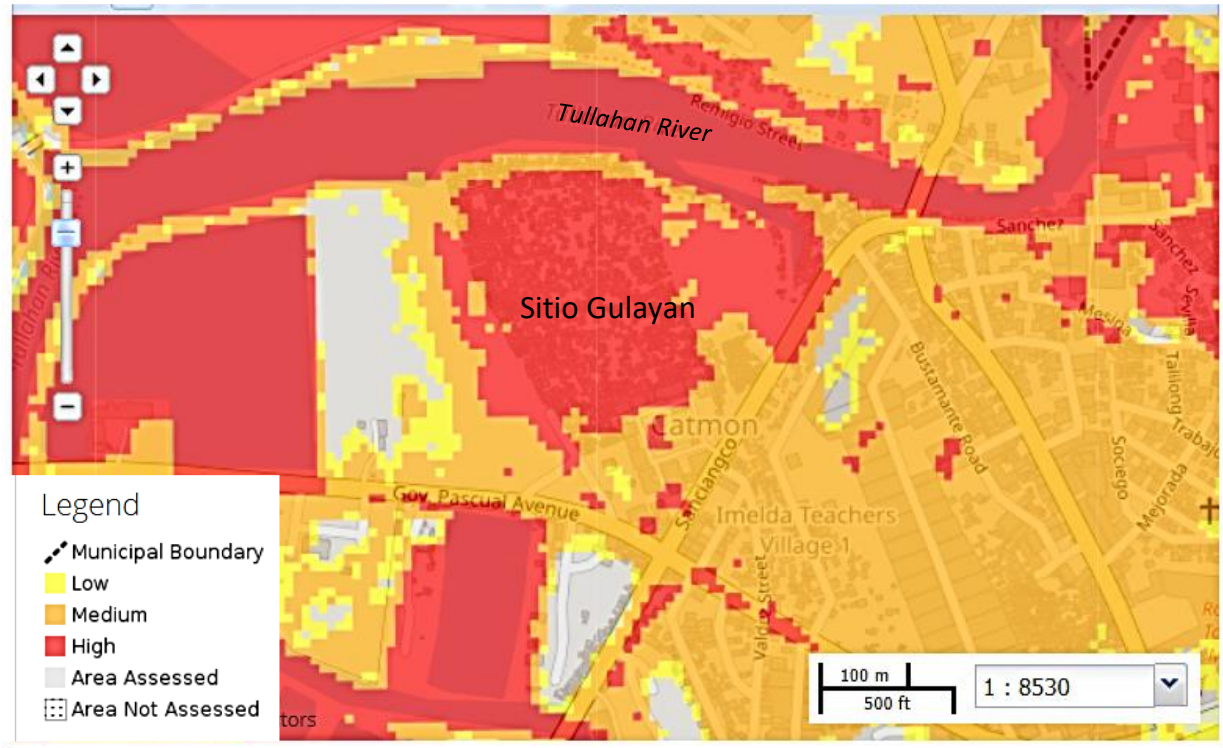


Figure 43c. Sitio Gulayan 100-year Flood Hazard Map (source: DOST-UP DREAM and Phil-LiDAR Program, 2017)

The main section on hazard features presented the existing and future hazards, and discussed the climate with the extreme weather events in the city. Various hazard maps were also presented starting from Metro Manila down to Malabon City and Sitio Gulayan community, to identify the possible extent of environmental hazards, particularly flooding in the city at large and the community. The succeeding final main section in this chapter, will discuss how these risk hazards are being managed in the city and community levels.

5.2 Flood risk management

This last section will present the management of flood risk in the city and in Sitio Gulayan by discussing initially the flood types being experienced in Malabon City. The magnitude and extent of flooding in terms of flood level, duration, and damage incurred, will be presented next by identifying and describing the previous flooding events that devastated the city. The impacts will be identified through the cost of damage and the number of affected residents during the worst flooding events experienced.

Prevention and mitigation will then be presented by discussing firstly, the flood control projects implemented and on-going in Metro Manila which involves the city of Malabon. Secondly, the efficiency of the mitigation measures in the community level and lastly, the programmes for non-structural measures in terms of preparedness and response to identify the extent of involvement or non-involvement of the community with the measures being proposed and executed by the local government. The focus will be on the flood types inherent in the city, which will be discussed in the next section.

5.2.1 Flood types

There are two types of flooding being experienced in the city of Malabon - urban flooding and fluvial or riverine flooding. Fluvial flooding refers to a condition when a river overflows its banks and in the case of Malabon City, it is the result of the multiple rivers and waterways bordering and traversing the city. Both these types, however, are brought about either by typhoons or heavy monsoon rains, further aggravated by the physical features of the city including high tides, land subsidence, and sea level rise.

Urban flooding in Malabon similar to Metro Manila as discussed in Chapter 2, is caused by insufficient and outdated drainage system in the city. River flooding on the other hand, is inherent in Malabon City with the two main rivers passing through Metro Manila. One of these is Tullahan River which carries the spill over from La Mesa Dam and all tributaries downstream of the dam (Paringit, 2016). The run-off from the dam starts upstream in Quezon City down to the CAMANAVA area with the heavily silted and clogged Tullahan River, contributing to the frequent flooding in the area (CDKN, 2015).

Starting from the La Mesa Reservoir, the 59.24-kilometre tributary traverses Valenzuela and Malabon cities to reach the mouth of Manila Bay through Navotas City (PNA, 2018). The substrate of Malabon City according to a study by the City of Manila Government (2018, p. 2-7), "…is predominantly estuarine deposits and beach/sandbar deposits". Water is discharged directly into the bay with the deposition within the bay becoming very active.

In the event of typhoon or heavy monsoon rains, the river system can overflow breaching the dike that protects the settlement areas along the riverbanks. To better describe the effects of flooding in Malabon City, the magnitude, extent, and impacts of the extreme flood events in the city, barangay, and Sitio Gulayan community, will be discussed in the succeeding sections.

5.2.2 Magnitude and impacts of flooding

The extent and impacts of floods in the city will be presented in this section, particularly the devastating extreme flood events. The focus will be on Tropical Storm 'Ondoy' as discussed in Chapter 2, as one of the devastating flooding events experienced in the city. In this section, the wrath of the flood event on the city, Barangay Catmon, and in Sitio Gulayan community will be discussed.

The city of Malabon has endured some of the most devastating flood events in the region. The magnitude and extent of which, have become more tragic with climate change and the influx of settlers in the city, particularly in the risk areas along the waterways. The two extreme flood events were in 2009 brought about by Tropical Storm 'Ondoy', and the 2013 'Habagat'.

In Sato and Nakasu's 2011 study on the aftermath of 'Ondoy' in Malabon City, it was reported that there were 159 houses completely destroyed, and 9,851 residents affected with one casualty. Economic loss was estimated at Php 20,354,400 (Sato and Nakasu, 2011). OCHA's Reliefweb reported that the health centre in barangay Catmon during the storm, was completely submerged and all equipment and supplies were either damaged or destroyed (OCHA, 2009).

Even the houses along the Tullahan River surrounded by the seven-foot-high concrete dike, have not been spared from flood. Those with two-storey houses opted to stay rather than evacuate, whilst those with their houses totally inundated, used small boats to reach the public schools which served as evacuation centres (JJCICSI, 2015). The Justice Compound located in the same barangay, was inundated destroying most court documents, supplies and equipment inside the courtrooms and offices (Philstar, 2009). Court judges reported water inside their offices was chest-deep with some areas around the complex experiencing as high as 3.6 meter-deep (12 feet) floodwaters.

In terms of flood-related impacts, a survey study conducted by Porio in 2014 with the affected residents in the city of Malabon, encountered the following impacts: 1) shortages of transport, fuel, food and water supplies; 2) disruption of power, water distribution and communication services; 3) piles of garbage and mud clogging the drainage system; 4) illness; 5) rise in commodity prices; 6) damage to their homes, and; 7) the children unable to go to school with their parents unable to report for work.

The schools were closed for almost a month after the floods with some used as evacuation centres, whilst others were heavily damaged. The factories were also closed causing enormous income loss for the residents (Porio, 2014). Four years after, the 'Habagat' flood event in 2013 caused the same devastation and impacts in the city and its residents. In the city government's incident report, the affected population comprise of 1,465 families and 7,650 individuals. The cost of damage was estimated at PHP14 million pesos (CPDD, 2013).

These two major flood events, prompted the national government to revisit its flood control and drainage improvement projects like the *KAMANAVA Flood Control Project* which was audited in 2013. This project, including the other major regional projects to mitigate flooding in Metro Manila and CAMANAVA area, will be discussed in the succeeding sections.

5.2.3 Prevention and mitigation

In comparison with the other cities and lone municipality in Metro Manila, Malabon City together with its neighbouring cities of Caloocan, Navotas, and Valenzuela, as earlier mentioned are

prone to flooding. Most of the existing land uses such as residential, commercial, and industrial, were originally fishponds developed and reclassified into their current land uses. Add to this, rapid urbanisation, land subsidence, sea level rise, high tides, and insufficient and outdated drainage systems that exacerbate the area's susceptibility to flood hazards. Due to these challenges, most of the regional flood control and drainage improvement measures directly involve the CAMANAVA area. Three major projects will be presented in this section starting off with the flood control and drainage improvement conceptualised specifically for the area.

The *KAMANAVA Flood Control Project* was conceptualised in 1997 "…to alleviate the progressive deterioration of flood condition in the area" (COA, 2017 p. 2). The PHP 3.5-billion-peso flood control project, aims to mitigate flood damages through flood control and drainage improvement, and to reduce water pollution in rivers and waterways by channel dredging. Aside from the relocation of the informal settlers living along the affected rivers and waterways, the project mainly involves the raising of river walls, construction of flood control gates, pumping stations, polder dikes, and regulation ponds (figure 44).

The project commencing in year 2000 was scheduled to finish in 2007, but was extended and audited in 2013 by the Commission of Audit (COA) with an accomplished work of 88 percent out of the total project scope. The report concludes that the project was not able to completely mitigate the flooding due to: 1) deficiencies in the structure; 2) existence of informal settlers and large volume of uncollected garbage, and; 3) inadequate personnel and communication facilities.

Figure 44. KAMANAVA Flood Control Map (source: Commission on Audit, 2013)

Another huge regional project involving the city of Malabon is the *Oplan LIKAS: Lumikas para Iwas Kalamidad at Sakit* (Operation Plan: Evacuate to Avoid Calamity and Sickness), which involves the relocation of about 104,000 ISFs in Metro Manila living in danger areas along major waterways (NEDA, 2017). It is a relocation program according to World Bank (2016), that began in 2012 and is being implemented by DILG, in conjunction with LGUs, NHA, PCUP (Presidential Commission on the Urban Poor), and DSWD (Department of Social Welfare and Development).

The 5-year project was allocated PHP50 billion by the government for both in-city and off-city relocation of the affected ISFs. Between the years 2015 to 2016, around 25,000 ISFs had been relocated to 20 in-city and off-city resettlement sites mostly administered by NHA. In terms of the housing provision, more than 83,000 housing units or 69 percent according to the Philippine Development Plan 2017-2022 report, were completed by NHA and SHFC as of September 2016. The report also shows that for the total housing units delivered, 11 percent are in-city resettlements whilst 89 percent are off-city.

The government, however, admitted that the implementation of the housing programme "…has been slow due to land acquisition, site development, and relocation issues and bottlenecks" (NEDA, 2017 p. 183). For land acquisition, the challenges involved lack of suitable and affordable land, LGUs objection to receive ISFs from other cities or municipalities, delay in the BIR's (Bureau of Internal Revenue) ruling on developers' tax exemption on capital gains, and non-compliance of ISFs on technical requirements.

Problems encountered on site development include late issuance of permits and similar requirements by the LGUs, whilst for relocation, one issue is the delay in power and water connection in resettlement areas. Aside from the delay in basic services provision, the ISFs would not want to voluntarily relocate because of: 1) lack of livelihood opportunities in resettlement areas; 2) delay in financial assistance payment by the government; 3) titling for high-density housing, and; 4) housing units that are unaffordable to most ISFs.

Related to the Oplan LIKAS project is the *Manila Bay Clean-up Rehabilitation and Preservation Program* assigned by the national government to the DILG (Department of Interior and Local Government). This project is a court mandamus in 2008 to the various government agencies including the DILG as a result of the complaint filed by the Concerned Residents of Manila Bay on the contamination of the marine life in the bay. The complaint according to DILG (2013, p.1), "…further claims that these National Government Agencies should be held liable and be ordered to clean up Manila Bay".

In response to the project, the Metro Manila LGUs were grouped into three clusters based on their geographical location and proximity to a particular river basin system. The CAMANAVA area including Quezon City, were assigned as one cluster being in proximity with the Tullahan-Tenejeros River System. The rehabilitation programme according to DENR, comprise of three phases: 1) clean-up/water quality improvement; 2) rehabilitation of old sewer lines and

resettlement of informal settlers, and; 3) education and sustainment. The operational plan which started in 2017 is targeted to be accomplished by 2022.

To date, DENR reports indicate that coliform levels have drastically decreased with more than 3,810 tons of garbage, water hyacinth, and silt removed from the bay coastline and drainage system. In terms of resettlement, a total of 70,165 ISFs from Metro Manila, Central Luzon, and Calabarzon, have also been relocated (Gamboa, 2020). In support and to complement these major regional projects, the local government conceptualised and implemented its own projects and programmes related to flood risk preparedness and response, which will be discussed in the ensuing final section.

5.2.4 Preparedness and response

With the spate of extreme flood events in the city, the flood control programme in the city of Malabon became the primary concern of the local administration. According to the City Planning Department, various flood control projects and activities were conducted by the city government together with the Barangays and the DPWH, to complement the national government's flood control project (CPDD, 2019). The current local programmes and projects will be presented in this section.

An important flood mitigation project in the city is the building of pumping stations and flood gates strategically located in and around the city. There are currently 52 pumping stations and 120 flood gates in the locality (CPDD, 2019), which require regular maintenance, particularly during the rainy season. Other flood-related activities include construction and maintenance of river walls, polder dikes, and the rehabilitation and improvement of the drainage system like the regular declogging of canals. Tullahan River similarly, is being desilted regularly, but operations stopped at the height of the COVID-19 pandemic.

Proper solid waste management (SWM) is an important deterrent to the clogged drainage system in the city of Malabon. As part of the city's programme, clean-up activities conducted by volunteers enabled the collection of more than 30,000 kilograms of waste covering about 18,000 linear metres of waterways and roads at the end of the programme (CPDD, 2019). With the city having its own plant nursery, urban greening is also a regular city activity consisting of tree planting and landscaping.

Other non-structural flood mitigation measures include setting-up of the Early Warning System (EWS). In 2018, the city government secured EWS devices consisting of sirens, CCTVs, and flood monitoring system. This complemented the existing system provided by PAGASA along the Tullahan River System in their EWS-3 project. The devices consist of rainfall gauges, water level gauges, CCTV stations, relay station, and warning posts that have a 3-tone siren corresponding to different warning levels (Alert, Alarm and Critical levels) at each forecasting

point (PAGASA, 2016). Aside from the EWS devices, emergency vehicles, equipment, and gears were also procured in the same year.

In terms of disaster preparedness and response trainings, the city handed out disaster preparedness handbooks containing information on existing hazards, preparation for disasters, and first aid procedures (CPDD, 2019). Seminars and trainings on capacity building are being regularly conducted as well in the Barangays, schools, and with various organisations in the city. Another programme that has become a regular activity in the city since its inception in 2016, is the DRR Caravan. Inspired by Japan's Disaster Preparedness Programme, the Caravan is an information and education campaign that targets the youth and students to learn about disaster preparedness and response.

The local projects and programmes discussed in this section have helped the city of Malabon in complementing the national government's flood control and drainage system improvement projects in the CAMANAVA area. However, most of the activities were put on hold during the last two years due to the COVID-19 pandemic. The city, however, is slowly implementing the programmes and would need to work double time to catch up with the original schedule of these programmes.

5.3 Summary

This chapter on the *Study Area* presented an overview of Sitio Gulayan community as the case in the study. Malabon City and Barangay Catmon, where the community is located, were also presented starting with their location and historical development to serve as a prelude on the succeeding main section on flood risk management. The hazard features in the first section presented various hazard maps with focus on the flood hazard, highlighting Barangay Catmon and Sitio Gulayan under three return periods – 5 years, 25 years, and 100 years.

In the final section, the two flood types in the city were discussed describing the magnitude, extent, and impacts on the most recent devastating flood events. The description of the flood events will help determine the possible technical adaptation approach that could be appropriate for the community in developing as a transitional settlement. The section and the chapter concluded with the presentation on the prevention and mitigation of the flood hazards in the regional level, complemented by the preparedness and response programmes and projects in the city level.

The chapter will also serve as a preface to the ensuing Chapter 6, *Data Analysis*, where the data collected in the study area, will be analysed qualitatively and quantitatively. The approaches to the analyses will be discussed in detail, and will conclude with the housing dwelling typologies established from the data gathered through the survey and semi-structured interviews conducted.

6 Chapter 6 Data Analysis

This chapter details the analysis of the data by presenting the chosen approaches to both qualitative and quantitative analyses. Qualitatively, the codes and themes are derived from the participant narrative and presented through thematic maps brought together into three main themes. The chapter concludes with the structural classification of dwellings and flood damage assessment established from the quantitative data analysis.

6.1 Qualitative data analysis

The key feature and one of the challenges in this study, is the breadth of data that requires a suitable approach to analyse and draw out the meaning of the participant narrative. In analysing the extensive data, thematic analysis was utilised to provide an account of the complicated story the data will narrate and identify patterns in meaning across the data. The approach allowed the researcher to make his epistemological and other assumptions clear (Holloway and Todres, 2003) that enabled to address the research questions.

The succeeding sections will present the appropriateness of using thematic analysis in the study, how the collected data were analysed using the chosen method, and the application of the conceptual model in the overall analysis. The assigning of codes into themes and how these were drawn out of from the participant narrative will be presented next with the resultant themes, starting from the more general to the more specific themes with their respective sub-themes.

6.1.1 Thematic analysis

Thematic analysis was chosen as the method because of its suitability in analysing large qualitative data sets (Nowell et al., 2017). As King (2004) argued, thematic analysis is useful for summarising key features of a large data set forcing the researcher to take a well-structured approach to handling data, which help produce a clear and organised final report. The analysis also provides a flexible approach modifiable for many studies to provide a rich and detailed, yet complex account of data (King, 2004).

Using Pojani's framework in this study, a deductive or 'top-down' approach was adopted in identifying the themes or patterns within the data. The identified themes had a close relation to specific questions that were asked of the participants, and the analytic process involved coding the data to fit into a pre-existing coding frame including the researcher's analytic presumptions (Braun and Clarke, 2006). A detailed analysis was then conducted for each individual theme to fit into what Braun and Clarke (2006, p. 92) referred to, as "…the broader overall 'story' being told about the data in relation to the research question".

An inductive or 'bottom-up' approach was also undertaken with the identified themes strongly linked to the data, bearing little relation to the specific questions that were asked of the participants. This form of thematic analysis according to Braun and Clarke (2006), is data-driven

and not driven by the researcher's theoretical interest in the topic that helped generate the key outcomes of the study. The themes were identified using both the explicit meanings of the data with the analysis, and anything beyond what the participant said. With the researcher subscribing to the theoretical position of critical realism, the contextualist method is used in the analysis integrating the method to report experiences, meanings and the reality of research participants, and the method to examine the ways in which these experiences, meanings, and realities "…are the effects of a range of discourses operating within the society" (Braun and Clarke, 2006, p. 81). Applying the qualitative analysis guidelines, the process went through the six phases of analysis: 1.) familiarisation with the data; 2.) generating initial codes; 3.) searching for themes; 4.) reviewing themes; 5.) defining and naming themes; and, 6.) producing the report (ibid.).

6.1.2 Themes

The codes were produced from the participant narrative and developed using *NVivo* as a tool to generate the initial sub-themes, subsequently consolidated into three central main themes. Direct quotations from the participants were applied inductively drawing out the meanings of the data, and deductively through the conceptual framework being utilised in the study. The framework is shown again below in table 6 as a guide in the discussion on the link and application of its key elements and constructs, to the final themes presented in this section.

Table 6. Conceptual framework for housing characteristics adapted from Pojani, 2018 (Author's addition [a]).

Context (social, economic, cultural, political, institutional- national and local)			
Settlement	House	Dwellers	Process
• Size and location • Layout and density • Land use • Public space • Image and identity • Basic services[a]	• Architecture and symbolism • Materials and technology	• Conditions of existence • Place attachment	• Origins • Consolidation • Gentrification • Redevelopment

The succeeding section details how the resultant three main themes were generated by creating thematic maps from the identified initial codes. With the aid of *NVivo*, the codes were then sorted out to mix and combine those with similar meanings to produce common patterns or themes. The general meaning of the themes was established with the patterns consolidated into one main theme. The three main themes are identified and presented in the succeeding sub-sections.

Flood-risk reduction strategies

The *flood-risk reduction strategies* theme is a consolidation of the three common flood themes- *flood control measure, flood reduction,* and *flood-risk* (see figures 45 to 47 thematic map

development). The *flood control measure* is significant in identifying both structural and non-structural measures existing in the community, and help to establish the residents' trust in the authorities. When asked about the existing structural measures, the participants commonly referred to the visible concrete dike as an effective measure, but failed to recall the unseen box culverts constructed in 2010. Credit may not be acknowledged where it is due, but when reminded, the participants did acknowledge the box culverts' value in improving the city's flood control system. The government officials interviewed, similarly attested to both the culverts and dike's contribution in the efficient flood control measure not only in the community, but in the entire barangay.

When inquired about the non-structural measures, the community and government officials interviewed referred to the disaster risk reduction (DRR) programmes and early warning systems (EWS) in place and being practised in the barangay. These were not mentioned, however, by any of the residents interviewed, except for one barangay health worker who discussed going around the community to give advanced warnings and convince residents to evacuate. Most residents instead refer to their own emergency plans and not those from the authorities, which gives the impression that DRR programmes may not be well-coordinated with the community. These inputs were included both in *the flood control measure* and *flood-risk* themes, whilst designated refuge areas within and outside the community as part of the DRR programme, fell under the *flood control measure* theme.

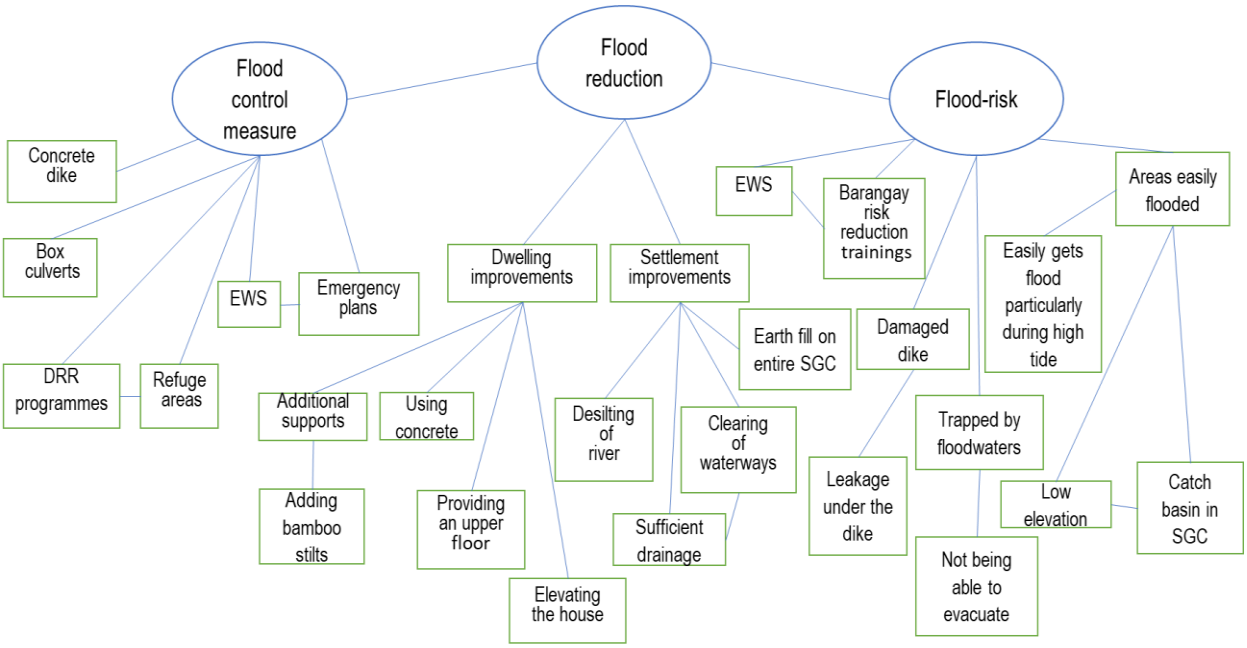


Figure 45. Initial thematic map of *Flood-risk reduction strategies* theme

The residents often discussed improvements to their homes and the community to reduce the impacts of flood events. These included elevating their houses, adding an upper floor, using concrete as a building material, sufficient drainage, waterways clearing, desilting of river, and

earth filling for the entire community. To understand and better illuminate the distinctions between personal and community improvements, these were coded separately under the *flood reduction theme*.

Alongside improvements effected, residents would often talk about their personal aspirations which are linked to their financial capability to realise their future plans. Some were able to accomplish their goals albeit incrementally, as one participant attested, *"We elevated our ground floor and added an upper floor. We really prepared after 'Ondoy' and 'Habagat'"*, whilst another having experienced accommodating evacuees retorted, *"Our house previously was all wood and we renovated using all concrete. We elevated our ground floor and added two upper floors"*.

The motivation for the residents to home improvement primarily is flood resilience based on the most extreme flood event experienced. Structural materials and floor heights are the fundamental considerations over other basic features such as material finishes, size, and space requirements. These are all dependent on what the home owner can afford to start the improvement, without much thought on when to finish the upgrade depending wholly on available funds.

Most residents are aspiring for permanent improvements like a participant who responded- *"Probably just to use concrete instead of wood at the ground and upper floors. We don't need to expand or add another floor, the size is fine as it is".* Diversely, some participants would not want to invest in permanent housing structures due to insecurity of tenure as one resident who is not a legitimate lot owner asserted, *"I will raise our ground floor and replace our roofing. I will just reinforce our house but will not use concrete"*.

The possibility of eviction is an added burden to the settlers which dictates the manner of upgrading one's home. Legitimate lot owners would not hesitate to aspire and invest in permanent improvements using concrete, whilst unauthorised owners would often opt for light materials in terms of cost and ease of disassembling. As one legitimate owner declared, *"If we could really afford it, we will rebuild using concrete. You will not hesitate to use concrete if you will own the lot eventually"*.

Under the theme *flood-risk* in figure 45, most participants referred to low elevation, areas being easily flooded, and damage in the dike as additional flood hazards. These added to their concerns of being trapped in floodwaters and not being able to evacuate under the same theme. The flood reduction and flood risk themes were combined into *flood risk reduction* theme with their sub-themes consolidated into two common constructs- *barangay trainings* and *dwelling improvements* (figure 46).

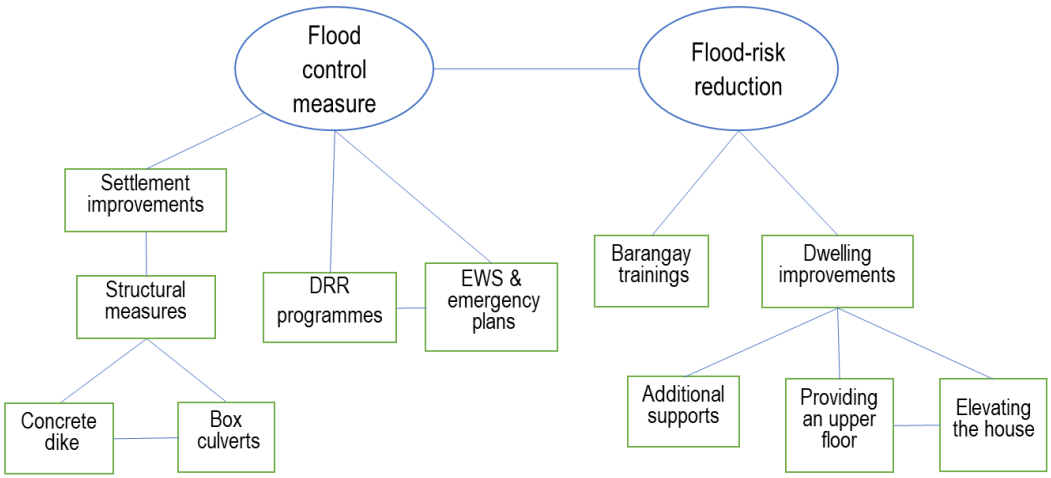


Figure 46. Developed thematic map of *Flood-risk reduction strategies* theme

The two themes, *flood control measure* and *flood-risk reduction* were further combined into the main theme- *Flood-risk reduction strategies.* The codes and sub-themes under this theme were consolidated by combining settlement improvement and flood measures into *structural measures*, whilst mixing DRR programmes and barangay trainings under *EWS and emergency plans. Dwelling improvements* was retained as the last of the final three constructs (figure 47).

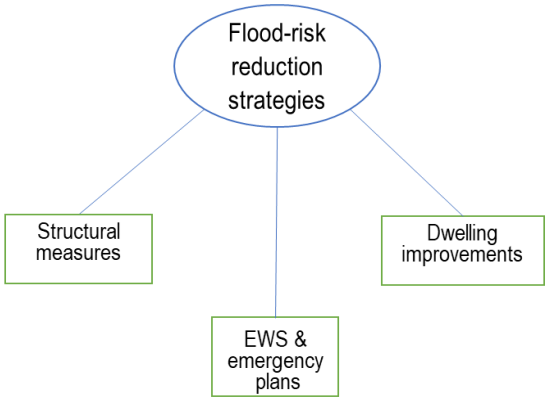


Figure 47. Final thematic map of *Flood-risk reduction strategies* theme

The main theme is significant in investigating the latent technical qualities or abilities that can be found in the settlement, dwellings, and the dwellers themselves, which can lead to establishing the technical adaptability as part of the research question. The sub-theme of *structural measures* will help identify the existing flood control system in the community and its efficiency or inefficiency as attested by the participants. The findings will help assess whether or not the community can be developed into a transitional settlement given the suitability of the flood measures in place.

Excerpts on the interview responses under the *structural measure* sub-theme are shown in the table below with some participants (B3-1-10/3A-5; B3-1-10/3B-26; B3-1-10/3B-46) responding after being reminded of the existence of the box culverts.

Table 13. Excerpts on *Structural measures*

Control no. / Participant no.	Quotation
B2-1-10 / 2A-24	"I am just aware of the dike, but I think they need to reinforce it for added protection."
B3-1-10 / 3A-1	"The water storage tunnels under Sanciangco St. and Gov. Pascual helped a lot in mitigating floods. Water that usually will inundate the community is diverted into these tunnels."
B3-1-10 / 3A-5	"I know that the tunnel under the road helps also in controlling flood in the area."
B3-1-10 / 3B-26	"The dike and water tunnel storage are good measures but proper drainage and canal should also be provided."
B3-1-10 / 3B-46	"Previously it easily floods here, but since the raising of the dike elevation and the provision of the box culverts, not anymore."
B1-1-10 / 1A-24	"Before without the dike, water from the river just flows in, but now the dike and floodgates help a lot."
C2-1-5 / 3	"The canal culvert is really a big help in flood mitigation. There are canals on the sides and in the middle. Also, if you'll notice the river wall where water is being pumped in has been elevated above my height."

The prospects of any planned development in Sitio Gulayan community will be based on the *structural measures* in place which could help determine the appropriate approach given the existing community conditions. *Redevelopment* as a construct under the key element of *Process* in the adapted framework, can be applied should the findings result into the community still being dangerously sited despite the structural measures in place.

This could mean demolition of the floodplain settlement and relocation of the dwellers to allow public redevelopment of the same land. Considering the challenges of *Redevelopment*, however, in terms of available land for relocation and the inexpedient displacement of dwellers, this development approach should very well be the last resort after exhaustive considerations for a probable transitional settlement through in-situ development.

The *EWS and emergency plans* sub-theme refers to the existing non-structural measures which complement the structural measures in mitigating flood hazards. Most of the detailed accounts for the settlement came from the community and local government officials, who discussed the programmes that have already been implemented not only during the flood events, but on other calamitous events such as fire and earthquakes.

The residents on the other hand, narrated their own emergency plans during flood events such as preparing a makeshift elevated platform as refuge area, or moving to a neighbour's house with an upper floor. Having their own plans apart from that of the officials, delays their need to evacuate with the hopes of getting through the floods inside the house or within the premises, where they can watch over their houses and belongings.

Similarly, it is critical to identify the efficiency and sufficiency of these emergency plans and warning systems to determine the community's potential to develop into a transitional settlement. The improvement of existing neighbourhoods into transitional settlements according to USAID (2017), calls for the need to reduce both the hazard risks and the need to relocate affected populations to new settlements. Some of the responses from the interview questions on *EWS and emergency plans* are shown below in table 14.

Table 14. Excerpts on *EWS and emergency plans*

Control no. / Participant no.	Quotation
C3-1-5 / 1	"On the refuge areas, there is an evacuation centre in the Barangay Centre. There is also a multi-purpose hall near the basketball court inside the community. The court also functions as a refuge area as these communities are required to have provisions for open spaces."
C1-1-5 / 1	"There are on-going trainings in the community for risk reduction in terms of fire and flooding."
C2-1-5 / 3	"If it's earthquake we have designated the Gabriel Compound, the empty lot beside the community along Gov. Pascual as refuge area. In case of fire, the covered courts here in the Justice Hall are the designated refuge areas."
C2-1-5 / 2	"We provide them letters, SMS, and through social media like FB and also sirens to warn them. There are also people assigned to go around the community to provide the necessary information and warnings to the residents."
B2-1-10 / 2A-1	"We just stayed home and detached our door to use as platform for our children. We also made use of our table and a hammock as refuge area and to secure our things. We setup a temporary shelter on our roof just in case we need to move up."
B3-1-10 / 3A-3	"My Papa builds us an elevated platform where we could stay in case we will be inundated."
B2-1-10 / 2A-10	"Yes of course, some neighbours come over our place when they need to evacuate. We help each other during calamities."
B3-1-10 / 3A-1	"Neighbours accommodate those who are inundated and need to evacuate. We also help each other in securing things or household items that might get wet."
B1-1-10-1A-18	"Maybe by providing a rescue boat for the community."

From the responses of the local government and barangay officials above, *Public space* is existing in Sitio Gulayan, although inadequately with only the open basketball court serving as the lone public area. As one of the constructs under *Settlement* in the framework, *Public space* which can serve both as an open space and refuge area, is a necessity in community development. It can be used during emergencies, but more importantly, it creates a sense of community through the experiences and values derived from this shared resource (Mean and Tims, 2005).

The Justice Compound as discussed by one of the participants, house the necessary facilities of a public space with the covered courts, parks and playground, public buildings, and the Barangay Centre, interconnected by the network of roads. The accessibility to Sitio Gulayan, however, was not considered in the planning stages of the public space with the former undergoing privatisation through its housing programme during the planning, and construction of the latter. These were supported by the sentiments expressed by some of the participants:

- "*There are no facilities in SGC, it's all here in the Barangay Centre. It would be better if it's inside the community*."
- "*Facilities are sufficient but inaccessible to the community*."
- "*Facilities here in the Barangay Centre are okay, but it's far from the community.*"
- "*Facilities are lacking, there is an evacuation centre but it is far from the community*."

Provision of access through the wall that literally separates the two spaces can further justify the deliberations for in-situ development as opposed to *Redevelopment*. By gaining access to the public space, the community can be reconnected to the formal city with the shared use of the facilities provided for the local population. More importantly, it can open up the community to the general public and eliminate social exclusion by enhancing economic, social, cultural, and political activities in the neighbourhood.

The challenges in providing access may be the image of informal settlements being perceived as eyesores and crime haven (Pojani, 2018), and the on-going privatisation of the community under the CMP project. Access could only possibly be provided should the approved site development plan would be implemented bringing order to the settlement layout. The wall at present serves as a convenient barrier to cover and hide the settlement from the public eye.

For the sub-theme *dwelling improvements*, the local knowledge in mitigating flood hazards through the dwellers lived-experience will be identified to determine their capability to adapt technically to the hazards of flood. It is important to recognise those who were able and unable to adapt, and the reasons behind their capability or incapability. Majority of the dwellers refer to additional supports for their houses as a necessary improvement for flood-risk reduction, whilst others who are more fortunate either elevated their houses, or added an upper floor.

The findings in this sub-theme are significant in determining the improvements that made a dwelling technically adaptable, and if such improvements can be applicable to some, if not most of the housing typologies particularly the vulnerable types identified. The results can draw out the appropriate improvements for each dwelling type that will help establish a transitional settlement. Excerpts from the interviews on *dwelling improvements* are tabulated below.

Table 15. Excerpts on *Dwelling improvements*

Control no. / Participant no.	Quotation
B1-1-10 / 1A-1	"We elevated our house and added wood posts and beams below to support it."
B1-1-10 / 1A-18	"Most of us here in our area are used to the floods and have an upper floor so we don't need to move to another's house."
B1-1-10-1 / 1B-36	"Our neighbours are on high ground with their houses elevated so no one really needs to evacuate or needs help."
B3-1-10 / 3A-7	"Recently, I just had a portion of my house renovated using concrete foundation and posts. I also elevated our flooring and added a 2nd floor as our refuge area."
B3-1-10 / 3A-16	"Also, clearing of the existing garbage under the houses and on vacant lots."
B3-1-10 / 3A-1	"We raised our ground floor and added a 2nd floor. We also elevated our cabinets and power outlets at the ground floor." "Providing sufficient drainage will also be a huge help."
B2-1-10 / 2A-3	"…perhaps cleaning the canals. In our case, we don't have any canals in our area so water can't drain outside."

The technical adaptability in building resilience drawn from the dwelling improvements, is dependent on the *Materials and technology* utilised by the self-building dwellers. Under the key element of *House* in the framework, *Materials and technology* is an integral factor in gauging the capability of the structure to either resist or adapt to environmental hazards. The obvious building material of preference according to the participant narrative is concrete, with the basic technology of elevating the habitable spaces.

As a generally accepted building material, the use of concrete with its prohibitive cost in a typical informal settlement like Sitio Gulayan, is an exception rather than the rule. Majority of the residents rely on the same basic technology, but with the use of more affordable and accessible materials like bamboo, 'coco lumber', and regular wood. Galvanized iron (G.I.) sheet is the preferred roofing material, but given its high cost, recycled sheets sourced from nearby junk shops are commonly used.

The unconventional use and mix of building materials found in the surroundings, contribute to the construct of *Image and identity* under the key element of *Settlement* in the framework. The

resourcefulness and innovativeness of the dwellers in the use of materials, reflect the simple yet contented way of living that is prevalent in the settlement. Even the concrete structures seemed to lack the embellishments that project an abstruse and intricate lifestyle image that can be found in formal middle-class settlements.

The image and identity of the settlement is commonly seen and perceived as a visual and social pollution (Kellett and Napier, 1995), with its disorderly organic growth that defies building rules and urban planning regulations. The amorphous characteristic in the organic configuration on the one hand, contributes to the challenges of basic services provision with the limited space available. On the other hand, it promotes the creation of cities which according to Berenstein-Jacques (2001) as cited by Fernandez (2011), represent various human societies. Matos (1977) as similarly cited by Fernandez (2011), also argues that the formation highlights the skill and creativity of the dwellers in land appropriation.

As one of the constructs in the framework under *Settlement, Land use* can be altered in the process of *dwelling improvements*. Sitio Gulayan started out with a few dwellings on what originally was a fishpond, and in due course was transformed into a residential plot. The alteration continues on even at present, with the interminable organic growth creating a mix of residential, commercial, and institutional land uses within the community. Retention of the co-located mixed land uses in an integrated manner, can encourage the dwellers to allow for a transitional settlement development.

Related to land use is the unplanned stages of *Consolidation* in the settlement under the *Process* key element in the framework. The incremental growth of the dwellings in Sitio Gulayan occur mostly in a vertical manner considering the scarcity in space. Existing rooms can be partitioned to house more residents instead of the more costly vertical expansion, typical of informal settlement growth either room-by-room (Kamalipour, 2016) or house-by-house (Pojani, 2013). Some participants also attested to converting available space into commercial areas as their main or additional means of livelihood:

- "*We have a small variety store*."
- "*We sell fruit shake in the store and milk tea again, hopefully*."
- "*My children stay on the 2nd floor and we're renting out the ground floor*."
- "*We have a stall to sell food- raw and cooked meat, vegetables and the like*."

The main theme of *Flood-risk reduction strategies* could provide leads in assessing the technical adaptability of Sitio Gulayan through the effected dwelling improvements by the owners. Combined with the existing structural and non-structural measures being practised, the capability of the community in mitigating flood hazards could be assessed for its transformation into a transitional settlement.

The materials and technology notably used in dwellings that have withstand environmental hazards, can provide invaluable local knowledge in terms of building resilience. Supplemented with proper zoning of residential, commercial, and institutional land uses in an integrated manner, the dwellers can be encouraged to willingly allow progression towards a transitional settlement.

Local culture

The next theme comes from the merging of initial themes related to local practices, community values, and traditional construction methods. Consolidated as *Local culture* from the three sub-themes of *local practices*, *construction methods*, and "*bayanihan*" (see figures 48 to 50 thematic maps), the theme captures the values inherent in Filipino families and communities including the quintessential traditional dwelling "bahay-kubo", where most of the makeshift houses are patterned after.

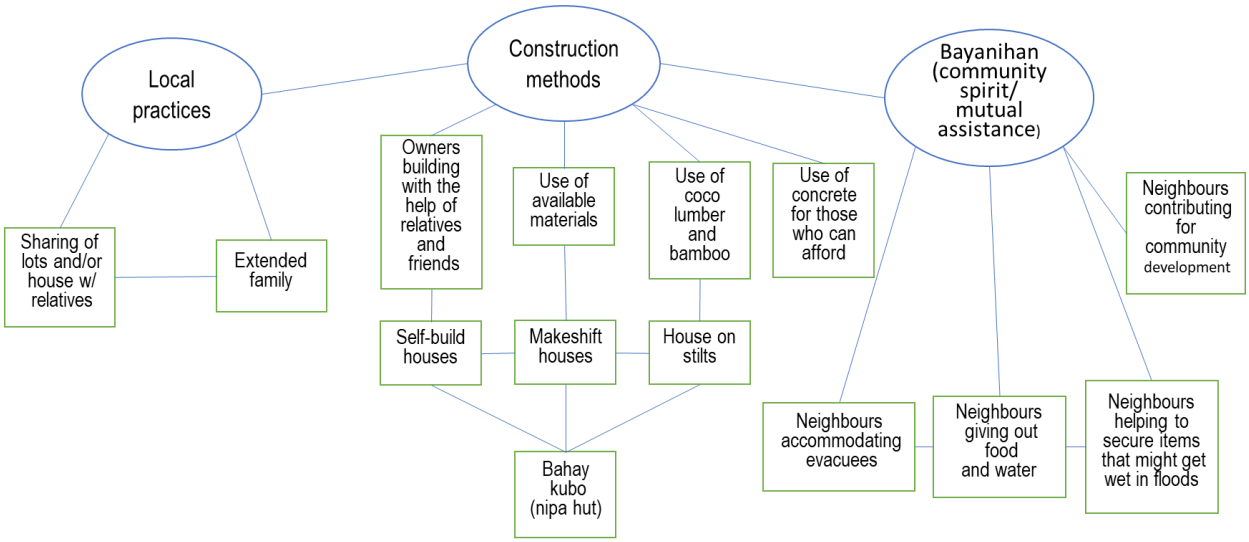


Figure 48. Initial thematic map of *Local culture* theme

Under the *local practices* theme, the traditional extended family as observed in the multi-family and multi-generational households, is commonly practised in the community. Not only are the dwellings shared by most of the participants, but the lots as well where a typical 60 square meter lot can be shared by two siblings and their parents as confirmed by a participant- "T*here are actually 3 houses in one lot- my house, my sister's, and our parents' house".*

Houses usually accommodate two families but could lodge as much as four or more families as narrated by another participant who bantered when asked about the prospects of relocating- "*Possibly, we're already cramped inside the house and my children need to have their own house. They already have their own families, we're four families in our house!"*

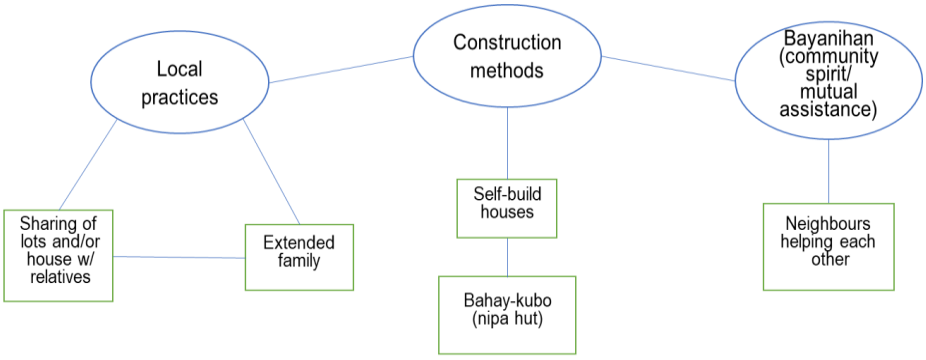


Figure 49. Developed thematic map of *Local culture* theme

Under the *construction methods* sub-theme, the characteristics of the traditional nipa hut (bahay-kubo) are expressed and manifested in most makeshift houses. Aside from being self-built, the houses are usually on stilts to allow water to pass through under the house typical to all nipa huts. The building materials are similarly sourced from what is available in the surroundings and in the case of Sitio Gulayan, these are 'coco-lumber', tin sheets, assorted wood, and tarpaulin or plastics as canopies or temporary roofing materials.

The "*bayanihan"* sub-theme, which literally refers to a spirit of communal unity or effort to achieve a particular objective (Hirano, 2012), denotes forms of common association and shared identity as part of the more culturally specific forms of coping practices (Jocano, 1999 and Bankoff, 2004). This could be much observed during calamities where neighbours reach out and help each other offering food and shelter to those in need. Most of the participants opted to stay in the community with a neighbour during extreme flood events, instead of seeking refuge in the evacuation centre:

- "*Our neighbours accommodate us during typhoon when we need to evacuate.*"
- "*We stayed at our neighbour's because our roofing was stripped off."*
- "*…we just help each other by giving food or other needs when needed by a neighbour*."

In the final thematic map, the three themes were merged into the main theme of *Local culture* with *extended family*, '*bahay-kubo'* (nipa hut), and '*bayanihan'*, emerging as the sub-themes (figure 50). These three sub-themes will determine how the traditions and values have in any way, influenced either constructively or detrimentally, the technical adaptability of these self-build houses in potentially becoming a part of a transitional settlement.

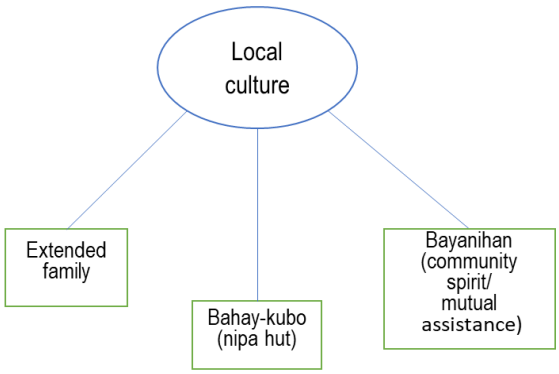


Figure 50. Final thematic map of *Local culture* theme

The '*bahay-kubo'* for instance has proven to be a reliable utilitarian structure in rural living, but even modified versions given the environmental hazards particularly in floodplain settlements, might not be able to cope with the demands in the urban landscape. These were expressed by the participants in the excerpts in table 16 below.

Table 16. Excerpts on *Bahay-kubo*

Control no. / Participant no.	Quotation
B2-1-10 / 2A-1	"We regularly check our house for additional reinforcements needed and provide supports like bamboo which is affordable and easy to install."
B1-1-10-1 / 1B-34	"We reinforced our house by adding posts and beams."
B3-1-10 / 3A-5	"We reinforced our house by adding 10 bamboo stilts for support and elevated the flooring."
B3-1-10 / 3B-40	"We make sure that our roofing is secured, we tie it if needed to be sure."
B1-1-10-1 / 1B-35	"We reinforced our house but not that much because we only used coco lumber."
B3-1-10 / 3A-7	"If there's a typhoon, we tie our roofing with tie wires."
B2-1-10 / 2B-26	"We added supports and bracing in our house and secured our roof with tie wire."

Architecture and symbolism as another construct under the key element of *House* in the framework, directly applies to the '*bahay-kubo'* theme. The theme reflects the traditional vernacular architecture that symbolises the carefree living in the rural areas where most of the dwellers migrated from. The dwellings when individually seen up-close from the inside and out,

evokes the simplistic and uncomplicated way of living, as opposed to the commonly portrayed convoluted and complex image when observed as collective parts of an entire community.

The dweller's main concern as noted in the participant narrative, is the functional rather than the aesthetic features of the house, particularly the structural integrity required to endure impending environmental hazards. Even the more substantial dwellings using concrete blocks, are seldom plastered with cement, more so painted nor embellished. Having lived previously in makeshift houses, the owners may not want to flaunt, but rather empathise with their neighbours who are still struggling to improve their living conditions. The empathy somehow preserves the architecture of informality in Sitio Gulayan community, which continue to symbolise basic living at its barest minimum.

The *extended family* sub-theme is noteworthy in establishing the ideal number of household members in a given standard lot size in Sitio Gulayan community. At an average of 60 square meters per lot, majority of the household participants obviously exceeded the standard number allowed in the housing programme, which requires one family only for each individual lot. Coping practices nonetheless as previously discussed, may be more critical to the residents than what the building standards require. Single lots and dwellings being shared are articulated by the participants in table 17.

Table 17. Excerpts on *Extended family*

Control no. / Participant no.	Quotation
B3-1-10 / 3B-26	"There are four families living in our house."
B3-1-10 / 3A-16	"We are two families."
B2-1-10 / 2A-1	"Two families including my daughter and her own family."
C3-1-5 / 1	"The population of SGC is more than the 804 households allotted for the community because the members now have their children and grandchildren who are staying with them."
C1-1-5 / 1	"However, for each lot, there are three or four families who are part owners with the original owner's name listed as the lot owner." "…because of extended families, these houses are just partitioned to accommodate new members."

The sub-theme *extended family* also relates to both *Size and location*, and *Layout and density* constructs under the framework's key element of *Settlement*. The *Size and location* of the community is critical in establishing the appropriate set-up for development into a transitional settlement. The challenge posed as discussed earlier, is in reducing the need to relocate to new settlements, whilst correspondingly reducing hazard risks to the population.

The land size of Sitio Gulayan community as determined by its planners in the proposed site development plan back in 1992, should only house about 800 families on single lots, in stark contrast to the current threefold 2,500 households 30 years after. Multi-level housing systems similar to some existing dwellings, may be considered as long as the structural integrity of the temporary shelters to withstand calamities will not be compromised.

Location is an equally crucial element in the development of Sitio Gulayan as a floodplain settlement exposed to environmental hazards. River easements currently being occupied by some dwellers, should be vacated to mitigate impending risks. Allocation for open spaces as earlier discussed is an important consideration as well, more so with the present intractable size compounded with the precarious location of the community.

Associated with the settlement location, is its *Origins* under the key element of *Process* in the framework. The riverine settlers of Sitio Gulayan relied on the bounty of the river in the past, and proliferated with the industrialisation of the city. Factories built along the stretch of the river required workers who were mostly rural migrants without permanent residences in the city. Proximity and affordability even to this day, are the attractive and compelling features for most residents to call Sitio Gulayan community their home.

The *extended family* sub-theme similarly shapes and alters the *Layout and density* of the community. Starting from a linear form, Sitio Gulayan has morphed into a gridiron pattern and advanced into a convoluted organic form, typical of an unplanned settlement. The form is often associated with the rhizomic structure (Pojani, 2018), that grows horizontally in all directions and spreads uncontrollably. The irrepressible escalation is contributory and directly correlated to the high-density in the community, effecting *Layout and density* as equally essential in establishing the appropriate set-up to a transitional settlement development.

The last sub-theme under *Local culture* is '*bayanihan*' which is equally important in terms of establishing any attachments to the place by the residents. From the participant narrative, it would seem that the local social structure has been strengthened by the trials and challenges brought about by calamities and inherent poverty in the community. These were substantiated by participants who expressed their desire to stay in Sitio Gulayan community despite being offered the opportunity to relocate:

- "*No, I will not choose to relocate. I'm used to our place and I like it there.*"
- "*We have been through a lot of hardships in acquiring the lot and would not like to relocate anywhere else."*
- *"This is where our heart is, we are poor but we are happy here."*
- *"This is where we started. This is home for us."*

Place attachment under the *Dwellers* key element in the framework, plays a pivotal role in terms of community participation and support in developing into a transitional settlement. As a positive

emotional bond between individuals and groups and their environment (Altman and Low, 1992), place attachment fosters sense of community that is apparent in Sitio Gulayan.

Indicative in the consensus of opinion amongst the local population, is a strong sense of community predominantly during calamities which may permit lesser challenges in terms of improving the current situation in Sitio Gulayan. The spirit of communal unity in the settlement can thus, enable general participation and cooperation amongst the population on housing improvements leading towards a transitional settlement development.

The *Local culture* theme is also closely linked to the *Conditions of existence* as one of the constructs under the framework's *Dwellers* key element. Material and cultural conditions taken together according to Stea and Turan (1990), comprise the conditions of existence. Cultural conditions, which may include kinship, social and labour relations (Kellett, 2011), staunchly apply in the case of Sitio Gulayan. The settlement in essence can be said to have been built and endures with the kindred relationships within the community as stated by most participants:

- "*We built it ourselves and did not hire any workers*."
- "*…just my Papa and his friends. He works in a construction firm*."
- "*We hired workers with my brother who knows masonry helping out*."
- "*My father who knows carpentry and some relatives build our house*."

Dwellings are traditionally self-built with the aid of family and neighbours who may either be skilled builders or just had previous experience erecting their own houses. The latter being the common practice, is exhibited in most of the dwellings that were poorly built using sub-standard building materials. Material conditions in terms of resources according to the participants, is dictated by the funds available in purchasing and building incrementally:

- "*I hired a carpenter and on Sundays, I help him out*."
- "*It's just us in here who built the house. Just gradually, whenever I would have money in December*."
- "*We elevated our ground floor, added an upper floor and incrementally building a concrete wall. These were all wood before. Just gradual construction whenever we have funds*."

Local culture as a main theme involves the dwellers individually and as a group, together with their self-built dwellings independently and collectively, in the form of the settlement. The interactions amongst the dwellers directed by their common values and traditions, engender social relations that allow for the creation and realisation of both their individual and shared goals.

The social connectedness amongst the residents may increase their desire to stay in a place where they feel a sense of belongingness albeit perilously, and could motivate them to strive for better living conditions with the help and support of both family and community. Any planned

improvements in the community, therefore, may be favourably received by the residents particularly those that could discard the imminent risk they face.

Local services delivery

The final main theme unravelled from the initial sub-themes of *basic services*, *government delivery*, and *adaptive capacity*, is *Local services delivery* (see figures 51 to 53 thematic maps). An imperative theme that sustains the life of the community, delivery of basic services and facilities notably discriminates between the formal and the informal neighbourhood. The lack of basic services defines what constitutes a slum which according to UN Habitat (2006) is, “One or a group of individuals living under the same roof in an urban area, lacking in one or more of the five amenities…”, with two pertaining to basic services: access to improved water, and access to improved sanitation facilities.

Under the *basic services* initial theme, two differing but rational points came out from the participant narrative- sufficient services that are not affected by flooding, and insufficient services affected by flooding. Most of the participants claimed to be satisfied with the power supply and facilities in the community, and contrastingly dissatisfied with solid waste management (SWM), sanitation, and water supply.

Identifying the polarities in the basic services delivery in the community, will help establish the reasons behind the current state of basic services provision. Whilst there were some participants who have formal access to basic services, most depend on informal means to gain access which tend to be more costly and precarious. Illegal connections for instance, in the main utilities of water, power, and sanitation, pose health and safety risks in the entire neighbourhood.

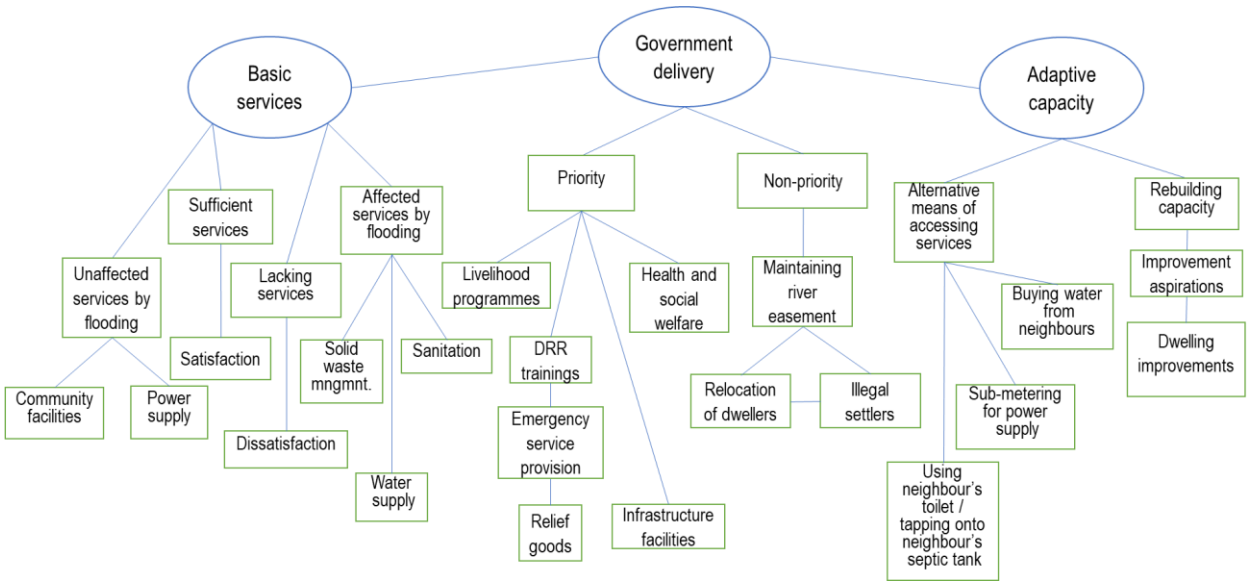


Figure 51. Initial thematic map of *Local services delivery* theme

Sanitation and solid waste management are indisputably the two most lacking basic services in Sitio Gulayan community. Walking through the interiors of the neighbourhood and catching sight of empty lots and spaces underneath the houses with rubbish, one need not ask around to learn which services are most insufficient. As one barangay official admitted when asked of the services most affected during flooding, *"At present, it's both solid waste management and sanitation."*

One community official similarly acknowledged the state of sanitation in the settlement, "*Oh yes, this is where we get a 'failed' mark. There was a programme to provide communal toilets before but with problems on water supply and maintenance, it did not push through.",* with yet another barangay official, untangling the link between the two, *"It goes hand in hand, both are partners, all the trash not properly disposed of will affect sanitation."* As evidenced from the participant narrative in table 18 below, lack of discipline, non-delivery of service, and the on-going pandemic, have been the grounds for the current sorry state.

Table 18. Excerpts on *Basic services*

Control no. / Participant no.	Quotation
B2-1-10 / 2A-2	"I think we just need to cooperate through "bayanihan" and be more disciplined. There are just a lot of hard-headed people."
B3-1-10 / 3A-1	"In our case, we take our garbage outside to the bin but not everybody is doing so which is why it becomes a problem."
B3-1-10 / 3A-16	"Nothing to add really except for the management of garbage. They should be strict, perhaps for every house or area, there should be a trash bin and collection should be done regularly."
B2-1-10 / 2A-18	"Some people just throw garbage anywhere so the canals get clogged. This should be addressed."
C3-1-5 / 1	"Actually, we had a meeting with DENR (Dept. of Environment and Natural Resources) regarding that and what they want is a tally and proof of dwellings with septic tanks. We could do that but with the pandemic, it was put on hold."
B1-1-10 / 1A-23	"There were trash collectors before the pandemic but there's none at the moment."
B2-1-10 / 2A-2	"The river is also being desilted regularly, but it has stopped since the pandemic."

Another challenge that complicates the delivery of the basic services in the community, is the delineation of responsibilities between the community and barangay officials. Under the initial theme *government delivery* (figure 51), neither of the two lacking services is a priority nor a non-priority service. Being technically a privately-owned neighbourhood, the local government

officials claim that their hands are tied in providing some services which the HoA officials claim otherwise:

- Barangay officials on infrastructure development-
  - "*Technically, it's not the Barangay who does the development. It is a common donation from homeowners as the government cannot allocate funding for privately-owned lands*."
  - "*As long as it is privately-owned, the government's hands are tied*."
- HoA officials on river easement maintenance-
  - "*We have called the attention of the city government regarding this a number of times as it is outside the scope of the HoA to maintain the required easement. Up to now, they have not responded to our plea."*
  - *"There are no plans currently from the city government, and they are actually asking us to convince those residing along the easement to relocate.*"

Issues on accessibility also adds to the poor or non-delivery of basic services in the community. Garbage for instance cannot be collected from the house doorsteps considering the absence of road networks for the garbage trucks to access. A concrete bin was constructed instead in front of the community easily accessible to the trucks, but the residents would be responsible to bring and deposit their rubbish in the bin.

In addition, the wall that isolates the community as discussed earlier, not only dissociates the settlement from the formal city, but lengthens its distance from the public facilities and Barangay Centre. Providing access could improve poor services by minimising the travel time from the settlement to the infrastructure facilities, particularly those most frequented during calamities like the evacuation and health centres.

Gentrification as another construct in the framework under *Process*, is tied to the present conditions in basic services access and provision. Whilst the location of Sitio Gulayan has become strategic and marketable with the construction of the Justice Hall compound, the poor delivery of basic services including the indirect circuitous access to public facilities deter its gentrification.

Providing direct access to the public facilities may deliver good results in basic services provision, but could also be the cause of displacement should gentrifiers start to populate the community. Businesses would flourish within the settlement raising rental rates unaffordable for the residents, which could cause them to be displaced eventually. Access to basic services would be made available even informally to support the businesses, but in effect become costlier forcing the dwellers to relocate to an area where informal access to basic services may be more affordable.

In coping with the lack of basic services, the dwellers seem to have developed survival skills under one of the emergent themes, *adaptive capacity* (figure 52). As an example, those without legal connections from the providers, purchase electricity from neighbours with power lines via sub-meters installed in their houses. Rates, however, are more than the regular amount as the dweller/supplier eke out a living from these connections. Water similarly is being sold with mark-up as additional income for those who have legal lines as declared by some participants:

- *"Water supply is lacking we're just buying in drums and containers."*
- *"It's also difficult if you don't have a water line. One container costs Php 4 pesos so end of the day, it's like you're the one paying for the water being consumed by the meter owner."*
- *"I would also like to have a MERALCO (power provider) meter. I have applied since last year but to no avail. I'm only using a sub-meter which is more expensive in terms of consumption at Php 20 pesos per kilowatt. MERALCO charges less, around Php 10 pesos only so we're paying twice as much."*

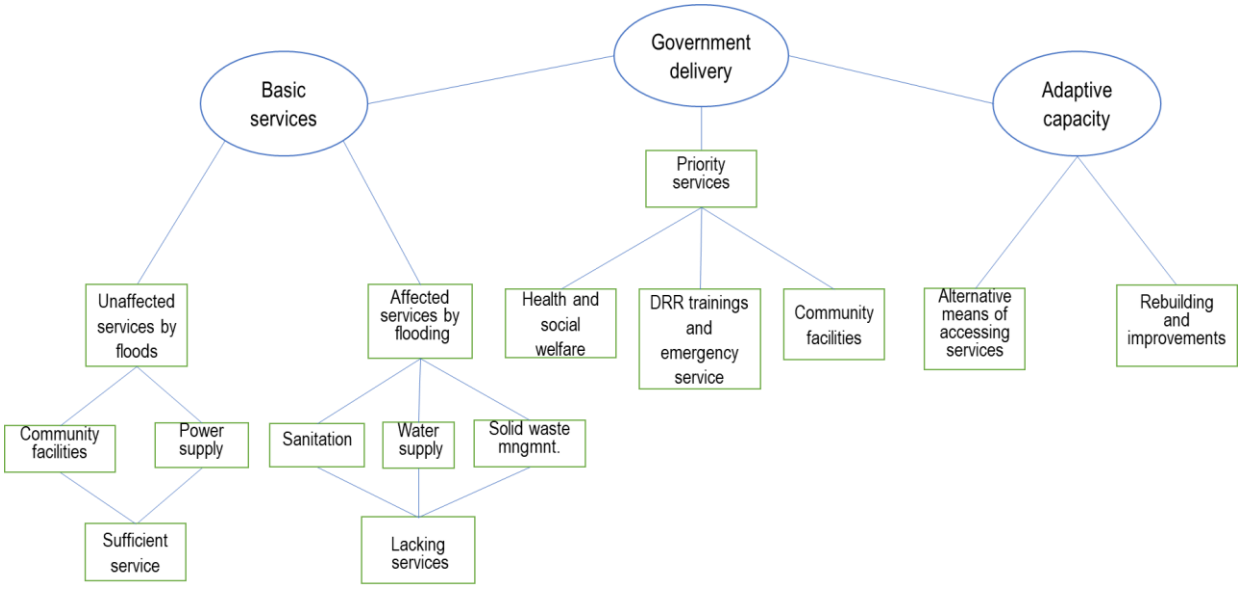


Figure 52. Developed thematic map of *Local services delivery* theme

The 'buy and sell' scheme to access services exhibits the residents' aptitude for *adaptive capacity*- to access both power and water for the consumer, and to provide access whilst creating additional income for the vendor. Sanitation to a great extent is more challenging particularly with dwellings at the core of the community, where main sewer lines are unavailable. The dwellings along the perimeter near the main road are in a better location with the existing sewer pipes to tap into.

Both sanitation and water supply pose a challenge as well in terms of pipes being linearly laid out inside the community. With the rhizomic-like dwelling layouts, pipes would be problematic to lay out particularly the rigid ones in a standard gridiron pattern. Building a septic tank is also

unaffordable for most residents even with the local funding assistance as one participant voiced out, "*There was a programme by the government before to lend you Php 5000 pesos for building a septic tank, but you have to pay it in 6 weeks' time for Php 1000 pesos per week. Nobody can afford those terms*."

With the challenges in sanitation, the dwellers resort to either tapping their lines into a septic tank of a consenting neighbour as verbalised by one participant, "*…our neighbours for instance just connected their sewer pipes to ours*.", or make use of their toilet facilities altogether as affirmed by another, "…*we are currently using our neighbour's toilet*." There are those, however, who make use of the space beneath the house as cesspool which seem like an accepted sanitation practice, notwithstanding the serious health risks it poses in the neighbourhood.

Basic services is the construct added to the adapted framework under the *Settlement* key element. Its emergence as the final sub-theme under the *Local services delivery* theme (figure 53), underscores its importance in the current and future state of the community. The basic services delivery, or lack thereof, is a foremost determinant in the quality of life and well-being of the residents, directing their roles either as social assets or liabilities, both in the local and national development.

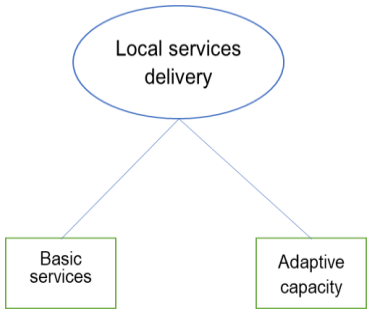


Figure 53. Final thematic map of *Local services delivery* theme

Adaptive capacity in the same degree, is exigent as a coping mechanism of the residents from social exclusion, or their sorry state of being relegated further to the fringes of society. It forces them to be resourceful and innovative until either the challenges of *Local services delivery* are overcome, or they are able to escape the perceived abject poverty- a seemingly more viable route as recounted by some residents:

- "*We have our own house and we're also renting a place near our house for our store*."
- "*We are still building our house, from the original one-storey that we bought, we renovated it and added a 2nd and 3rd floor*."
- "*We elevated our ground floor, we added a 2nd floor, all with concrete slabs. Before, our house was just makeshift, but we did it out of perseverance*."

The main theme of *Local services delivery* reveals how the dwellers subsist in the midst of deprivation. It could be taken as a challenge by some that compels them to work their way out

of destitution, or considered an intangible tool by most that could not break the chains of poverty. Unscrambling these revelations can identify both constraints and means, which can serve as an instrument to catalyse change in delivering the much-needed basic services.

Whilst there are households in the community who have the means to formally access basic services sufficiently, majority rely on their survival skills to acquire access informally. The skills assimilated through adaptive capacity could help the providers in coordination with the government, to devise innovative ways in efficiently delivering affordable goods and services to the patrons' doorsteps in a transitional settlement.

Acquiring access individually, may not provide quality basic services as compared to a collectively executed planned access. As cited previously under sanitation, the informal means can also compromise the health and well-being not only of the informal subscribers themselves, but the entire community as well. Developments holistically planned for Sitio Gulayan, therefore, may be the only means to deliver affordable quality basic services sufficiently, to every single household in the community. Following the qualitative analysis of data presented in this section, the next section will discuss the quantitative analysis.

6.2 Quantitative data analysis

The analysis for the quantitative data collected from the survey protocol comprised of two procedures - establishing the structural classification of dwellings, and flood damage assessment on the dwellings. The responses from the survey questionnaire provided the data needed to identify the physical characteristics of the dwellings which determined the existing structural classifications, together with the required data that identified the damages and costs incurred from the extreme flood events, to assess the flood damage on each of the classifications established.

These procedures were complemented by the interviews and field observations, which confirmed the validity of the survey responses. The following sections will discuss in detail how the procedures were implemented and the data analysed, with the initial results presented in bar charts as a lead-up to the next chapter 7, *Results and study findings*.

6.2.1 Structural classification of dwellings

As discussed in the last part of section 4.4.1 *Survey protocol*, the survey responses related to the housing characteristics addressed the study's objective of forming a classification of the dwelling units to establish the various housing typologies. The dwelling types were formed by gathering initially the building materials of the major components of the house namely, the floor, walls, roof, and plinth or stilts, including the number of storeys, as shown in the bar charts from Figures 54 to 58 below. The data gathered were then triangulated with the interview protocol and subsequent field observations, with measurements visually recorded through photographs.

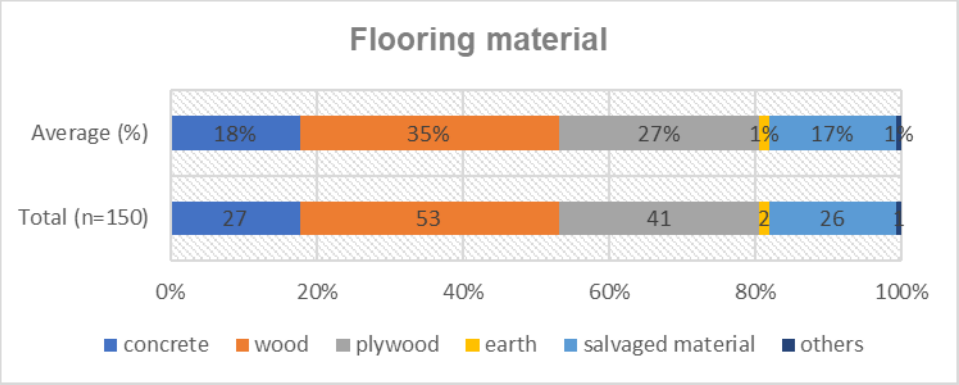


Figure 54. Flooring material used in the dwellings

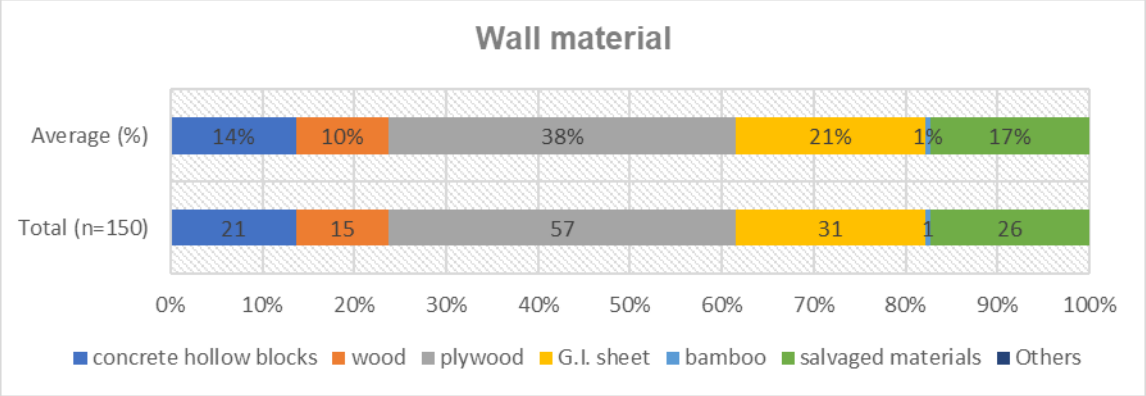


Figure 55. Wall material used in the dwellings

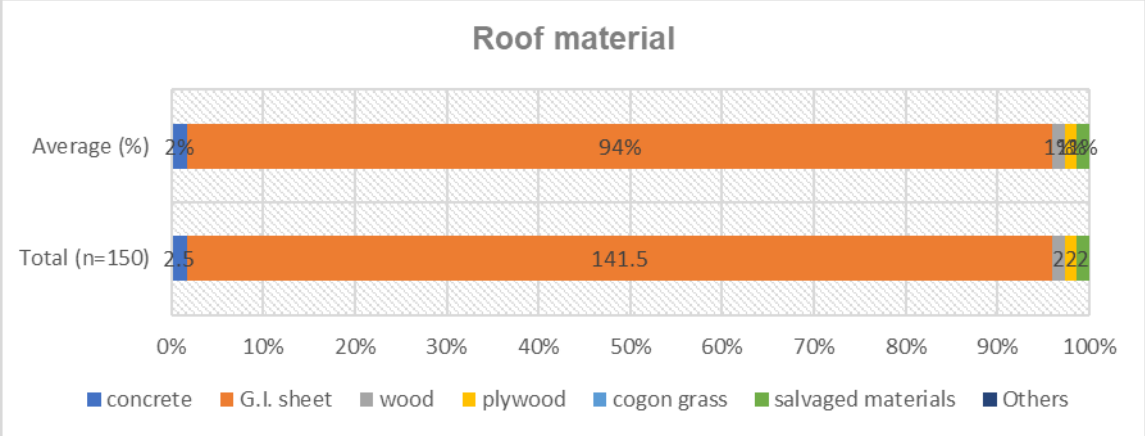


Figure 56. Roof material used in the dwellings

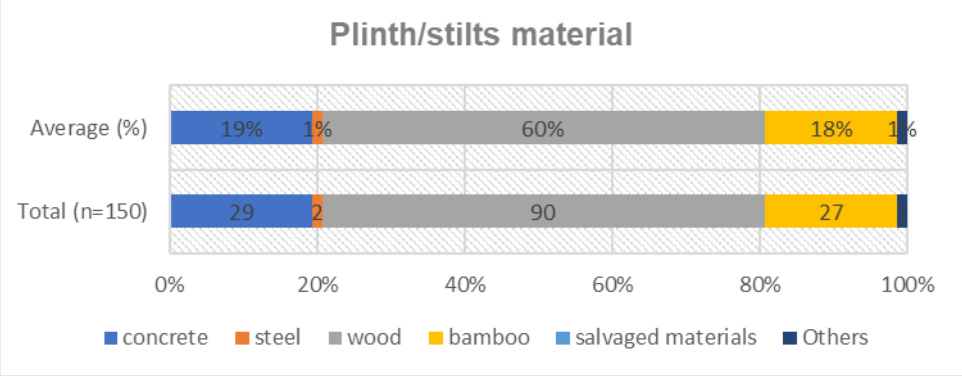


Figure 57. Plinth / stilts material used in the dwellings

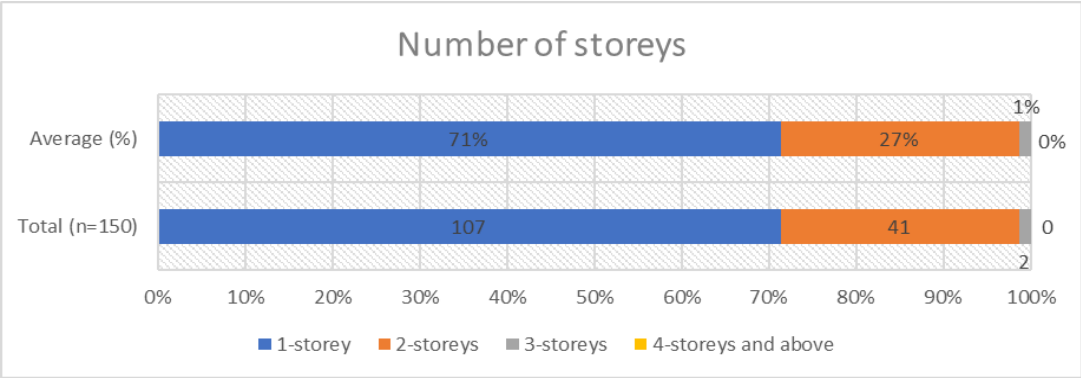


Figure 58. Number of storeys in the dwellings

The figures above indicate the wide variety of materials being used for the dwellings in the community. For the flooring, figure 54 indicates that majority of the respondents use wood and plywood, followed by concrete and salvaged materials. Aside from being light materials which can easily be transported and installed, used wood or plywood can be purchased at a lower cost. Concrete being more permanent and expensive, can be found usually in dwellings near the roads where building materials can be easily hauled and delivered. Salvaged materials are a mixture of recycled materials such as wood, plywood, or bamboo commonly found in makeshift houses.

In figure 55, the predominantly used wall material is plywood followed by G.I. sheets, again for their low costs and ease of installation, followed by salvaged materials and concrete. Only one respondent used bamboo for the walls. For the roofing material in figure 56, a large number of respondents at 94%, use G.I. sheets being a reliable material against the elements and could also be bought as used or second-hand material. Concrete follows at a far second with only 2% of the respondents, closely followed by the respondents who used wood, plywood, and salvaged materials.

Figure 57 shows that majority of the respondents at 60% preferred using wood for the plinths or stilts in their dwellings, followed by concrete and bamboo at 19% and 18% respectively. There were two respondents who used steel for their stilts and being a main structural support of the house, no one used salvaged materials to carry and support their houses. To determine the class heights or levels of the dwellings, figure 58 indicates the number of storeys from the sample. The chart shows that 71% or 107 out of the 150 dwellings are one-storey, 41 dwelling units are two-storeys, with only 2 houses at three-storeys high.

From the summary of the survey responses discussed above, and adopting the *GMMA Risk Analysis Project* informal settlement building types, six types were established: 1) one-storey makeshift house (N-1S); 2) two-storey makeshift house (N-2S); 3) one-storey wood house (W-1S); 4) two-storey wood house (W-2S); 5) one-storey concrete block house (MWS); and, 6) two- to three storey concrete houses (CWS-2S). Details of the housing types with height classes are

shown in the table below, with the building technology for each of the types detailed in the ensuing secgtion.

Table 19. Housing types with height classes

Classification	Number of storeys	Materials			
		Flooring	Wall	Roof	Plinth / stilts
Concrete (CWS)	2-3	Concrete	Reinforced concrete frames with concrete hollow blocks (chb)	Galvanised Iron (G.I.) sheet	Concrete
Concrete hollow blocks (MWS)	1	Wood / plywood	Concrete hollow blocks with no reinforced concrete frame and with wood or light metal	G.I. sheet	Concrete
Wood (W-2S)	2	Wood	Wood framing with wood / plywood / G.I. sheet sheathing	G.I. sheet	Wood / bamboo
Wood (W-1S)	1				
Makeshift (N-2S)	2	Wood / plywood / bamboo / earth	Light wood framing with plywood / G.I. sheet / bamboo / canvass / tarpaulin / cardboard sheathing	G.I. sheet / canvass / tarpaulin	Wood / bamboo
Makeshift (N-1S)	1				

6.2.2 Building Technology

The data collected from the case study will be elaborated in this section discussing and depicting detailed information on the nature of construction in terms of the building form, structural frame construction and use of building materials such as concrete, timber and salvaged materials. With most of the dwellings using non-conventional construction practices, it will be useful and important to present the buildings as found that could provide a baseline of the building technology of the time, place, and situation as a relatively detailed account of the practice.

Concrete house (CWS)

Amongst all the building types, the concrete house can be observed as constructed using standard building materials and conventional construction methods. Most of the owners can afford to hire skilled labour which is apparent on the participant dwelling samples observed. However, in terms of architectural and structural design, not all the houses have been designed by professionals with the owners relying on their acquired expertise from previous design and build experiences, either from their own or their neighbours' houses.

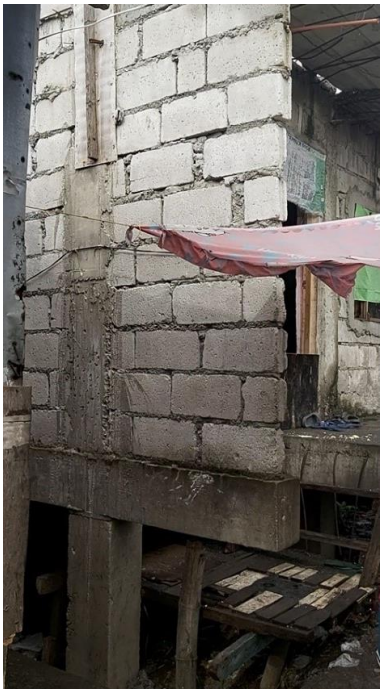
As shown in the succeeding figures below, concrete houses usually are two storeys in height (figure 58a) with a few reaching three-storeys (figures 58b to d). With most of the houses without plastering and painting, the quality of construction can be seen as either built by skilled or non-skilled workers. Roof materials are commonly pre-painted G.I. sheets either on wood or steel trusses. G.I. gutters are usually installed, but it is common to see houses without any, particularly those without cement plaster and painting.

Figures 58a & 58b. Two- and three-storey concrete houses

Figures 58c & 58d. Cement plastered, tiled, and painted 3-storey concrete houses

Structural moment frames are present with some observed as either under- or over-designed using ordinary plywood and coco lumber for formworks as shown in the figures below. These houses are mostly elevated with concrete stilts or plinths (figures 58f to h) with the floors usually finished with cement plaster whilst those who can afford opting to use floor tiles. Construction typical to all dwelling types, is incremental depending on the funds available. Architectural finishes are the least priority in the building process and are normally not completed. As long as the house is habitable with all the necessary utilities in place, the architectural elements can wait and follow when extra funding is available.

Figures 58e & 58f. Structural frames on concrete houses are either over- or under-designed



Figures 58g & 58h. Elevated concrete houses on stilts

Concrete hollow block house (MWS)

Concrete block houses similarly use standard building materials, but with unconventional construction methods compared with the concrete houses. As discussed earlier, the main difference is the absence of structural frames in most of the dwellings observed, with the blocks interlocking at the corners. Most of these houses can be observed as constructed by unskilled labour with the low construction quality either done by the owners themselves, or neighbours with basic building knowledge. The structural integrity of these structures, therefore, is suspect with some blocks not even aligned and out of plumb as shown in the three figures below.

Figures 58i & 58j. Poor quality block layout on concrete hollow block houses

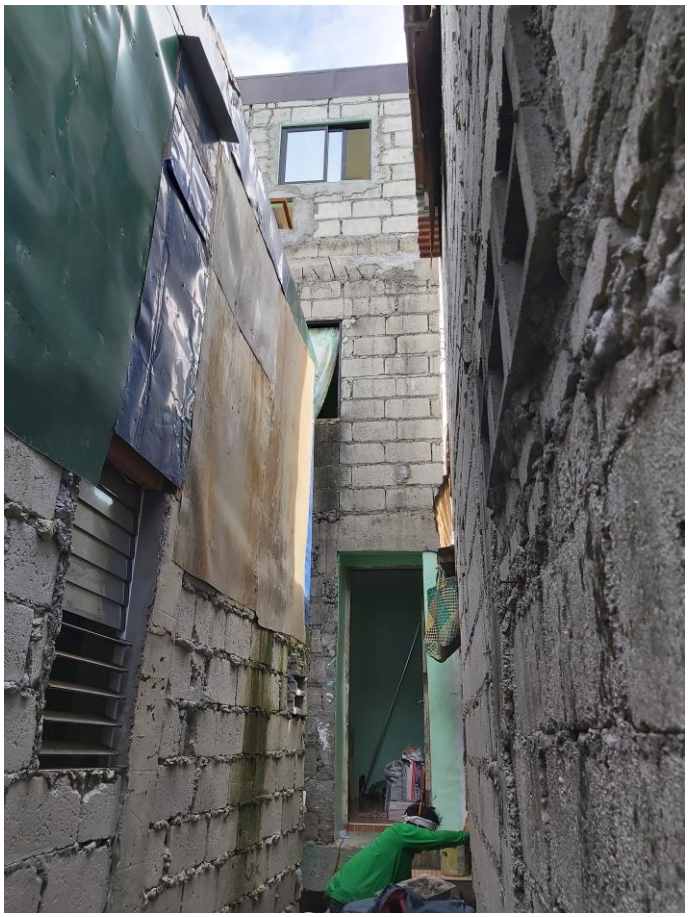


Figure 58k. Concrete hollow block houses on the left and right side.

Walls are commonly without plastering and covered with G.I. sheets to repel rainwater as shown in the figures above (figure 58k) and below (figure 58l & m). Floors are either made of concrete or plywood that are elevated on concrete plinths or stilts. Roofs are usually corrugated G.I. sheets with some using long-span pre-painted G.I. sheets. Roofing materials are commonly purchased from second-hand or surplus shops with any defects repaired during installation. To further save on material costs, ceilings are seldom found in these houses. Roof sheets are thus, exposed which make the habitable spaces hot and humid during the summer days (figures 58n & o).

Figures 58l & m. Concrete hollow block houses with plain G.I. sheet cover for weatherproofing

Figures 58n & o. Concrete hollow block houses with exposed interior and exterior roofing

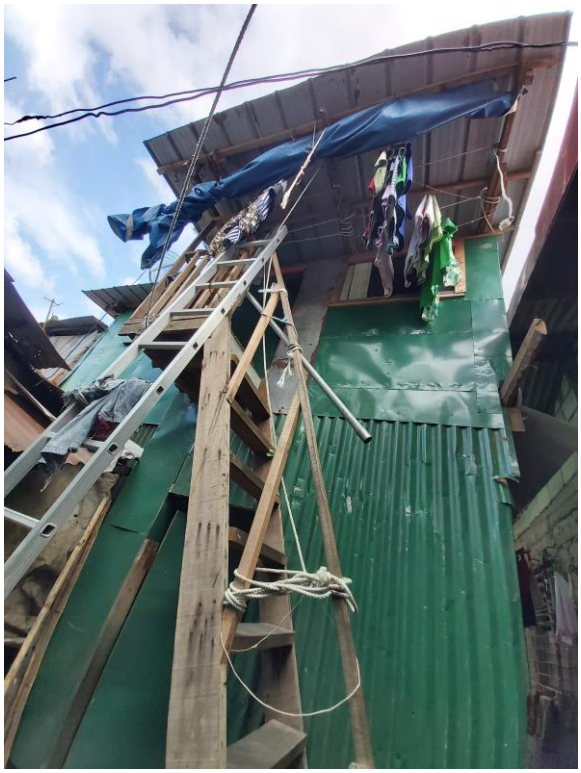
Two- and one-storey wood houses (W-2S & W-1S)

Wood houses use a mix of standard and non-standard or recycled building materials. The construction method is typically conventional and simplistic with overlapping wood joined by using nails. Machine bolts can be seldom seen even in concrete pier supporting wood posts. The posts are instead embedded partially on concrete with the exposed rebars connected to the wood posts. Roofing is similarly corrugated or reused long-span G.I sheets which are commonly used for the walls as well. These houses are usually elevated on wooden stilts with the mixed-use of good lumber, coco lumber and bamboo (figure 58p). Those who can afford use concrete piers supporting wood posts to protect the wood from floodwaters as shown below (figure 58q).

Figure 58p. Mix of wood stilts found in a one-storey wood house

Figures 58q. Wood post on concrete pier found in a two-storey wood house

The walls are either made of plywood, an assortment of wood and G.I. plain, or roofing sheets as mentioned above. The side of the house that is mostly exposed to the elements are covered with plain G.I. sheets for added protection. Instead of replacing the already worn-out wood or plywood exterior skin, the house owners would usually cover it with plain or corrugated roofing sheets as shown in figures 58r and 58s below. Purchased from second-hand stores or junk shops, these are repaired and repainted for added protection. The sheets can be easily hauled and installed using roof fasteners or common wire nails, which make it one of the most preferred exterior building materials in the settlement (figure 58t). The floors are commonly made out of wood or plywood which can be covered with inexpensive linoleum sheets for easy maintenance and variety in design. This material could be easily cleaned, rolled-up and stored in the event of flooding.



Figures 58r & 58s. Two-storey wood house using G.I sheets for exterior building skin

Figures 58t. Pre-painted G.I. sheet is the building skin material of choice in the settlement

The common aspiration of the one-storey wood house owner, is to transition to two-storey for additional habitable space for the growing family which also functions as refuge area. With the limited space, vertical expansion is the only logical way to add rooms in these existing structures. The houses will not be demolished in the process, but would only be provided with additional posts and lintel to support the upper floor. The lower floor could also be leased out like in the case of the owners of the house in figure 58s above, where their family lives at the upper floor with the ground floor being rented out to a starting family.

Two- and one-storey makeshift houses (N-1S & N-2S)

The makeshift house being the most vulnerable type to flood disasters in the community, can be considered as the most innovative amongst the dwelling types as well. Both the building materials and technology are unconventional making use of whatever is available that can be assembled and constructed by the dwellers themselves. The building materials could range from recycled roof sheets and wood, to canvass, tarpaulin and even plastics. Most families start out from these temporary types, transitioning to the semi-permanent wood with the hopes of ending up in a permanent concrete house type. With their vulnerability to floods, most of the makeshift houses are elevated on wood stilts commonly found resting beside the concrete dike protected from the elements (figures 58u to 58w).

Figure 58u. Mix of recycled roofing sheets in a one-storey makeshift house along the dike

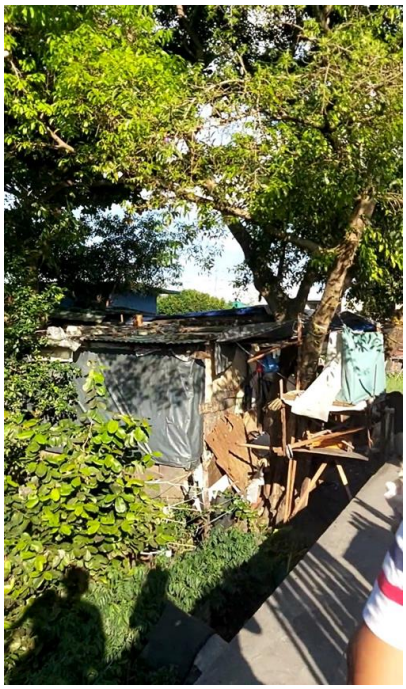


Figure 58v. Makeshift house relying on both natural and built elements for support

Figures 58w. Old and new one-storey elevated makeshift houses beside the dike

The contrast between the rigidity of the dike in the foreground, and the flimsiness of the makeshift dwellings on the background, seem to complement each of the built elements situated in a hostile natural environment. These houses, however, may be more vulnerable to eviction and relocation with their encroachment on the “no-build zone” river easement. With the prospects of eviction, semi-permanent and permanent dwelling types are rarely seen in this prohibited area. The residents in this area are thus, taking their chances and fully aware of being evicted and relocated any time. The goal is to find a more secured space in the settlement before the authorities decide to impose the law.

6.2.3 Flood damage assessment on dwellings

The stage-damage curve for this study which measures the damage fractions at different hazard intensity levels, was similarly adopted from the *GMMA Risk Analysis Project*. The damage fraction refers to the ratio of damage to building replacement value, with the damage ratios calculated and plotted based on the house asset value.

The damage fraction was directly enquired in the survey and validated in the interviews with the following damage values: 0 = no damage; 0.2 = slight damage; 0.4 = moderate damage; 0.6 = heavy damage; 0.8 = severe damage; and, 1.0 = total damage. Similarly, estimated damage costs were also included in the survey and confirmed by the respondents in the interview protocol.

Table 20 shows the adapted building costs per square meter for the different house types, whilst Figures 59 and 60 indicate the estimated damage costs from the two extreme flood events as gathered from the survey responses and interviews.

Table 20. Building costs per square metre (m2) in pesos (PhP) for informal settlement dwellings (source: GMMA RAP, 2016)

L4 USE (level 4 land use)	L5 USE (level 5 land use)	Building Types / Building Costs in PhP per M2			
		W1 (wood, light frame)	**N** (makeshift)	**MWS** (chb with wood or light metal)	**CWS** (reinf. concrete moment frames with wood or light metal)
Informal Settlements	Mixed Informal Settlements	4000	1200	5200	7800

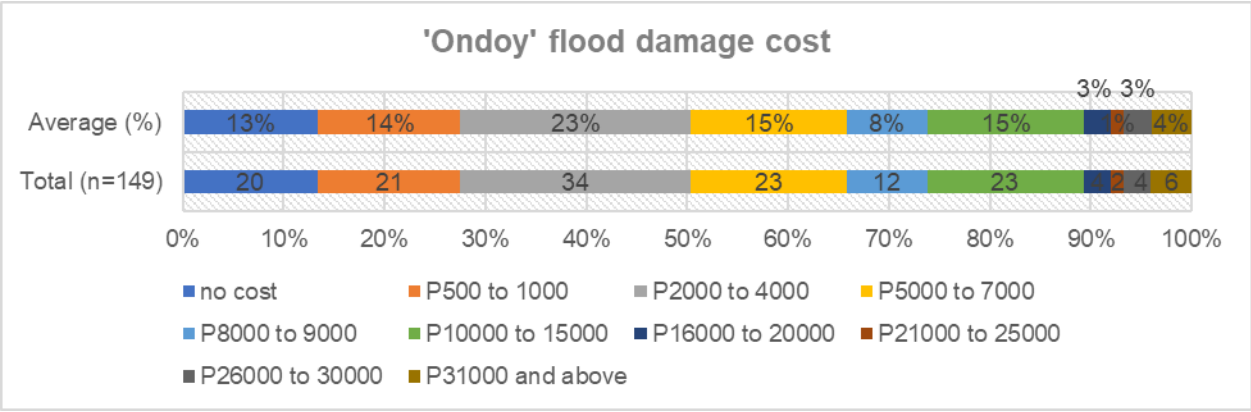


Figure 59. TS 'Ondoy' flood damage cost

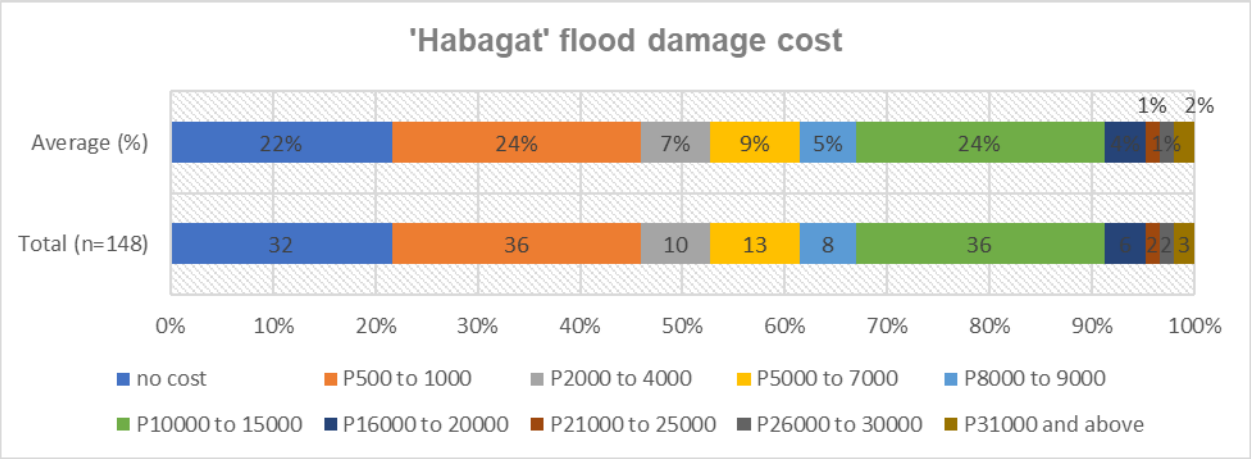


Figure 60. 'Habagat' flood damage cost

In plotting the damage fraction at the peak flood depth for the six housing types, the following variables were identified: 1) highest flood level from ground floor (M); 2) duration of highest flood level (days); 3) value of damage (0.0 to 1.0); 4) cost of damage (PHP); 5) floor area (M2), and 6) damage extent (%). The values for each variable are tabulated as a result of the direct responses from the survey questionnaire corroborated in the interviews.

To compute for the damage extent in percentage value, the following formula adopted from *GMMA Risk Analysis Project* is used: [*damage cost (Php) / building cost (Php from table 17) x floor area (M2) = damage extent (%)*]. An actual example is presented below with the tabulated values and the plotted depth damage curve shown respectively in table 21 and figure 61 below:

A participant (1A-19) who owns a 5.00 M2 (square-metre) one-storey makeshift house (N-1S) which costs Php 6000, experienced the worst flooding event from TS Ondoy. The peak flood depth was reported at 0.60 metre which lasted for two days with the damage value at 0.8 (severe) and the damage cost at Php 5000. The damage extent expressed in percentage, will be computed as Php5000 / Php 6000 x 5.00 M2 = 83%.

Table 21. Makeshift (N-1S) damage fraction variables

Participant	Flood event	Peak flood depth (meters)	Duration (days)	Damage value (0.0 to 1.0)	Damage cost (PhP)	Floor area (M2)	Damage extent (%)
1A-19	'Ondoy'	0.60	2	Severe / 0.8	5000	5.00	83

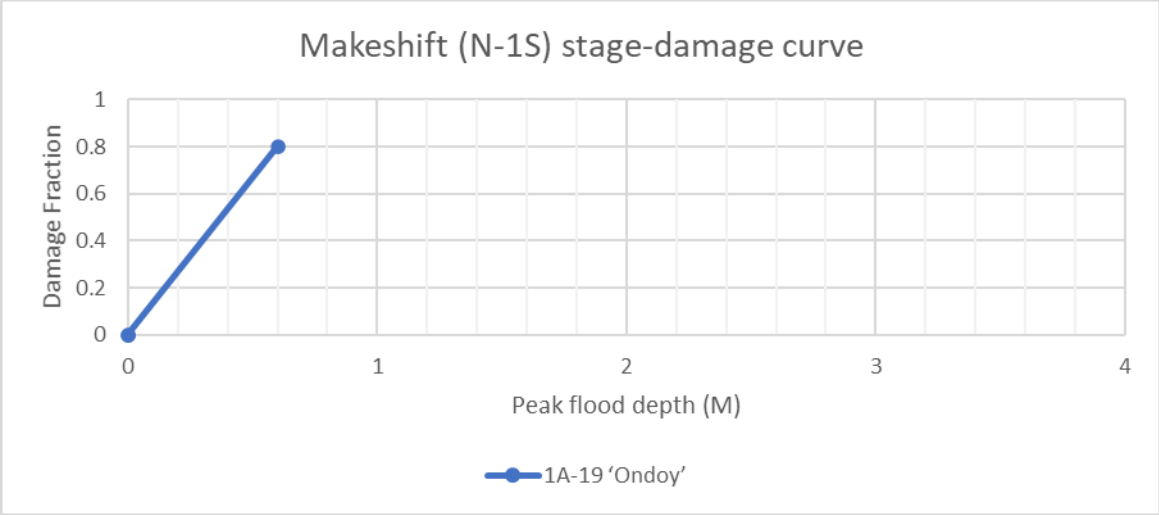


Figure 61. Makeshift (N-1S) dwelling stage-damage curve

The tabulated values with the resultant depth-damage curve for all the 30 dwelling samples representing each of the six housing types, will be presented and discussed in the ensuing chapter 7, *Results and study findings*.

6.3 Summary

The *Data analysis* chapter presented the application of the research design and methods in the study as discussed in chapter 4. It started with the qualitative data analysis, discussing and justifying the use and suitability of thematic analysis, in consideration of the large data sets involved in the study. Applying the proposed guidelines in the published literature, the process of the analysis was discussed thereafter, presenting how the meanings were drawn out from the responses of the participants, both inductively and deductively.

The resultant three main themes were presented next, complemented by the thematic maps that were shown to develop from the more broad (initial to developed thematic map) to the more specific diagram (final thematic map). The direct quotations from the respondents were presented in three different approaches to help present the qualitative data comprehensibly and coherently. In the process, the conceptual model is applied with the adapted tabulation included for easy referencing.

In presenting the quantitative data analysis, the process of establishing the structural classification of the dwellings were discussed, with the building materials for the major components of the dwellings summarised in bar charts. Together with the number of storeys, the building materials were encapsulated in the tabulation of the house types with height classes. The building technology for each of these types were also discussed in detail complemented by photos taken to elaborate on the construction methods and building materials used including the distinct features of the dwellings in comparison with conventional methods and standard materials.

The flood damage assessment on dwellings was presented last in the chapter by introducing the concepts of stage-damage curve and damage fraction, adapted from the published literature. Correspondingly, the damage cost per square meter for all the house types were adapted from the same *GMMA RAP* literature, accompanied by the flood damage costs from the two extreme flood events as reported by the participants.

The procedure in plotting the damage fraction was also discussed with an actual sample of the damage fraction tabulation, and dwelling stage-damage curve presented for reference. The final presentation for these tables and plots covering all the dwelling types, will be discussed and interpreted in the succeeding chapter.

7 Chapter 7 Results and study findings

The relevance and meaning of the findings in the study will be explored and presented in this penultimate chapter. The housing types will be discussed first in detail with the photos of each type presented, to complement the description established from the survey and interviews conducted as discussed in chapter 6, Data Analysis. The flood damage assessment results will be presented next with the tabulation of the damage fraction variables and the stage-damage curves. This will be followed by the basic services delivery and the findings on the main themes presented in the previous chapter. The presentation of the findings in this chapter, will serve as the foundation of the study's closing discussion and overall conclusion, to be presented in the succeeding final chapter.

7.1 Introduction

The results of the survey conducted with the 150 respondents will be discussed and presented in bar charts and tabulations in this section. The dwelling locations based on the assigned zones will be discussed first, followed by the respondents' demographics. The housing typologies will then be presented in the ensuing main section discussing the dwelling features where the total of six types were established. The basic services for the 150 dwellings surveyed will be discussed in the next main section, to identify which amongst the services are sufficient or insufficient. This will also show how the residents, with lacking or absent services in their dwellings were able to cope.

For each dwelling type, five representative participants were chosen to be interviewed with their houses photographed to show – 1) the distinct features in the typology; 2) the flood level during the two extreme flood events, and; 3) any technical adaptation measures effected by the dwellers. This will help determine the effectiveness of the measures during extreme flood events and also address the sub-questions in the study by identifying which amongst the housing types have already adapted technically to flood hazards. The sub-questions to be addressed are reiterated as follows:

1. What are the technical adaptation approaches being applied by floodplain communities to address flood risk?

2. What are the upgrading programmes being adopted in informal floodplain settlements in mitigating flood hazards? and,

3. How can informal floodplain settlements be developed and managed to form transitional settlements?

The answers to these sub-questions will also provide the response to the central research question that will be discussed in the ensuing final chapter 8, *Discussion and conclusion*. The next section will present the findings and results of the survey protocol.

Survey results

The division of Sitio Gulayan community into five main zones where the survey forms were distributed to 30 respondents in each zone for a total of 150 participants, is shown in the map below (figure 19). This is presented again in this chapter as reference for the bar chart (figure 62) that shows the dwelling location of the participants. The chart shows that the greatest number of participants is located in zone *B- Middle area* at 23% or 35 respondents, followed by zone *E- Interior area* at 21% or 31 participants. These are the areas where most of the residents are willing to participate in the study as opposed to zones *B- Exterior* and *Middle areas*, where there was only one willing participant for each zone respectively.

Ideally, an equal distribution of participants on the assigned zones will be an effective strategy to achieve an accurate representation within the community. However, even with the purpose and objective of the survey clearly explained to all participants, there are those who are wary that the study might expose them as settling informally and may be subjected to eviction, hence, the unequal participation of residents in the assigned zones. Another reason for the non-participation of some residents is the on-going pandemic when the survey was conducted, which was also the period when lockdowns were being imposed in the barangay. Other than the zones mentioned above, the rest are fairly representative of the assigned zones with the numbers reaching close or slightly exceeding the targeted 30 participants per main zone.

Figure 19. Map of Sitio Gulayan with the five main zones showing the assigned participant House I.D. and Block I.D.

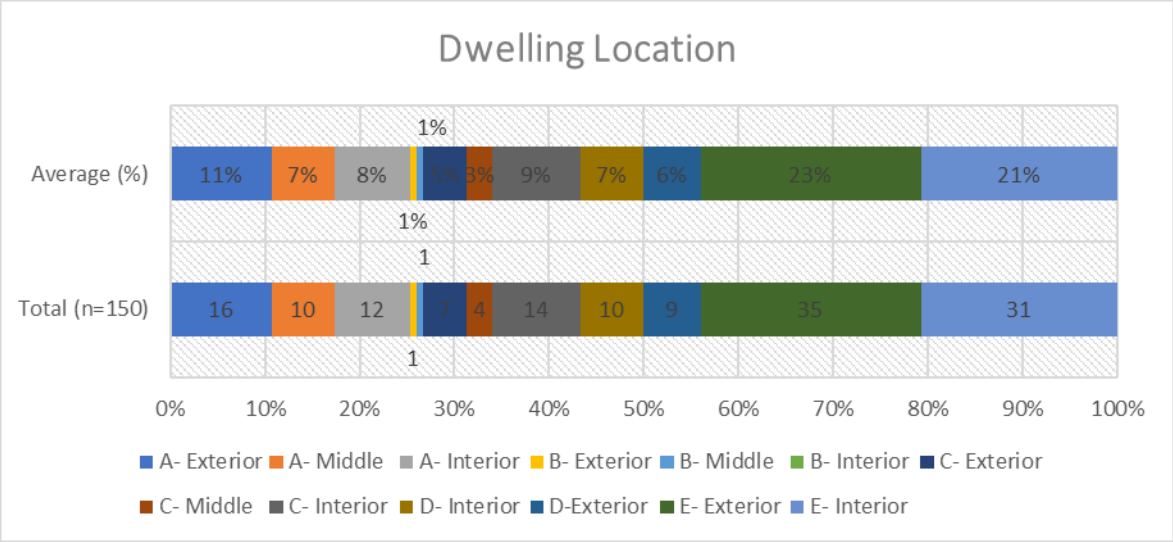


Figure 62. Participant dwelling location with number and percentage breakdown

In terms of demographics, the charts below show the statistical characteristics of the respondents in the following order: age (figure 63); gender (figure 64); household status (figure 65); occupation (figure 66); length of stay (figure 67), and; house ownership status (figure 68). Under the age category, majority of the participants are between the 41 to 60 years age groups with the requirement of either the head of the family, or family member representing the head of the family to participate in the study.

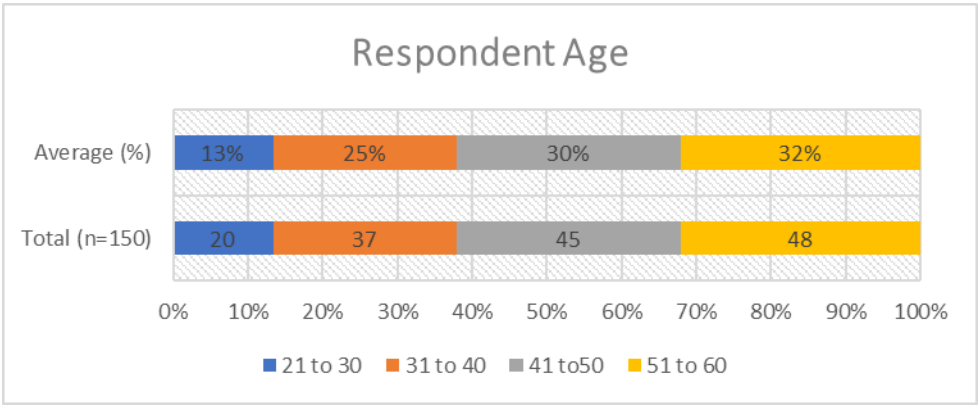


Figure 63. Participant age

With the husbands usually out to work, majority of the participants as shown in figure 65, are the wives with some being single-parent female participants. The male participants are almost half of the female participants, and more than half of the participants are the heads of the family at 56% as indicated in figure 66. In terms of occupation, majority or 48% of the participants are jobless with the survey conducted as mentioned earlier, at the height of the COVID-19 pandemic. This number is followed by vendors at 18% which could be attributed to the community and barangay markets in the area. The other common jobs of the participants are construction worker, factory worker, and store owner as shown in figure 66.

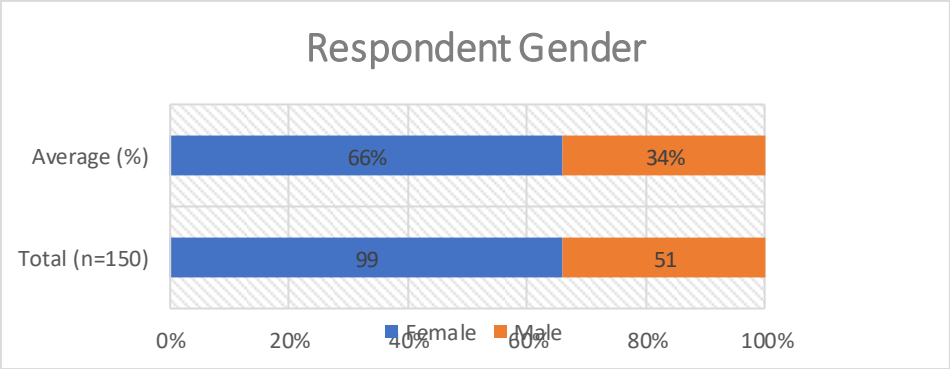


Figure 64. Participant gender

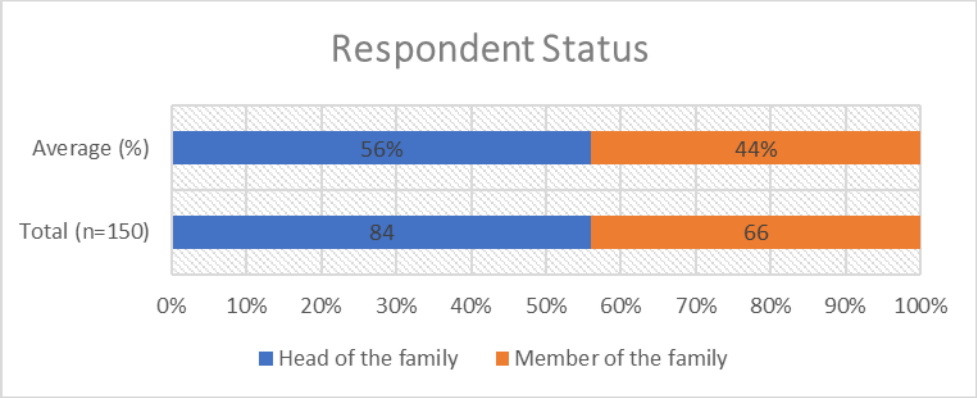


Figure 65. Participant household status

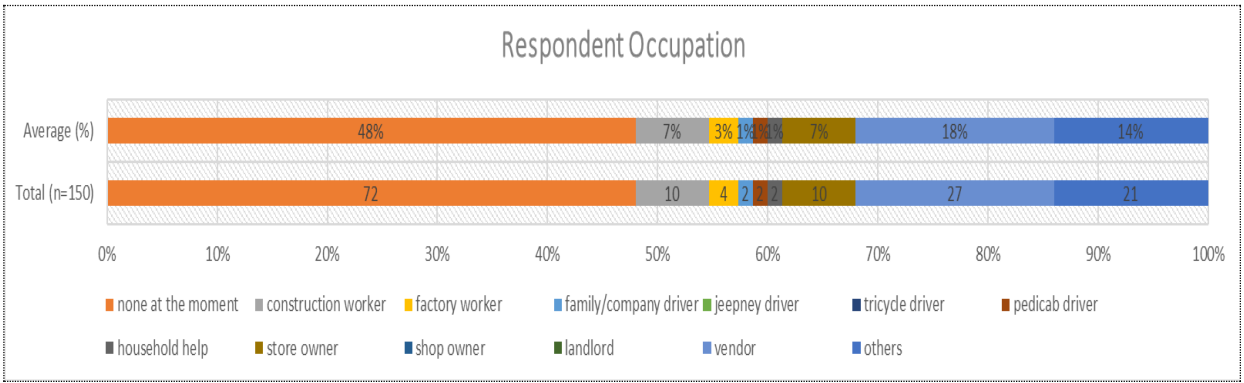


Figure 66. Participant occupation

The participants were also asked about the duration of their stay in the community and the results show that 28% have lived in Sitio Gulayan for more than 30 years, followed by 22% for 26 to 30-year residents (figure 67). These results can be attributed to the community being one of the oldest informal settlements in the city as discussed in chapter 5, *Study Area*, with the third or fourth generations as current residents. There were no participants who have stayed in the community for only a year or less, and only three have been residents of the community between two to five years. In terms of house ownership, 93% or 138 participants own their houses whilst only ten are currently renting their houses as shown in figure 68.

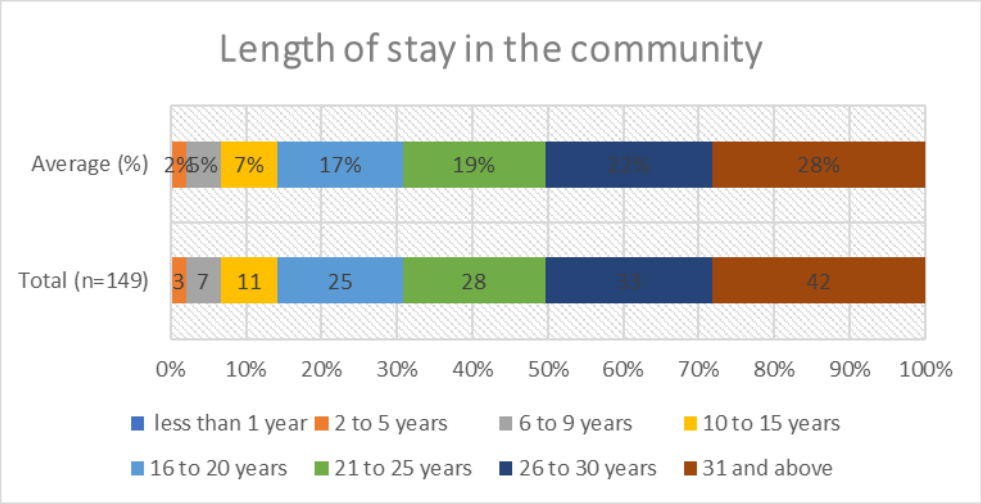


Figure 67. Participant number of years in the community

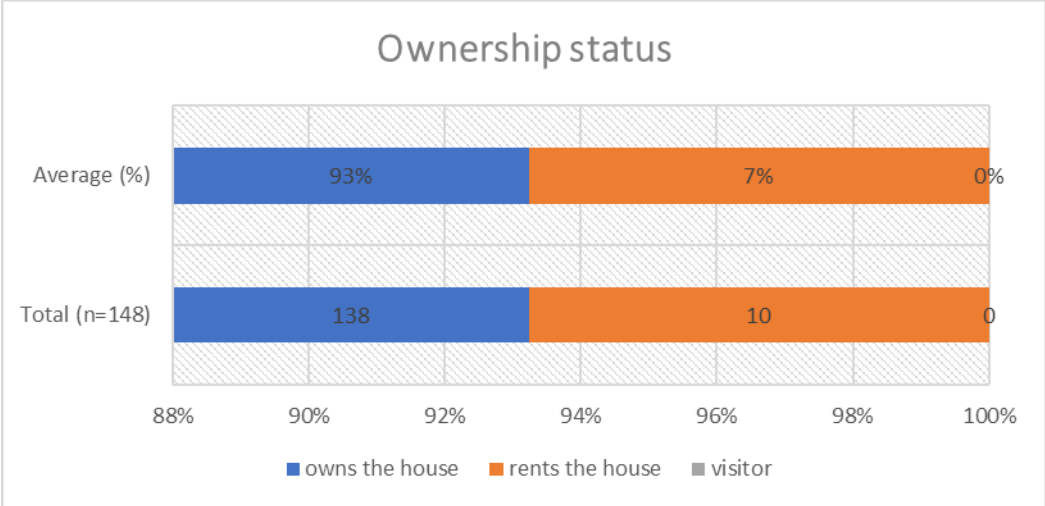


Figure 68. Participant home ownership status

The demographics presented above will be followed by the housing characteristics survey results which established the dwelling typologies found in the community. The ensuing section will discuss the results of the survey on the house features, by presenting the bar charts summarising the results together with the accompanying photos of the various house types.

7.2 Housing typologies

This section will present in detail the six housing typologies initially discussed in the previous chapter under section 6.2.1, *Structural classification of dwellings*. Each type will be described with accompanying examples visually recorded as mentioned earlier, to show the distinct characteristics of each of the dwelling types, namely: 1) Makeshift one-storey (N-1S); 2) Makeshift two-storey (N-2S); 3) Wood one-storey (W-1S); 4) Wood two-storey (W-2S); 5) Concrete hollow blocks (MWS), and; 6) Concrete type (CWS). With a number of possible combinations of building types, these are the most commonly found in the community.

Table 22 below shows the summary of building materials used by the participants in the major components of their houses – floor; walls; roof; and, plinth/stilts, initially presented as bar charts in the previous chapter 6, *Data analysis*. The table indicates that wood is the commony used material for the floors and plinth/stilts, with plywood for the walls and G.I. sheet for roofing. These commonly used materials are those used for the makeshift and wood type houses indicating that these are the predominant house types in the community. The ensuing sub-sections present the details on each of these typologies.

Table 22. Building materials used on floor, walls, roof, and plinths / stilts

Floor	Respondents	Walls	Respondents	Roof	Respondents	Plinth / stilts	Respondents
Concrete	27	Concrete hollow blocks	21	Concrete	2	Concrete	29
Wood	53	Wood	15	G.I. sheet	142	Steel	2
Plywood	41	Plywood	57	Wood	2	Wood	50
Earth	2	G.I. sheet	31	Plywood	2	Bamboo	27
Salvaged mat'ls.	26	Bamboo	1	Cogon grass	0	Salvaged	29
Others	1	Salvaged	26	Salvaged	2	Others	2
		Others	0	Others	0		

7.2.1 Types 1 and 2 Makeshift houses (N-2S & NS-1)

The makeshift types are improvised one to two-storey houses using light wood frames with walls attached made from various light materials such as plywood, bamboo, galvanised iron (G.I.) sheets, canvass, tarpaulin, or even cardboards. Roofs are commonly recycled G.I. roofing sheets or salvaged light materials which are usually anchored to the structure by tying them to the house, or by placing weights such as rubber tires, stones, or hollow blocks. These types are the most vulnerable to natural hazards lacking in structural support and adequate protection from the elements.

As shown in figure 69 below, the two-storey makeshift house sample is made up of various light materials predominantly using a variety of G.I. sheets as exterior building material. This particular house built alongside the concrete dike, was inundated by Habagat flooding with the owners still living in another house in the middle of the community during Ondoy flooding. The level of floodwaters during Ondoy in the area, however, was at 1.50 metres as shown in the figure. The house was originally one-storey before Habagat flooding, and the owners decided to elevate the ground floor and added a second floor after the flood event.

Figure 69. Two-storey makeshift house with flood level heights from 'Ondoy' and 'Habagat'

The house was able to technically adapt to the flood hazards with the provision of the second floor which serves as a refuge area for the household. However, should the dike be breached, the second floor which is at the same level as the dike will also be inundated with floodwaters which fortunately has not happened yet after the dike was elevated.

Figure 70 below shows an example of a one-storey makeshift house with plywood and G.I. sheets used for exterior material. The plain unpainted plywood has been weathered by the elements prompting the owner to start covering it with G.I. sheets for added protection (figure 71). The lower portion of the wall is badly damaged with flood level heights reaching about 0.60 metres from the flooring on both extreme flood events as indicated in the figure.

This type needs to technically adapt to flood hazards despite the house being elevated by about a metre from the ground. Replacing or covering the plywood exterior with G.I. sheets would provide additional strength to the walls, but would increase the temperature inside the house. The wood posts which are submerged in water most of the time, need to be regularly checked for structural integrity.

The NS-1 or one-storey house type in comparison with NS-2, would not be able to withstand damages brought about by disasters prompting its residents to take refuge either in evacuation centres or in a neighbour's house. The residents of the particular sample in fact, evacuated to a relative's house on both extreme flood events with the mother deciding to be left behind to watch over their house and belongings staying atop a built-up platform.

Figure 70. One-storey makeshift house

Figure 71. One-storey makeshift house with flood level heights from 'Ondoy' and 'Habagat'

Flood damage results

The damage fraction at the peak flood depth for each of the house types are plotted using the variables from the survey and interviews as discussed in the previous chapter 6, *Data Analysis*. For the makeshift house types, tables 23 and 24 below show the tabulated values, whilst figures 72 and 73 show the depth-damage curve for the one-storey and two-storey makeshift houses respectively.

Table 23 shows that all the participants experienced the peak flood height from TS 'Ondoy' in their one-storey makeshift dwellings. The damage cost ranged between P5000 to P25000 pesos, with the damage extent ranging from 48 percent to the highest at 83 percent. The peak flood heights experienced between 0.60 and 3.00 meters plotted in figure 72, resulted to damage values of 0.60 heavy or 0.80 severe respectively.

Table 23. Makeshift (N-1S) damage fraction variables

Participant	Flood event	Peak flood depth (meters)	Duration (days)	Damage value (0.0 to 1.0)	Damage cost (PhP)	Floor area (M2)	Damage extent (%)
1A-19	'Ondoy'	0.60	2	Heavy / 0.6	5000	5.00	83
1A-22	'Ondoy'	3.00	2	Severe / 0.8	8000	8.00	83
1B-27	'Ondoy'	3.00	2	Heavy / 0.6	20000	34.50	48
2A-24	'Ondoy'	2.00	8	Heavy / 0.6	25000	36.00	58
3A-5	'Ondoy'	2.10	4	Heavy / 0.6	8000	17.50	38

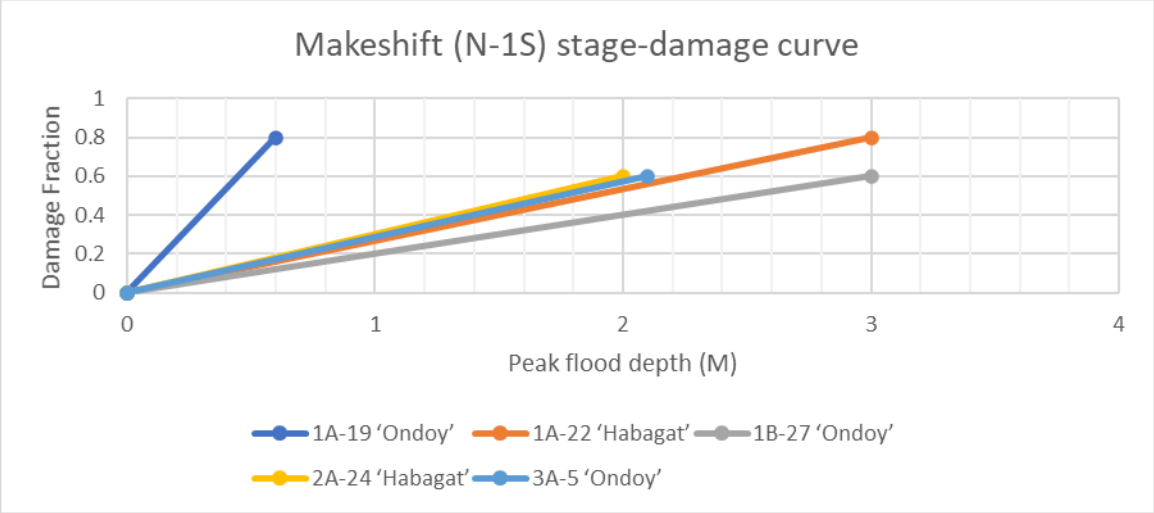


Figure 72. Makeshift (N-1S) dwelling stage-damage curve

The results above indicate that the one-storey makeshift house will either experience heavy or severe damage between the peak flood depths of 0.60 to 3.00 metres. The damage cost will range between Php 5000 to 25000 depending on the size of the dwelling. This shows that N-1S house type is not technically adapted to flood hazards in the community and, therefore, needs to be modified and improved for transitional settlement development.

For the two-storey makeshift house type, table 24 and figure 73 below show that the houses were inundated from a peak flood depth ranging from 1.50 to 2.10 metres. This resulted to a damage value of 0.4 moderate and 0.6 heavy at a damage cost range of Php 3000 to Php 30000. The damage extent is lowest at 8 percent and highest at 83 percent. Compared with the one-storey makeshift houses, the addition of the second floor made the damage extent relatively low in most of the house samples.

Table 24. Makeshift (N-2S) damage fraction variables

Participant	Flood event	Peak flood depth (meters)	Duration (days)	Damage value (0.0 to 1.0)	Damage cost (PhP)	Floor area (M2)	Damage extent (%)
1B-29	'Ondoy'	1.50	2	Moderate / 0.4	3000	32.40	8
2A-3	'Habagat'	1.90	6	Heavy / 0.6	8000	63.00	11
2A-10	'Ondoy'	2.00	3	Heavy / 0.6	5000	80.00	5
2A-23	'Ondoy'	2.10	2	Heavy / 0.6	25000	60.00	35
3B-46	'Habagat'	1.60	7	Heavy / 0.6	30000	30.20	83

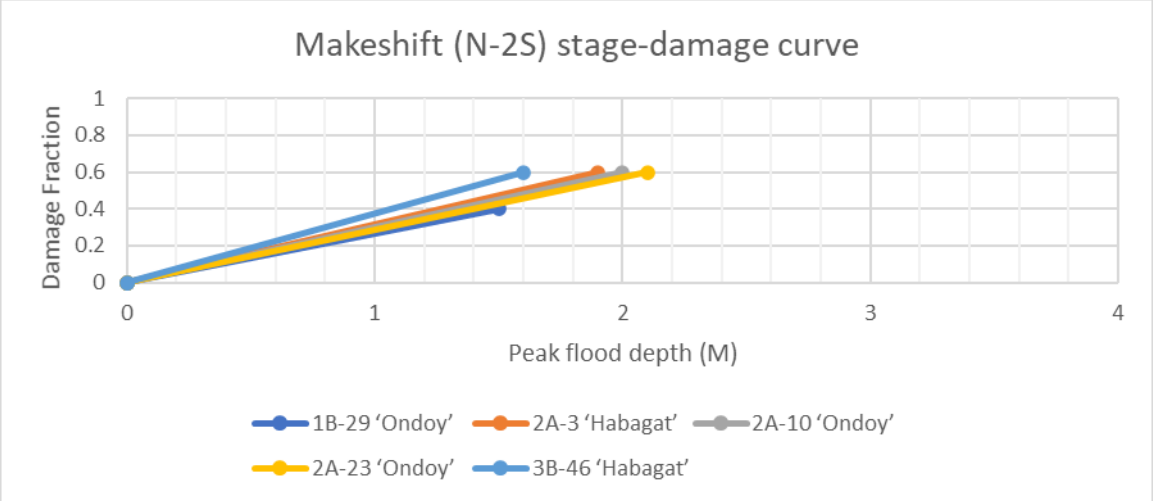


Figure 73. Makeshift (N-2S) dwelling stage-damage curve

The results indicate that although the two-storey makeshift house is more adapted to the flood hazards compared with the one-storey, it is still prone to heavy damage particularly when flood inudation lasts for several days. This could be attributed to the use of sub-standard materials common to the house type such as coco-lumber, plywood, canvass or tarpaulin, which could not withstand damage from the elements. The buiding materials used for the ground floor which is more exposed to the elements, should at least be more structurally sound than the second floor.

7.2.2 Types 3 and 4 Wood houses (W-2S & W-1S)

The wood structures are typically single or two-storeys with its repetitive wood framing as its essential feature - joists on the floor, studs on the walls, and rafters on the roof. Materials

commonly used are coco-lumber which is less expensive than regular timber. Flooring is either made of wood boards or plywood whilst walls could be plywood or G.I. sheets. Roof is typically corrugated or long-span pre-painted G.I. sheets.

As an example in figures 74a and 74b below, the two-storey wood house sits on concrete plinth about 0.60 metre high to protect the wood house from the elements. The house is elevated from the ground, but was still inundated by both Habagat and Ondoy flooding. The ground and second floor exterior uses plywood painted for added weather protection. This house type has technically adapted with the ground floor elevated and a second floor added. However, with the low elevation, extreme flood events would inundate the entire ground floor as indicated in the photos.

Figures 74a & 74b Two-storey wood house with flood level heights from ‘Ondoy’ and ‘Habagat’

An example of a one-storey wood house below (figure 75) similar to the two-storey example, is also elevated by about a metre. The difference, however, are the materials used for stilts which is all timber and the presence of water underneath the house. The posts are literally submerged underwater all year round with the owners needing to regularly check the material condition and structural integrity for either replacement or additional support. This type has partially adapted by elevating the house and adding a mezzanine floor, but with the extreme flood events

particularly during Ondoy (figure 76a), the entire house was underwater with the residents finding refuge on top of the roof.

Figure 75. One-storey wood house

Figure 76a & 76b. One-storey wood house with flood level heights from 'Ondoy' and 'Habagat'

The owners during the interview, stated their plan to replace the wood posts with concrete incrementally with the four corners first, and the others in between and in the middle next. With the posts made out of concrete, the owners could entertain the idea of adding a second floor for additional space and as refuge area during extreme flooding.

Flood damage results

For the one-storey wood dwellings in table 25 and figure 77, the residents recorded peak flood depths from 1.00 to 3.00 meters for both flood events. This resulted to damage costs between Php 4000 to Php 15000 at two percent to 35 percent damage extent. The low damage extent for participant 1A-1 could be attributed to the duration of inundation which only lasted a day, whilst for 3B-26, the use of G.I. sheets for exterior covering contributed to minimal damage with only a few plywood sheets in contact with the floodwaters for three days were replaced.

Table 25. Wood (W-1S) damage fraction variables

Participant	Flood event	Peak flood depth (meters)	Duration (days)	Damage value (0.0 to 1.0)	Damage cost (PhP)	Floor area (M2)	Damage extent (%)
1A-1	'Ondoy'	2.40	1	Moderate / 0.4	4000	54.00	2
1A-4	'Habagat'	1.00	2	Severe / 0.8	8000	7.50	27
2A-1	'Ondoy'	1.50	2	Severe / 0.8	15000	40.00	9
2B-26	'Ondoy'	3.00	3	Heavy / 0.6	15000	10.80	35
3B-26	'Habagat'	2.00	3	Moderate / 0.4	3000	48.00	2

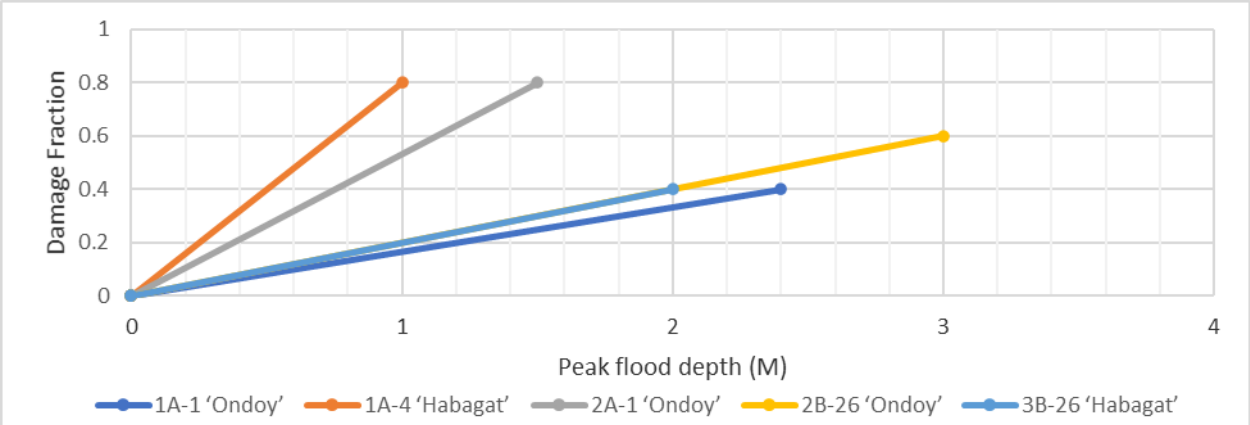


Figure 77. Wood (W-1S) dwelling stage-damage curve

The two-storey wood dwellings similarly encountered peak flood depths for both flood events with table 26 showing the flood depths from a low of 0.90 metre to a high of 1.60 metres, and damages costing from Php 1000 to Php 30000. The high damage cost for participant 1B-35 included all their belongings which were all damaged in a single day inundation. These should have not been included as the damage value should refer to the house per se. In contrast, participant 3A-1 reported a low damage cost with G.I sheets as the main exterior building material used.

Figure 78 indicates the damage fraction from 0.2 slight to 0.8 heavy as a result of the peak flood depths. The house of participant 3A-1 is the least damaged at a relatively low 0.4 percent only with nothing really being damaged as reported despite the two-day inundation of about 1.50-metre-high floods. Participant 1A-24 on the other hand reported a heavy damage from the two-day 1.60-metre-high inundation which only resulted to a five percent damage, due to the relatively small size of their dwelling at only 16.20 M2.

Table 26. Wood (W-2S) damage fraction variables

Participant	Flood event	Peak flood depth (meters)	Duration (days)	Damage value (0.0 to 1.0)	Damage cost (PhP)	Floor area (M2)	Damage extent (%)
1A-24	'Habagat'	1.60	2	Heavy / 0.6	3000	16.20	5
1B-35	'Habagat'	1.30	1	Severe / 0.8	30000	32.40	23
1B-36	'Ondoy'	1.50	1	Slight / 0.2	15000	17.30	22
2A-2	'Ondoy'	0.90	2	Heavy / 0.6	15000	30.00	13
3A-1	'Ondoy'	1.50	2	Moderate / 0.4	1000	60.00	0.4

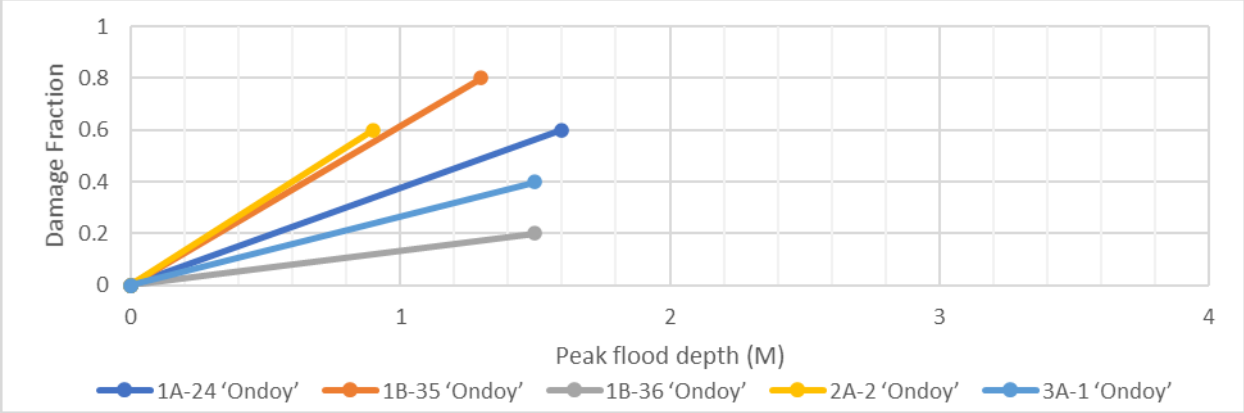


Figure 78. Wood (W-2S) dwelling stage-damage curve

7.2.3 Type 5 Concrete hollow block house (MWS)

Usually made of concrete hollow blocks interlocked at the corners, the difference of the MWS type with the materials of CWS concrete house, is the absence of reinforced concrete frames. Floor material usually consists of concrete or plywood supported by wood framing. Roofs are commonly corrugated G.I. sheets on wooden or light metal roof trusses. If there are upper storeys, the walls are usually made of either wood sheathing or light metals, but there are those that also use concrte hollow blocks like the example below in figure 79.

This particular house type sample, being located at a higher elevation area in the community did not get inundated in both extreme flood events with the house elevated by concrete posts at about 1.50 metres from the ground floor. There is also a second floor, but noticeably, only the front of the house was plastered with the sides and rear left bare exposing the concrete hollow

block walls to the elements. This is common in the community even for three-storey concrete houses as will be discussed in the next section.

Concrete hollow block type houses particularly the elevated ones with upper floors, have technically adapted to the flood hazards in the community. The structural integrity, however, is uncertain with the framings missing in the structure. In the example below (figure 79), the posts were provided, but the beams to support the upper floor and roofing are missing. These house types may be adapted to flood hazards, but may be doubtful in terms of earthquakes.

Figure 79. Concrete hollow block house with flood level heights from 'Ondoy' and 'Habagat'

Flood damage results

The concrete block dwellings recorded both flood events in their peak flood depth from 0.90 to 1.50 metres with damage costs between P5000 to P30000 as indicated in table 27. The damage extent ranged from 0.5 percent to 53 percent with the three participants reporting 0.4 or moderate damage extents. Plotted in figure 80 are the two damage fractions at 0.4 moderate and 0.6 heavy.

Compared with the first four house types above, the damage extent for MWS house type is less severe with only one participant having a damage extent of 53 percent with the rest relatively low at 0.5 percent to 5 percent only. Similar to the reported case discussed earlier, the house contents of participant 1B-34 were included in the reported damages which resulted to a high damage cost and damage extent value.

Table 27. Concrete block (MWS) damage fraction variables

Participant	Flood event	Peak flood depth (meters)	Duration (days)	Damage extent (0.0 to 1.0)	Damage cost (PhP)	Floor area (M2)	Damage extent (%)
1A-17	'Ondoy'	1.20	4	Heavy / 0.6	5000	20.00	5
1B-34	'Ondoy'	1.50	2	Heavy / 0.6	30000	10.80	53
2A-18	'Habagat'	1.00	2	Moderate / 0.4	10000	40.00	5
3A-3	'Ondoy'	0.90	4	Moderate / 0.4	5000	36.00	3
3A-7	'Ondoy'	1.50	7	Moderate / 0.4	5000	180.00	0.5

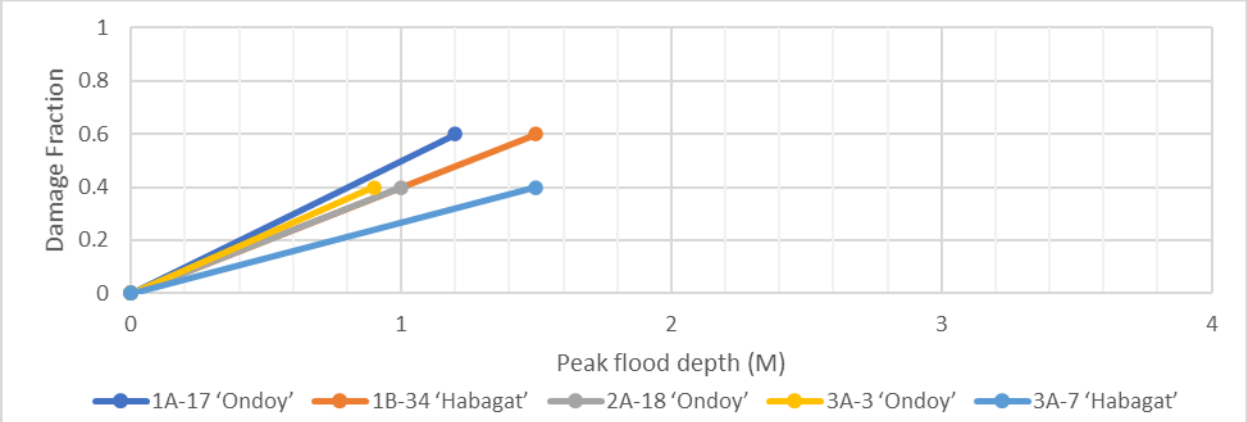


Figure 80. Concrete block (MWS) dwelling stage-damage curve

The stage-damage curve above shows that only two participants reported heavy damage extent with the remaining three similarly reporting moderate or 0.4 damage extent values only. Comparing again with the four house types above, none of the houses reached the severe or 0.8 damage fraction. This indicates that the MWS house type is more technically adapted to the flood hazards in the community, particularly if located in high elevation areas as shown in the example provided.

7.2.4 Type 6 Concrete house (CWS)

This type of house is uncommon in a typical local informal settlement, but given the number of years in existence, some of the residents of Sitio Gulayan have improved their living conditions comparable to a middle-class neighbourhood. Concrete houses in the settlement are usually two-storeys, but there are houses up to three-storeys high (figures 81a & 81b and 83). These structures are made of concrete hollow blocks (CHB) with reinforced concrete frames.

As shown in the figures below (81a & 81b), this three-storey concrete house has structural framings, albeit commonly bare without cement plaster as mentioned earlier. The construction of the second floor of the house was on-going when 'Ondoy' flooding occurred which made the owners decide to add another level. Concrete houses are commonly situated on original plots provided in the CMP project with some of the owners continuously paying their amortisation. The owners of this house sample in particular, have already completed paying their dues just last March 2021.


Figure 81a & 81b Front and rear elevations of a concrete house

With the addition of a third floor, the ground level was converted into storage areas with the living areas starting at the second floor. As shown in figures 82a & 82b, the ground floor was inundated at 1.20- and 1.60-metre-deep floodwaters during Habagat and Ondoy flooding respectively. This house can be considered to have technically adapted to the flood hazards where the owners will not be affected should similar events occur in the future.

Another house example is shown in figure 83 below, with the owners elevating their concrete house at 1.20 metres and similarly adding a third floor. The second and third floors are the main living areas which would allow for the ground floor to be inundated without really affecting the household activities as shown in figures 84a & 84b. This house has also adapted technically to flood hazards in the community with the house being elevated and provided with upper floors.

Figure 82a & 82b Concrete house with flood level heights from 'Habagat' and 'Ondoy'

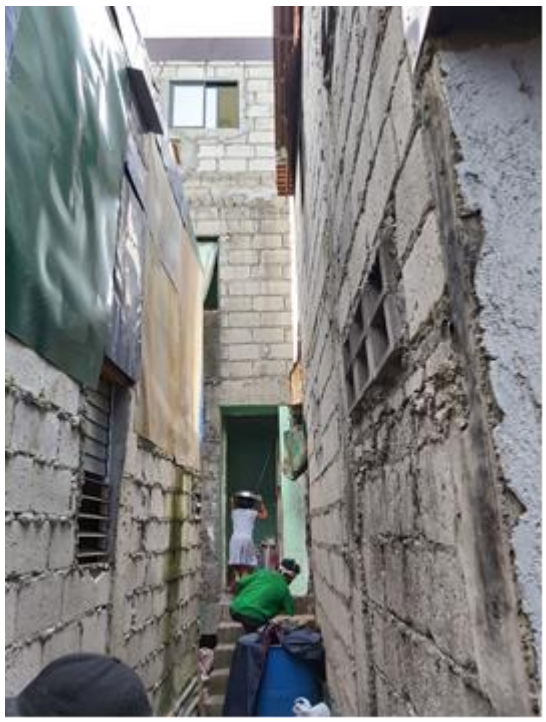


Figure 83. Concrete house

Figure 84a & 84b Concrete house with flood level heights from 'Ondoy' and 'Habagat'

Flood damage results

Finally, for the concrete dwellings, both flood events recorded the peak flood depths ranging from 1.50 to 1.80 meters which resulted to damage costs between P2000 to P35000 as shown in table 28. Despite the relatively high flood depths, notable is the damage extent which is only between 0.4 to 2 percent. From figure 85, the plot shows that the damage fraction is from 0.2 slight to 0.8 severe.

Table 28. Concrete (CWS) damage fraction variables

Participant	Flood event	Peak flood depth (meters)	Duration (days)	Damage extent (0.0 to 1.0)	Damage cost (PhP)	Floor area (M2)	Damage extent (%)
1A-18	'Ondoy'	1.60	6	Heavy / 0.6	2000	70.00	0.4
1A-23	'Habagat'	1.60	5	Severe / 0.8	35000	200	2
3A-16	'Ondoy'	1.80	5	Heavy / 0.6	10000	160.00	0.8
3B-34	'Ondoy'	1.50	2	Slight / 0.2	10000	120.00	1
3B-40	'Habagat'	1.80	2	Heavy / 0.6	15000	80.00	2

Participant 1A-23 claimed the damage cost estimate was about Php 35000 because it was then when they were having their second floor constructed with all the building materials stored at the ground floor inundated. Despite the cost and the severe damage extent at a value of 0.8, the damage extent percentage was only at two percent due to the huge house floor area.

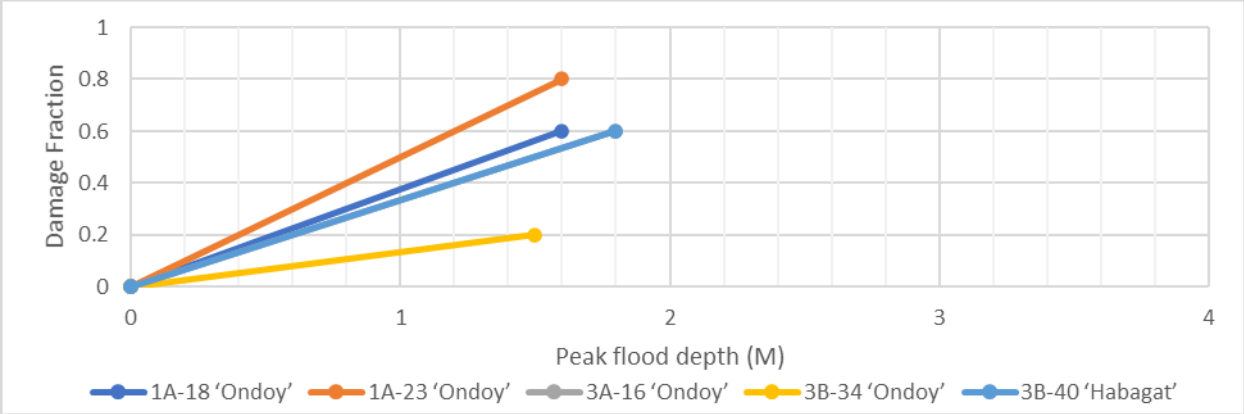


Figure 85. Concrete (CWS) dwelling stage-damage curve

Figure 85 above shows that in comparison with all the other house types, the concrete house type has a similar damage extent value ranging from slight 0.2 to severe 0.8, but still has the least damage extent percentages ranging from 0.4 to two percent only. This confirms the finding that the CWS concrete house is the most technically adapted house type amongst the six types observed.

With regard the changes made in the dwellings, the participants were also asked in the survey about the improvements they made for their houses to be more flood resilient. The table below summarises the improvements for each major house component – floor; wall; roof, and; plinth/stilts. Table 29 below shows that majority is unanimous in replacing the components with more durable materials. For the floor, elevating the ground floor ranked second whilst the wall, roof, and plinths/stilts, were all similarly reinforced with bracing or supports.

As mentioned in the previous chapter, participants who technically have security of tenure, preferred using permanent materials like concrete and concrete hollow blocks. Those without tenure security on the other hand, prefer semi-permanent dwellings using light materials such as wood, plywood, and G.I. sheets. This is in anticipation of possible eviction in the future, where they can still make use of their building materials to relocate, perhaps in another settlement.

Durable materials in terms of flooring may refer to concrete or wood boards, whilst for walls, these could be concrete hollow blocks, plywood, or G.I. sheets. For the roof, durable materials are either corrugated or long span pre-painted G.I. sheets. Finally, for plinths/stilts, replacement of more durable materials refers to either good lumber (as opposed to coco lumber and bamboo) or concrete.

Table 29. Physical changes made on floor / floor level, walls, roof, and plinths / stilts

Floor / floor level changes	Respondents	Wall changes	Respondents	Roof changes	Respondents	Plinth / stilts changes	Respondents
No improvements made	25	No improvements made	38	No improvements made	41	No improvements made	36
Replaced with more durable material	73	Replaced with more durable material	61	Replaced with more durable material	63	Replaced with more durable material	55
Elevated the ground floor	23	Added bracing / supports	33	Added bracing / supports	32	Elevated plinths / stilts	21
Added an upper floor	10	Added double walling	4	Added double roofing	3	Added bracing / supports	28
Added roof deck	4	Others	4	Others	0	Others	0
Others	5						

The improvements effected by the residents in their dwellings as discussed above, serve as the local knowledge in technically adapting to the flood hazards in the community. Based from their lived experiences spanning up to thirty years for most of the participants, these improvements have proven effective in flood risk reduction and critical in the community's transforming into a transitional settlement. Part of developing into a transitional settlement, however, is the proper delivery of basic services. In the ensuing section, the status of the basic services delivery in the community will be discussed from the results of the survey and interviews conducted.

7.3 Basic services

This section will present the availability/non-availability of basic services in Sitio Gulayan community as briefly discussed in the previous chapter. The services that will be discussed in detail are power, water, sanitation, solid waste management, and public facilities. This will be similarly presented in bar charts and tables resulting from the survey and interviews conducted. As discussed also in the previous chapter, the only means to deliver affordable quality basic services to every single household in the community, may be holistically planned developments for the community.

7.3.1 Power

Based on the survey conducted, figure 86 below shows the power supply source where 60% of the respondents are direct customers of the *MERALCO* concessionaire, whilst 35% are buying from these customers with the remaining 5% either without electric lines, or sharing with a neighbour. Those buying from their neighbours usually have their own sub-meters to monitor consumption and are charged at a higher rate than the regular as discussed previously.

The electric meters supplied by the concessionaire are located atop their posts as shown in figure 87a, to prevent tampering and for easy meter-reading. These are found along the perimeter of the community with the lines connected to concrete posts provided by the homeowners' association at strategic points inside the community as shown in figure 87b. Lines leading to the individual dwellings can be commonly found criss-crossing above pathways (figure 87c).

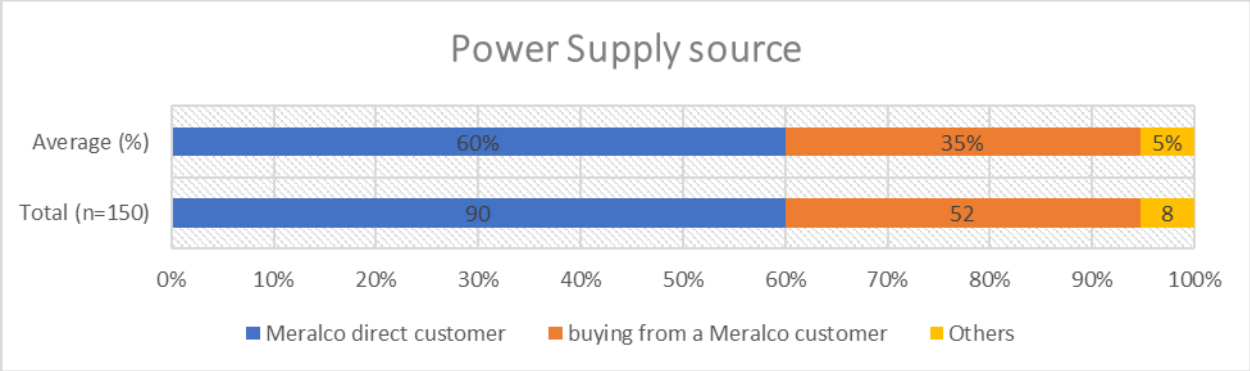


Figure 86. Electricity supply source

Figure 87a Power meters atop main posts

Figure 87b Electric post inside the community

Figure 87c Electric lines along pathways

7.3.2 Water

For water supply, figure 88 below indicates that 50% of the respondents are customers of the *Maynilad* concessionaire with 48% buying from these customers. The remaining 2% or three respondents are sharing with their neighbours. Unlike in power supply, most of the respondents buying from their neighbours are paying per five-gallon container (figures 89a & 89b), with only a few using sub-meters for monitoring consumption.

The water meters from the concessionaire are located on two central points outside the community. One along the road leading to the community entrance (figure 89c), and another along the alley from the minor road side entrance (figure 89d). Similar to the electric meters, these are centrally located for easy meter-reading and to discourage tampering. The customers, however, are the ones providing the lines from the water meter to their dwellings which makes it expensive, particularly for those located in the core of the community.

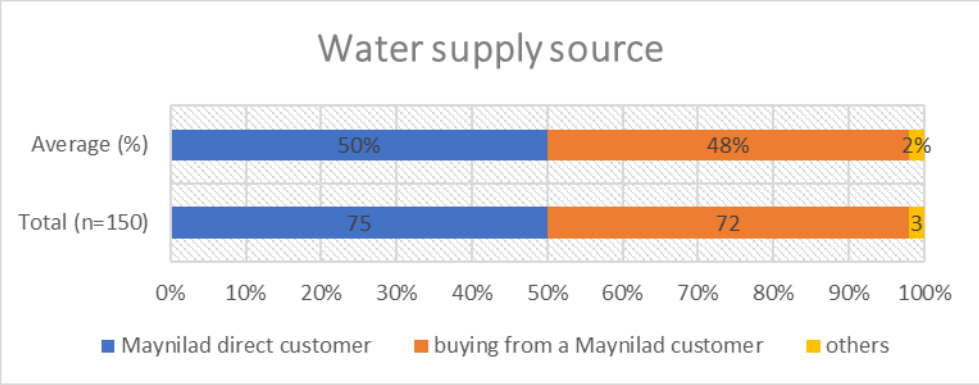


Figure 88. Water supply source

Figure 89a & 89b Water bought in five-gallon containers

Figure 89c & 89d. Water meter location along the road and alley

7.3.3 Sanitation

Sanitation is one of the most lacking basic services in the community as previously discussed and as shown in the survey results on toilet and septic tank ownership in figures 90a and 90b respectively. Although toilet ownership is at 88%, those without septic tank provisions are more than half of the respondents at 53%. The others who do not have their own toilets either rent or use their neighbour's toilets, whilst those without septic tanks either tap their sewage pipes to a neighbour's line or make use of the space underneath the house as cesspool.

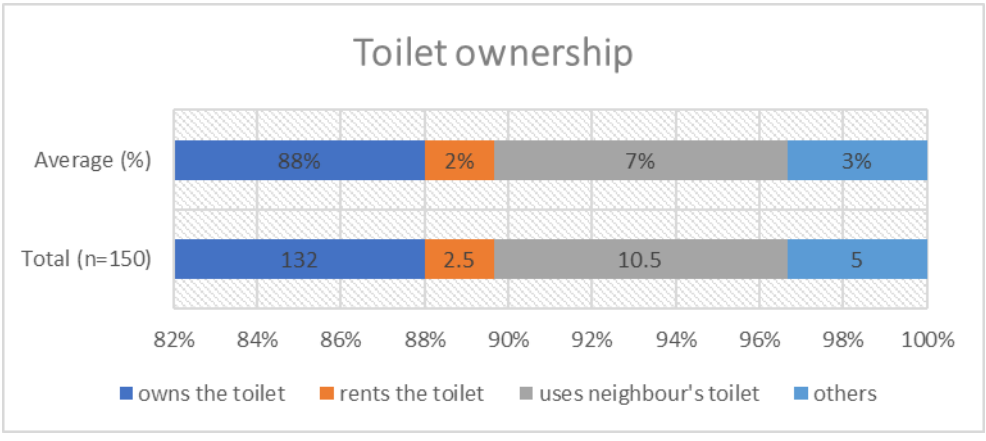


Figure 90a. Toilet ownership status

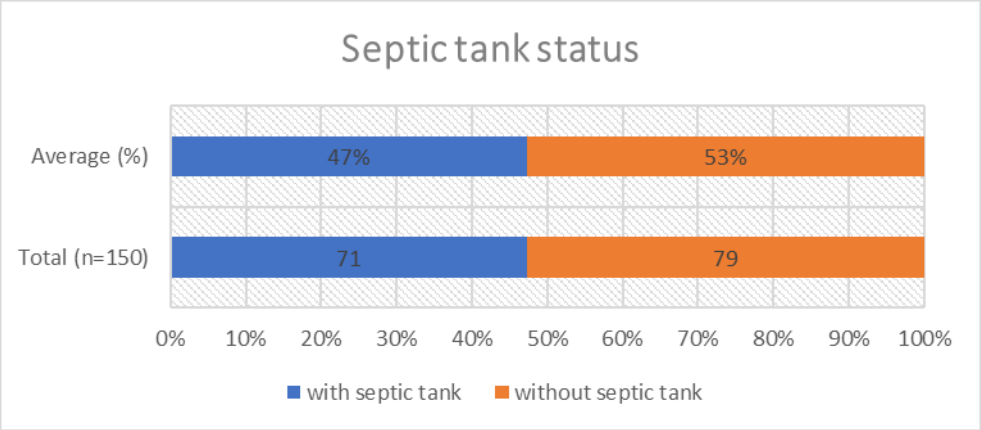


Figure 90b Septic tank ownership status

The challenge in providing individual septic tanks as discussed in the previous chapter, is the irregular layout of dwellings and limited space to run and connect the sewage pipes to the main sewer lines outside the community. There are some who provided their own septic tanks in preparation for future sewer line provisions, but currently without any outlet pipes which could lead to clogging and overcapacity of tank. Alternative solutions should, therefore, be considered in the manner specific to the challenges in Sitio Gulayan for the community to be developed into a transitional settlement.

7.3.4 Solid Waste Management

According to most of the participants, the issue on SWM being one of the most lacking amongst the services is the result of lack of discipline. Despite the designated areas for storing trash outside the community, the residents tend to just throw their rubbish on vacant lots or on the spaces underneath the houses (figures 91a & 91b). Without considering the health hazard it poses to the entire community, there are residents who reason that the trash could be used as filling material for future constructions.

Although the problem can be seen mostly in vacant lots within the community, floodwaters scatter rubbish everywhere within and outside the community making it more hazardous to health within and outside the community. The riverbanks have not been spared of this dilemma which makes it convenient for the residents living along the river to just dispose of their rubbish across the dike.

Figure 91a & 91b Rubbish on vacant lots and underneath houses

There are a number of suggestions from the participants as discussed in the previous chapter, which should be taken into consideration both by the community and the barangay officials. The barangay programme on awareness by exchanging recyclable materials such as plastic bottles for vegetables or food, would only be sustainable if implemented regularly. The idea of providing an MRF, however, to recycle trash may be a good start in addressing the issue on SWM. There are a lot of waste pickers in the community who could be tapped into recycling programmes that would not only provide jobs, but would benefit the community as a whole.

7.3.5 Public facilities

As discussed in chapter 5, *Study Area*, Barangay Catmon is at the heart of the city which is strategic in locating the Justice Compound within the barangay with Sitio Gulayan community benefitting as the closest settlement. Aside from the Barangay Centre, People's Park, Police Headquarters, City Jail, and the Justice Hall, other facilities in the compound include a covered basketball court, Multi-purpose Hall, Library, Evacuation Centre, and the new Health Centre (figures 92a to 92e).

Based on the interview results, public facilities for the majority are lacking inside the community, but the provisions of the local government just outside the community in the Justice Compound, compensates for the deficiency. The original CMP plan has allotted about 800 square metres of open space for community facilities which the legitimate lot owners welcome, but not the others as this could mean their displacement.

Out of all the basic services, the proximity of the public facilities to Sitio Gulayan, would credibly justify the community being developed and transformed into a transitional settlement. The community is actually better off compared with most of the settlements both formal and informal, in terms of the available facilities and their nearness to the settlement. Providing a direct

access, however, would bring the residents closer to the facilities as discussed in chapter 5, particularly those located at the core of the community.

Figure 92a & 92b Covered court and Multi-purpose Hall

Figure 92c & 92d City Library and Evacuation Centre

Figure 92e City Health Centre

The findings in this section and the previous section, will be consolidated to discuss the results in relation to the main themes established in the previous chapter. Based from the results on the survey and interviews conducted on the dwelling typologies and basic services delivery as

presented above, the findings on the three main themes will be presented in the succeeding sections.

7.4 Main themes

This section will present the findings using the three main themes discussed in the previous chapter 6, *Data Analysis*, namely: 1) Flood-risk reduction strategies; 2) Local culture, and; 3) Local services delivery. The results will be presented through the resultant sub-themes for each of the main themes based on the analyses discussed in chapter 6.

7.4.1 Flood-risk reduction strategies

The analysis for the main theme of flood-risk reduction strategies enabled the assessment of the technical adaptability of the established house types through the dwelling improvements made by the residents. The strategies being practised by the community as a whole both for the structural and non-structural flood mitigation measures show that some have been effective whilst others, with the lack of coordination, have been not so effective as discussed in the succeeding sub-sections.

Structural measures

Both the concrete dike and the box culvert have been effective flood mitigation measures not only for the community, but for the entire barangay. The dike, however, being very visible is given more credit compared to the hidden box culvert. Both the residents and the barangay officials interviewed, recognised both structural measures in the end as effective. The dike was constructed in 1989 and was elevated in 2013 which has not been breached since then. The structural integrity, however, is being compromised with dwellings being attached to the structure as support. As discussed in the previous chapter, leaks have already been discovered in some parts contributing to floods in the area.

The box culvert built in 2010 on the other hand, is the result of the effects of TS ‘Ondoy’ and have proven effective in flood reduction in the area. Built under the main roads of Governor Pascual Ave. and Sanciangco St. surrounding Sitio Gulayan community, these storage tunnels were built to store floodwaters and pumped into the other river across the community. From the time it became operational, major flooding similar to the historical event has not been experienced again to date. The most recent devastating tropical storm ‘Ulysses’, occurred in November 2020 where most areas in Metro Manila hit by TS ‘Ondoy’ in 2009 experienced the same or even worse devastation. The community of Sitio Gulayan had floodwaters as a result, but up to ankle or knee-deep only at the highest.

EWS and emergency plans

The community’s early warning system and emergency plans as discussed, are not well coordinated with the residents. Only the barangay and community officials interviewed are fully

aware of the programmes, whilst the residents interviewed are only aware of the designated refuge areas and evacuation centre to go to in times of calamities. Barangay staff, however, go around the community and provide notices and warnings during typhoons.

Although there are warning systems in place such as updates in social media like the barangay *Facebook* account and sirens on standby, these were not mentioned by any of the residents during the interview. There were no drills being conducted in the community to train and prepare the residents for disasters. With the high congestion and population in the community, disaster drills are a must in case of any emergency or life safety situations that would require evacuation skills.

Dwelling improvements

In terms of dwelling improvements, the aspiration of most of the participants are to make their dwellings flood resilient by using more durable materials, elevating their ground level, and adding an upper level. These are the improvements made by owners of the more technically adapted dwellings like concrete, concrete hollow blocks, and wood house types, but not all the residents as discussed earlier, aspire for permanent dwellings.

Considering the number of unauthorised dwellings far outnumbering those that are erected on legitimate plots based on the originally approved CMP site development plan, there are only 804 lots as against the exiting 2,500 households in the community. Even if two families own each lot, almost 1000 households are still not authorised to be on their existing lots and, therefore, would be displaced should the CMP project pushes through.

The residents also aspire for improvements in the community knowing that despite all their efforts to improve their living conditions, there are also improvements that the community needs as a whole to make it more flood resilient. These include providing sufficient drainage, cleaning of canals and waterways, desilting of river, and proper waste disposal. The residents are also aware that other than river desilting, the rest of the improvements can be done by the residents themselves through *bayanihan* or communal unity, which will be discussed in the next section.

7.4.2 Local culture

Out of all the local cultures observed in the community of Sitio Gulayan, there are three practices that stood out in the data analysis – 1) Extended family; 2) *Bayanihan*, and; 3) *Bahay-kubo*. These local cultures serve as a form of coping practices which in a way, have influenced the technical adaptability of the dwellings and the community both constructively and adversely in building resilience.

Extended family

The multi-family household practice is common not only in Sitio Gulayan community, but in most local informal settlements. It has helped provide the much-needed housing for city dwellers on

the one hand, who cannot afford living in formal settlements, but on the other hand, has contributed to the high density and further congestion in informal settlements. In terms of its influence on the technical adaptability at the dwelling level, the effects are typically adverse with the additional number of residents in an already cramped space which the house may not be able to support structurally. Technical adaptability is thus, reduced together with the structure's resilience to flood hazards.

On the community level, extended family similarly diminishes the technical adaptability with additional houses occupying open space, whilst adding to the demands of the much-needed basic services. Additional households also mean additional wastes and with the lack of space in Sitio Gulayan community, new dwellings are starting to occupy the 'no-build-zone' river easement which could further deteriorate the already contaminated river system. Extended families, nonetheless, add to the coping system of households with the day-to-day responsibilities being shared by all the family members, and could be further extended to the neighbourhood in the form of *bayanihan*.

Bayanihan (community spirit/mutual assistance)

The close-knit relationship in the household as part of the local culture mentioned above, extends to the community particularly amongst the neighbours. When parents need to leave the house for instance, the neighbours are asked to watch over their children and this favour is returned either in the same manner, or through other means of assistance. It could be through accommodating neighbours in need during extreme flood events or disasters as earlier discussed, which strengthens the local social structure in the community.

With the strong social structure, mutual assistance or *bayanihan* is similarly strengthened as can be observed from neighbours helping out in house repairs after a disaster, or in contributing and participating in community development programmes. Technical adaptability is hence, constructively influenced in this local culture with resilience being built both in the dwelling and community levels through the dwelling improvements and community programmes. One of the most aspired for improvement by the dwellers particularly for those who cannot afford to provide an upper level, is to elevate their houses. This is usually done by providing stilts about a metre high from the ground which as discussed in the previous chapter, is inherent in the traditional nipa hut where most of the houses are patterned after in terms of form, layout, and materials.

Bahay-kubo (nipa hut)

The characteristics of the *bahay-kubo* particularly in its form and materials, constructively influence the technical adaptability of the dwellings. The elevated structure with its simple cube form makes it resilient to regular flooding and structurally stable. It is also easy to build with its light and durable materials like bamboo, cogon, and nipa. The materials in the urban setting, however, are replaced with recycled or salvaged materials found in the local area except for

bamboo which is readily available and can be used both as structural and architectural building material.

The three local cultures discussed above serve as a coping mechanism for the residents to improve their living conditions in terms of the flood hazards and the lack of basic services in the community. These will be further discussed in the ensuing section by presenting the final theme with its two sub-themes as a result of the data analysis from the previous chapter.

7.4.3 Local services delivery

Local services delivery in Sitio Gulayan community is lacking due to challenges in the irregular site layout, conflicts in the delineation of duties between the local government and the homeowners' association, and unaffordability. Further findings on basic services and adaptive capacity as the two sub-themes of this final main theme, will be discussed in this section.

Basic services

Basic services in Sitio Gulayan community as discussed in the earlier section 7.3, are mostly lacking typical of informal settlements. For the community to be transformed into a transitional settlement, the issues related to the delivery of the basic services should be addressed. Although the residents find ways on accessing the services such as power and water, majority who rely on buying from legitimate customers are paying more than what the concessionaires are charging. There are also cases of illegal tampering of lines to access these utilities despite the electric and water metres being centrally located in strategic areas in the community.

Amongst the basic services, sanitation is the most crucial that affect not only those who are deprived of the service, but the entire community in terms of health hazards. The programme to provide public toilets in strategic areas within the community eventually was abandoned due to lack of water and maintenance problems. With the provision of individual septic tanks as an unrealistic solution, communal septic tanks strategically positioned to accommodate various zones, perhaps could be the rational approach in addressing the sanitation issue. The settlement could be surveyed for vacant lots or open areas like the abandoned basketball court, which could potentially be a good location for communal septic tanks.

Electricity and water supply issues are mainly due to non-affordability for most residents which can be considered less of a challenge compared to sanitation. The problem could be addressed through a number of possible solutions in the form of alternative energy and water sources. Similarly, solid waste management issues in the community may not be as difficult to address with the survey and interview responses pointing to discipline amongst the residents as the main problem.

Finally, for the public facilities, the existing facilities inside the Justice Compound which actually serve the entire city is already in close proximity to Sitio Gulayan. Direct access to the compound, however, will bring it closer to the community making it easier and more convenient

for the settlers to access the available services and facilities. If this can be provided, Sitio Gulayan can be integrated with the formal city with the Justice Compound serving as the common ground.

The challenges of flood hazards and non-delivery of basic services have been contributory in developing the adaptive capacity of the residents. Adding supports or replacing sub-standard materials for instance, with more rigid building materials have always been the common goal of most residents in improving their living conditions. They also aspire to improve their dwellings to become flood resilient by elevating the ground floor and with funds available, provide an upper floor.

Regular houses in Sitio Gulayan community, thus, become flood-based particularly in low-lying areas where improvised bridges interconnecting houses during the rainy season can be observed. Elevated platforms become common house fixtures during floods to secure basic furnishings from getting inundated in floodwaters, and in extreme conditions, roofs are also provided access to serve as refuge area whilst waiting for rescuers.

These coping systems together with the inherent local culture developed over the years as discussed above, have made the vulnerable community of Sitio Gulayan survive regular disasters and should, therefore, be translated and applied in developing the community to form as a transitional settlement.

7.5 Summary

This chapter presented the findings in the study starting with the housing typologies established in the community. Amongst the six types presented, the one-storey makeshift (NS-1S) and wood houses (W-1S), are the types that require technical adaptation the most to mitigate the flood hazards in the community. Although most of these houses are elevated on stilts, the sub-standard construction materials used and the lack of an upper floor which serves as refuge area, make them highly vulnerable to flooding.

Based from the construction materials used, these house types (both one-storey and two-storeys) are also the most common amongst the six types which indicates that majority of the dwellings in the community require technical adaptation to flood hazards. The most common improvements effected by the owners for these house types are replacing their building components with more durable materials, adding bracing and supports as reinforcement, and elevating the ground floor.

The concrete hollow blocks (MWS) type has technically adapted in terms of the building materials used and the ground floor elevation height, more so for those with upper floors. Although single-storey MWS types are usually elevated on concrete plinth or stilts, extreme flood events still inundate these houses. The two-storey type in comparison, is more adapted to flood hazards with the upper floor serving as refuge area commonly built with light materials.

These houses tend to have more structural reinforcements to support the upper floor making them also more rigid in comparison.

The concrete (CWS) type house finally, is the most technically adapted amongst all the types. Although not commonly found in a typical informal settlement, these houses are mostly two-storeys high with a few having a third floor or even a roof deck. These houses as discussed earlier, are usually owned by legitimate lot owners whom when given the chance, would not hesitate to build permanent houses, especially those who are dutifully paying their amortisations. These are also the houses that serve as refuge areas for the owners' relatives and neighbours needing to be evacuated during extreme flood events.

In terms of basic services, the more well to do residents usually with concrete and concrete hollow blocks houses, are the legitimate customers of concessionaires who can afford these services. These are also the entrepreneurs selling power and water to their neighbours in need. Toilets are commonly found in these houses as well as in two-storey and one-storey wood houses, whilst the one- and two-storey makeshift houses are the types mostly without toilet provisions. For the septic tanks, houses located along the perimeter of the settlement are the ones with provisions which can easily be tapped to the sewer line along the roads. Houses in the interiors on the other hand, either do not have provisions or have septic tanks, but without any outlets.

The findings in the context of the three main themes show that for the flood-risk reduction strategies, the structural measures have been effective, whilst the non-structural were less effective due to lack of coordination between the authorities and residents. For the local culture, both b*ayanihan* and *bahay-kubo* have positive or constructive influences to the technical adaptability of the dwellings and the community as a whole.

Whilst the extended family culture is more detrimental than beneficial to the technical adaptability, the concept of close-knit relationships is carried over to the practice of *bayanihan* which helps nonetheless, in building resilience at the dwelling and community levels. Finally, the local services delivery findings show that most basic services are lacking typical of informal settlements, with only the public facility readily available to the community which could better serve Sitio Gulayan, if direct access can be provided.

With the results and findings presented in this chapter, their relevance to the study will be discussed next to interpret their meaning that would address the central research question and sub-questions. These will be presented in the final ensuing chapter 8, *Discussion and conclusion*, together with the recommendations and proposals leading to the future directions of the study.

8 Chapter 8 Discussion and conclusion

The findings and results in the previous chapter, will be drawn together in this final chapter by reflecting on their meanings and significance. The main section, 'Discussions', will reflect on the headline messages from the 'Results and study findings' chapter, linking them back to the 'Literature review' and 'Conceptual model' chapters, to highlight where the findings either align or come into conflict with the prevailing body of knowledge. The study's recommendation and reflection on future research directions will be presented next, drawn from the limitations of the study. The chapter will then conclude with the practical and theoretical contributions, discussing how they can change the prevailing knowledge and thinking on informal settlements.

8.1 Introduction

In concluding this study, the answer to the central research question and sub-questions articulated at the outset will be discussed. The different elements and constructs in the adapted conceptual model will be brought together to answer the questions, by discussing the overall set of observations analysed over time, leading to the results and interpretations in this study. The discussion will reflect back on the published literature reviewed and cited, to bring out and underscore the findings in the study that concur, differ, or conflict with those from the literature.

The flood history and projections based on the survey results and hazard maps presented in chapter 5, *Study area*, will be discussed as well, to establish scenarios relative to the future flood levels, on which the postulated transitional settlement development for Sitio Gulayan community would be deemed viable. The two extreme flood events used as reference in the study, together with the projections on the various return periods as presented in chapter 2, *Literature review*, will also be considered for future flood level estimation. These will all be brought together and presented in the succeeding sections to conclude the study.

8.2 Discussions

This section will present the interpretations on the results and findings, firstly on the conceptual model applied in the study, by discussing each of the key elements that informed and guided the research. The findings will be related with the previous studies conducted, validating the study's findings that are in concurrence, and explaining the study's position on results in conflict with the published findings. The viability of the transitional settlement development for the community, will be presented next in relation to the prevailing and future flood hazards. This will be ensued by the discussion on the flood projections derived from the referenced flood events and flood hazard map data. The section will conclude by answering the research sub-questions and central question.

8.2.1 Conceptual model key elements

The key elements and constructs in the adapted conceptual model, to study the urban form and architecture of informal settlements will be revisited in this section to interpret the findings as

discussed in the previous chapter. The characteristics under each of the key elements of context, settlement, house, dwellers, and process, will be discussed simultaneously in the succeeding sub-sections,

Context

The findings on the context of the informal settlement of Sitio Gulayan, confirms its framing in the published literature in two different ways - "emancipatory" frame, and as a product of over-urbanisation, inequality, poverty, exclusion, and vulnerability to disasters. The first frame refers to informal settlements as "…a spatial manifestation of autonomy and entrepreneurship […] hence, "…can foster social mobility and serve as fertile ground for bottom-up democratic practices and political participation" (Pojani, 2018, p. 296).

The results in this study show that autonomy has been the status quo in the community from the start, which continued on despite government intervention in implementing the housing programme. The programme has in fact, been contributory with the community becoming a private entity represented by the homeowners' association, that has gained control independent of the local government. There is still no clear-cut direction towards the formalisation of the community, nor any upgrading plans to improve the living conditions of the settlers because of this self-governing status.

Entrepreneurship as part of the first frame correspondingly, is very much present and thriving in the community. With low-wage paying jobs commonly landed by the settlers and the high unemployment rate in the community, the settlers' resort to setting up small enterprises in the comforts of their home. The ever-present *sari-sari* (variety) store for instance, is a favourite go-to business venture with its small capital requirement, and the ever-growing market within the confines of the community. The autonomy and enterprise allowed the community to develop into a microcosm of the city which validates the argument of Berenstein-Jacques (2001), that informal settlements promote the creation of cities which represent various human societies.

The second framing which could be considered as the negative effects of informality, is similarly validated by the findings in the study. Sitio Gulayan community is indeed a product of over urbanisation that resulted to poverty, inequality, exclusion and vulnerability. The mere contrast between the authorised number of households in the proposed CMP development plan, and the actual number of inhabitants, demonstrates these adverse effects of informality in the community.

Poverty for one, is incontestable with the majority of houses belonging to the typologies of makeshift or wood houses. The lack of basic services also attests to the inherent poverty in the community where the majority rely on informal means of accessing utilities. Inequality can be seen from the *laissez-faire* attitude of the local government towards the community as claimed

by the homeowners' association, whilst exclusion is discernible with the boundaries that separate the Justice Compound and coincidentally, obscure the community.

Collectively, these effects ultimately resulted to the community's vulnerability to disasters, albeit not entirely to be considered an adverse effect. As an effect of informality, vulnerability developed the coping capacity of the community enabling the settlers to bounce back from flood disasters. A third framing as conjectured in section 3.2.1, *Context*, in chapter 3 can thus, be included as "resilience" frame. The findings in the study confirm that, whist informality can contribute to vulnerability, it can also be an enabler in countering vulnerability through resilience building.

The dwellers have learned to adapt with meagre resources, rebuilding better and more rigid structures against similar future flood disasters. Aligned with the argument of Zevenbergen et al. (2010, p.156), that a resilience-focused approach to flood risks is underpinned by anticipation and precaution, the findings also agree with Folke's (2006) argument on disturbances, having the potential to create opportunity for doing new things, for innovation, and for development. This potential could be directed towards the development of Sitio Gulayan community into a transitional settlement.

The opportunity to create new things would be the technical adaptation effected by the dwellers themselves, particularly those belonging to the two-storey wood, concrete block and concrete house typologies. The local knowledge from those who have already adapted, can be applied by the rest belonging to the one-storey wood and makeshift house types to mitigate flood hazards. The opportunity for innovation finally, would be the mode and strategy in the delivery of basic services, specifically those that are most lacking - sanitation and solid waste management. The actualisation of these opportunities will be further discussed in the succeeding sections.

Settlement

The findings on the urban form of the settlement confirm the study's postulation that informal settlements have become a permanent fixture in urbanism. Confirming Olthuis, et al. (2015) and Pojani's (2018) conclusions of informal settlements as a permanent feature in the urban landscape and part of the housing supply on the one hand, the findings are in opposition on the other hand, with the claims as observed by Olthuis, et al. (2015) in their study. Their study found out that there is a perception of temporariness in these settlements which prohibits upgrading due to the low incentive to invest in their improvement. In contrast, Sitio Gulayan community as an informal settlement, has been in existence for at least 30 years, based on the length of residency by the participants in the study.

With the housing programme in an impasse, and notwithstanding other challenges such as unavailability of land for relocation, and the immanent issues in resettlement programmes, the

prospects of formalisation remain bleak. Houses in the community are also being converted to more permanent typologies, for owners who have found the means to improve their living conditions. The common aspiration is to rebuild using concrete and provide an upper floor as refuge area in times of flooding. This concurs with the findings in the study of Liao et al. (2016) on the principle of "living with floods", where the ground area is allowed to be inundated during the flooding season with the upper floor as the main habitable area.

In addition, the social climate in the community has been an incentive for the residents to stay put. Instead of moving out to a more secured formal settlement, most of the participants from the results of the study, would opt to stay in the community. The findings indicate that the customs and traditions inherent in the community, create the sense of belonging that provides the impetus for the settlement's permanence.

The size and location of Sitio Gulayan, falling under the medium-sized class and danger area respectively, further correspond with the observations from UN-Habitat (2003), that this type of settlement is effective in resisting demolition or relocation. With their formed cohesiveness that supports leadership through their voting power, political support is thereby, gained. Its location meanwhile, agrees with the findings of Davis (2006) and Satterthwaite (2020), that hazardous locations being unattractive to developers, provide some security against eviction.

The results on the layout and density, similarly match the findings of Fernandez (2011) and Dovey (2017), on irregularly shaped settlements on flat lands. The corridors in Sitio Gulayan are determined by its site features for the access needs of the settlers, forming a winding and tangled layout that is impervious to non-residents. Its high-density on the other hand, make the community car-free and walkable and with its close proximity to factories, markets, and other livelihood sources, it has indeed a very high population density with houses often accommodating five or more residents.

In terms of land use, Sitio Gulayan started out as mainly residential which has evolved into a mixed-use development with the commercial, institutional, and recreational areas being added eventually. The existing condition aligns with the findings of Matos (1977) as cited by Fernandez (2011), that this formation demonstrates the skill and creativity of the settlers in terms of land appropriation. The main commercial area in the community for instance, is located along the main entrance where the stalls are lined-up along the road, attracting not only the residents, but the neighbouring communities as well.

Institutional areas would comprise of the places of worship catering to various denominations, and the day-care centres found inside the community. The recreational area would be the lone basketball court which serves as the public space, plaza, and as the main refuge area of the settlement. In addition, any available open space is regarded as public space, utilised as congregation areas for the adults and play areas for the children. The concrete dike serves this

purpose where balconies of houses can be found extended towards the dike, whilst children commonly make use of the dike as play area.

The image and identity of Sitio Gulayan community similarly, is perceived as a visual and social pollution in concurrence with the findings of other scholars (Kellett and Napier, 1995; Lico, 2008; Kellett, 2011; Dovey and King, 2011). Being linked to poverty, crime, and corruption, the wall that separates the Justice Compound and hides the community, may not at all be coincidental. Aside from obscuring the apparent visual pollution, it also serves as protection that secures the government property and its users, from the dwellers possibly engaged in criminal activities.

The perceived identity is equally distorted, focusing on visual appearances independently of socio-economic structures and conditions, which corresponds with Kellett's (2011) argument. In visiting the settlement and interacting with the residents for this study, the negative perception does not entirely apply to Sitio Gulayan community. From the inside, it is noticeable that the dwellers strive to improve their surroundings to make it as orderly as possible. With the exception of rubbish that is commonly found in vacant lots, the corridors and other open spaces are well kept and uncluttered.

The findings on the image and identity of Sitio Gulayan, coincide with the argument of Lynch (1960), that through long familiarity, the perception start to gain identity and organisation, providing coherence of the image. Comparably, the findings on basic services agree with the published studies in terms of their non-delivery and insufficiency. UN-Habitat (2017) for one, validly and rightfully included the lack of basic services in the distinct characteristics of informal settlements. The findings further align with that of Avis's (2006), that the insufficiency of basic services hinder the dwellers' efforts to overcome vulnerability, with their resources and time spent looking for alternative means at higher cost and of substandard quality.

Finally, the interrelatedness of basic services with land security as observed by See and Porio (2015), holds partly true for the community wherein those without land security, tend to have inadequate access to basic services and even lack access to disaster information and recovery aid. From the interview results, majority of the participants are indeed not privy to the disaster preparedness programme of the government. In terms of aid, however, the local government efficiently responds to the needs of the settlers as attested by the participants.

The results as presented in this section, discussing each of the characteristics under the key element of *Settlement*, largely indicate congruency with the published studies. This confirms that the key element is a vital component in the framework, which has been useful in guiding the research relative to previous studies in investigating the urban form of informal settlements. The findings on the dwellings that collectively make up the settlement, will be interpreted and presented in the next section.

House

The study's focus of interest as earlier articulated, is in the urban form and architecture of informal settlements. After discussing the findings on the urban form of Sitio Gulayan above, the findings on the architecture component will be presented in this section. The houses in the community, both correspond and contradict with the findings made in the previous studies in terms of the architecture.

The agreement lies firstly, in the vernacular mode that symbolises indigenous or traditional architecture related to its context, as strongly influenced by the geographic features and cultural aspects of its surroundings. This description in the findings of Lico (2008) and Ghisleni (2020), can be observed in most makeshift and wood houses in the settlement. Secondly, the transition of these houses is also very much present in the community, from temporary (makeshift) to semi-permanent (wood), and to permanent (concrete block and concrete), similarly observed in the previous studies (UN-Habitat, 2003; Roy, 2005; Lico, 2008).

The contradiction on the other hand, is the common observation of poverty to a great extent in these settlements, that is reflected in the houses. Conversely, the findings in this study show that there are some houses that would not fit the observation. As reported, majority of the houses belong to either the makeshift or wood types, but there are houses permanently built using concrete, particularly those along the main entrance near the major road.

There are also three-storey houses with roof decks, which even in a middle-class formal settlement in the locality, is rarely seen. Interestingly and as previously mentioned, most of these concrete houses are not plastered nor ornamented, seemingly to remain inconspicuous and in keeping with the surroundings. To an observer, the informality becomes preserved in this manner which could symbolise equality amongst the dwellers, whether one has moved out of poverty, or is still struggling.

In addition to symbolism, the makeshift house type as derivative of traditional architecture, corresponds as well with the findings of Lico (2008) on the type as the degraded mode of vernacular architecture in the form of the reinvented "shanty". The mode similarly corresponds with its hands-on incremental building process, using available materials found in the vicinity. The technology is also an off-shoot of the domestic vernacular architecture that is elevated on stilts, with flexible layout to accommodate changes. The study's findings on the dwellers and builders of these houses will be discussed in the next section.

Dwellers

From previous studies, the origins of the dwellers of most informal settlements in the Global South are typically rural to urban, or urban to urban (Chen, 2012; Lico, 2008). The "informal sector" which was coined in 1971 as earlier discussed, actually referred to the migrants from Northern Ghana to the city of Accra. Similar to the case of Sitio Gulayan community, migrants

from the rural areas flocked to the city, filling the demand for workers in the industrialising town then. With most of the factories still in operation and new ones continually being added, the migration continues on.

The original dwellers, however, contrary to the observation of Dovey and King (2011), have little or no economic connection at all to the river alongside their settlement. The findings show the pioneers as vegetable farmers, who may have just used the river for crop irrigation. The current dwellers on the other hand, similar to most studies are employed in the city mostly in low-paying jobs serving the formal communities as hired hands, factory workers, construction staff, or vendors.

Both the conditions of existence and place attachment in Sitio Gulayan community as features of the *Dwellers* key element, align with the findings from the other studies (Kellett and Napier, 1995; Pojani, 2018). The cultural conditions hugely influence the flexible design and layout of the dwellings, when extended family members either move in or out of the house. Rooms or spaces can be deftly added to accommodate, or converted to other functions when freed up or made available for use. Place attachment, similar to the findings of Anacio et al. (2016), allows and motivates the residents to stay in their flood-prone community and adapt to the flood hazards.

Finally, the findings on the dwellers on their innovativeness and resourcefulness in building their houses using materials in their immediate environs, agree with the published studies (Lico, 2008; Jakab et al., 2014; Kamalipour and Dovey, 2020). With no blueprints to follow and standard building materials available, the spatial logic and design ingenuity are demonstrated by the builder/dweller in engaging with the architecture of informality (Dovey, 2013). The findings on the steps taken to produce this key element, together with the previously presented, will be discussed in the final key element below.

Process

The emergence of settlements in risk areas like Sitio Gulayan, as discussed in the *Context* section above, is brought forth by the unbuildable land that does not appeal to the developers. Despite the risks involved both environmentally and legally, the settlers take their chances, typical to the findings of the studies cited, in exchange for affordability, social networks, and proximity to place of work. The consolidation likewise, starting off as mainly residential and evolving into a mixed-used development as the population grows, is similar to most unauthorised settlements here and in other regions.

In terms of gentrification, the findings in Sitio Gulayan indicate that only a small portion of the land along the basketball court, has slightly changed the character of the community with the presence of a multi-storey and two-storey apartment buildings in the area. With the limited space, however, the possibility of attracting new businesses with the relatively wealthier residents as either the investor or the target market, remains inauspicious.

Lastly, redevelopment of risk area settlements particularly in the local context, is unlikely the approach taken by the authorities considering the complexities of temporary relocation prior to redevelopment. In the case of Sitio Gulayan community technically becoming a private entity, redevelopment can only take place when the majority of the HoA members are able to pay up their dues, which has been the issue since the inception of the housing programme in 1992. The chances, therefore, for the community to be finally redeveloped and formalised, similarly remains unfavourable.

This main section discussed the findings in this study and their interpretation relative to the results of the cited published literature. The concurrence and differences were presented with the overall findings, mostly in agreement with the other studies. With the results in the application of the conceptual model key elements presented, the next section will discuss the viability in applying transitional settlement development in Sitio Gulayan community.

8.2.2 Transitional settlement development

The feasibility of applying the concept of transitional settlement to the community, as an alternative approach to redevelopment or resettlement will be discussed in this section. The findings on the urban form and architecture of Sitio Gulayan community discussed above in relation to transitional settlements, will be presented to establish the extent on which the concept can, or cannot be applied. The ten principles in the UN guidelines which "…cover coordination and strategic planning and implementation relevant to transitional settlement and reconstruction", will serve as the foundation in establishing the concept's applicability in the study (Corsellis and Vitale, 2008, p. 5).

Incidentally, it is noteworthy that the UN principles were originally formulated for post-disaster events, which will be applied in this study in the context of the current state of the community, or prior to any flood disaster events occurring. The application, hence, will vary in consideration of the different context involved in the study. The immediate assistance and support coming from international stakeholders as a standard procedure in response to a flood disaster for instance, will not apply in this study.

Out of the ten principles, the findings in the study indicate that only one is inapplicable to the current state of the community which is, "…to ensure rights and secure tenure for all those affected" (Corsellis and Vitale, 2008, p. 5). However, without any definitive answer on the tenure security even for the legitimate lot owners, particularly those with delinquent accounts, the principle's actualisation is beyond the scope of the study. This limitation nonetheless, could be an interesting subject worth recommending for future studies to build on.

The findings in the study meanwhile, show that the other principles are achievable as follows: 1) support the affected community; 2) coordinate and promote a strategy for response; 3) maintain continuous assessment of risk, damage, needs and resources; 4) avoid relocation or

resettlement unless it is essential for reasons of safety; 5) minimise duration and distance, when displacement is essential; 6) support settlement and reconstruction for all those affected; 7) support the affected population in making informed choices; 8) ensure that vulnerability to disaster is not rebuilt; and, 9) undertake contingency planning (Corsellis and Vitale, 2008).

The first principle (*support the affected community*) based on the findings, can be achieved with the local government being responsive to the recovery needs of the dwellers. The focus will be on the dwellings that have not technically adapted yet from the recent flood disaster and, therefore, can be considered as still undergoing the recovery period. Support coming from the residents themselves, is also encouraging with the culture of "bayanihan" entrenched in the community.

Whilst there are disagreements between the local officials and the homeowners' association, the findings also show that both entities can work together, particularly in response to disasters. The second principle (*coordinate and promote a strategy for response*), hence, can be applied in terms of the coordination between the local government and homeowners' association, participated in by the affected dwellers in developing strategies on the potential and anticipated responses necessary for a resilience-based approach to flood risks.

With the community's long-standing experience with flooding, the third principle (*maintain continuous assessment of risk, damage, needs and resources*) similar to the first, can be based on previous flood events and local knowledge gained, again from the 30-year inhabitancy for the majority of the respondents. UN notes that the strategy for response in the second principle, should be reviewed and updated according to the results obtained from this on-going process of assessment. Regular coordination, therefore, is imperative in the successful application of the principle.

The position taken by this study as posited in chapter 2, section 2.6.1, is incremental upgrading for Sitio Gulayan community, but with considerations on risk mitigation. This argument can be based on the fourth principle (*avoid relocation or resettlement unless it is essential for reasons of safety*) and in keeping with safety, the findings show that the dwellings encroaching the 3.0-metre river easement or 'no-build zone', should be relocated. The relocation site is preferentially specified in the fifth principle (*minimise duration and distance, when displacement is essential*), and based on the findings, the available vacant lots within the community could potentially be used for this purpose.

Closely linked to the fifth is the sixth principle (*support settlement and reconstruction for all those affected*), wherein 'those affected' referring to both legitimate and unauthorised lot owners, particularly those who have been displaced, should be supported in the process of relocating and rebuilding. According to Sphere Association (2018, p. 267) in their guidance notes to tenure, "People living in informal settlements, who are often internally displaced, may not possess a legal right to occupy the land but still possess the right to adequate housing and

protection against forced eviction from their home". The support that should come from the local government and homeowners' association in accord with the seventh principle (*support the affected population in making informed choices*), should include the presentation of available options to enable those affected, to make their choices based on informed decisions.

Considering the disaster risk reduction (DRR) programmes being implemented by the local government, the eighth principle (*ensure that vulnerability to disaster is not rebuilt*) can be achieved by including these programmes in the development process. This should complement the technical adaptation measures applied in the dwellings to enable resilience building against the worst flood disaster experienced, either with 'Ondoy' or 'Habagat'. Closely related to this is the last principle (*undertake contingency planning*), which according to UN (Corsellis and Vitale, 2008, p. i), "…must be developed and/or previously existing plans updated in light of experience gained". Similar to most principles discussed, close coordination by all actors, is imperative in the contingency planning as the final stage in the transitional settlement development.

In terms of transitional shelters described by IFRC (2013) as being made from materials that can be upgraded or re-used in more permanent structures or can be relocated, the description fits closely the dwellings observed in the community. The majority as Types 1 and 2 makeshift dwellings and Types 3 and 4 wood dwellings, are comparable to transitional shelters. These types also fit the transitional shelter characteristics identified by Shelter Centre reiterated here as: 1) upgraded into part of a permanent house; 2) reused for another purpose; 3) relocated from a temporary site to a permanent location; 4) resold, to generate income to aid with recovery; and, 5) recycled for reconstruction.

In the first characteristic, both shelters are built initially as temporary with the end goal of building with standard materials as a permanent dwelling. Aside from its main function of habitation, most spaces in the informal dwellings also serve as commercial spaces for additional or as main source of income which fits the second feature. For the third feature, transitional shelters are temporarily built either on-site or near-site after the devastation, and moved to its original location or in a more secured permanent location. Similarly, informal shelters particularly those on high-risk areas, can be relocated to permanent sites. In terms of reselling the building materials to aid with recovery, the process is similar in informal settlements where the materials are constantly being upgraded in building resilience. Finally, these materials are often recycled and used for reconstruction in the upgrading process similar to transitional shelters.

The striking similarities between the informal and transitional shelters can be attributed mainly to the incremental or step-by-step process involved in the construction or reconstruction, with the meagre resources available in rebuilding in the case of transitional shelters, and upgrading or both in the case of informal dwellings. Both activities are also often undertaken by the affected settlers and as described by IFRC (2013), should be provided with support for

resourcefulness and self-management. USAID (2017) correspondingly describes its transitional shelter approach as the provision of inputs which include salvaged materials, technical advice, and oversight necessary in shelter construction.

With regard to implementation, the shelter and settlement standards from Sphere Association (2018), will be presented to discuss how the community's development to a transitional settlement may be implemented following the standards. The seven standards are: 1) planning; 2) location and settlement planning; 3) living space; 4) household items; 5) technical assistance; 6) security of tenure; and, 7) environmental sustainability.

Although these standards are formulated for post-crisis scenarios, the Sphere minimum standards include non-displaced population informally occupying accommodation or land, which directly applies to Sitio Gulayan community. Planning as the first standard for example, requires the understanding of both the pre- and post-crisis context to allow the assessment of the direct and indirect impact of the crisis on the living conditions, including any social, economic and political repercussions.

Except for the *household items* standard, which refer to damaged or lost items essential for domestic activities, all the other standards will be considered in this study including the standards for *security of tenure*. Although not included in the principles discussed earlier, the minimum standards and guidance in dealing with land tenure, may provide alternative responses to insecurity issues. For ease of reference, the description of each standard and its application to the case study will be discussed, whilst the relevant key actions, key indicators, and guidance notes from the Sphere standards applicable to the community will be presented in tabulated form (tables 30a to 30f).

Planning

The planning standard specifies that shelter and settlement interventions should contribute to the safety and well-being of affected people, and promote recovery from crisis. It should thus, be well planned and coordinated, by identifying the needs to develop appropriate options for response. In the case of Sitio Gulayan community, the development to a transitional settlement should first identify the availability of habitable land for the permanent relocation of the dwellings along the river easement, and those located on areas for infrastructure development. The adjacent unoccupied lots as discussed earlier would be ideal for minimum disturbance.

The first standard works in conjunction with the second, *location and settlement,* in terms of planning for both the temporary relocation site and the final site development. Without the site development plan, the areas to be vacated cannot be determined including the number of households to be relocated. The households from the river easement as discussed previously, should be accommodated within the settlement as much as the available habitable area in the

site would allow. The key actions for this preliminary planning stage are presented in the table below, including the key indicators and notes on guidance as suggested by Sphere Association.

Table 30a. Shelter and settlement planning standards (adopted from Sphere Association, 2018).

Key actions	Key indicators	Guidance notes
• Work with the affected population as well as national and local authorities to assess the shelter and settlement needs and capacities. • Work with stakeholders to identify the most effective and appropriate assistance options and how to provide these. • Develop a shelter and settlement plan in coordination with relevant authorities and the affected communities.	• The shelter and settlement plan provides for the essential needs of the target population and is agreed with the population and relevant authorities. • Percentage of affected people indicating that shelter and settlement assistance reflects their needs and priorities and contributes to a more durable solution.	• Consider the direct and indirect impact of the crisis on people's living conditions, including social, economic and political consequences. • As well as having immediate needs for shelter, displaced people also require specific support to make informed decisions about shelter solutions available to them.

The key actions above indicate the significance of working with all the stakeholders which will help develop an effective plan appropriate for the community. The key indicators on the other hand, serve as a list of targeted results that will justify the success of the actions taken, and the guidance notes are the steps to be taken to achieve the results.

Location and settlement planning

The standard requires the dwellings and settlement to be located in a safe and secure area with adequate space and access to basic services and livelihood, including opportunities to connect to a broader network. Again, relocating those along the river easement and providing hard or soft flood protection measures on the vacated area, would enable the community to be safer from flood hazards. The proposition of providing a road from end to end along the vacated river easement of the settlement as earlier discussed, could serve as the connection to a broader network. The settlement planning should likewise consider the provision of basic services and the reintegration of livelihood sources that will be affected by the transitional settlement development.

A site development plan crafted by the stakeholders in coordination with the authorities can then be approved for implementation as agreed by all concerned. With the limited space to work on, the implementation could be conducted incrementally through reblocking, by subdividing the site into zones where road networks, pathways, utilities, and public facilities will be laid out first per zone, before finally reconstructing the dwellings. Table 30b shows the key actions, indicators, and guidance notes to execute the location and settlement plan. The actions similar to the previous, underscore the importance of working with all the stakeholders in planning and efficient space allocation. The key indicators make use of percentages as the metric for

measuring the success of the actions. Notable in the guidance notes is the participation of the community as a key component in planning.

Table 30b. Shelter and settlement location and settlement planning standards (adopted from Sphere Association, 2018).

Key actions	Key indicators	Guidance notes
• Work within existing planning processes and regulations and agree terms with the community and relevant authorities. • Involve diverse stakeholders, including groups within the affected population, in site selection and settlement planning. • Ensure the affected population has access to essential services and facilities, including livelihoods opportunities. • Plan the use of land to provide sufficient space for all functions, accessibility to all shelters and services, and adequate safety measures throughout the settlement. • Include rainfall or floodwater drainage planning in site selection and settlement development.	• Percentage of shelters and/or settlement sites that are located in areas with no or minimal known natural or man-made threats, risks and hazards • Percentage of shelters and/or settlement sites that have safe access to essential services within an acceptable amount of time or distance • Percentage of those receiving settlement assistance who feel safe about the location of their shelter or settlement • Percentage of settlement sites that offer sufficient usable surface area to carry out private and public outdoor activities appropriate to the context	• Advocate for risk-informed planning and appropriate assistance options. A "no-build zone" does not mean a "no-assistance zone", and should not delay shelter or settlement responses. • Settlement planning should support existing social networks, allow opportunities for new networks to form, contribute to safety and security, and enable self-management by the affected people. • Consider pre-disaster economic activities and potential livelihoods opportunities in the post-disaster context. • Key components of a plan include community participation, establishing user groups, defining roles and responsibilities, and having a cost recovery or cost sharing plan.

Living space

Similar to the second standard, shelter and settlement requires a safe and adequate living space that will enable performing household and livelihood activities with dignity. This can be accomplished with the provision of spaces for the fundamental activities such as eating, sleeping, washing, studying/working, which offer security, privacy and consider local culture. The basic requirements for ventilation, lighting, and protection from the elements with proper roofing, walls, and openings should be key considerations.

Adequate living space means minimum living space provision per person at 3.5 square metres and between 4.5 to 5.5 square metres including spaces for cooking, bathing including sanitation facilities. In hot climates, floor to ceiling height should be at 2.6 metres. Provisions for water and food storage, food preparation, and protection for household valuables should also be considered with the plans in accordance with the cultural norms and practices. The key indicators in the table 3c below indicate that a relatively high percentage of the settlers with

adequate living space, that are culturally acceptable and built in the agreed technical and cultural standards, would determine the appropriateness and effectivity of the key actions. The guidance notes reiterate the requisites to enable delivery of the standard living space.

Table 30c. Shelter and settlement living space standards (adopted from Sphere Association, 2018)**.**

Key actions	Key indicators	Guidance notes
• Ensure that each affected household has adequate living space to perform basic domestic activities. • Ensure that the space immediately surrounding the living space supports safe access to fundamental activities. • Promote the use of shelter solutions, construction techniques and materials that are culturally and socially acceptable and environmentally sustainable.	• Percentage of the affected population who have adequate living space in and immediately around their shelters to carry out daily activities. Minimum 3.5 square metres of living space per person, excluding cooking space, bathing area and sanitation facility. • Percentage of shelters that meet agreed technical and performance standards and are culturally acceptable. • Percentage of people receiving shelter assistance that feel safe in their shelter.	• Living space should be adequate for daily activities such as sleeping, preparing and eating food, washing, dressing, storing food and water, and protecting household possessions and other key assets. • Carefully consider the potential consequences of adopting the minimum calculated space (3.5 square metres per person. • Respect existing practices and customs and how these affect the need for internal subdivisions (curtains, walls). For example, design the dwelling to accommodate sleeping arrangements for extended family members or different families within the same household. • In warm, humid climates, design and orient shelters to maximise ventilation and minimise entry of direct sunlight. A higher ceiling helps air circulation.

Technical assistance

Related to all the standards, technical assistance according to Sphere Association (2018, p. 262), "…is an integral part of shelter and settlement responses", […] and, "supports the self-recovery of the affected people and improves the quality and safety of their shelter and settlement". Particularly important in post-event responses, technical assistance should be accessed in a timely manner. In the case of Sitio Gulayan community, technical assistance is similarly required in every development stage, albeit not as immediate compared to emergency responses.

Technical assistance required in the community could come from building professionals (architects, engineers, urban designers, environmental planners, contractors), local government, NGOs, skilled labour, legal experts, and emergency service providers. These

experts should work closely with the settlers offering training programmes to engage them in the community development that could also provide them with livelihood opportunities.

Table 30d. Shelter and settlement technical assistance standards (adopted from Sphere Association, 2018)**.**

Key actions	Key indicators	Guidance notes
• Understand the pre-crisis planning and building practices, available materials, expertise and capacities. • Involve and support the affected people, local government and local professionals in the building process. • Promote safer building practices to meet current shelter needs and reduce future risks. • Ensure that people have access to adequate technical assistance. • Establish appropriate project management of materials, finance, labour, technical assistance and processes for regulatory approval requirements to ensure quality outcomes.	• Percentage of programmes where local authorities are involved in defining construction standards and in the monitoring of construction activities. • Percentage of construction activities that demonstrate active involvement of the affected population. • Percentage of shelter units that are constructed, repaired, retrofitted, upgraded or maintained according to the agreed safe building practices for the specific context and hazards. • Percentage of households that report having received appropriate technical assistance and guidance.	• Participation in shelter and construction activities should be compatible with existing local practices. • Being part of a construction project can provide young people with valuable skills, confidence, self-esteem and connectedness to the community. • Provide advice on issues such as site and spatial planning, local construction techniques, damage assessment, demolition and debris removal, construction, site management, assessment of existing building stock and security of tenure. • Find out whether local or national building codes are usually followed or enforced. Where there are no existing standards, establish Minimum Standards in collaboration with the local authorities and relevant stakeholders (including, where possible, the affected people) to ensure they meet safety and performance requirements. • Increase community capacity by contributing to training and awareness-raising among the affected populations, local authorities, local building professionals, skilled and unskilled labour, landlords, legal experts and local partners.

The guidance notes above again, indicate the importance of participation by the community in the development which is considered as one of the key indicators in the standard. The participation according to Shelter Association, (2018, p. 266), would "…enable households to maintain, adapt or upgrade the shelter to meet their longer-term needs". Another important

indicator is the participation of the local authorities which translates to the number of households who will receive technical assistance.

Security of tenure

The Sphere standards make it clear in its description of security of tenure for the affected population even in informal settlements, to be able to live in their homes without fear of forced eviction. Thus, it does not discriminate between owners or non-owners of land in terms of providing assistance. It is advised, however, to work with local authorities to understand the regulations that will be or will not be enforced, and with legal professionals to understand how tenure relations and disputes are managed and resolved.

In the case of Sitio Gulayan community, the majority of the households are tenure-insecure, starting with those encroaching the river easement, non-owners of lots, and those who have defaulted on their loans. As an indication of vulnerability, these residents should be provided with assistance that will "…address complex tenure situations and consider incremental tenure approaches for renters, informal settlers, squatters and others" (Sphere Association, 2018, p. 268). The actions to achieve this is shown in the table below with the indicators and guidance notes on how it could be achieved.

Table 30e. Shelter and settlement security of tenure standards (adopted from Sphere Association, 2018)**.**

Key actions	Key indicators	Guidance notes
• Undertake due diligence in programme design and implementation. • Understand the legal framework and the reality on the ground. • Understand how tenure systems, arrangements and practices affect security of tenure for at-risk groups. • Implement shelter and settlement programmes to support security of tenure. • Support protection from forced eviction.	• Percentage of shelter recipients that have security of tenure for their shelter and settlement option at least for the duration of a particular assistance programme. • Percentage of shelter recipients that have an appropriate agreement for security of tenure for their shelter option. • Percentage of shelter recipients with tenure challenges that have accessed, independently or through referral, legal services and/or dispute resolution mechanisms.	• Information such as tenure documentation and organisational use of due diligence methods are required in order to determine if an appropriate security of tenure is in place. • It is important to understand how tenure relations, including dispute resolution mechanisms, are managed and practised All people, including women, should possess a degree of security of tenure. • Shelter and settlement assistance options for urban areas should address complex tenure situations and consider incremental tenure approaches for renters, informal settlers, squatters and others.

The key actions above will help determine the status of the community association's stake on the land they are occupying, and could provide options for tenure security that will benefit all

concerned given the constraints and complexities. The indicators measuring the success of the actions, consider the assistance provided on dispute resolution, agreement for security of tenure, and those who already have security of tenure at least for the duration of the development programme. Notable in the guidance notes is the inclusion of all affected particularly women, which is equally applicable to Sitio Gulayan community with a number of households headed by women.

Environmental sustainability

In developing the built environment, the assistance programme aims to minimise any negative impacts on the natural environment. The standards call for addressing the environmental issues even in the short term, in order not to worsen the existing problems nor cause new ones. The environmental impacts, risks, and vulnerabilities as a result of the floods for instance, should be assessed according to Sphere Association, to minimise the negative effects of the shelter and settlement options.

One of the negative impacts of the encroachment on the river easement is the degradation of Tullahan River with the riverbank becoming a convenient rubbish area. With debris management and waste reuse or repurposing as part of the environmental sustainability standards, the relocation of the dwellings along the area will be an opportune time to rid the banks of wastes including the debris from disassembling the dwellings that could be reused in rebuilding and relocating.

Table 30f. Shelter and settlement environmental sustainability standards (adopted from Sphere Association, 2018)**.**

Key actions	Key indicators	Guidance notes
• Integrate environmental impact assessment and management in all shelter and settlement planning. • Select the most sustainable materials and techniques among the viable options. • Manage solid waste in a safe, timely, culturally sensitive and environmentally sustainable way in all settlements. • Establish, restore and promote safe, reliable, affordable and environmentally sustainable energy supply systems. • Protect, restore and improve the ecological value of operational sites (such as temporary settlements) during and after use.	• Percentage of shelter and settlement activities that are preceded by an environmental review. • Percentage of shelter constructions using low carbon emission construction materials and procurement methods. • Percentage of solid waste on the site that is reused, re-purposed or recycled. • Percentage of temporary settlement sites that are restored to better environmental conditions than before use.	• Promote the use of multiple sources, the reuse of salvaged materials and the production of alternative materials. • Environmental impact assessments should inform site selection. • Retain trees and other vegetation to stabilise the soil and maximise shade and protection from the climate.

As part of the key actions above, improving the ecological value of Sitio Gulayan community should be considered in the transitional settlement development. With the overcrowding of dwellings, trees and vegetation which could help mitigate flood are sparse. Restoring the site to a better condition with natural resources is one key indicator of an environmentally sustainable community.

Through the application of the principles and guidelines in transitional settlement and shelters vis-a-vis the findings in the study, this section discussed the viability of the transitional settlement as the proposed approach in upgrading Sitio Gulayan community. The viability of the application and implementation of the concept to the community was established in this section by applying the ten principles in the UN guidelines and the six standards from Sphere Association. Given the viability of the development in Sitio Gulayan community, the succeeding paragraphs will provide an understanding on the temporal factor of the development in the community.

As discussed in the previous chapters, the concept of transitional settlement is based on post-disaster events where rebuilding of dwellings and the community at the quickest possible time is the main goal. In this study, the goal is to rebuild with focus on technical adaptation based on historical flood events and the provision of deficient basic services. The time factor therefore, is not as limited or restricted in comparison to the original conceptual context. The development, however, should follow a sequence of activities vital to the completion of the transition which could be structured into three work phases as discussed in the ensuing paragraphs.

Site survey phase (see Appendix C.1 for the existing site development plan)

The first stage in the development process is the surveying of the settlement to identify the following: 1) vacant lots along the periphery as relocation sites; 2) vacant lots and strategic areas within the settlement for infrastructure placement; 3) dwellings to be relocated along the river easement and on identified strategic areas (item 2), and; 4) dwellings for technical adaptation. The infrastructure on the identified vacant lots and strategic areas will include roads, communal septic tanks with toilet and bath facilities, water stations, materials recovery facility (MRF), commercial space, and open space for vegetable farming.

The houses surveyed along the easement and sitting on strategic areas, should be relocated on the identified vacant lots along the periphery of the settlement. Identified dwellings for technical adaptation should consider the adaptation measures during relocation and rebuilding which should commence only after the sites have been identified and the transitional site development plan has been finalised as discussed below.

Site development planning phase (see Appendix C.2 for the site survey plan)

After the site survey phase, the site development planning could commence where the necessary infrastructure and facilities can be designed on the identified vacant lots and

designated areas. The level of service to be designed should be affordable both to the community and the local government as suggested by UN-Habitat (2014). The dwellings to be relocated could then be accommodated on the vacant periphery lots subdivided into aligned residential lots and provided with alleys and pathways. Roads should also be provided inside the settlement to allow for vehicular access connecting the roads of Gov. Pascual Ave. and Sanciangco Street.

Applying the lessons learned by UN-Habitat in in-situ upgrading as discussed in section 2.9, projects designed from the 'bottom-up' should include the participation of dwellers and community organisations. Planning should be headed by the responsible local government department, City Planning and Development Department, in coordination with the Barangay and HoA officials including all concerned stakeholders particularly the dwellers, to allow them to make informed decisions in terms of their dwelling relocation and rebuilding. The City Engineering Department responsible for the flood control and drainage improvement, and the City Environmental and Natural Resources Office (CENRO) handling solid waste management, should also be involved in the design process. Concessionaires and utility providers like MERALCO (power) and MAYNILAD (water) should be included in the planning phase as well, to provide inputs on the new utility line layout and re-layout of existing lines.

Relocation and rebuilding phase (see Appendix C.3 for the conceptual master development plan)

The construction could commence once the site development plan has been approved by the stakeholders and funding has been obtained from various sources initiated by the local government. With the upgrading programme being led by the local authority, the implementation should start at the community level through a set of intermediaries including CBOs, NGO, and other agencies involved (UN-Habitat, 2014). As advised by UN-Habitat, upgrading programmes must be integrated with city level and country policies, programmes and strategies, to achieve synergies with other supporting interventions and for the initiative to be sustainable, upgrading should be undertaken within a framework that is inclusive and responsive to local conditions that involve the dwellers and their representative organisations. A conceptual master development plan of the transitional development of Sitio Gulayan community is included in the Appendix as design guidance.

The findings on the future flood events will be discussed in the next section, to establish the flooding projections in relation to the community's development into a transitional settlement. The overall findings will then be brought together to answer the research questions in the penultimate *Conclusion* section.

8.2.3 Flood Projections

The extreme flood events of TS 'Ondoy' and 'Habagat', together with the projected flood scenarios from the flood hazard maps presented in chapter 2, *Literature review*, and chapter 5, *Study area*, will be discussed in this section. The projections would provide a course of events in relation to the future flood hazards in the community, to further justify its transformation into a transitional settlement. The results would also help establish the extent of technical adaptation necessary, for the effective application of transitional settlement development in Sitio Gulayan community. The findings on TS 'Ondoy' and 'Habagat' will be presented in bar charts from the results of the conducted survey. Starting with the worst flood event, figure 93 below shows that for the majority of the respondents, 'Ondoy' was more serious than 'Habagat' at 64% and 36% respectively.

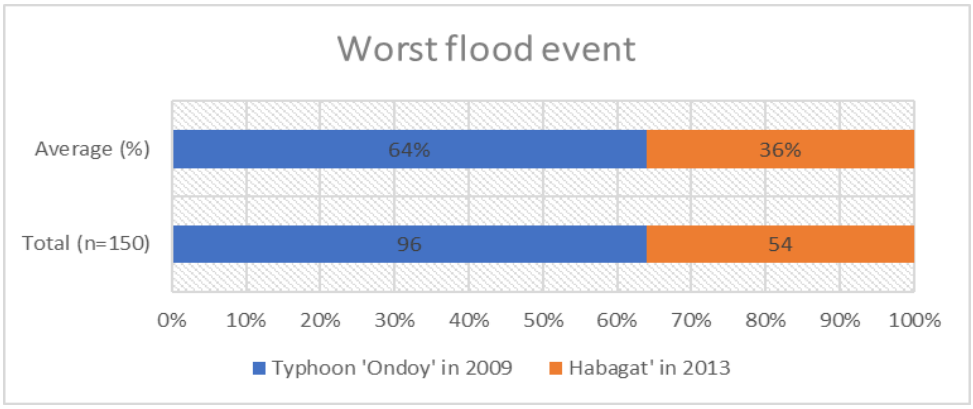


Figure 93. Worst flood event experienced

In terms of the highest flood level from the ground floor, figure 94 indicates that for 'Ondoy' flooding, 25% experienced between 5 to 6 feet (1.50 to 1.80 metres) high flood levels, closely followed by 10 feet (3.00 metres) and above for 36 respondents or 24%.

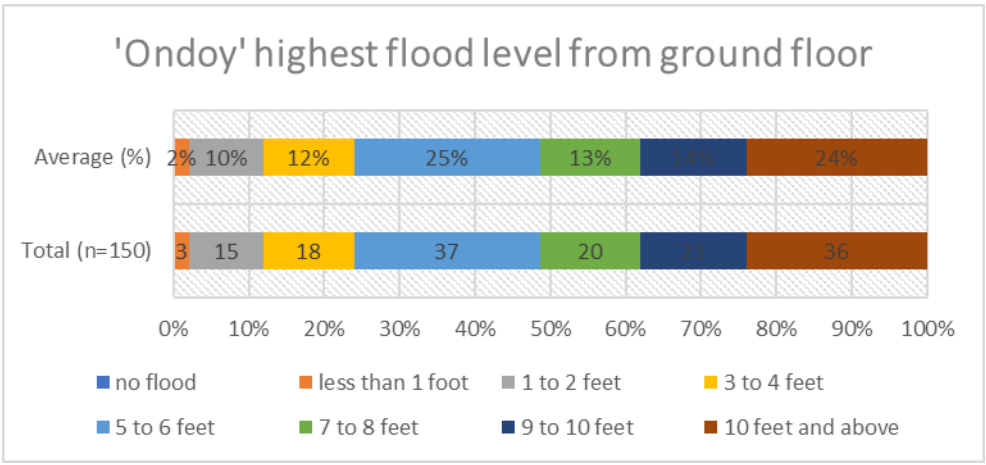


Figure 94. Highest flood level from TS Ondoy

B For 'Habagat', the highest flood level as shown in figure 95 below, was between 5 to 6 feet (1.50 to 1.80 metres) at 25% or 38 respondents, followed by 7 to 8 feet (2.10 to 2.40 metres)

and 1 to 2 feet (0/30 to 0.60 metre), both at 15% or 23 respondents. For the highest level at 10 feet (3.00 metres) and above, 14% or 21 respondents were affected similar to the remaining levels at 9 to 10 feet (2.70 to 3.00 metres) and 3 to 4 feet (0.90 to 1.20 metres).

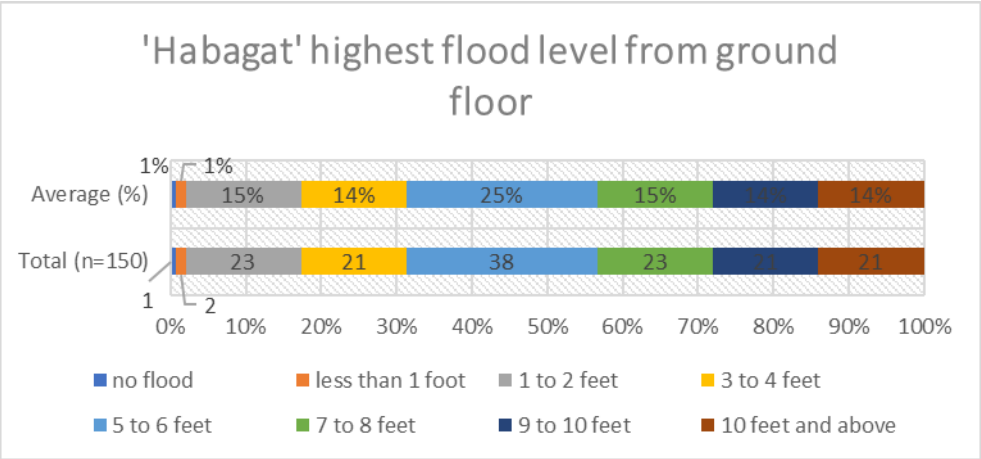


Figure 95. Highest flood level from Habagat

Finally, for the duration in days of the highest flood level for both events, figure 96 below shows that for 'Ondoy', 60 respondents or 40% experienced two days of the highest level before the floodwaters receded. This was followed by 19% or 28 respondents experiencing the highest flooding for 3 days, whilst the longest number of days at 8 days or more, was reported by only 9 respondents. In the case of 'Habagat' as indicated in figure 97, the majority similarly experienced the highest level for two days at 39 respondents or 26%, followed by 3 days for 29 respondents or 19%. The longest number of days, again at 8 days or more, was reported by 16 respondents or 11%.

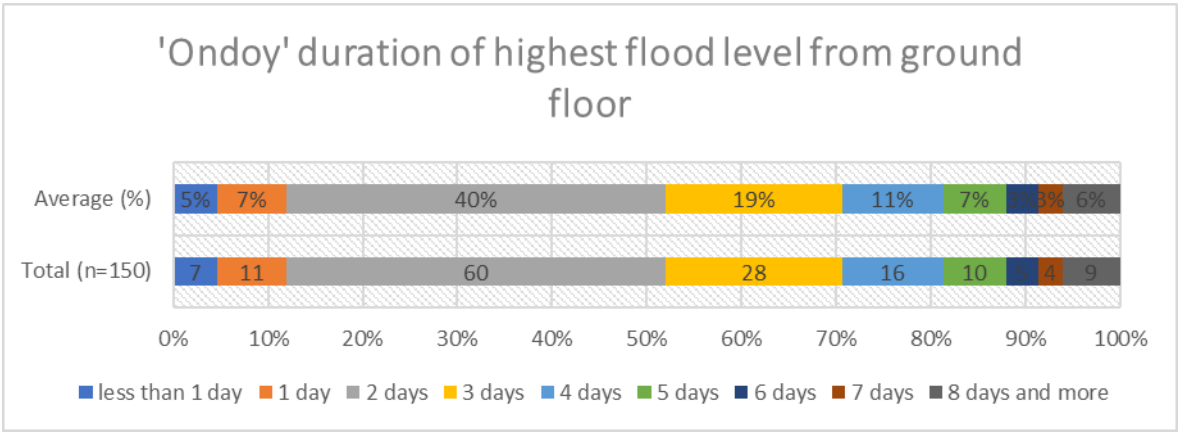


Figure 96. Duration in days of highest flood level from TS Ondoy

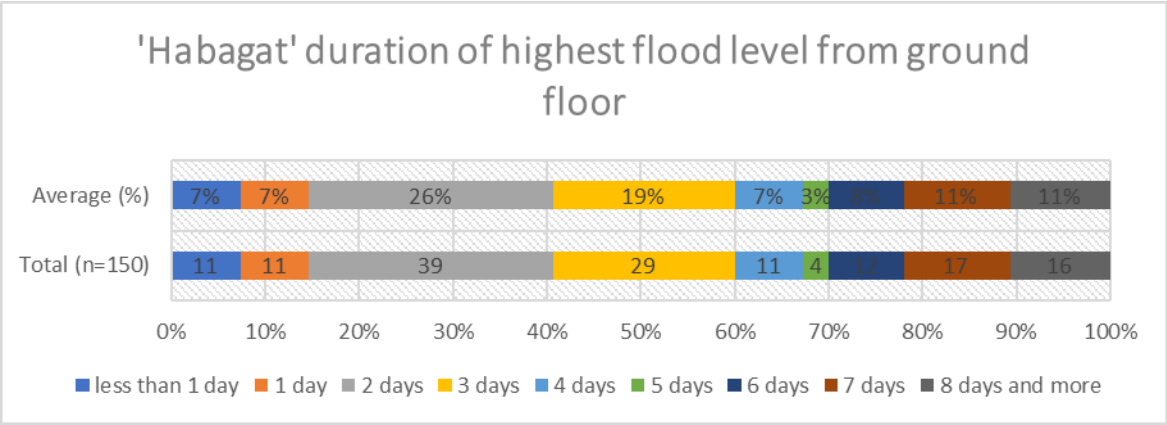


Figure 97. Duration in days of highest flood level from Habagat

From the results above, the highest level of flood for both TS 'Ondoy' and 'Habagat' was at 10 feet (3.00 metres) and the longest duration for the highest level in both events was at 2 days. The same results can be expected to recur in future flood events and should therefore, be considered as one of the bases for the technical adaptation measures to be taken in the community.

Another basis is the data from the reviewed literature on future climates in the country which indicate that the highest projected rainfall amount in 2050 will be at 300mm which is lower than the actual rainfall amount from 'Ondoy' at 455mm. The final basis of the flood projection will be the data provided by the flood hazard maps in various return periods as presented in chapter 5, *Study area*. Starting with the 5-year flood return period for Malabon City, the data indicate that the levels of hazard range from low to medium in most areas, with Sitio Gulayan community generally at medium level. This hazard level means that the community can experience flood levels between 0.5 to 1.50 metres (1-1/2 to 5 feet) with a 20% chance of occurring in a one-year period.

For the 25-year flood return period, the city hazard level range generally is medium to high with areas in the core of the community at high level. These areas will, therefore, experience flood levels beyond 1.50 metres (5 feet) with a 4% chance of occurring in a one-year period. Finally, for the 100-year flood return period, Malabon City's hazard level similarly ranges from medium to high, but with more areas at high level. Sitio Gulayan on the other hand, will generally be at high level or again, beyond 1.50-metre-deep flood level with a 1% chance of occurring in a one-year period.

Comparing the findings both from the survey protocol and flood hazard map data, the more extreme flood level is depicted in the survey results at 3.00-metre high. However, in combining the findings above, the results would indicate that the high flood hazard level could be considered to be somewhere between 1.50 to 3.00 metres high projected up to 2050. The technical adaptation for the dwellings in Sitio Gulayan community, and its development to form

a transitional settlement, therefore, should consider this scenario. The succeeding section will discuss how the technical adaptation of the dwellings in relation to the flood projections, will be applied in the context of transitional settlement development in the community through the responses to the research questions.

8.2.4 Research questions

This section will discuss the answers to the research questions starting with the sub-questions followed by the central research question. The rationale behind the responses will be presented by simultaneously revisiting and discussing the related relevant findings, both in the published literature and in this study. There are three sub-questions formulated and originally included in the introductory chapter to help address the main research question.

The first of the three sub-questions enquired about the technical adaptation approaches that are being applied by floodplain communities to address flood risk. Based on the reviewed literature and the findings in this study, the technical adaptations are generally included within the four broad approaches of protect, accommodate, retreat, and avoid. Included in the review are structural and non-structural measures to cover the physical and regulatory applications for the community. Focusing on floodplain communities, the traditional protect approach involves structural measures such as seawalls, dikes, catchments, and vegetation, whilst non-structural includes the restoration and creation of coastal wetlands. The maintenance of these network of flood defence is also included in the non-structural measures.

In the case of Sitio Gulayan community, the existing measure is the concrete dike which has been effective in mitigating flood risk. Its maintenance, however, could be considerably improved based on the study findings where it was found for instance, to have leaks in some areas and continue to be structurally compromised with the presence of dwellings connected and being supported by the dike. The clearing works and desilting of the river prior to the pandemic, complemented the dike as a flood defence measure as well.

For the accommodate approach, the adaptive measures include changes on activities, buildings and infrastructure such as retrofitting, structural fill to raise elevations, building area restrictions to allow flooding on non-habitable areas only, watercourse setback adjustments, or adjustments in land use planning. It also includes flood storage areas, floatable or elevated homes, and wet flood proofing. Unsurprisingly, the findings indicate that the accommodate approach was most adopted amongst the four approaches in Sitio Gulayan community.

The box culvert as a flood storage system for example, is the most obscure yet effective measure serving not only the community, but the entire barangay as well. For the dwellings, the applied measures are retrofitting, filling to raise elevations, elevated homes, and wet flood proofing. The last three is commonly mixed particularly in the concrete hollow block and

concrete house types, wherein the ground floor is raised either by filling or stilts and allowed to be flooded with the upper floors serving as the main habitable area.

The retreat approach as an adaptive strategy, involves abandonment of land or structures at risk resulting to partial or total relocation, or resettlement of floodplain communities. Also known as managed retreat or resettlement, this strategy was implemented in Sitio Gulayan community when the river easement was cleared off of dwellings and the affected residents resettled off-city in 2015. Most of the evacuees, however, claiming lack of basic services and livelihood in their newfound homes, either returned back to the community or resettled somewhere else.

Avoid as the final adaptive approach, is closely connected to the retreat approach and often refers to new developments that are ensured of being outside the flood risk areas. This simply means avoiding the construction of houses and infrastructure in flood-risk areas like in the river easement of Sitio Gulayan community, but when allowed in exceptional circumstances, should be suitably constructed. It also involves promoting appropriate land uses and adapting future developments to flood risk.

The second question is about the upgrading programmes being adopted in informal floodplain settlements to mitigate flood hazards. From the findings in the published studies, participatory or community-driven in-situ slum upgrading, is considered as the best practice programme, particularly those that include urban poverty reduction objectives (UN-Habitat, 2003). The key according to UN-Habitat (2007), lies in the responsibility and participation of the community in the process, which can create ownership in the project as a recognised prerequisite for sustainable development.

Participation involves the community in the formulation of upgrading programmes including financing and implementation, with the participants building on their own innovative solutions and formally recognised CBOs (UN-Habitat, 2003). From the study's findings, the community of Sitio Gulayan having around five to six community organisations each with a different agenda, makes participation in the community divided. The recognised organisation, *Gulayan Community Homeowners' Association* (GC-HoA), consisting of the 804 assigned subdivided lot owners, share the community with five other organisations making it difficult to set common goals for the good of the community at large.

However, the results of the study are still encouraging, with the organisations being set aside when collective efforts for a project or to help others are called for. The dwellers for instance, are willing to help out on improvements in the community like in their footpath projects where the residents living along the portion of the dilapidated walkways or muddied alley, contributed to the building materials and labour required for the paving or repairs. During times of disaster, neighbours also help those in need regardless of their organisation affiliations. These show that the different groups can work together on a common goal geared towards the community and their own well-being.

Participation to be sustainable, should also include other stakeholders like the NGOs, CBOs, and similar associations helping out to provide technical assistance to the community. The NGOs in the local Community Mortgage Programme (CMP) projects for instance, act as 'originator' for community organisations who could assist them with land development (UN-Habitat, 2012). The findings in the study, however, indicate that there is not much participation from these organisations, with only one NGO being mentioned both by the barangay officials and residents in the interviews, who reached out to the community with their waste collection system development and implementation programme. Fruitful negotiations with external organisations in the past, may have been discouraged by the presence of multiple organisations within the community.

The final sub-question to be addressed is on how informal floodplain settlements can be developed and managed to form transitional settlements. Deconstructing the adopted definition of transitional settlements for this study, will help analyse the response to the enquiry. Again, it is defined, "…as the improvement of existing neighbourhoods, including informal settlements, to permit provision of shelter and basic services, whilst reducing hazard risks and the need to relocate affected populations to new settlements".

The development and management in Sitio Gulayan community should therefore, consider the general improvement of the settlement in the context of providing: 1) dwellings that are resilient; 2) basic services that are sufficient, and; 3) an environment that is less prone to flooding which could accommodate most, if not all of its settlers. For the dwellings to become resilient, the study shows that there are houses that have already technically adapted to the flood hazards and have in fact, become refuge areas for neighbours in need. These are the concrete, concrete block, and two-storey wood dwellings. The fundamental attributes of these dwellings both for the concrete and wood types, are the ground floor elevation, the existence of an upper floor, and the use of standard building materials.

Dwellings that would still need to technically adapt are the one-storey wood and makeshift dwellings. Based on the flood projections discussed earlier, the ground floor elevation should be maximised and an upper floor with an elevation of 3.00 metres from the ground floor may be considered as additional habitable and refuge area. For one-storey wood and makeshift dwellings that will have an additional upper floor, this study recommends raised construction or stilt dwellings as the viable technical adaptation strategy, whilst floatable homes through amphibious retrofitting would be the practical approach for one-storey makeshift and wood dwellings. Aside from being relatively inexpensive, it is also applicable to low-cost housing with the use of more traditional building materials on new structures, whilst preserving those in the existing structures when retrofitting.

For the basic services, the findings indicate that the overcrowding of dwellings resulting to the irregular and rhizomic urban form of the settlement, pose as a major challenge in providing

sufficient basic services. Particularly for sanitation, where the majority of the respondents do not have their own septic vaults, the alternative is to provide communal vaults strategically located within the community to accommodate the households. There are a number of vacant lots that could be utilised for this purpose where the main septic vault could be located in the basketball court area connected to all the secondary vaults. The location of the basketball court would be ideal being near the entrance road to the community where the sewer pipes run.

Although water supply is not a major issue, it could be improved by providing water stations in strategic areas to serve the households without running water. Through the homeowners' association, water in these stations could be sold at a profit and at a lesser price, to discourage selling at prohibitive costs by those who have metred water lines, whilst providing additional income for the association. Existing water lines could also be improved by replacing them with standard rigid plastic pipes instead of the substandard flexible pipes commonly used in the community. For added protection, the pipes could also be secured inside larger pipes to discourage damage or tampering.

Power similar to water, is not a major concern aside from the provision of more lines by the concessionaire. This could be negotiated by the homeowners' association with the support of the local government, to acquire more lines and again, discourage illegal selling of electricity. Aside from being a safety hazard, the cost is more than the standard price per kilowatt-hour that makes for an additional source of income for the seller. The layout of power lines, however, could be improved by providing more intermediary posts within the community to avoid criss-crossing of wires along walkways.

Solid waste management would not really be problematic if firstly, a sense of discipline could be instilled within the community. Secondly, designated rubbish areas where properly marked bins are located, will help in cutting the long trip to the lone trash area in the community. Lastly, the suggested Materials Recovery Facility (MRF) by a barangay official could be explored in addressing the issues in waste management, and as an additional means of income for the community. Collection will be easier with the bins marked as recyclables, directly taken to the facility for sorting, processing, and selling, with the rest taken to the main trash bin for disposal.

Addressing waste management would help in building an environment that is less prone to floods. As the findings indicate, uncollected rubbish is one of the main causes of flooding in the community with the clogged drainage system. The findings also show that the structural measures in place are effective in mitigating floods, but maintenance should be an integral component in the system as a non-structural measure, to maximise and prolong the serviceability of the existing flood protection structures. The reported leak on the dike for example, should be immediately addressed to avoid irreparable damage. Similarly, the inoperable flood gate as reported in the interviews need to be repaired forthwith.

To prevent future damages to the dike, the houses located right beside the dike, with some directly attached to it should be relocated. The required three-metre river easement where these houses are located, should be reclaimed and converted to another use that will discourage future inhabitation. The stretch of the easement could be converted to a road that will connect the minor road of Sanciangco St. in the east end, to the main entrance road to the west end allowing vehicular access that will open up the community to the rest of the city. It could also be converted to either an agricultural plot that could again provide income to the residents, or vegetation as a soft solution to flood protection.

The easement being considered as a high-risk area, currently accommodates around 200 homes from the west to the east end, and under the premise of minimal relocation in transitional development, the open plot adjacent to the community that is being gradually occupied by new settlers, could be allocated as relocation site. Being a private property, the local government could negotiate with the owner to put the land into more productive use that could benefit all concerned. In accommodating the suggested provisions for basic services discussed above, some houses should be relocated as well to the designated relocation site to strategically locate the communal septic vaults, water stations, trash areas, and MRF.

The three sub-questions were addressed above through the findings in this study along with the other published studies, and based on the main findings and results discussed thus far in this chapter, the central research question could finally be responded to. To answer the main question, “Could informal floodplain settlements be technically adapted for resilience building and developed to form transitional settlements?”, the main findings indicate that the floodplain settlement of Sitio Gulayan can be technically adapted and developed to form a transitional settlement. However, in the strictest sense of the definition for the adopted concept, the community can only be developed over time with the overcrowding of dwellings being addressed in the process.

Addressing the issue on overcrowding and high density in the community will allow for the much-needed space in the general improvement of the community where roads, footpaths, public space, and utility facilities can be provided. The key is to provide space for the infrastructure by relocating some of the dwellings outside the perimeter, but in very close proximity to the settlement. Aside from the suggested open area beside the community in the east side, another open area in the west side can be utilised for the same purpose. Again, being a private property, the usage of the land necessitates the local government’s intervention.

The prospects of fully developing Sitio Gulayan community to form a transitional settlement in its current condition may seem implausible, but it is still worth exploring considering the last three decades without any significant progress on the approved housing programme. The potential for the settlers to improve their living conditions, by technically adapting to the flood hazards makes it all the more encouraging. Those who have already adapted could serve as

inspiration to those who are still struggling to adapt, and impart the lessons they have learned as invaluable local knowledge in building resilience. The potential can still be enhanced by implementing the propositions presented earlier, which could help minimise the limitations that restrict both the dwelling and community improvements.

8.3 Conclusion

The foundations of the overall conclusion in this study, will be laid on the arguments asserted in the analysis from the previous chapters, and the discussions made in this chapter. The limitations on the research work that may have affected the findings in the study, will be presented at the end of the section, as a preface to the recommendations for future research work to be discussed in the ensuing section. The chapter and the study will conclude with its contribution to the body of knowledge in the study and analysis of informal settlements.

The case study on the community of Sitio Gulayan, brought to light the inherent coping capacity of the settlers to adapt both socially and technically to the flood hazards in their risk area. This was revealed through the investigation on the urban form of the settlement, and the establishment of the housing typologies, which indicated the respective attributes of the different types in mitigating the impacts of flooding. Although most of the dwellings have yet to adapt, the aspirations of the majority are similar with the technical adaptation measures observed in the improved dwellings.

The community's adaptability could be attributed to the application of socio-ecological or adaptive resilience, characterised by the settlers' ability to transform, learn, and innovate. This was revealed in the modifications effected by the settlers, both in the community and in their dwellings. As a result of the extreme flood events that devastated not only the community, but most barangays in the city, their efforts were complemented by the structural measures put in place by the national and local government, which have proven effective in mitigating flood hazards.

The extant culture of *bayanihan* is also an invaluable component in the community's adaptive resilience, where differences amongst the settlers are set aside to attend to the needs of their neighbours. Thus, as risk is immanent in the settlement, the study showed that resilience is equally inherent in the community through the collective efforts of the settlers. The culture of extended family on the other hand, proved to be both useful and detrimental in the adaptation of the community. Useful in terms of strengthening social relations amongst the settlers where kinship is extended outside the household, but detrimental at the same time being contributory to overcrowding and unsafe construction practices.

The aforementioned main findings, collectively demonstrates as well the importance of local knowledge in the community. With the settlers' extensive experience in flood disasters, allayed by their established customs and traditions generated over time, they possess amongst

themselves an invaluable repository of information, that is an essential component in enhancing their adaptive capacity. The study showed that for the majority, leaving the settlement despite its inherent wide-ranging challenges, will always be the last resort. This attitude also confirms the permanency and persistence of these settlements, as opposed to the perception of temporariness encountered in some of the published studies.

Without any remotely conceived designs and prototypes so far implemented in the community, the local capacities remain intact and could be clearly recognised and utilised for an effective shelter response (Sharma, 2018). This should encourage participatory upgrading where the residents can be engaged and involved in decision-making that would consider the wider and longer-term benefits. Typically targeted in transitional settlement development, these benefits may include comfort, cultural appropriateness, sense of ownership, acceptance, and willing adoption of solutions delivered. As Sharma (2018) further noted, these benefits cannot be measured by the indicators of quantifiable service delivery, and with programmes emerging from the local context using local resources and ideas, the acceptance from the community is greater.

The study's use of the concept of transitional settlements as an alternative approach to resettlement in the case of Sitio Gulayan community, complemented the best practice approach of participatory in-situ upgrading. The location of the community with its peripheral attributes, also showed the potential for the proposition given the possibilities of expansion to accommodate the existing population, together with the proposed facilities and infrastructure. It is noteworthy, however, that the current population should be maintained to retain the workable density in the developed community.

Finally, the main findings discussed in this section, were brought together by the adapted conceptual model utilised for this study. As a result of the existing views both from the theoretical and empirical findings in the published literature, the original framework served as a map of the relationships amongst the different concepts, which enabled to view the research problem in an integrated manner. The addition of *basic services* in the adapted conceptual model from Pojani, proved to be very useful in the investigation, both on the delivery and means of accessing the essential services. It showed not only the restrictions and limitations in the provisions as a result of the urban form and architecture of the community, but also how these could be addressed with minimum disturbance.

In light of the findings presented above, a two-pronged recommendation will be formulated in the succeeding section. The first part will be for the future studies on Sitio Gulayan community which may build on this particular study given the limitations encountered, and the second part will be on the study on informal settlements in general.

8.4 Recommendation and future directions

The goal of the study is to investigate the viability of the community to develop into a transitional settlement, as an alternative approach to the originally approved, albeit deadlocked housing programme. This study presented an option through in-situ upgrading with a few limitations encountered in the process which could be worth investigating in the future. From these limitations, recommendations were put together for future research studies on informality which will be presented in the ensuing paragraphs.

Future studies on Sitio Gulayan

The first part of the recommendation is for the succeeding studies in the community to look into other avenues of upgrading approaches applicable to the case study. One of the limitations in this study is the viability of making use of the adjacent open areas as suggested in the previous section. Further studies could thus, be conducted to explore the feasibility of tapping into these properties for more sustainable solutions to the problem. The prospect of being able to tap into these resources can open up more options in addressing the issues not only on flood mitigation, but in housing provision as well.

With the land made available to be utilised in upgrading, reblocking[10] for example, can be implemented on the community with the affected dwellings temporarily relocated in the adjacent areas. Holistic upgrading can thus, be accomplished without displacing the population. To accommodate more settlers in the city, the introduction of medium-rise buildings (MRBs), could also be explored as another avenue for an in-city housing programme. Although this approach may be prohibitive given the existing soil conditions in the site, the concept of vertical resettlement as discussed in section 2.9, *Informal settlement in-situ upgrading*, may be considered as an alternative financing scheme for the development. Future studies could then be more elaborate and detailed by depicting the propositions into architectural and engineering drawings, clearly interpreting and presenting the discussions through graphical illustrations.

Another limitation encountered is the utilisation of flood modelling in the study. With the two extreme flood events utilised as references for the flood damage analysis, the data collected from published works together with the available hazard maps, were applied in the study instead. Future studies could conduct flood modelling for the community in the context of climate change, with the future impacts in relation to subsidence, liquefaction, and accelerated sea level rise. As UNISDR reported, “The pre-existing physical exposure to environmental hazards, urban densities, and social marginalization of informal settlements renders them at the highest risk to the impacts of climate change” (Jean-Baptiste, et al., 2018 p. 402).

[10] The realignment of structures to provide alleys and pathways connecting the interior area to the major roads and subdividing the area into residential lots for on-site development. Reblocking operates on four (4) basic principles: (a) maximum retention of structures and minimum displacement of families; (b) provision of basic services and utilities; (c) land ownership by qualified beneficiaries; and (d) maximum community participation.

Finally, with the limited time, the complexities of land tenure were not explored in this study which could be an interesting research topic for the community, considering the impasse in the housing programme which was approved 30 years back. Although it has been established in the study that the default by the homeowners' association is the primary reason for the long delay in formalisation, the role of urban governance in local politics which could be the underlying reason for the stalemate, may be worth investigating to get to the root of the problem.

Study on informal settlements

In the introduction of the study, one of the underlying reasons mentioned for the proposition of transitional settlement, is the disregard for the locational attributes in the upgrading approaches found in most of the published literature. Informal settlements in themselves are dynamic, complex, and multi-scalar, and their location further adds to these intricacies. One of the recommendations thus, is to consider the characteristics of the settlement's location in the upgrading programmes particularly those in risk areas. As earlier discussed, a one-size-fits-all solution of basic services and infrastructure provision, will not address the issues sustainably.

Another recommendation is on the concept of the minimum construction standard exclusive for informal dwellings. As a permanent fixture in urbanism, the proposition of John Turner on setting guides that will allow for the intermediate stages in the incremental building of informal dwellings should be introduced. This could be formulated similar to the housing construction manuals that provide engineering solutions to reduce the impact of disasters, particularly in risk-prone localities through the building of resilient dwellings. (for example Ahmed, K.I., 2005; NBRO, 2015; Gatoo, A. et al., 2015; Espina, 2016; and, Da Nang DoFA, 2017).

In the local context, the manual could serve as an addendum to the National Building Code, where the minimum requirements will be introduced in consideration of the progressive stages in the construction of informal dwellings. Notwithstanding the non-compliance of the dwellings to the building and fire codes, provisions on exceptions or formulating a performance-based building standard for these settlements that is non-prescriptive, may be included as a policy recommendation. The guidelines on the construction of transitional settlements and shelter itself, would be a good place to start as "…it offers a common planning tool for developing and implementing settlement and shelter strategies", […] and "many aspects of transitional settlement work are relevant to policy making" which would be helpful in drawing up standards (Corsellis and Vitale, 2005).

Lastly, in the study of informal settlements, the inaccurate figures in the demographics are commonly noted in the literature. As encountered in this study, new houses are being built every time a field visit was made which makes it hard to accurately establish the figures. Should there be any census conducted in the future, there would already be additional settlers who have moved into the settlement even before the survey is concluded. It is therefore,

recommended for future studies, to conduct their own estimates whilst exploring all available sources, for more accurate figures.

8.5 Research contributions

To end the study, the practical and theoretical contributions to the body of knowledge in the study and analysis of informal settlements, will be presented in this final section. It is the hope of this study to further the knowledge in the urban form and architecture of informality through these contributions, which could help improve the living conditions in informal settlements by providing more secure and safer communities.

As mentioned in Section 1.3 *Significance and limitations of the study*, there are no informal settlements alike and the analysis of Sitio Gulayan community, can contribute to the body of knowledge in the urban form and architecture of informality. The exploration of the community through the four key elements of settlement, house, dwellers, and process, with their respective constructs as adapted from the conceptual model applied, provided detailed information on the urban form, morphology, and architecture of the community. The six housing typologies established as a result of the investigation, presented the varied building characteristics which will help in the future intervention plans of the government in the community. The findings in the study, thus, will be useful not only to future research works, but to the local government as well in terms of addressing the physical, social, and environmental challenges encountered in the community, including the political issues discussed in this study.

In the study of Olthuis et al. (2015) on slum upgrading, one of their recommendations for future studies is to make slum investments pre-disaster as opposed to post-disaster or emergency relief. With the adoption of the concept of transitional settlement in on-site upgrading, this study responded to the recommendation and contributed to the body of knowledge, by exploring an alternative upgrading approach in a pre-disaster environment that considers the post-disaster impacts. From the detailed statements of the participants on their experiences with the two extreme flood events referenced in this study, the information gathered on the damages incurred and the adaptation measures implemented, will help both the community and the local government in planning for similar future flood events. With the information provided on the various housing types and the adaptive measures applied respectively, the most vulnerable dwellings can easily be identified and provided with the necessary technical adaptation measures to mitigate impending flood hazards.

Investigating the diverse urban form and architecture of the case study, required a framework that could combine and coordinate the different views to understand its complexity. The constructs in the model helped in identifying the essential features of the community that guided the study. Each of the elements served as a tool to probe in detail the characteristics and peculiarities of the dwellings, the residents, and the community at large. Building on the adapted conceptual model, which functionally served its purpose in studying the urban form and

architecture of Sitio Gulayan community, can contribute to future works in the field. Future researchers of informal settlements particularly in risk areas, could further build on the framework by adding or altering the key elements to suit the context of their own study areas.

Finally, the exploration and application of the transitional settlement concept for in-situ upgrading in a pre-disaster environment, can be considered as a novelty in the study of informal settlements. This study is, therefore, hopeful that the adoption will be able to extend knowledge in the discipline, into new domains to address the multi-faceted issues on informal urbanism. A new domain perhaps, that would meritoriously give new meaning to “transitional settlements” as an alternative phraseology to informal settlements.

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10 Appendices

Appendix A: Interview protocol

A.1 Sitio Gulayan community residents

Control no. B1-1-10 _____ ☐
B2-1-10 _____ ☐
B3-1-10 _____ ☐

Date: _____

Interview Questions for SGC residents

Thesis title: **Flood risk reduction and resilience building in flood-prone settlements: The case of Sitio Gulayan Community**

Part I: **General Information**
Part II: **Housing and Settlement**
Part III: **Adaptive Capacity and Damage Assessment**

Introductions:

Good morning / afternoon. My name is Joey de Vera. In this interview, I would like to ask you a series of questions to help me better understand your community, dwelling, and household. There will be three parts in the interview starting off with the General Information where I will be asking information about yourself, followed by Housing and Settlement where I will be asking questions about your dwelling and community. The interview will be concluded with the Adaptive Capacity and Damage Assessment where I will be asking about your experiences during flood events in the community and how you and your family are coping, or were able to cope.

Your identity will remain confidential as stated in the Information Sheet and Participant Consent Form. At any time during the interview, you can feel free to let me know if you do not want to answer a question, or ask me why I am asking a particular question.

Before we begin, do you have any questions for me about the study?

Part I: General Information

A. Location ID (to be filled out by researcher)
House ID :_____
Block ID :_____

B. Participant information
1. Could you introduce yourself please?
Name:_____
Age bracket: 21 to 30 ☐ 31 to 40 ☐ 41 to 50 ☐ 51 to 60 ☐ (N.B. *60 years old and above can only participate if the restrictions for senior citizens to go out have already been lifted by the local government.*)
Address:_____Occupation:_____

Control no. B1-1-10 _____ ☐
B2-1-10 _____ ☐
B3-1-10 _____ ☐

Topics / Key Questions	Prompts (points not mentioned, if necessary)	Probes (supplementary questions)
Part II: Housing and Settlement		
C. Housing		
2. How long have you lived in Sitio Gulayan Community? _____		○ if originally from SGC ○ if not, where before SGC_____
3. Why did you choose to live in Sitio Gulayan Community? _____	○ relatives / friends ○ work	
4. Do you own the house you are living in or are you renting? _____		○ if owned, self-built or hired workers ○ if renting, responsible for house repairs/upgrade _____
5. What about the lot, do you own it or are you renting? _____		○ if owned, own choice of location or: ○ chosen by HOA ○ chosen by Barangay office
6. Are there any rules being followed in building a house in the community such as setbacks, right of way, or open spaces to be retained? _____	○ by HOA or by Barangay office	
7. What is the approximate size of house either in square feet or square meters? _____		○ lot size_____ ○ no. of rooms_____
8. Are you only one family living in the house or with another/other family (ies)? _____	○ in-laws / relatives ○ friends ○ lessees / renters	○ total no. of household members _____
9. Do you have a store or shop in the house? _____	○ type of store ○ type of shop	
D. Settlement		
10. What do you think are the basic services lacking in Sitio Gulayan Community? _____	○ water ○ power	○ what about transport? _____

Control no. B1-1-10 _____ ☐
B2-1-10 _____ ☐
B3-1-10 _____ ☐

	○ sanitation ○ solid waste management	○ what about community facilities (playground/open spaces, multi-purpose hall, day care centre, schools, chapel, others as defined under BP 220)? _____
11. What basic services are mostly affected in your community during flood events? _____	○ water ○ power ○ sanitation ○ solid waste management ○ community facilities (playground/open spaces, multi-purpose hall, day care centre, schools, chapel, others)	
12. Is Sitio Gulayan easily flooded during the rainy season? _____	○ location ○ ground elevation	
13. Using the community map below, could you please locate the area flooded the most in your community?		○ why do you think it is the most flooded area? _____
14. What about the least flooded area?		○ why do you think it is the least flooded area? _____
15. Is the location of your house easily flooded during the rainy season? _____	○ location ○ ground elevation ○ house elevation	
16. Given the choice, where would you like to locate your house in the map of the community?		○ why that location? _____
17. If you will be a part of a government housing programme to be relocated within the city, would you relocate, or would you rather stay in Sitio Gulayan Community?		○ why or why not? _____

Control no. B1-1-10 _____ ☐
B2-1-10 _____ ☐
B3-1-10 _____ ☐

_____		
Part III: Adaptive Capacity and Damage Assessment		
E. Physical Adaptation		
18. What do you do in preparation for the typhoon and flooding season? _____	○ elevated platform ○ barrier	
19. What have you done if any, to make your house more resilient to flooding? _____	○ raised ground floor ○ added floor/s ○ structural reinforcement	

20. How do you and your neighbours help each other in times of flooding? _____	○ secure furniture / appliances ○ stay in neighbour's house ○ help evacuate	
21. Given the resources and opportunity, what would you do to make your house more resilient to flooding? _____	○ raise ground floor ○ add floor/s ○ structural reinforcement ○ additional solid boundary walls ○ change materials (floor, walls, roof)	
22. Aside from the dike along the river and on the city-side of SGC, are there any other measures in place that you know of to mitigate flooding in the community? _____	○ culvert ○ water diversion through channels or pumping stations ○ reclamation (non-engineered) ○ raising of street elevation ○ additional solid boundary walls ○ refuge areas	
23. Do you have any suggestions on how the community could possibly reduce flood risks? _____	○ culvert ○ water diversion through channels or pumping stations ○ reclamation (non-engineered) ○ raising of street elevation ○ additional solid boundary walls ○ refuge areas	
F. Damage Assessment		
24. What is your experience of the 2009 typhoon 'Ondoy'? _____	○ stayed on upper floor/roofdeck/roof ○ stayed with neighbour's ○ evacuated (where specifically, e.g. community facility; public school, etc.?)	○ how high was the flood waters from your house and how long did it remain dangerously flooded before subsiding to a safe level? _____

		○ what kind of physical danger or harm, if any, did you experience? _____
25. Can you describe the damage it has caused, if any, to your dwelling? _____	○ 0: no damage ○ 1: no damage, wall paint/cover deteriorated ○ 2: no structural damage, wall plaster/cover may need repair and/or painting; wooden frames need to be treated ○ 3: considerable structural damage to wooden doors /windows and frames, plaster/cover and painted walls ○ 4: partial destruction of foundations, posts/plinths, walls and doors/windows ○ 5: total destruction of the house	N.B. *refer to response from survey questionnaire and ask to elaborate in more detail*
26. Can you estimate the cost of the damage? _____ (note: *use NEDA formula to compare prices for different years*)		○ were you able to repair the damage? _____
27. What is your experience of the 2013 Habagat? _____	○ stayed on upper floor/roofdeck/roof ○ stayed with neighbour's ○ evacuated (where specifically, e.g. community facility; public school, etc.?)	○ how high was the flood waters from your house and how long did it remain dangerously flooded before subsiding to a safe level? _____ ○ what kind of physical danger or harm, if any, did you experience? _____

Control no. B1-1-10 _____ ☐
B2-1-10 _____ ☐
B3-1-10 _____ ☐

28. Can you describe the damage it has caused, if any, to your dwelling? _____	○ 0: no damage ○ 1: no damage, wall paint/cover deteriorated ○ 2: no structural damage, wall plaster/cover may need repair and/or painting; wooden frames need to be treated ○ 3: considerable structural damage to wooden doors /windows and frames, plaster/cover and painted walls ○ 4: partial destruction of foundations, posts/plinths, walls and doors/windows ○ 5: total destruction of the house	N.B. *refer to response from survey questionnaire and ask to elaborate in more detail*
29. Can you estimate the cost of the damage? _____ (note: *use NEDA formula to compare prices for different years*)		○ were you able to repair the damage? _____
30. Is there any other information you would like to add? _____ _____.		

Thank you for your participation in this interview.

A.2 Sitio Gulayan community officials

Control no. B1-CO-1-3 _____ ☐
B2-BO-1-2 _____ ☐

Date: _____

Interview Questions for HOA officials

Thesis title: **Flood risk reduction and resilience building in flood-prone settlements: The case of Sitio Gulayan Community**

Part I: **General Information**
Part II: **Settlement and Housing**
Part III: **Housing Programme and Future Plans**

Introductions:

Good morning / afternoon. My name is Joey de Vera. In this interview, I would like to ask you a series of questions to help me better understand the role of your office and yourself as an official of the Home Owners' Association in Sitio Gulayan Community. There will be three parts in the interview starting off with the General Information where I will be asking information about yourself, followed by Settlement and Housing where I will be asking questions about the dwellings in Sitio Gulayan Community. The interview will be concluded with the Housing Programme and Future Plans where I will be asking about the past, current, and future programmes and plans for the community.

Your identity will remain confidential as stated in the Information Sheet and Participant Consent Form. At any time during the interview, you can feel free to let me know if you do not want to answer a question or ask me why I am asking a particular question.

Before we begin, do you have any questions for me about the study?

Part I: General Information

A. Participant information

1. Could you introduce yourself please?
   Name:_____
   Occupation:_____
   Position:_____ from year_____ to _____
   Resident of Malabon City: Yes ☐ No ☐

Control no. B1-CO-1-3 _____ ☐
B2-BO-1-2 _____ ☐

Topics / Key Questions	Prompts (points not mentioned, if necessary)	Probes (supplementary questions)
Part II: Housing and Settlement		
2. Is the land being occupied by Sitio Gulayan Community government property? _____	○ private property ○ part gov't and part private ○ under litigation or with legal encumbrances	○ if not, does the city government plan to acquire the land? _____ ○ if under litigation, what kind of legal constraints? _____
3. Does your office keep a record of the total no. of residents living in Sitio Gulayan Community? (barangay Catmon at 36, 450, NSO 2010 / 38, 010 2020 projection in CDP 2017-2020) _____	○ average no. of household members (4.3 city ave., NSO 2010) ○ population density ○ growth rate (0.42%, NSO 2000-2010)	○ what about the total no. of dwellings? Or dwelling typologies? _____ ○ if not, would you know which department / office has the record, if any? _____
4. Are there any rules or regulations being enforced by the barangay office or HOA in the construction of dwellings in the community? _____	○ location ('no build' zone) ○ setbacks ○ right of way ○ open spaces ○ alleys / walkways ○ location of sanitary facilities	○ what about permits like building permit or barangay clearance? _____
5. Does your office have a record on the basic services being provided in Sitio Gulayan Community? _____	○ water ○ power ○ sanitation ○ solid waste management ○ community facilities (playground/open spaces, multi-purpose hall, day care centre, schools, chapel, others as defined under BP 220)	○ which do you think is the most lacking amongst the services? _____

Control no. B1-CO-1-3 _____ ☐
B2-BO-1-2 _____ ☐

6. Would you know which basic services are mostly affected in Sitio Gulayan community during flood events? _____	○ water ○ power ○ sanitation ○ solid waste management ○ community facilities (playground/open spaces, multi-purpose hall, day care centre, schools, chapel, others as defined under BP 220)	
7. Does your office have a part in the formulation of the CBDRMM (Community-based Disaster Risk Reduction and Management) Plan on flooding in particular? _____		○ If so, what is the role of your office in the CBDRMM?_____ ○ are there any plans formulated specific to Sitio Gulayan Community? _____
8. Is your office involved in providing Early Warning Systems (EWS) to warn the community of an impending flood hazard? _____	○ water level sensor module ○ rain gauge sensor station ○ real-time and acquisition software ○ CCTVs ○ SMS advisories / bulletins	○ what about the Community-based monitoring system (CBMS) in partnership with DILG (using StatSim and QGIS which started) in 2017? _____
9. Are there any designated refuge areas in the community? _____	○ covered basketball court ○ People's Park ○ Public schools ○ Chapel	
Part III: Housing Programmes and Future Plans		
10. Is your office involved in any housing programmes for Sitio Gulayan Community? _____	○ slum upgrading / reblocking ○ in-city / near-city relocation ○ off-city relocation ○ MRBs or HRBs	○ what about NGOs and CBOs like Gawad Kalinga, Habitat for Humanity, educational researchers, faith-based organizations? _____
11. Is Sitio Gulayan Community under the CMP (Community Mortgage Program) of the local government?	○ People's plan	○ are there any CMP projects already taken out? (GCHoA with 804 families, IHRU 2019)

Control no. B1-CO-1-3 _____ ☐
B2-BO-1-2 _____ ☐

_____		_____
12. What is the current plan of the barangay office/HOA in addressing the dwellings along the 'no build' easement zone? _____	○ in-city / near-city relocation ○ off-city relocation ○ MRBs or HRBs / densification	○ what happens if there are no available relocation areas within or outside the city? _____
13. Have there been any on-site upgrading programmes in the past to make the dwellings, particularly the most vulnerable, more resilient to flood hazards? _____	○ retrofitting ○ on-site relocation to higher ground ○ transitional housing ○ consultations or recommendations	○ what about the upgrading plans in partnership with the Human Cities Coalition (HCC) (with the MoA signed in 2017)? _____
14. Does your office work in coordination with the MCDRMMC (Malabon City Disaster Risk Reduction and Management Council) on flooding in SGC? _____	○ 'no build' risk areas ○ relocation ○ evacuation	○ what about MDRRMO (Malabon Disaster Risk Reduction Management Office)? _____
15. Aside from the dike along the river, are there any other measures in place that you know of to mitigate flooding in the community? _____	○ culvert ○ water diversion through channels or pumping stations ○ reclamation (non-engineered) ○ raising of street elevation	
16. Do you have any suggestions on how the community could possibly reduce flood risks? _____	○ culvert ○ water diversion through channels or pumping stations ○ reclamation (non-engineered) ○ raising of street elevation ○ raising of dike elevation	
17. What is the plan of the barangay office/HOA for Sitio Gulayan Community in terms of flood reduction? _____	○ In-situ upgrading / reblocking ○ in-city / near-city relocation ○ off-city relocation ○ MRBs or HRBs / densification	○ what about capacity building for the residents? _____
18. Is there any other information you would like to add? _____.		

Thank you for your participation in this interview.

A.3 City and Barangay officials

Control no. B1-CO-1-3 _____ ☐
B2-BO-1-2 _____ ☐

Date: _____

Interview Questions for City and Barangay officials

Thesis title: **Flood risk reduction and resilience building in flood-prone settlements: The case of Sitio Gulayan Community**

Part I: **General Information**
Part II: **Settlement and Housing**
Part III: **Housing Programme and Future Plans**

Introductions:

Good morning / afternoon. My name is Joey de Vera. In this interview, I would like to ask you a series of questions to help me better understand the role of your office and yourself as an official of the city / barangay in relation to Sitio Gulayan Community. There will be three parts in the interview starting off with the General Information where I will be asking information about yourself, followed by Settlement and Housing where I will be asking questions about the dwellings in Sitio Gulayan Community. The interview will be concluded with the Housing Programme and Future Plans where I will be asking about the past, current, and future programmes and plans for the community.

Your identity will remain confidential as stated in the Information Sheet and Participant Consent Form. At any time during the interview, you can feel free to let me know if you do not want to answer a question or ask me why I am asking a particular question.

Before we begin, do you have any questions for me about the study?

Part I: General Information

A. Participant information

1. Could you introduce yourself please?
   Name:_____
   Occupation:_____
   Position:_____ from year_____ to _____
   Resident of Malabon City: Yes ☐ No ☐

Control no. B1-CO-1-3 _____ ☐
B2-BO-1-2 _____ ☐

Topics / Key Questions	Prompts (points not mentioned, if necessary)	Probes (supplementary questions)
Part II: Housing and Settlement		
2. Is the land being occupied by Sitio Gulayan Community government property? _____	○ private property ○ part gov't and part private ○ under litigation or with legal encumbrances	○ if not, does the city government plan to acquire the land? _____ ○ if under litigation, what kind of legal constraints? _____
3. Does your office keep a record of the total no. of residents living in Sitio Gulayan Community? (barangay Catmon at 36, 450, NSO 2010 / 38, 010 2020 projection in CDP 2017-2020) _____	○ average no. of household members (4.3 city ave., NSO 2010) ○ population density ○ growth rate (0.42%, NSO 2000-2010)	○ what about the total no. of dwellings? Or dwelling typologies? _____ ○ if not, would you know which department / office has the record, if any? _____
4. Are there any rules or regulations being enforced by the city government in the construction of dwellings in the community? _____	○ location ('no build' zone) ○ setbacks ○ right of way ○ open spaces ○ alleys / walkways ○ location of sanitary facilities	○ what about permits like building permit or barangay clearance? _____
5. Does your office have a record on the basic services being provided in Sitio Gulayan Community? _____	○ water ○ power ○ sanitation ○ solid waste management ○ community facilities (playground/open spaces, multi-purpose hall, day care centre, schools, chapel, others as defined under BP 220)	○ which do you think is the most lacking amongst the services? _____

Control no. B1-CO-1-3 _____ ☐
B2-BO-1-2 _____ ☐

6. Would you know which basic services are mostly affected in Sitio Gulayan community during flood events? _____	○ water ○ power ○ sanitation ○ solid waste management ○ community facilities (playground/open spaces, multi-purpose hall, day care centre, schools, chapel, others as defined under BP 220)	
7. Does your office have a part in the formulation of the CBDRMM (Community-based Disaster Risk Reduction and Management) Plan on flooding in particular? _____		○ If so, what is the role of your office in the CBDRMM?_____ ○ are there any plans formulated specific to Sitio Gulayan Community? _____
8. Is your office involved in providing Early Warning Systems (EWS) to warn the community of an impending flood hazard? _____	○ water level sensor module ○ rain gauge sensor station ○ real-time and acquisition software ○ CCTVs ○ SMS advisories / bulletins	○ what about the Community-based monitoring system (CBMS) in partnership with DILG (using StatSim and QGIS which started) in 2017? _____
9. Are there any designated refuge areas in the community? _____	○ covered basketball court ○ People's Park ○ Public schools ○ Chapel	
Part III: Housing Programmes and Future Plans		
10. Is your office involved in any housing programmes for Sitio Gulayan Community? _____	○ slum upgrading / reblocking ○ in-city / near-city relocation ○ off-city relocation ○ MRBs or HRBs	○ what about NGOs and CBOs like Gawad Kalinga, Habitat for Humanity, educational researchers, faith-based organizations? _____
11. Is Sitio Gulayan Community under the CMP (Community Mortgage Program) of the local government?	○ People's plan	○ are there any CMP projects already taken out? (GCHoA with 804 families, IHRU 2019)

Control no. B1-CO-1-3 _____ ☐
B2-BO-1-2 _____ ☐

_____		_____
12. What is the current plan of the city government/barangay office in addressing the dwellings along the 'no build' easement zone? _____	○ in-city / near-city relocation ○ off-city relocation ○ MRBs or HRBs / densification	○ what happens if there are no available relocation areas within or outside the city? _____
13. Have there been any on-site upgrading programmes in the past to make the dwellings, particularly the most vulnerable, more resilient to flood hazards? _____	○ retrofitting ○ on-site relocation to higher ground ○ transitional housing ○ consultations or recommendations	○ what about the upgrading plans in partnership with the Human Cities Coalition (HCC) (with the MoA signed in 2017)? _____
14. Does your office work in coordination with the MCDRMMC (Malabon City Disaster Risk Reduction and Management Council) on flooding in SGC?_____	○ 'no build' risk areas ○ relocation ○ evacuation	○ what about MDRRMO (Malabon Disaster Risk Reduction Management Office)? _____
15. Aside from the dike along the river, are there any other measures in place that you know of to mitigate flooding in the community? _____	○ culvert ○ water diversion through channels or pumping stations ○ reclamation (non-engineered) ○ raising of street elevation	
16. Do you have any suggestions on how the community could possibly reduce flood risks? _____	○ culvert ○ water diversion through channels or pumping stations ○ reclamation (non-engineered) ○ raising of street elevation ○ raising of dike elevation	
17. What is the plan of the city government/barangay office for Sitio Gulayan Community in terms of flood reduction? _____	○ In-situ upgrading / reblocking ○ in-city / near-city relocation ○ off-city relocation ○ MRBs or HRBs / densification	○ what about capacity building for the residents? _____
18. Is there any other information you would like to add? _____.		

Thank you for your participation in this interview.

Appendix B: Survey protocol

Control no. B1-1-50 _____ ☐
B2-1-50 _____ ☐
B3-1-50 _____ ☐

Date:_____

Survey Questionnaire

Thesis title: **Flood risk reduction and resilience building in flood-prone settlements: The case of Sitio Gulayan Community**

Part I: **General Information**

Part II: **Housing and Settlement Characteristics**

Part III: **Flood Assessment and Physical Adaptation**

Researcher: **Joey de Vera**

Contact: _____ or j.devera@pgr.reading.ac.uk
UST Graduate School and UoR School of the Built Environment

This survey is part of a study on urban form and architecture of floodplain settlements which is being conducted by Joey de Vera, a PhD student in Architecture and Built Environment, from the Graduate School of the University of Santo Tomas and School of the Built Environment at the University of Reading. As a resident of the study area, Sitio Gulayan Community, you are invited to participate in this study.

Could you please complete this form and return it to the Research Assistants after accomplishing. Thank You.

Please note that participation is voluntary and your responses are confidential. The only persons to see the completed questionnaire will be myself and my Supervisors. Your identity and place of employment will not be mentioned within any publication or presentation resulting from this survey. By completing and returning this survey you understand that you are giving consent for your responses to be used for the purposes of this research project.

If you have any questions or concerns, please contact me at j.devera@pgr.reading.ac.uk or my Supervisor at k.hyde@reading.ac.uk

Part I: General Information

A. Location ID (to be filled out by researcher)
House ID :_____
Block ID :_____

From this point forward, please tick the box ☑ with your corresponding answer and/or write your answer on the blank line.

B. Participant information
1. Participant ID
Name :_____
Age : 21 to 30 ☐ 31 to 40 ☐ 41 to 50 ☐ 51 to 60 ☐
Gender: Male ☐ Female ☐
Status : Head of family ☐ Family member ☐
Occupation: none ☐ construction worker ☐ factory worker ☐
family driver ☐ jeepney driver ☐ tricycle driver ☐
pedicab driver ☐ household help ☐ store owner ☐
shop owner ☐ landlord ☐ vendor ☐
Others, please specify:_____
Address:_____
_____

2. Household members
Number: 1 to 2 ☐ 3 to 5 ☐ 6 to 9 ☐ 10 and above ☐

Control no. B1-1-50 _____ ☐
B2-1-50 _____ ☐
B3-1-50 _____ ☐

3. Length of stay in the community
   Years : less than 1 ☐ 2 to 5 ☐ 6 to 9 ☐ 10 to 15 ☐
   16 to 20 ☐ 21 to 25 ☐ 26 to 30 ☐ 31 and above ☐
   Status : owns the house ☐ rents the house ☐ visitor ☐

Part II: Housing and Settlement Characteristics

C. Basic services

4. Water supply:
   a. Level I
      hand pump ☐ well ☐ rainwater collector ☐
   b. Level II
      piped water from borewell ☐ piped water from spring system ☐
   c. Level III
      Maynilad direct customer ☐ buying from a Maynilad customer ☐
      Others, please specify: _____

5. Power supply:
   MERALCO direct customer ☐ buying from a MERALCO customer ☐
   without power supply ☐
   Others, please specify: _____

6. Sanitation:
   a. owns the toilet ☐ rents the toilet ☐ uses neighbour's toilet ☐
      Others, please specify: _____
   b. with septic tank ☐ without septic tank ☐
      Others, please specify: _____

D. House age and location:

7. Age:
   less than 1year ☐ 1 to 2 years ☐ 3 to 4 years ☐
   5 to 6 years ☐ 7 to 8 years ☐ 9 to 10 years ☐
   11 to 15 years ☐ 16 to 20 years ☐ 21 and above ☐

8. Proximity:
   along the river ☐ along Sanciangco St. ☐
   along the alley from Gov. Pascual Ave. ☐
   along the wall of People's Park ☐ middle interior ☐

Control no. B1-1-50 _____ ☐
B2-1-50 _____ ☐
B3-1-50 _____ ☐

9. From the map below, please locate your house approximately by encircling the lot:

E. House features:

10. Materials:

a. Floor
concrete ☐ wood ☐ plywood ☐ earth ☐ salvaged materials ☐
Others, please specify: _____

b. Walls
concrete hollow blocks ☐ wood ☐ plywood ☐
G.I. sheet ☐ bamboo ☐ salvaged materials ☐
Others, please specify: _____

c. Roof
concrete ☐ G.I. sheet ☐ wood ☐ plywood ☐
cogon ☐ salvaged materials ☐
Others, please specify: _____

d. Plinth / stilts
concrete ☐ steel ☐ wood ☐ bamboo ☐
Others, please specify: _____

11. Number of storeys:
1-storey ☐ 2-storeys ☐ 3-storeys ☐ 4-storeys and above ☐

12. Floor height from ground line:
less than 1 foot ☐ 1 to 2 feet ☐ 3 to 4 feet ☐
5 to 6 feet ☐ 7 to 8 feet ☐ 9 feet and above ☐

13. Last repair or renovation:
less than 1 year ago ☐ 1 to 3 years ago ☐ 4 to 6 years ago ☐
7 to 9 years ago ☐ 10 years and above ☐

14. House components repaired or renovated:
flooring ☐ wall ☐ roof ☐ plinth / stilts ☐
doors ☐ windows ☐ paintworks ☐
Others, please specify: _____

Control no. B1-1-50 _____ ☐
B2-1-50 _____ ☐
B3-1-50 _____ ☐

Part III: Flood Assessment and Physical Adaptation

F. Historical flood event

15. Worst flood event:
Typhoon 'Ondoy' in 2009 ☐ 'Habagat' in 2013 ☐

16. Highest flood level from ground floor:
a. Typhoon 'Ondoy': (2009) no flood ☐ less than 1 foot (0.30M) ☐
1 to 2 feet (0.30 to 0.60M) ☐ 3 to 4 feet (0.90 to 1.20M) ☐
5 to 6 feet (1.50 to 1.80M) ☐ 7 to 8 feet (2.10 to 2.40M) ☐
9 to 10 feet (2.70 to 3.0M) ☐ 10 feet and above (3.0 and above) ☐

b. 'Habagat' (2013): no flood ☐ less than 1 foot (0.30M) ☐
1 to 2 feet (0.30 to 0.60M) ☐ 3 to 4 feet (0.90 to 1.20M) ☐
5 to 6 feet (1.50 to 1.80M) ☐ 7 to 8 feet (2.10 to 2.40M) ☐
9 to 10 feet (2.70 to 3.0M) ☐ 10 feet and above (3.0 and above) ☐

17. Duration of highest flood level from ground floor:
a. Typhoon 'Ondoy' (2009): less than 1 day ☐ 1 day ☐
2 days ☐ 3 days ☐
4 days ☐ 5 days ☐
6 days ☐ 7 days ☐
8 days and more ☐

b. 'Habagat' (2013): less than 1 day ☐ 1 day ☐
2 days ☐ 3 days ☐
4 days ☐ 5 days ☐
6 days ☐ 7 days ☐
8 days and more ☐

G. Damage assessment

18. Damaged house components from flood events:
a. Typhoon 'Ondoy' (2009): no damage ☐ flooring ☐
walls ☐ roofing ☐
plinth/stilts ☐ doors ☐
windows ☐

b. 'Habagat' (2013): no damage ☐ flooring ☐
walls ☐ roofing ☐
plinth/stilts ☐ doors ☐
windows ☐

19. Extent of damage:
a. Typhoon 'Ondoy' (2009): no damage ☐ heavy damage ☐
slight damage ☐ severe damage ☐
moderate damage ☐ total damage ☐

b. 'Habagat' (2013): no damage ☐ heavy damage ☐
slight damage ☐ severe damage ☐
moderate damage ☐ total damage ☐

20. Cost of damage:
a. Typhoon 'Ondoy' (2009): no cost ☐ P10000 to 15000 ☐
P500 to 1000 ☐ P16000 to 20000 ☐
P2000 to 4000 ☐ P21000 to 25000 ☐
P5000 to 7000 ☐ P26000 to 30000 ☐
P8000 to 9000 ☐ P31000 and above ☐

b. 'Habagat' (2013): no cost ☐ P10000 to 15000 ☐
P500 to 1000 ☐ P16000 to 20000 ☐
P2000 to 4000 ☐ P21000 to 25000 ☐
P5000 to 7000 ☐ P26000 to 30000 ☐

Control no. B1-1-50 _____ ☐
B2-1-50 _____ ☐
B3-1-50 _____ ☐

P8000 to 9000 ☐ P31000 and above ☐

H. Physical adaptation

21. Course of action during flood events:

a. Typhoon 'Ondoy' (2009): stayed home and did nothing ☐
vacated ground floor and stayed at the 2nd floor ☐
vacated ground floor and stayed on the roof ☐
vacated 2nd floor and stayed at 3rd/upper floor/roof ☐
vacated the house and stayed at neighbour's house ☐
vacated the house and stayed at evacuation centre ☐
Others, please specify: _____

b. 'Habagat' (2013): stayed home and did nothing ☐
vacated ground floor and stayed at the 2nd floor ☐
vacated ground floor and stayed on the roof ☐
vacated 2nd floor and stayed at 3rd/upper floor/roof ☐
vacated the house and stayed at neighbour's house ☐
vacated the house and stayed at evacuation centre ☐
Others, please specify: _____

22. Course of action after flood events:

a. Typhoon 'Ondoy' (2009): no action taken ☐
cleaned the house ☐
minor repairs ☐
major repairs ☐
renovated the house ☐
totally replaced the house ☐

b. 'Habagat' (2013): no action taken ☐
cleaned the house ☐
minor repairs ☐
major repairs ☐
renovated the house ☐
totally replaced the house ☐

23. Improvements done on the house to reduce flood impacts:

a. Floor / floor level: no improvements made ☐
replaced with more durable material ☐
elevated the ground floor ☐
added an upper floor ☐
added roof deck ☐
Others, please specify: _____

b. Walls: no improvements made ☐
replaced with more durable material ☐
added bracing / supports ☐
added double walling ☐
Others, please specify: _____

c. Roof: no improvements made ☐
replaced with more durable material ☐
added bracing / supports ☐
added double roofing ☐
Others, please specify: _____

d. Plinths / stilts: no improvements made ☐
replaced with more durable material ☐
elevated plinths / stilts ☐
added bracing / supports ☐
Others, please specify: _____

Control no. B1-1-50 _____ ☐
B2-1-50 _____ ☐
B3-1-50 _____ ☐

24. Improvements to be done on the house if given the choice:

a. Floor / floor level:
- no improvements needed ☐
- replace with more durable material ☐
- elevate the ground floor ☐
- add an upper floor ☐
- add roof deck ☐
- Others, please specify: _____

b. Walls:
- no improvements needed ☐
- replace with more durable material ☐
- add bracing / supports ☐
- add double walling ☐
- Others, please specify: _____

c. Roof:
- no improvements needed ☐
- replace with more durable material ☐
- add bracing / supports ☐
- add double roofing ☐
- Others, please specify: _____

d. Plinths / stilts:
- no improvements needed ☐
- replace with more durable material ☐
- elevate plinths / stilts ☐
- add bracing / supports ☐
- Others, please specify: _____

25. Please use the space below if there are any other information you would like to add:

_____

_____

_____

_____

_____

_____.

Thank you for your participation in this survey.

Appendix C: Transitional settlement development work phase plan

C.1 Sitio Gulayan community existing SDP

C.2 Sitio Gulayan community site survey plan

3.0-metre river easement

Tullahan River

Concrete dike

Sanciangco St.

People's Park

Gov. Pascual Ave.

N

W

E

S

Legend:

- Vacant lot
- River easement
- Concrete dike
- Property line

C.3 Sitio Gulayan community conceptual master development plan

Relocation site for 300 houses along roads

Relocation site for 450 houses along roads

Road 1: 200 houses relocated to zones 1 & 4

Road 2: 200 houses relocated to zones 1 & 4

Relocation site for 75 houses along communal toilets and water station areas

Road 3: 200 houses relocated to zones 1 & 4

Road 4: 150 houses relocated to zones 1 & 4