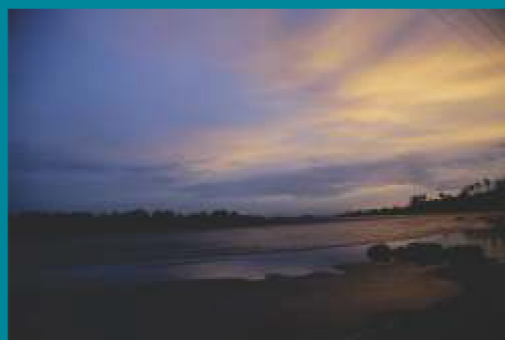


Mullaitivu

Disaster Risk Reduction and Preparedness Plan

Towards a Sustainable and Resilient City



Disaster Resilient City Development Strategies for four Cities in the Northern and Eastern Provinces of Sri Lanka

Mullaitivu (Maritimepattu Pradeshiya Sabha)

Disaster Risk Reduction and Preparedness Plan

Towards a Sustainable and Resilient City

Disaster Resilient City Development Strategies for four cities
in the Northern and Eastern Provinces of Sri Lanka



© United Nations Human Settlements Programme (UN-Habitat) - Sri Lanka

DISCLAIMER

Views expressed in this publication do not necessarily reflect those of the United Nations Human Settlements Programme, the United Nations and its member states or those of the Government of Australia. The designations that are employed and the presentation of the elements contained therein do not imply the expression of any opinion whatsoever on the part of UN-Habitat and its Board of Directors concerning the legal status of any country, territory, city or its authorities, or concerning the delimitation of its frontiers or boundaries.

Published by the United Nations Human Settlements Programme. This publication may be reproduced in whole or in part, in any form, for educational or non-profit purposes, without the prior authorization of the copyright holder, on condition that the source is indicated. UN-Habitat would like to be informed whenever excerpts of this guide are reproduced. This publication may not be resold, or used for other commercial purposes, without the prior written authorization of the United Nations Human Settlements Programme.

The United Nations Human Settlements Programme (UN-Habitat) - Sri Lanka
202-204, Baudhaloka Mawatha, Colombo 07, Sri Lanka
Tel : +94 11 2580691
Fax : +94 11 2581116
Web: www.unhabitat.lk

Contents

Abbreviations and Acronyms	vi
Acknowledgements	vii
Foreword	viii
Executive Summary	ix
1. Introduction	1
1.1 Project Background	2
1.2 Rationale for the Project	4
1.3 Project Methodology	6
1.4 Resilient Cities	8
1.4.1 Incorporating the Hyogo Framework for Action	9
1.5 Disaster Response Governance	9
1.6 Conclusion	12
2. Baseline Information	13
2.1 Local Area Profile	14
2.1.1 History	14
2.1.2 Topography	15
2.1.3 Geology	15
2.1.4 Climatic Conditions	15
2.1.5 Hydrology	17
2.2 Socio-Economic Profile	20
2.2.1 Demography	20
2.2.2 Housing	22
2.2.3 Economic Base	22
2.2.4 Land Use	22
2.3 Conclusion	24
3. Strategic Assessments	25
3.1 Methodology	26
3.1.1 Hazard, Vulnerability, Risk and Capacity Assessments	26
3.2 Community Hazard Assessment	29
3.3 Detailed Hazard Mapping	33
3.4 Vulnerability and Risk Assessment	36
3.5 Capacity Assessment	40
3.6 Risk Mapping	40
3.7 Multiple Hazards and Very High Risk Locations	44
3.8 SWOT Analysis	46
3.9 Core Problem Analysis	50
3.10 Conclusion	52

4.	Strategic Directions	53
4.1	Vision and Strategic Directions	54
4.2	Strategic Directions, Strategies and Action Projects	55
4.2.1	Improving the Physical Environment of the City and its Land Use Management for Risk Sensitive Development	56
4.2.2	Empowered and Capable Communities	57
4.2.3	Enhance Safety and Wellbeing of Citizens	57
4.2.4	Resilient Communities with Social Networks, Information Managing and Sharing	58
4.2.5	Promote Proactive Disaster Management through DRR Programmes	58
4.3	Conclusion	58
5.	Action Projects	59
5.1	Actions Projects to Improve the Physical Environment and Land Use Management for Risk Sensitive Development	64
5.1.1	Drainage Master Plan and Drainage Construction	64
5.1.2	Construction and Reconstruction of Culverts, Drains and Canals	71
5.1.3	Riverine Development along Main Hydrological Canals and Lagoon, and Urban Beautification	72
5.1.4	Coastal Green belt	77
5.1.5	Promotion of Nature Parks	79
5.2	Action Projects to Empower and Build the Capacity of Communities	82
5.2.1	Horticultural Gardening Awareness Programmes	82
5.2.2	Rainwater Harvesting Systems	82
5.3	Action Projects to Enhance the Safety and Well being of Citizens	84
5.3.1	Reconstruct Bridges	84
5.3.2	Develop an Early Warning and Early Communication System	87
5.3.3	Training Programmes for Forecasting and Early Warning Centres	87
5.3.4	Training, Awareness and Campaigns for Community Action	87
5.3.5	Supporting aspects of Early Warning Centres	88
5.4	Action Projects to Enhance the Capacity for Resilience in Vulnerable Communities and Enable Preparedness and Response Strategies	91
5.4.1	Community Awareness and Coordination	91
5.4.2	Sharing National and International Experience	92
5.4.3	Provide Disaster Recovery Equipment and Materials	92
5.4.4	Develop a Cooperative Donation System	93
5.5	Action projects to ensure Continuous Monitoring and Evaluation	94
5.6	Conclusion	94
6.	Conclusion	95
	References	97
	Annexure	99
	Annexure A – Links to the Hyogo Framework for Action	99
	Annexure B – Evaluation Form: Significance of the Impact on Elements at Risk in Hazard Events	106
	Annexure C – Draft Implementation Plan, Physical Improvement Projects	109
	Annexure D – Hydrology Analysis and Information for Drainage Master Plan	111

List of Figures and Tables

Figure 1: Project Locations	3	Figure 41: "V" Shaped flow deflectors on piers	86
Figure 2: Planning Process	7	Figure 42A: Proposed Bridge	86
Figure 3: Institutional Disaster Management Framework	11	Figure 4B: Proposed Bridge and the surrounding area	87
Figure 4: Soil Map of Maritimé pattu PS area	16	Figure 43: Early warning communication network	90
Figure 5: Monthly Rainfall Pattern	17		
Figure 6: Annual Rainfall Variation	17		
Figure 7: Average Annual Temperature	17		
Figure 8: Average Monthly Temperature	17	Table 1: Project Partners	4
Figure 9: Hydrological System of Maritimé pattu PS	19	Table 2: Major and Medium size tanks in aritimé pattu DS division	18
Figure 10: Population Pyramid by Age Group	20	Table 3: Minor tanks in each agrarian service division	18
Figure 11: Population Density map of Mullaitivu Project Area	21	Table 4: Hazard Assessment Process	27
Figure 12: Land Use Map of the Project Area	23	Table 5: Process to Access Vulnerability	27
Figure 13: Vulnerability and Risk Assessment Methodology	29	Table 6: Risk Assessment Process	28
Figure 14: Drought Hazard Map developed by the community	30	Table 7: Hazard, Vulnerability and Risk Considerations	36
Figure 15: Flood Prone Areas identified by the community	31	Table 8: Capacity Assessment Factors and Indicators	40
Figure 16: Tsunami Prone Areas identified by the community	32	Table 9: SWOT strengths	47
Figure 17: Drought Hazard Prone Area of Maritimé pattu PS	34	Table 10: SWOT weaknesses	48
Figure 18: Flood Hazard Prone Area of Maritimé pattu PS	35	Table 11: SWOT opportunities	49
Figure 19: Social Vulnerability of Maritimé pattu PS	37	Table 12: SWOT threats	50
Figure 20: Economic Vulnerability of Maritimé pattu PS	38	Table 13: Strategic Directions and Rational	55
Figure 21: Environmental Vulnerability of Maritimé pattu PS area	39	Table 14: Strategic Direction 1 – Strategies and Action Projects	56
Figure 22: Composite Flood Risk Map	42	Table 15: Strategic Direction 2 – Strategies and Action Projects	57
Figure 23: Composite Drought Risk Map	43	Table 16: Strategic Direction 3 – Strategies and Action Projects	57
Figure 24: Multiple Hazard Risk Map	45	Table 17: Strategic Direction 4 – Strategies and Action Projects	58
Figure 25: Structural and Non-Structural Action Projects	64	Table 18: Strategic Direction 5 – Strategies and Action Projects	58
Figure 26: Kallappadu South GND	65	Table 19 A-D: Priority Action Projects under the Strategic Directions	60-63
Figure 27: Drainage Master Plan Methodology	66	Table 20: Implementation Schedule	70
Figure 28: Vinayagar Road drainage options at either centers or side of the road	71	Table 21: Warning levels and actions required	88
Figure 29: Proposed Vinayagar Road with center drainage	72	Table 22: Warning messages and actions required	89
Figure 30: Nanthikadal Lagoon	73		
Figure 31: Proposed Boardwalk site at Nayar Lagoon	75		
Figure 32: Proposed Boardwalk site at NanthiKadal Lagoon	76		
Figure 33: Boardwalk and Lagoon	77		
Figure 34: Proposed Site for Coastal Vegetation	78		
Figure 35: Coastal Re-vegetation	79		
Figure 36: Proposed Site for Natural Parks	80		
Figure 37: Basic Elements of Rain water Harvesting System	83		
Figure 38: Rainwater Harvesting System	83		
Figure 39: Bridges of Maritimé pattu PS	85		
Figure 40: Depth of Footings	86		

Abbreviations and Acronyms

Ac.ft	Acre-foot
CBO	Community Based Organisation
CCD	Coastal Conservation Department
CEA	Central Environmental Authority
CEB	Ceylon Electricity Board
DFID	Department for International Development
DMC	Disaster Management Centre
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DS	Divisional Secretariat
DSD	Divisional Secretariat Division
FGD	Focus Group Discussion
G.C.E O/L	General Certificate of Education Ordinary Level
G.C.E A/L	General Certificate of Education Advanced Level
GN	Grama Niladhari
GND	Grama Niladhari Division
ha	hectare
HFA	Hyogo Framework for Action
ICTAD	Institute for Construction Training and Development
km	kilometre
km/h	kilometre per hour
LA	Local Authority
LKR	Sri Lankan Rupee
m	metre
mm	millimetre
MPS	Maritimepattu Pradeshiya Sabha
MUC	Mannar Urban Council
NBRO	National Building Research Organisation
NCDM	National Council for Disaster Management
NGO	Non-Government Organisation
NWSDB	National Water Supply and Drainage Board
PS	Pradeshiya Sabha
RDA	Road Development Authority
SLILG	Sri Lanka Institute of Local Governance
SWOT	Strengths, Weaknesses, Opportunities and Threats
UC	Urban Council
UDA	Urban Development Authority
UNISDR	United Nations Office for Disaster Risk Reduction
UNOPS	United Nations Office for Project Services
UOM	University of Moratuwa
VUC	Vavuniya Urban Council

Acknowledgements

The *Mullaitivu Disaster Risk Reduction and Preparedness Plan: Towards a Sustainable and Resilient City* was jointly prepared by the United Nations Human Settlements Programme (UN-Habitat) in partnership with the Maritimpattu Pradeshiya Sabha and the Project Director, Project Consultancy Unit, Faculty of Architecture, University of Moratuwa. The Maritimpattu Pradeshiya Sabha is located in the Mullaitivu District on the eastern coast of Sri Lanka, in the Northern Province, and has jurisdiction over Mullaitivu town, which is the main town in the Mullaitivu District.

As the principal implementing partner, UN-Habitat gratefully acknowledges the time and expertise of our partners and many contributors in preparing this Plan. In particular, the Secretary and officers of the Maritimpattu Pradeshiya Sabha and staff of the Assistant Commissioner of the Local Government Office involved in this project are acknowledged for their unstinting support towards formulating the Plan. The Government Agent of the Mullaitivu District and the Divisional Secretariat of Maritimpattu and its officers are also acknowledged for their support to the Project team.

UN-Habitat appreciates the support provided by the Project team, Project Consultancy Unit, Faculty of Architecture, University of Moratuwa, who have been tireless in their efforts to undertake vulnerability, hazard and risk assessments and disaster risk reduction planning in the Maritimpattu Pradeshiya Sabha area.

Our appreciation is also extended to the following national organisations: the Ministry of Disaster

Management, the Urban Development Authority, the Disaster Management Centre, the Meteorological Department, the Survey Department and the Irrigation Department, for providing data and information and sharing their technical knowledge. The staff at the Sri Lankan Institute of Local Governance have provided training and teaching to local authority officials to ensure disaster risk reduction practices can be implemented at the Pradeshiya Sabha level. The staff at the Institute for Construction Training and Development have trained local masons, carpenters and artisans in innovative ways to implement Disaster Risk Reduction designs into building construction at the local level.

The officers of other institutions who represented government and non-government agencies, community based organisations, the Grama Niladhari Divisions (GNDs) and the local communities of the Maritimpattu Pradeshiya Sabha area are gratefully acknowledged for sharing their ground level experience, and for their active participation in workshops and meetings.

UN-Habitat is grateful to the Government of Australia for the financial assistance provided to implement this project and in making Maritimpattu a disaster resilient area.

Finally, thanks must go to the drafters of the report, photographers, our editors as well as our translators who have ensured that the Disaster Risk Reduction and Preparedness Plans can reach all audiences in Sri Lanka.

Foreword

The Disaster Resilient City Development Strategies for Sri Lanka Project is a strategic plan to deliver Disaster Risk Reduction strategies and increase resilience, leading to healthier, sustainable cities throughout Sri Lanka. The project has been implemented by UN-Habitat in collaboration with the Disaster Management Center (DMC), the Urban Development Authority (UDA), the Sri Lanka Institute of Local Governance (SLILG), the Institute for Construction Training and Development (ICTAD), the University of Moratuwa (UOM), and four Local Authorities: Maritimpattu Pradeshiya Sabha (Mullaitivu), Mannar Urban Council, Vavuniya Urban Council and Akkaraipattu Municipal Council. This is the second phase of the Disaster Resilient City Development Strategies for Sri Lanka. The first Phase was completed in 2013 in collaboration with the Balangoda Urban Council, Ratnapura Municipal Council, Kalmunai Municipal Council and Batticaloa Municipal Council.

The main objective of this project is to establish the planning framework and then assist the Councils to implement selected projects that will enable each local authority to move towards reducing their vulnerability to disasters whilst increasing their sustainability and resilience.

This report compiles identified strategies into a Disaster Risk Reduction and Preparedness Plan developed specifically for the Maritimpattu Pradeshiya Sabha area. The Plan was prepared by conducting a thorough analysis of background information. This includes a comprehensive baseline assessment that is complimented by a comprehensive technical study incorporating the findings of the vulnerability and risk assessment and a SWOT analysis. These inputs were gathered through a participatory approach that included stakeholder workshops and focus group discussions. The goal of increased resilience and the outcomes of the assessments influenced the strategic directions that shape the action projects proposed in the final part of this document. The action projects component includes detailed descriptions of individual projects, estimated costs, benefits and responsible agencies for project implementation.

Fundamentals of the Plan and proposed activities are aligned with the priorities for action from the Hyogo Framework for Action to assist in establishing Maritimpattu as a resilient area.

**United Nations Human Settlements Programme
(UN-Habitat), Sri Lanka.**

Executive Summary

The *Mullaitivu Disaster Risk Reduction and Preparedness Plan*, themed “Towards a Sustainable and Resilient City,” was completed through the Disaster Resilient City Development Strategies for Sri Lanka Project. It assesses the current situation in Mullaitivu, provides detailed recommendations from a strategic planning perspective, and identifies projects that will assist in reducing risk and vulnerability, whilst enhancing resilience and preparedness of the citizens and the city. The Maritimpattu Pradeshiya Sabha is located in the Mullaitivu District on the eastern coast of Sri Lanka, in the Northern Province. It has jurisdiction over Mullaitivu town, which is the main town in the Mullaitivu District.

The introductory chapter outlines the background and governance of the project, and then presents a small study of resilience, moving from the global level to the context of Sri Lanka and to Maritimpattu to explain how this Pradeshiya Sabha (PS) was selected for this project. It contains a brief introduction to the project site, as well as an outline of the project methodology, in particular its strong participatory approach and stakeholder involvement elements. The introduction also includes a section on resilience and the Hyogo Framework for Action (HFA). It concludes with an explanation of the disaster response governance framework in Sri Lanka.

This project involved gathering and analysing a large volume of current and historical records across a range of fields. A summary of the analysis is presented in Chapter 2 – Maritimpattu Baseline Information. The chapter is divided into a Local Area Profile and a Socio-Economic Profile. The Local Area Profile includes information on history, topography, climatic conditions and hydrology in the Project Area, while the Socio-Economic Profile contains demographic, housing, economic base, social services and land use information.

Background information and stakeholder consultations were used as a base to conduct a number of assessments. These assessments, presented in Chapter 3 – Strategic Assessments, include the following:

- A hazard assessment to consult the community on the nature of the hazards they encounter and where they occur;
- A vulnerability and risk assessment to assess the city's vulnerabilities to disasters (physical, social, economic and environmental) and the ways in

which hazards and vulnerability occur, as well as to identify high risk areas;

A capacity assessment to understand where the strengths and gaps within the current social and institutional models are;

A strategic SWOT analysis to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in the process of achieving resilience in the Maritimpattu PS area; and

A core problem analysis to identify common problems, their locations and to assist in prioritising problem solving.

The assessments used an analysis of the baseline information and a series of interviews and workshops with stakeholders, including local communities and institutions, civil society, the government, the private sector, development practitioners and academics. The assessments produced a series of maps indicating risk levels relating to hazards identified by the community. These maps culminate with the multi-hazard risk map, which identifies ten very high-risk locations within the Maritimpattu Project Area.

Strategic Directions and Action Projects were derived from the assessments. Chapter 4 – Strategic Directions, outlines the five directions that were developed and how each satisfies the expectations of the Maritimpattu PS community, and simultaneously meeting the priorities and tasks listed through the HFA. Chapter 5 – Action Projects, provides detailed descriptions on the projects. Detailed Strategic Directions and Action Projects are given below.

Priority should be given to action projects for which resources and local capacity already exist, as visible results are then likely to occur. This may motivate stakeholders, while also contribute to creating awareness on the importance of Disaster Risk Reduction (DRR) in the city.

This Plan suggests realistic and fundamental improvements to the existing DRR framework of the city — improvements that will minimise the effects of hazards and provide local authorities and citizens of the Maritimpattu Pradeshiya Sabha area with clear and achievable directions to become a sustainable and resilient city.

Strategic Directions	Strategies	Action Project Detailed
Direction 1 – Improving the City's Physical Environment and its Land Use Management for Risk Sensitive Development	Strategy 1: Rehabilitate the existing irrigation tanks and canal systems, and drainage system to effectively manage flood, drought and sea erosion	Drainage Master Plan and Drainage Construction with best management practices (Kallappadu South GN Division); Construction and Reconstruction of culverts, drains and canals; Reconstruction of Vinayagar Road (join to main road).
	Strategy 2: Flood mitigation and protection of vulnerable public areas	Riverine development along main hydrological canals and lagoons in the Maritimé pattu area and the application of an urban beautification approach – (Nandikadal, Nayaru); Planting a green belt along the coastal line.
	Strategy 3: Implementation of eco-tourism in the area	Promote nature parks – (Chemmalai East, Kumulamunnai East close to the Nayaru Lagoon).
Direction 2 – Creating Empowered and Capable Communities	Strategy 1: Introduce a horticulture system with rainwater utilization	Encouraging horticulture gardens; Providing an introduction to and the building of rainwater harvesting systems to the villagers where safe drinking water is lacking in GNDs – (Kokkuthoduwai North, Kokkuthoduwai Centre, Kokkilai East, Keppapilavu Model Village); Organizing competitions for home gardens.
Direction 3 – Enhancing the Safety and Wellbeing of Citizens	Strategy 1: Protect vital facilities	Reconstruction of Bridges – Vadduvakal Bridge (Increase the height of the bridge).
	Strategy 2: Introduce an early warning system	Develop a methodology for forecasting disaster situations and introduce a mechanism to make people aware of potential disasters; Training programmes for Flood Forecasting and Early Warning Center (FFWC) and Zonal Early Warning Centers (ZEWC); Trainings, awareness programmes and campaigns within the community.
Direction 4 – Building Resilient Communities with Social Networks, Information Management and Sharing	Strategy 1: Develop an integrated experience sharing mechanism	Capacity Building Awareness Programmes International and national experience sharing; Teams with disaster management skills.
	Strategy 2: Empower community level organisations to have access to technology and knowledge that would assist in reducing vulnerabilities	Provide disaster recovery equipment and materials; Develop a cooperative disaster recovery donation system.
Direction 5 – Promoting Proactive Disaster Management through Risk Reduction Programmes	Continuous assessment, evaluation and monitoring of DRR Projects	This will be applied to all DRR Projects.



Introduction



Introduction

This chapter provides a background to introduce the Disaster Resilient City Development Strategies for Sri Lanka Project and how this document, the *Mullaitivu (Maritimepattu PS) Disaster Risk Reduction and Preparedness Plan* (the Plan), was prepared. This includes an explanation of the project background, the rationale for the project – going from the global context to the Sri Lankan context, before briefly introducing the Project Area. The project methodology, which was based around a participatory approach and encouraged stakeholder involvement, is also outlined. The chapter then moves to resilient cities and defines resilience and provides an introduction to the Hyogo Framework for Action (HFA) tasks and priorities. The benefits from following the HFA priorities in creating and sustaining a resilient city are also explained. Finally, a succinct explanation of the disaster response governance framework in Sri Lanka is provided.

1.1 Project Background

The Disaster Resilient City concept has been introduced globally as a tool for reducing the vulnerability of local governments to disasters through training, capacity building and capital investment programmes that identify priorities for building sustainable and resilient communities.

Understanding climate change, development policies, disaster management and the level of knowledge in a society are integral components of the disaster resilient city development approach. Cities require localised and integrated disaster management approaches to mitigate the impacts of hazards. Comprehensive studies on the consequences of climate change, the relationship between urban and financial trends, disaster risk management and sustainable development needs to underpin disaster resilience work. In this context, UN-

Habitat in collaboration with the University of Moratuwa (UOM), the Urban Development Authority (UDA), the Disaster Management Center (DMC), Mannar Urban Council (MUC), Vavuniya Urban Council (VUC), Maritimepattu Pradeshiya Sabha (MPS), Akkaraipattu Municipal Council (AMC), the Sri Lanka Institute of Local Governance (SLILG) and the Institute for Construction Training and Development (ICTAD), worked on this project to focus on practical outcomes that assist in creating disaster resilient cities in Sri Lanka. This project is financially assisted by the Government of Australia. This is Phase Two of the Project, with Phase One completed in 2013 in the Balangoda Urban Council, Ratnapura Municipal Council, Kalmunai Municipal Council and Batticaloa Municipal Council.

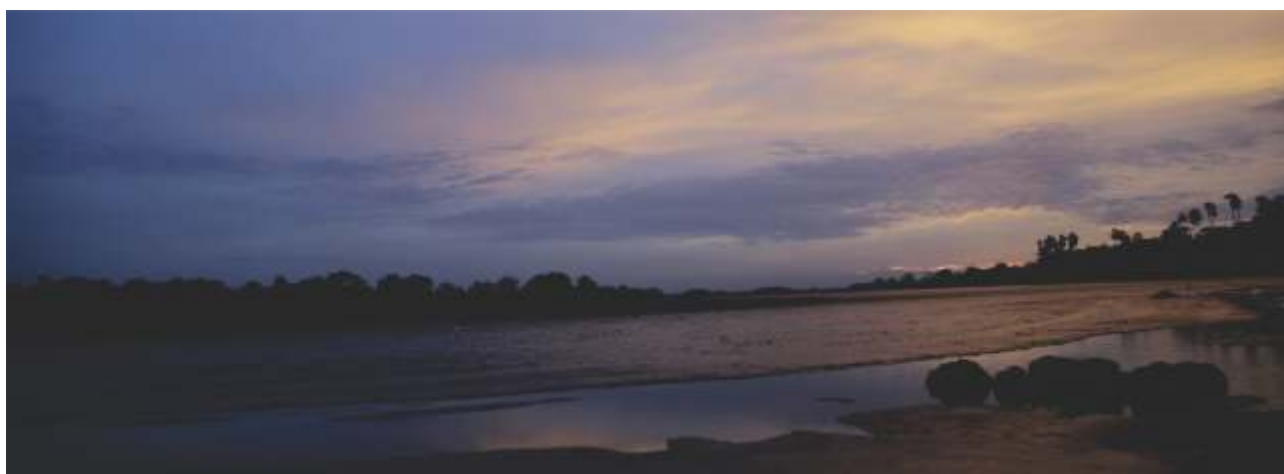
The primary goal of the project is to establish sustainable, disaster resilient and healthy cities and townships in disaster prone regions of Sri Lanka. The project is being conducted in the Northern Province (MUC, VUC and MPS), as well as the Eastern Province (AMC). Figure 1: Project Locations, provides a map to illustrate where each Local Authority (LA) is located in Sri Lanka. The Northern and the Eastern Province, are both considered as lagging regions, and all four Councils assisted:

- Have been declared as urban development areas identified under Urban Development Authority law indicating potential for, and government policy that supports, urban growth;

- Do not currently have approved development and land use plans, or their plan is out-dated and does not include disaster risk reduction considerations;

- Are vulnerable to multiple disasters; and

- Have been poorly rated based on socio-economic indicators such as economic performance and poverty, access to basic services and unemployment.



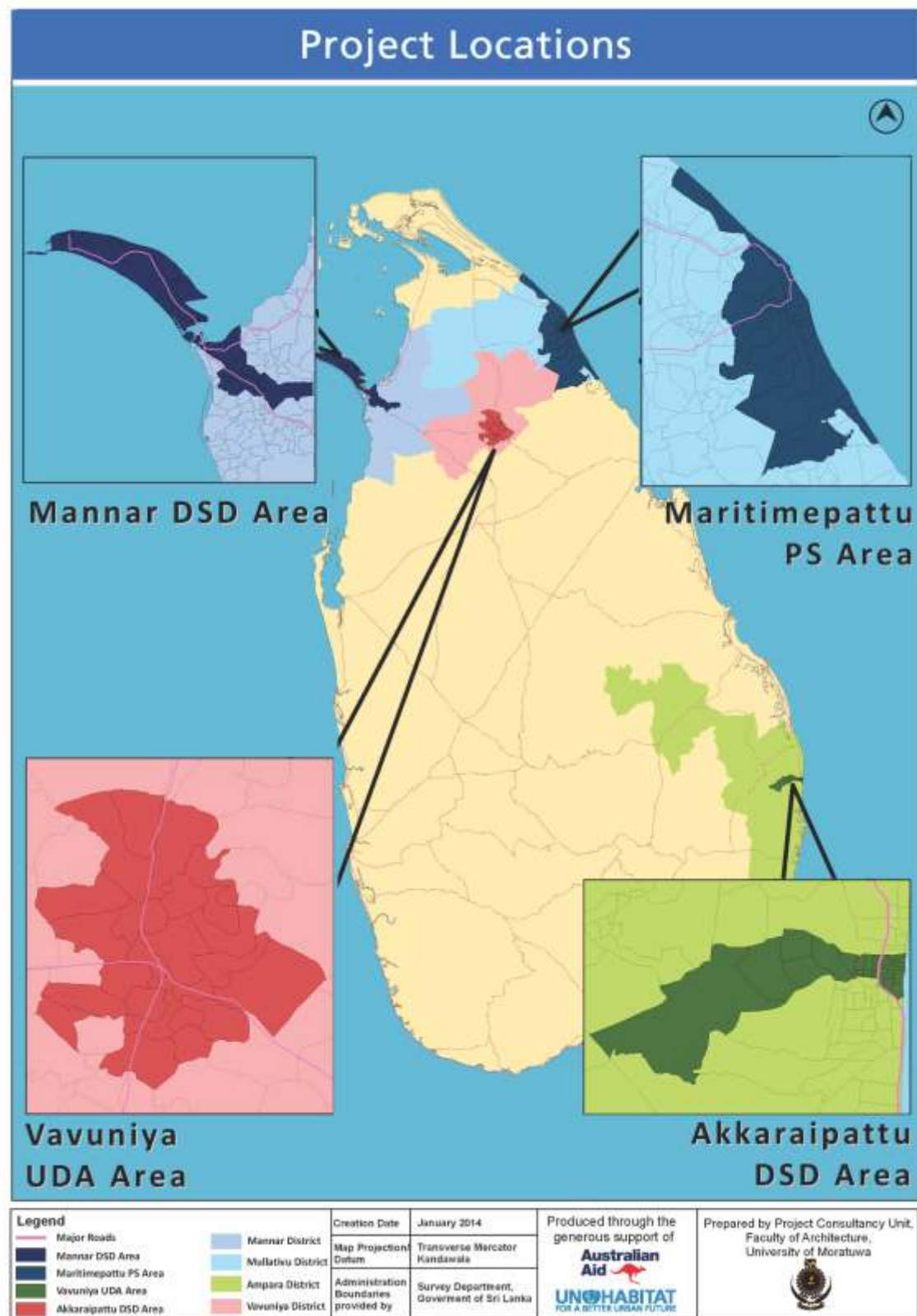


Figure 1: Project Locations

The Disaster Resilient City Development Strategies Project (Phase Two) has nine outputs:

1. Vulnerability assessments conducted to promote disaster resilient local development plans;
2. Disaster Preparedness Plans prepared for the selected LAs;
3. Capacity building of the LAs to enable them to promote disaster resilient human settlements;
4. DRR features incorporated into the LAs building guidelines and regulations;
5. Improved awareness and capacity of the communities to enable disaster resilience;
6. Community partnerships with LAs on disaster response activities promoted in lagging regions;
7. Guidelines for the incorporation of DRR aspects in housing construction introduced to LAs, local house builders and communities;
8. Guidelines and methodology for retrofitting to reduce disaster risk introduced to LAs, local house builders and communities; and
9. Lessons learned and good practices in selected LAs are well captured, documented and disseminated at local and international levels.

This *Mullaitivu Disaster Risk Reduction and Preparedness Plan* also includes the outcomes of the vulnerability and disaster risk assessments (outputs one and two as above).

The key project partners, their role, and how their work assists in meeting the outputs listed above, are listed in Table 1.

Project Partner	Role	Meets Project Output
Government of Australia	Financial Assistance	1-9
UN-Habitat Sri Lanka	Mobilisation and Technical Support	1-9
Disaster Management Center	Technical Support	3,5,6
Urban Development Authority	Planning Support	2,4,7,8
University of Moratuwa	Technical Support	1,2
Local Authorities (MUC, VUC, MPS and AMC)	Project Implementation	1-9
Sri Lanka Institute of Local Governance	Project Implementation / Capacity Building	3,4
Institute for Construction Training and Development	Project Implementation / Capacity Building	4,7,8

Table 1: Project Partners

1.2 Rationale for the Project

Disasters interrupt communities and city functions; they result in the loss of properties, loss of commerce, disrupt day-to-day lives and livelihoods, and sometimes take human lives as well. Many countries, especially those that have faced disasters and been badly affected, have updated their policy and development strategies with special consideration to disaster management, risk reduction and adaptation.

Global Context

Globally resilient cities, community development, environmental planning and disaster management have been influenced by several policy frameworks from the first United Nations Conference on Environment and Development held in Rio de Janeiro in 1992, when Agenda 21 was adopted, through to the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters.

The United Nations Framework Convention on Climate Change defines climate change as the change that can be attributed “directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.”¹ Meteorological conditions such as rainfall, temperature, wind and sunshine have changed considerably in their intensity, term and duration over recent decades. With the changed weather patterns, the intensity of natural hazards such as floods, landslides, cyclones and droughts have risen also increasing the vulnerability of human settlements to disasters. Mitigation measures have to be taken to reduce disaster risk with careful evaluation of settlements and their vulnerability to natural hazards.

Global experience indicates that social support networks, building social capital, knowledge sharing and improving self-reliance through capacity building, resource availability and governmental agencies' preparedness, have direct and positive impacts on disaster resistant communities and city development.

Protecting natural areas that can absorb and reduce the impacts of hazards is a strategic solution. Hazard mitigation saves lives and property and reduces vulnerability to future disasters. Avoiding development in hazard-prone areas by steering new development to lower risk areas, safeguarding existing development through engineered structural mitigation, relocating damaged buildings to safer areas following a disaster were practiced by most of the disaster prone cities.

Strategically planning land uses and constructing new buildings and infrastructure that are located in hazard-prone areas only through the application of strict building codes, design standards, and informed construction practices are also strategic solutions.

A resilient community can minimise economic and social disruptions, and recover much faster after a disaster, while safeguarding citizens and protecting economic, social, and environmental conditions.

The Sri Lankan Context

Sri Lanka is a tropical island with diverse topographic features and with two annual monsoons – the south-west and north-east – which bring heavy rains to particular areas of the country throughout the year. Sri Lanka is affected by many natural hazards: floods, droughts, landslides, cyclones, storms, winds, tsunamis, lightning, coastal erosion and coastal storm surge and inundation – all of which are experienced in differing frequencies and magnitudes. Many districts are affected

by multiple hazards. Climatic variations and change has caused an increase in hazard occurrences as well as other associated issues such as epidemics. This has ultimately resulted in increasing expenditure on social and emergency services and damage recovery.

Additionally urbanisation trends and pressures have increased. The National Physical Plan, which was gazetted in 2011, anticipates that more than 50% of the country's population will be living in declared urban areas by 2030. This urbanisation process will affect the natural environment. Several areas of Sri Lanka are already considered vulnerable to disaster, therefore it is essential to mitigate hazards and create sustainable urban development through innovative, locally driven initiatives.

Studies on global climate change have recognised the need for sustainable solutions for these problems. In this context, the urgent need for specific urban planning guidelines has been recognised and the Resilient City concept has been established as a pathway to build more sustainable cities for the future. As in other countries, in Sri Lanka there is a shared agreement to make cities resilient for future generations. Several frameworks, including the HFA provide valuable guidance on resilient city development and how to proceed with implementation.

In Sri Lanka, many declared urban areas do not have development plans, and of those that do, most do not consider disaster risk reduction. Participatory planning approaches are not commonly adopted, especially in the field of disaster risk reduction planning, because of a lack of skilled professionals in this area.

The Northern and Eastern Provinces are challenging areas to implement participatory planning processes for disaster risk reduction. Recent history, which has included three decades of conflict and resulted in serious damage throughout the provinces, also now includes many new developments and rebuilding, especially of housing and infrastructure. Vulnerability to natural disasters and disaster risk reduction methodologies must be included in these new developments to ensure their sustainability. The mainstreaming of disaster risk reduction, mitigation, adaptation and response must become an inherent part of LA practices and policies. Furthermore, communities must understand the risks they face and learn how to mitigate these or respond safely. This project has sought to address these issues in the Maritimpeattu Pradeshiya Sabha area by identifying the risks and climate change impacts, consulting widely with stakeholders, improving LA policies and linking the community with early warning systems.

¹ Article 1, United Nations Framework Convention on Climate Change, Available online at: http://unfccc.int/essential_background/convention/background/items/2536.php (accessed on 29 July 2014)

The Maritimpattu Project Area

The Project Area covers the Maritimpattu Pradeshiya Sabha Area, which includes the administrative boundaries of Maritimpattu's Divisional Secretariat Division. Another DSD of Welis Oya was added to this PS after the project started, and as such, is not taken into consideration in this plan. The Maritimpattu PS is located in the Mullaitivu District on the eastern coast of Sri Lanka, in the Northern Province, and has jurisdiction over Mullaitivu town, which is the main town in the Mullaitivu District. The area has been declared by several government and non-government agencies as a disaster prone area highly vulnerable to multiple disasters due to its physical, socio-economic and environmental situation. In this report the Maritimpattu PS, Mullaitivu and Project Area are used interchangeably to refer to the area under study.

Mullaitivu regularly experiences droughts, floods, strong winds and lightning and being a coastal area is open to the threat of coastal hazards. These have caused significant loss to life and property on a number of occasions over several years. The area was severely affected during the 2004 tsunami with heavy loss to life and property.

The Plan provides guidance to city planners and decision makers to assist in making Mullaitivu a resilient, sustainable and healthy city. DRR measures need to be implemented across multiple levels of city operations. These can be as varied as enforcing building codes, to providing training for community leaders on early warning. Issues that increase vulnerability and the incidence of hazards must be recognised and then solutions implemented to address the root causes.

The Plan will enable the Maritimpattu PS to address the following:

- Physical vulnerability – the likelihood of physical impacts on the built environment and population;

- Economic vulnerability – the potential impacts of hazards on economic assets and livelihoods, including the vulnerability of different economic sectors;

- Social vulnerability – the potential impacts of hazardous events on vulnerable groups such as people living below the poverty line, single parent households, including female headed households, pregnant or lactating women, the disabled, children, and the elderly. Considerations include public awareness about risks, the ability of different groups to cope independently with catastrophes, and the strength of institutional structures designed to help them cope; and

Environmental vulnerability – the potential impacts of events on the environment, and the ability of the environment to absorb impacts.

The Maritimpattu PS needs to plan interventions to build a resilient physical, social and natural environment for the future safety of its population. This project is intended to provide relevant guidance to urban planners and local authorities to prepare disaster resilient city development strategies for the Maritimpattu PS area.

1.3 Project Methodology

A participatory approach is at the core of this project. From the initial stages through to the completion of implementation, the project must meet stakeholder expectations. At the initial stage, the project team developed a stakeholder inventory. Workshops and Focus Group Discussions (FGD) were conducted to introduce the project to various stakeholders, to listen and learn from their knowledge and experiences. Throughout the project, feedback was continually sought from the stakeholders, and opportunities taken to update them on the progress of the Plan. The project methodology that was established for Phase One of the Disaster Resilient City Development Strategies for Sri Lanka Project was followed, however modifications from lessons learnt were incorporated to facilitate an improved outcome.

The Plan was prepared by conducting a comprehensive baseline technical study and incorporating the findings of the vulnerability and risk assessment, outcomes of the workshops and FGDs as well as field observations. In addition, international case studies were reviewed to understand how other cities in the world have adopted structural and non-structural disaster mitigation measures. Professionals, including Planners, Engineers, Architects and Designers were widely consulted in the plan preparation process. Advice on environmental management, social development, infrastructure planning, economic development and architectural design, including disaster risk reduction methodologies have been combined through this process to provide consistent guidance to the public participation and mobilisation processes.

The framework of the Plan is based on the international strategy for disaster reduction, the HFA (see Section 1.4.1 – Incorporating the Hyogo Framework for Action). Figure 2: Planning Process illustrates the methodology undertaken in completing this project from data collection through to identifying action projects to build city resilience.

Disaster Risk Reduction Plan - Processes

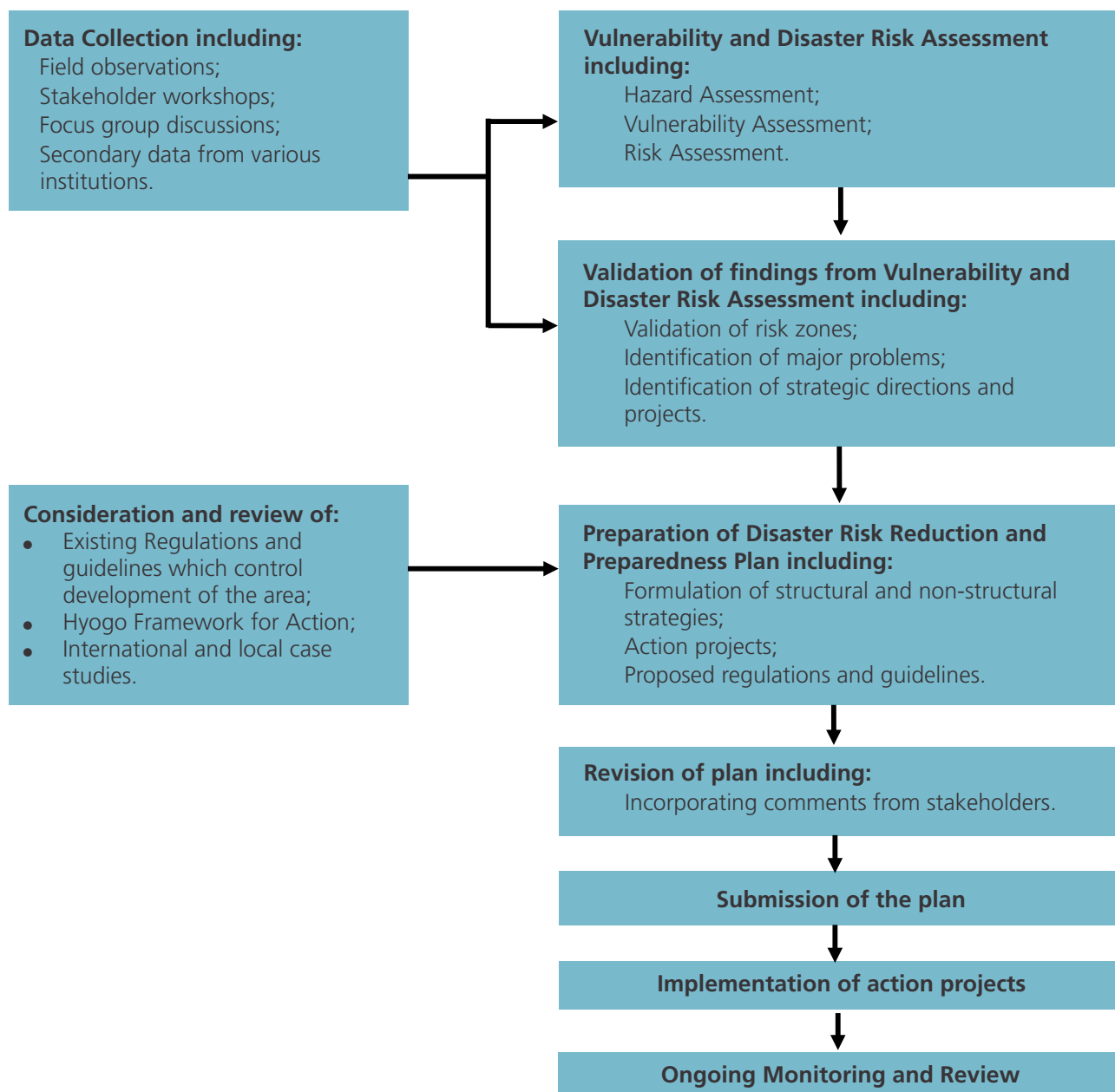


Figure 2: Planning Process

Stakeholder Involvement

Throughout the project processes, the vulnerability assessment and the identification of hazards and risks, was done through close consultation with local stakeholders. The strategic directions and action projects were identified based on local stakeholder perspectives and knowledge coupled with technical expertise. Community leaders, religious leaders, representatives of local government, the provincial council, the divisional secretary and grama niladhari officers, representatives of national government organisations, non-government organisations, community based organisations, research and academic organisations, women's and youth groups, as well as investors and representatives from business and trade associations were all contacted for their input. Broad public participation is critical in ensuring a higher level of acceptance of the Plan. This includes acceptance of policies for minimising disaster vulnerability, which is an important resource in formulating responses to DRR.

The major benefits of a broad community based planning approach include building confidence in the project and enhancing capabilities to improve disaster preparedness and mitigation, as well as building strong adaptive capacity at the local level. The commitment of individuals and community as a whole, as well as the recognition of traditional organisational structures and knowledge from formal and informal community leaders, alongside capacity building activities is needed for the acceptance of the Plan. Local knowledge and actions in disaster mitigation, including resource mobilisation, produce a wide range of appropriate, innovative and area specific DRR solutions, which are cost-effective and sustainable and which must be incorporated by the project team. The successful implementation of this Plan will occur following stakeholder involvement and empowering community disaster committees, volunteers and local authority staff.

1.4 Resilient Cities

This section provides an overview of the concept of a 'Resilient City.' The understanding of a 'resilient city' is drawn from findings of reviewed international case studies, journals and scholarly activity that examine the policies and strategies required to anticipate and respond to unexpected events that damage or destroy the social, environmental and economic fabric of cities. The concept of resilience is at the centre of a large and expanding body of research and application. As a result the term 'resilience' has acquired a range of definitions. Some recent definitions include:

"The ability of a system, community or society exposed to hazards to resist, absorb, accommodate and to recover from the effects of a hazard in a timely and efficient manner including through the preservation and restoration of its essential basic structures and functions" – United Nations Office for Disaster Reduction (UNISDR) (2009);

"Disaster Resilience is the ability of countries, communities and households to manage change, by maintaining or transforming living standards in the face of shocks or stresses – such as earthquakes, drought or violent conflict – without compromising their long-term prospects" – DFID Approach Paper Defining Disaster Resilience (2011); and

A disaster resilient city "is one where people participate, decide and plan their city together with the local government authorities, based on their capacities and resources. It has a competent and accountable local government that caters for sustainable urbanisation with participation from all groups" – UNISDR, My City is Getting Ready (2012).

These definitions have helped to shape this Plan and the methodology that was employed to produce it.

Climate change, increasing rates of urbanisation, poor quality housing and infrastructure coupled with communities living on land that is disaster prone has resulted in more frequent and severe disasters across the world. Defining Disaster Resilience: A DFID Approach estimates that in "2010 natural disasters affected more than 200 million, killed nearly 270,000 people and caused £110 billion in damages."² Resilience is, therefore, required to be at the core of city development strategies. Resilience extends from the physical to include institutional, social and economic factors.

Attributes of a resilient city include permanent houses, community and individual ownership of land, adequate food and income sources, family and community support mechanisms (especially in times of crisis), broad local knowledge as well as good leadership and management. Adaptation is a strong attribute of a resilient city. This enables the city to absorb future shocks and stresses to its social, economic, environmental, technical and infrastructure to enable these functions to continue through, or resume shortly after, a disaster.

There are many reasons for cities to prioritise resilience as part of their political and sustainable development agenda including improving environmental, social and economic conditions, and preparing for the future variables of climate change. Resilient cities have a more adaptive capacity for coping in any situation therefore

2 Defining Disaster Resilience: A DFID Approach, available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/186874/defining-disaster-resilience-approach-paper.pdf (accessed on 29 July 2014)

minimising vulnerability. Making Cities Resilient: My City is Getting Ready! informs local government, mayors and local actors of the benefits to building a resilient city. By capitalising on existing opportunities and capacities, a resilient city can minimise the potential consequences of hazards. A holistic vision of where the city stands with respect to risk and development can also assist in saving extra expenditure that would have been spent on recovering damages from disasters.

A resilient city also encourages participation, strengthens democracy and promotes consensus. Agreeing on city planning and realistic disaster resilience objectives generally represent the interests and expectations of all city sectors.³

Resilient city development must always prioritise actions strategically to respond to the needs of vulnerable or critical sectors and groups. Making Cities Resilient, My City is Getting Ready! shows the importance of assigning and managing resources according to existing realities and needs for DRR in short, medium and long term strategies from a development and sustainability perspective. It also indicates that information sharing, strengthening the leadership of local authorities and encouraging a sense of self-worth among all city sectors improves city capacities.⁴

1.4.1 Incorporating the Hyogo Framework for Action

The Hyogo Framework for Action 2005-2015: Building Resilience of Nations and Communities to Disasters (HFA) was a key outcome of the World Conference on Disaster Reduction which was held in 2005 in Hyogo, Japan.

In recognising the need for local governments to undertake DRR by implementing the HFA, a guide for implementing the HFA by local stakeholders was developed including the following tasks, which are aligned to the five priorities of the HFA:

1. Ensure that DRR is a national and a local priority with a strong institutional basis for implementation;
2. Identify, assess and monitor disaster risks and enhance early warning systems;
3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels;
4. Reduce the underlying risk factors; and
5. Strengthen disaster preparedness for effective response at all levels.

Table A1 set out in Annexure A illustrates how the different elements of the HFA are considered and incorporated into this document.

Post 2015 Framework for Disaster Risk Reduction

Currently, The Post-2015 Framework for Disaster Risk Reduction (HFA2): Report from 2013 Global Platform Consultations provides some insight into the possible future structures for building resilience. This document highlights twelve interventions or focus areas for DRR:

1. The importance of community level involvement;
2. Targeting and including the most vulnerable populations;
3. Women as leaders;
4. Children and youth: a new generation of opportunity;
5. Health;
6. Integrating climate change adaptation, development and disaster risk reduction;
7. The role of science;
8. Knowledge-sharing and education;
9. Capacity-building: financing, risk assessment, preparedness and early warning;
10. Private sector involvement in disaster risk reduction;
11. Political will and leadership; and
12. Governance, accountability, transparency and inclusiveness.

These new elements have been considered in preparing and developing this Plan.

1.5 Disaster Response Governance

At the national level, the Ministry of Disaster Management (the Ministry) is responsible for the implementation of government policies and managing international and national funds in relation to disasters and DRR. The National Council for Disaster Management (NCDM) is under the Ministry and responsible for disaster management in Sri Lanka under the Sri Lanka Disaster Management Act No. 13 of 2005. The formulation of a national policy and programme on the management of disasters is the prime responsibility of the NCDM. The DMC, National Building Research Organisation (NBRO), Department of Meteorology, and National Disaster Relief Services Centre all function under the Ministry.

³ Characteristics of a Disaster-Resilient Community: A Guidance Note (2007)
⁴ For more information on Making Cities Resilient: My City is Getting Ready! see: www.unisdr.org/campaign/resilientcities/

The main duties of the DMC are:

- Disaster risk assessment, data collection, research and analysis;
- Disaster management technology, mitigation and DRR;
- Forecasting and early warning;
- Emergency operations in case of a disaster;
- Preparedness planning at National, District, Divisional and Grama Niladhari Division (GND) levels;
- Training, education and public awareness;
- Formulate and implement National Disaster Management Plan and National Emergency Operation Plan;
- Implement, coordinate and monitor activities related to hazard mapping, risk assessment, disaster mitigation, disaster preparedness, management of emergency operations and post-disaster activities;
- Coordinate with mandated technical agencies on the issue of early warnings for natural hazards and disseminate such warnings to vulnerable communities on time; and
- Coordinate and facilitate emergency response, relief and recovery measures in the event of a disaster.

Under the DMC, District Disaster Management Coordinators, District Secretariats, District Committees and Provincial Level Disaster Management Committees function as intermediate coordinators in Disaster Risk Management (DRM).

Specialised institutions such as the NBRO, Centre for Housing Planning and Building, the UDA, National Physical Planning Department, Coastal Conservation Department (CCD), Sri Lanka Land Reclamation and Development Corporation, Irrigation Department, Central Environment Authority (CEA), Department of Meteorology, Geological Survey and Mines Bureau, Road Development Authority (RDA), and the Ministry of Agriculture play important roles in different aspects of Disaster Risk Management. Figure 3 illustrates the institutional framework of disaster governance in Sri Lanka.

At a regional level, provincial councils, district secretariats, line departments, Non-Government Organisations (NGOs) and regionally networked Community Based Organisations (CBOs), play a major role in DRR. These bodies are responsible for implementing the policies and strategies with funding, resources and support directed by the NCDM.

At a local level, Local Authority Committees, the Military, Police, Private Sector, NGOs, CBOs, Civil Society, Divisional Level Committees, GN officers and GN committees, village volunteer groups, business communities and Divisional Secretariats implement DRR-related projects. This includes the distribution of subsidies, primary level data collection, knowledge sharing and providing other necessary support at regional and national levels. Other groups related to Early Warning, Medical and Health, Search and Rescue, Coordination and Village Task Forces are also responsible for DRR at the grassroots level.



Focus Group Discussion with key stakeholders

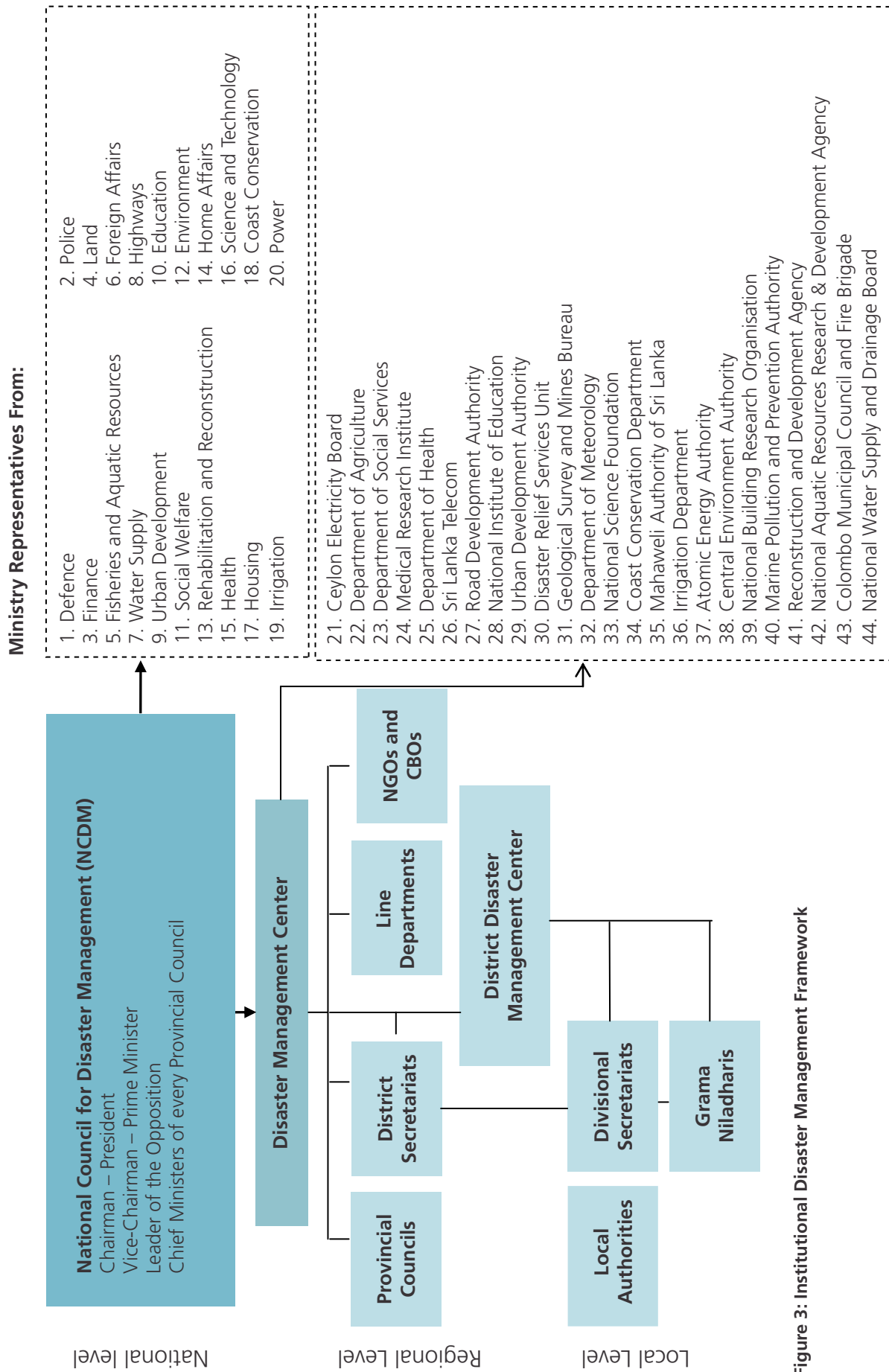


Figure 3: Institutional Disaster Management Framework

1.6 Conclusion

The Plan was formulated through a combination of participatory processes, technical analysis of secondary data and stakeholder feedback. The Plan and process builds the community's capability to develop a resilient city with strong adaptive capacity. This requires an understanding of what can make a city and community resilient and enable people to face disasters and recover faster.

Several common principles of successful resilience development frameworks are incorporated in this Plan. These include:

- Encourage personal and community preparedness;
- Encourage civic responsibility;
- Encourage productive actions to be taken by individuals to protect themselves and their community during an incident;
- Foster self and community reliance;
- Use effective risk communication to strengthen community resilience by providing accurate information and strong communication networks;
- Filling the gap between the Local Authority and the community they serve; and
- Traditional and novel structural measures utilised to build capacity, for knowledge sharing and the making of resilient communities.

The project team has gathered information, local knowledge and evidence from lessons learnt to deliver a Plan to be implemented. Many widely established comprehensive resilience city development mechanisms have been identified at the international level and this document combines these with local knowledge and practices to provide a solid platform to move towards a resilient city.

The following chapters in this Plan provide detailed information on the Maritimpattu PS area in Chapter 2 – Baseline Information. This includes both a physical area profile and a socio-economic profile. Chapter 3 – Strategic Assessment, provides details on the vulnerability, risk, hazard and capacity assessments as well as the SWOT and Core Problem Analyses that were undertaken. Chapter 4 – Strategic Directions, outlines the five key directions that were developed during the project with strong input from community consultation to enable Maritimpattu PS to become resilient. Finally, Chapter 5 – Action Projects, provides details on the project proposals that were developed under each of the five strategies to improve the resilience of Maritimpattu PS. Chapter 6 concludes the document.

2

Baseline Information



Baseline Information

The analysis of baseline information provides a starting point for understanding the environmental, social and economic situation in the Maritimpattu Project Area. The baseline information was collected from primary sources including field visits and observations as well as secondary data sources including the city resource profile, the District Statistical Handbook of Mullaitivu, and data from the DMC.

This chapter focuses on Mullaitivu town which is under the jurisdiction of the Maritimpattu PS. It includes a local area profile section which considers its history, topography, climatic conditions and hydrology through a study of the area. This is followed by the socio-economic section which focuses on the demography, housing, economic base, social services and current land uses.

2.1 Local Area Profile

The Mullaitivu District is located on the eastern side of the Northern Province of Sri Lanka, covering a land area of 2516.9km² which is 3.8 percent of the country's total area. It is located approximately 340km north east of Colombo. The MPS office is located at around 09°16'11" north and 80°48'52" east.⁵

The district of Mullaitivu emerged as part of the Northern Province in 1979; until then the Province consisted of only the Mannar, Trincomalee and Vauniya Districts. The District is divided into six Divisional Secretary's Divisions (DS Divisions), each headed by a Divisional Secretary (previously known as an Assistant Government Agent).⁶ The district has five Pradeshiya Sabhas, which are the local government units. One of the five PSs is the Maritimpattu PS, and the Maritimpattu Division falls under this PS. Weli Oya, a recently defined DS Division, has now been added to an expanded PS; however, this occurred after the project had commenced, and thus was not considered for project intervention.

The Maritimpattu Division covers a land area (including forest area, excluding large inland water) of approximately 728.6km². This Division is 28.9% of the District's total area, and is divided into 46 Grama Niladhari Divisions and 219 Villages.⁷

Environmentally, a large part of Maritimpattu is forest cover – 361.4km² (49.6% of the land area), and the coastal belt is 70km in length. With its abundance of lagoons, prawn and freshwater fishing are common activities in the area. Close to a quarter of the land area is used for agriculture.

2.1.1 History⁸

During the pre-colonial period the Mullaitivu District was part of the Jaffna kingdom and was ruled by the Vanni chieftains. The district came under the control of the Portuguese, Dutch and British at various points after the 15th century. These colonial powers built the road infrastructure that forms the basis for most linkages that exist even today. The Mullaitivu District was an administrative hub of the Portuguese after 1505. The Portuguese built the Mullaitivu-Mankulam Road which dissects the district, and the development of this road assisted expanding settlements and the agriculture of the area. The Mullaitivu-Paranthan Road was developed during the Dutch period and connected the settlement built around the large tanks including 'Viswamadu' and 'Kalmadu'.

While the Portuguese and the Dutch had control over only the coastal areas, in 1815 the British gained control of the entire island of Ceylon, and divided the island into three ethnic based administrative structures: Low Country Sinhalese, Kandyan Sinhalese and Tamil. The district, which was then part of the Vanni District, was part of the Tamil administration.

The British government developed many of the roads throughout Sri Lanka including the Puthukudiyirippu-Oddusuddan Road, the Mullaitivu-Puliyankulam Road and the Kandy-Jaffna A9 Road. The A9 road was the most important road developed connecting this region to the rest of the island. The Mullaitivu-Mankulam, Mullaitivu-Puliyankulam and Mullaitivu-Paranthan roads directly connect to the A9.

In 1833, in accordance with the recommendations of the Colebrooke-Cameron Commission, the ethnic-based administrative structures were unified into a single administration divided into five geographic provinces. The Vanni District, together with the Jaffna and Mannar Districts, formed the new Northern Province.

The Vanni District was later renamed as the Mullaitivu District and then part of the district became Vavuniya District. The district was reportedly colonized in the second half of the 18th century by residents from the Jaffna Peninsula, primarily from Alaveddy, Udupiddy and Navaly.⁹ At the time that Ceylon gained independence, Vavuniya was one of the three districts located in the Northern Province. The Mullaitivu District was carved out of the northern part of the Vavuniya District together with parts of the then Jaffna District, Mannar District and Trincomalee District in September 1978.

⁵ Wikipedia on the Mullaitivu District, http://en.wikipedia.org/wiki/Mullaitivu_District

⁶ "Statistical Information 2012." Northern Provincial Council

⁷ Divisional Secretariat, Maritimpattu website, <http://www.maritimpattu.ds.gov.lk/>

⁸ Much of this section has been obtained from the Wikipedia account, http://en.wikipedia.org/wiki/Mullaitivu_District

⁹ Wikipedia, quoting Sivaratanam, C. (1968). The Tamils in early Ceylon. p. 153.

Since the early 1980s, the Northern and Eastern provinces have been ravaged as a result of internal conflict between the LTTE and the Government of Sri Lanka. Most of the history of Mullaitivu, after the new demarcation, has been clouded by the civil war. The district was also greatly affected by the 2004 tsunami. Both contexts of disaster, man-made and natural, have severely hindered the growth of the town. Mullaitivu was one of the key battlegrounds of the civil war between the Sri Lankan Government and the LTTE, as one of the strongholds of the LTTE. Life and property losses were large and have severely impacted the human psyche.

Due to the hostilities, the A9 was closed in 1984. After the ceasefire between the two sides in 2001, the highway was ceremoniously reopened up to [Kilinochchi](#) (with certain restrictions) in 2002. After fighting resumed between the government forces and the LTTE, the road was closed again in 2006. In 2009, the entire highway was brought under government control. After demining along the highway was completed and damage done to the surface during the conflict repaired, the A9 Highway was reopened in April 2009.¹⁰ The reopening of the A9 re-established the contact that the District had with the rest of the island.

2.1.2 Topography

Physiographically, the area covered by the Mullaitivu District belongs to the lowest peneplain of Sri Lanka. The topography of the majority of the District is generally flat and includes a coastal plain, 1–2km in width along the eastern coastal stretch. Towards the west, the topography changes gradually to gentle undulating terrain, rising to 30m above mean sea level. An isolated hillock located at the south of the Kokavil has the highest elevation of 57m.

Specifically, the Project Area of Marimepattu is also flat, and the elevation varies from sea level to 36.5 meters above sea level. This topographical plain leads to areas being vulnerable to flooding.

A large part of the Martimepattu Project Area is under forest cover – 361.4km² (49.6% of the land). There are also four large lagoons, namely Kokkulai, Nayaru, Nanthikadal and Maththalan.¹¹

According to reports, the lagoons have extensive sea grass beds, small areas of mangrove swamp and mudflats, and have a high potential for prawn fishing

and culture. The Kokkulai Lagoon was designated a wildlife sanctuary in 1951. The shallow waters of the lagoon is said to attract a wide variety of water birds including pelican, cormorant, herons, egrets, wild duck, stork, waders and pink flamingoes.¹²

2.1.3 Geology

Most of Sri Lanka (90% of the island) is underlain by proterozoic high-grade metamorphic rocks with quaternary sediments being restricted to a narrow strip in the north west, north and north east coastal regions. The Precambrian basement is divided into three major lithotectonic units, namely the Highland Complex (HC), the Wanni Complex (WC) and the Vijayan Complex (VC). Geologically, the western half of the Mullaitivu District lies within the WC, while its eastern half is located within the Miocene to Quaternary cover.¹³ Figure 4 shows a map locating the soils in the area.

The major soil group of this area is reddish brown earth which is suitable for cultivation although there is a variation of soil types within the region. The following major soil types can be identified within the Project Area:

- Regosols on recent beach and dune sands – flat terrain;
- Solodized Solonetz and Solonchaks (salty soil) – flat terrain;
- Alluvial soils of variable drainage and texture – flat terrain;
- Red-Yellow Latosols – flat to slightly undulating terrain;
- Reddish Brown Earths and Low Humic Gley soils – undulating terrain; and
- Rock knob plain.

2.1.4 Climatic Conditions

Marimepattu is classified under Sri Lanka's Dry Zone, where a tropical dry climate is prevalent.

Rainfall Pattern

The area experiences heavy rains from October to December, during the northeast monsoon season. In comparison, the amount of rainfall during the rest of the months is considerably low. Average annual rainfall of the District is 121.80mm. Figure 5 illustrates the monthly rainfall variation, while Figure 6 illustrates the average annual rainfall over the past decade. Cultivation during the Maha season (October–January) is fed by excess rainfall during northeast monsoon.

10 Wikipedia, http://en.wikipedia.org/wiki/A9_highway_%28Sri_Lanka%29#cite_note-dn-a9reopened2009-3

11 Marimepattu DS website, <http://www.marimepattu.ds.gov.lk>

12 Wikipedia quoting "From Kanniyai to Kokkilai via Tiriyaya." Daily News, Sri Lanka. 10 August 2002

13 M.M.T.N.B. Munasinghe and K.T.U.S. de Silva, (2011). Final report on the mineral resources in Mullaitivu District (under the Integrated Strategic Environmental Assessment (ISEA) study of the Northern Province, pp 5-6

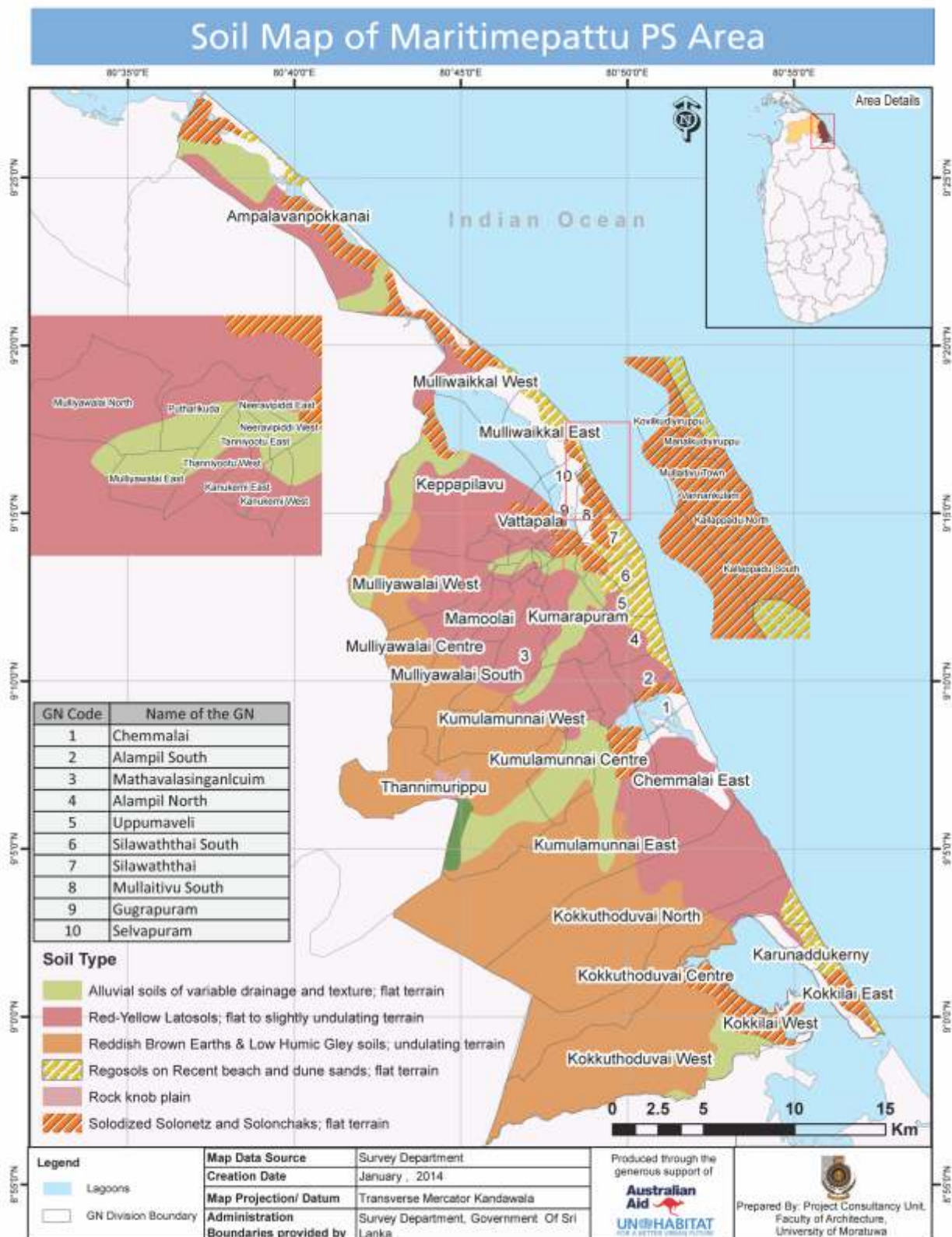


Figure 4: Soil map of Maritimepattu PS area

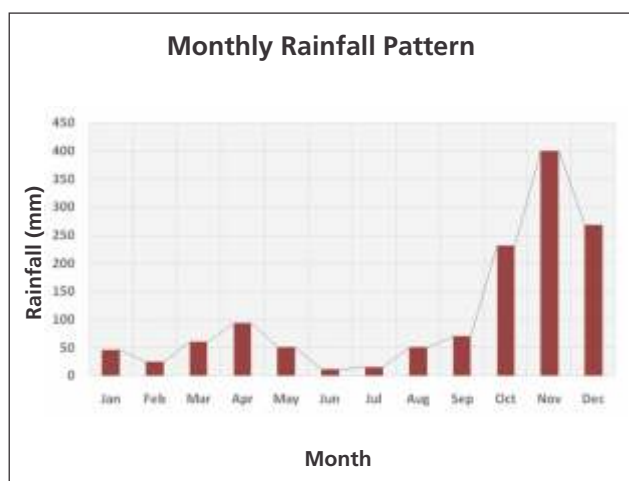


Figure 5: Monthly Rainfall Pattern
Source: Department of Meteorology, 2013

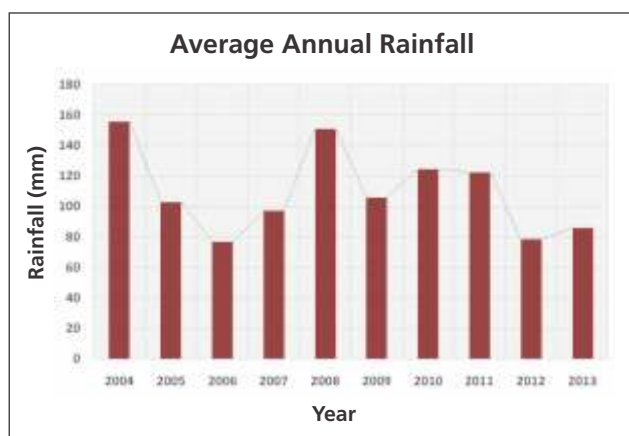


Figure 6: Annual Rainfall Variation
Source: Department of Meteorology, 2013

Temperature

The highest average monthly temperature is usually recorded in the months of April and May at 30°C, while the lowest average monthly temperature of 25°C is encountered in January and December. The mean annual temperature is about 28-30°C.¹⁴ The following figures provide the monthly averages and annual averages for the past decade.

2.1.5 Hydrology

The hydrological system of the Mullaitivu area consists of the sea, lagoons, small to medium scale streams and tanks. Kokkulai, Nayaru, Nanthikadal and Maththalan are the major four lagoons in the area that have high ecological and economic value. Most of the seasonal streams and tanks are active during the northeast

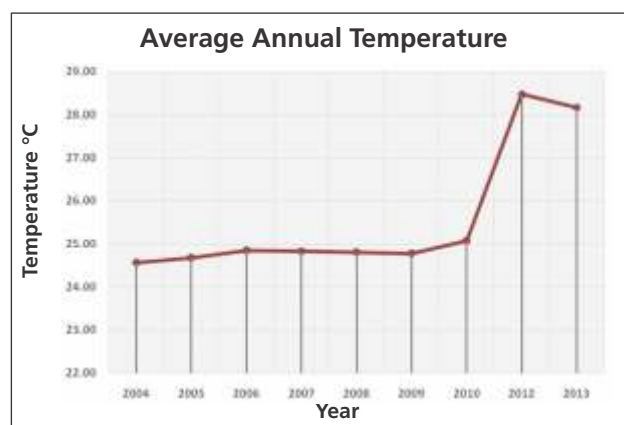


Figure 7: Average Annual Temperature
Source: Department of Meteorology, 2013

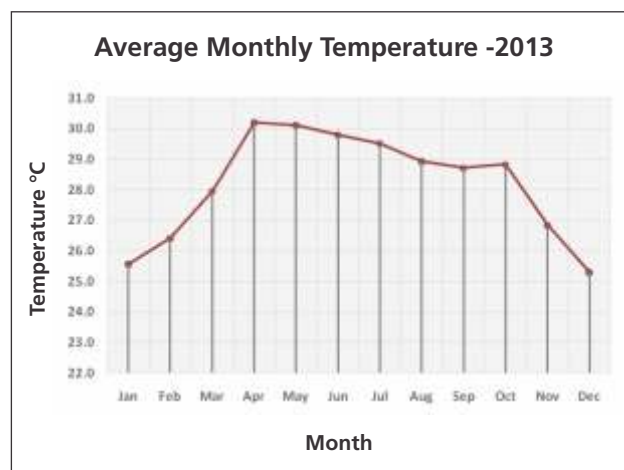


Figure 8: Average Monthly Temperature
Source: Department of Meteorology, 2013

monsoon. The majority of the streams in the area drain towards the northeast direction and connect with the sea between Kokkilai and Mullaitivu. Ma Oya and Periya Aru are the significant streams. In addition, some of the streams drain towards the northwest and flow through the Mannar District before reaching the sea.

Twelve major streams can be identified within the area and among them – Kodalikkallu Aru, Manal Aru, Nay Aru, Naruthapilly Aru, Chavar Aru are significant.

Additionally, there are a number of irrigation tanks in the Project Area (as the tables below show). According to the Department of Agrarian Development of Mullaitivu, 1,046 families benefit from these major, medium and minor tanks. The total irrigable area from these tanks is 17.19km².

Name Of Tank	Capacity (Ac.ft)	Irrigable Area (Ac.ft)	Catchment Area (Sq.Miles)
Kanukkerny Kulam	2,100	1,813	26.25
Madawalasingam Kulam	3,890	398	20

Table 2: Major and medium size tanks in Maritimpattu DS division

Source: Irrigation Department, Northern Province

The Maritimpattu Division is divided into four Agrarian Service Divisions by the Department of Agrarian Development in the Mullaitivu District. Table 3 shows the

total number of minor tanks in each Agrarian Service Division. Among the 37 minor tanks listed, 15 tanks require repair and improvement.

Name of Agrarian Service Division	No. of Minor Tanks
Muliyawalai	24
Kumulamunai	12
Alampil	0
Kokkuthoduwai	1

Table 3: Minor tanks in each Agrarian Service Division

Source: Department of Agrarian Development, Mullaitivu District



Nayaru Lagoon

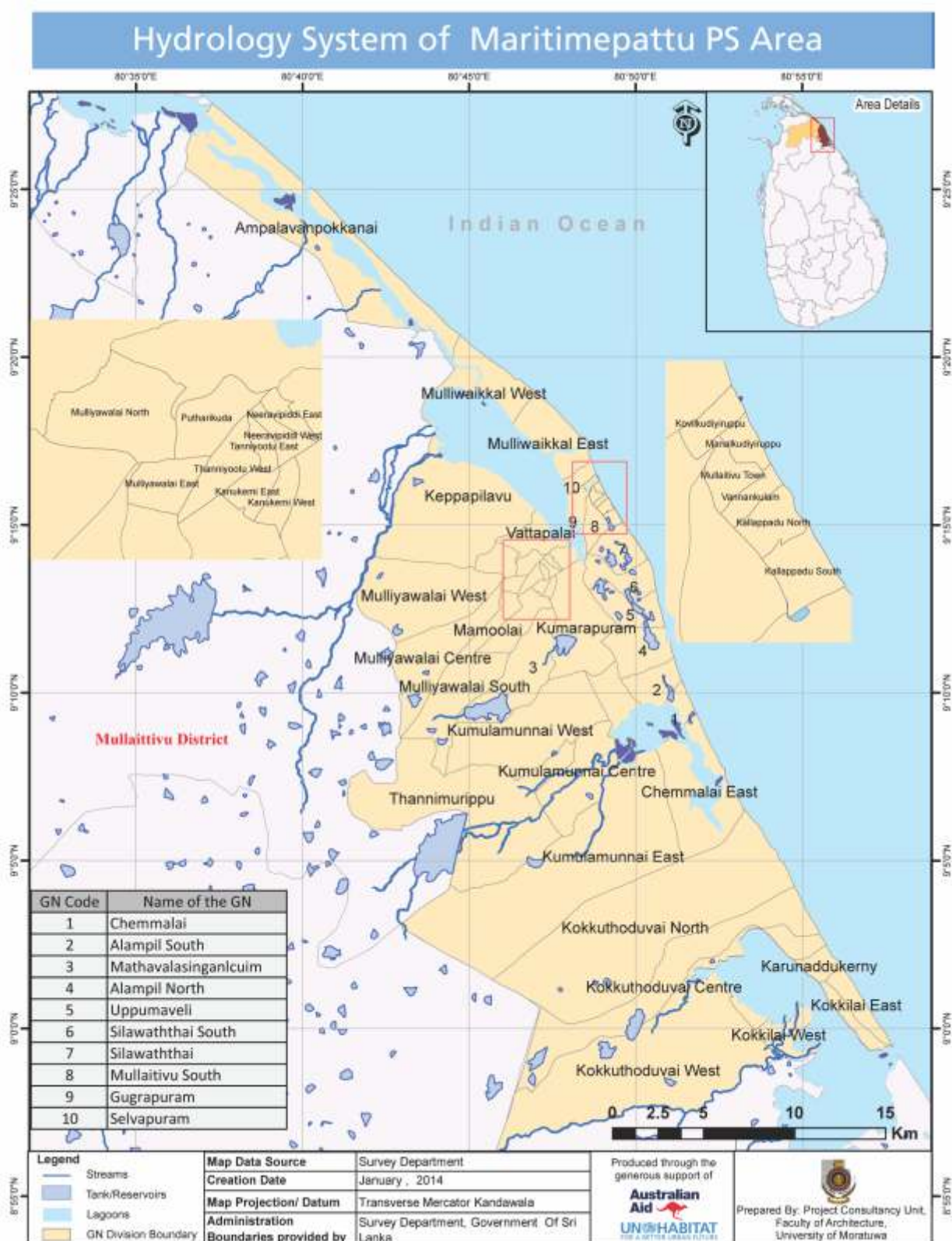


Figure 9: Hydrological System of Maritimepattu PS

2.2 Socio-Economic Profile

This section of the report reviews the demography, housing, economic base, social services and land uses in the Project Area. The information presented here highlights how vulnerable the communities within this area are to natural hazards. Statistics in this section come from the Resource Profile Maritimpattu Divisional Secretariat, 2011 (unless indicated otherwise).

2.2.1 Demography

In 2011, the total population of the Project Area of Maritimpattu was 34,573 persons living in 10,957 households (families). Figures from the District Secretariat Office - Mullaitivu, record that in 2013, the number of families was 12,637, with the total number of persons being 40,302.¹⁵ Of this 19,679 are male and 20,620 are female. Figure 10 below shows the distribution of the population by age and gender.

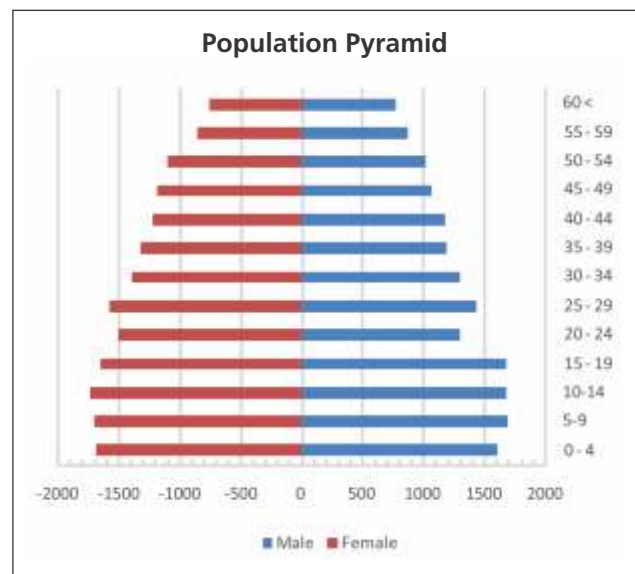


Figure 10: Population pyramid by age group

The total land area of the Maritimpattu DSD is 728.6km². The population density including the resettled population is 47 persons per km². Forest cover is extensive within the Project Area, resulting in a low population density, as the map below shows.



Public Market, Mullaitivu

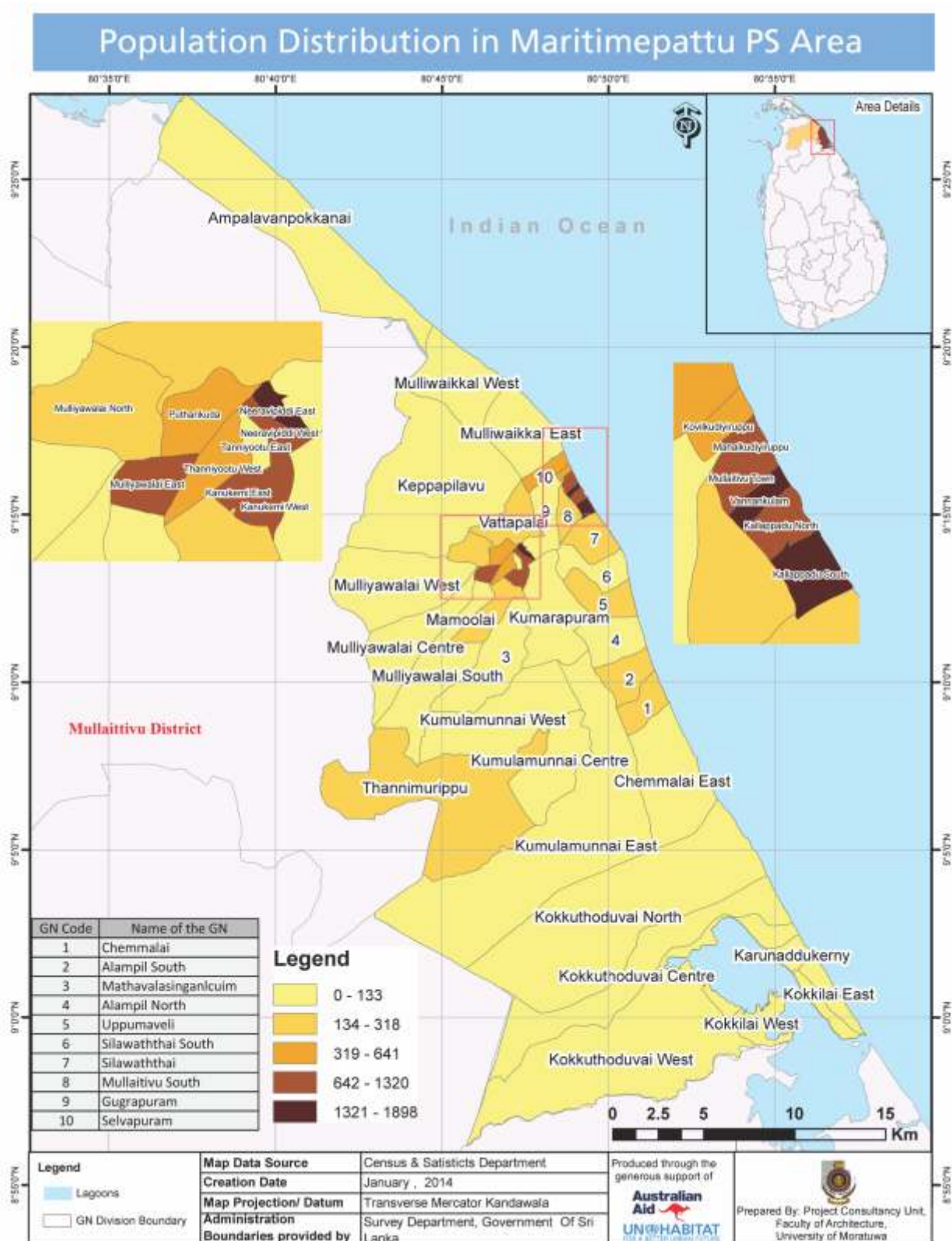


Figure 11: Population Density map of Mullaitivu project area

The ethnic breakdown is Sri Lankan Tamils 78.71%, Moor 20%, while the Sinhalese, Indian Tamil and Burghers represent a very small percentage.

2.2.2 Housing

The number of resettled families in Maritimpattu is 12,637 as of end 2013 as noted earlier; a total of 4,452 families from relief villages, and 8,205 living with friends and relatives. Fully damaged houses totalled 9,716, and 2,921 were partly damaged. Of these numbers, 4,761 new houses have been constructed, and 1,764 houses have been repaired. This leaves a deficit of 4,955 houses to be built and 1,157 houses to be repaired.

2.2.3 Socio-Economic Base

Ravaged by the conflict, Maritimpattu is currently one of the least developed areas in the country. The economy of the Project Area is mainly dependant on agriculture and fishing. As one side of the Project Area is bound by the coast, those living on the coastal areas rely largely on fishing for their livelihoods. Livestock farming is another source of employment. Other forms of employment include industrial activities, service sector employment in government and private establishments.

The heavy reliance on agriculture, which is easily affected by natural disasters, results in the local economy as a whole being vulnerable to disasters.

The road network and the reconstruction of houses has developed rapidly during the past four years after the end of the civil war in the district, which has improved its socio-economic situation. With this development the UOM team felt that there is a visible boom in the economy of the area, specifically the livelihood sector

such as farming, livestock and start-up businesses. However, much groundwork needs to be done to establish normalcy in the region in terms of uplifting lifestyles by implementing and creating awareness on legislation, vocational training, generating and sustaining safe drinking water and sanitation facilities, and developing infrastructure while establishing socioeconomic stability.

2.2.4 Land Use¹⁶

The total land area of Maritimpattu DSD is 728.6km² (including forest area, excluding large inland water) of which 173.375km² (23.8% of the total land) land is used for agriculture. Close to half the land of the area is under forest cover, i.e. 361.4km² (49.6% of the land).

About 53.16km² (7.3% of the land) is used for paddy cultivation, of which 16.16km² (2.2% of the land) is irrigated by major irrigation schemes, while 5.4km² (0.7% of the land) is irrigated by minor irrigation schemes and 31.6km² (4.3% of the land) is rain fed. In addition to this there are about 120.21km² (16.5% of the land) used for perennial and other crops.

Since paddy cultivation and fishery are the main occupations of people who live in the area, residential areas in Mullaitivu are located close to river banks and coastal areas.

After 2009, there have been a number of new roads and buildings constructed. However during the war time, a large extent of the area was covered by forest. Nagancholai (67.296km²), Andankulam (147.543km²) and Kulamurippu (39.53km²) are the major forest reserves in the Maritimpattu area. There are eight other forest reserves as well, ranging from 0.2 km² to 34km².



Dry fish processing in Mullaitivu

16 Statistics for this section are from District Statistical Hand Book, District Secretariat, Mullaitivu; and the Maritimpattu DSD website <http://www.maritimpattu.ds.gov.lk/>



Figure 12: Land Use Map of the Project Area

2.3 Conclusion

This chapter provided a background to the Project Area's physical, social, environmental and economic situation, which are integral components in disaster resilient planning. This primary level review provides an introduction towards understanding the aspects and elements which are highly vulnerable to disaster. Maritimé pattu has a large area of forest cover, but is a

fast developing area after the end of the civil war. A careful planning approach, and city resource management is needed to ensure that the current development trend proceeds in a manner that is both strategic and meaningful. The background provided in this chapter was used to understand the city and helped to shape the strategic assessments that are discussed in Chapter 3 Strategic Assessments.



Strategic Assessments



Strategic Assessments

The baseline information provided the foundation to conduct an analysis of the existing situation in the Maritimpeattu Project Area. The Strategic Assessments, keeping the presence of hazards and the occurrence of disasters as foremost concerns, build on the baseline information and identifies issues, locations, root causes, potential solutions and key stakeholders in order to improve the resilience of Maritimpeattu.

The Strategic Assessments were conducted in three parts:

1. Undertaking a hazard, vulnerability, risk and capacity assessment – identifying hazards, social, economic, natural and physical vulnerabilities, locations and hazards (both single and multiple);
2. A strategic Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis – systematic analysis of strengths, weaknesses, threats and opportunities to enable Maritimpeattu to develop as a disaster resilient city; and
3. Core Problem Analysis – threats and weaknesses identified through the SWOT analysis focused on both addressing and predicting major problems.

Stakeholder consultations and field observations were also important in testing the validity of the Strategic Assessments process.

3.1 Methodology

Detailed analysis and stakeholder consultations form the basis of the Strategic Assessments. Stakeholders include local communities, institutions, civil society, the private sector, development partners and academics.

3.1.1 Hazard, Vulnerability, Risk and Capacity Assessments

These assessments are interlinked and dependent on each other for an optimal outcome to achieve the following:

1. Identify natural hazards in the city of Mullaitivu;
2. Identify the consequences of the natural hazards;
3. Recognize the different elements at risk in the Pradeshiya Sabha, (for example, vulnerable groups and their locations) and evaluate their risk level;
4. Identify social, economic and environmental vulnerability dimensions in the area;
5. Assess information on current disaster adaptation measures and their constraints; and
6. Identify the root causes of the problems related to disasters in identified locations (especially in areas at risk from more than one hazard).

The assessments assist in identifying issues, priorities, key actors and in building commitment. The level of exposure, vulnerability and adaptive capacity are core elements in these assessments.

A series of hazard, vulnerability and risk maps have been produced as outcomes of the Hazard, Vulnerability and Risk Assessments.

Hazard Assessment

The Hazard Assessment determines which hazards will be evaluated in the vulnerability assessment and the priority levels for interventions. To establish hazard levels, the following equation can be used:

$$\left(\begin{matrix} \text{Frequency + Area} \\ \text{Impact} \end{matrix} \right) \times \begin{matrix} \text{Potential} \\ \text{Damage} \\ \text{Magnitude} \end{matrix} = \text{Total Score}$$

The hazard assessment that was conducted in this project was based on the Sorsogon City Climate Change Vulnerability Assessment.¹⁷ An additional element was included in the process detailing natural hazards by their intensity and frequency. Community Hazard Mapping enabled stakeholders to identify the areas they have experienced as vulnerable to different types of hazards. The people and resources located within the hazardous area are considered to be at risk from hazards, and may or may not be vulnerable to hazard impacts. The assessment is also integrated with projected climate scenarios and previous climate related disaster events. This includes incorporating people's accounts of the past events, as well as observations from site visits. outlines the Hazard Assessment Process.



Hazard Assessment with GN Officers

1. Preparation of Hazard Inventory using primary and secondary data.
2. Analysis of projected climate scenarios and previous climate-related disasters.
3. Community based hazard location mapping to identify experiences of hazards, locations and history.
4. Analysis of climate data, community inputs and hazard inventory data.
5. Mapping hazard locations using a Geographical Information System.
6. Verification of hazard locations by:
 - a. Field Visits;
 - b. Stakeholder Workshops; and
 - c. Data and information from NBRO, UDA, DMC, Department of Irrigation.
7. Preparation of Final Hazard Maps.

Table 4: Hazard Assessment Process

Vulnerability and Risk Assessment

The vulnerability and risk assessment process follows the conceptual framework developed by the European Commission on Assessing Vulnerability to Natural Hazards in Europe: A Manual on Concept Methodology and Tools,¹⁸ and the procedures presented in the Sorsogon City Climate Change Vulnerability Assessment.

The potential impact of the hazard on economic, social and environmental dimensions of society, the degree of risk, depends on the vulnerability (or fragility), and the lack of resilience of a society (and of the environment). Assessment of hazards, city vulnerability rankings and calculations of risk therefore need to be prepared to appropriately identify danger. The assessment process

was modified using practical lessons that have been learnt throughout the project. The mapping techniques and identification of risk elements was undertaken based on a technical research paper, “A Study on Extracting Important Elements for Vulnerability Assessment in a Sri Lankan Context,” which was carried out by the UOM. This identified that traditionally under-represented communities, including women, youth and marginalized groups, such as the urban poor, are often more susceptible to climate change driven impacts given their limited adaptive capacity and the vulnerable locations of their settlements. The process adopted to assess vulnerability is provided in Table 5: Process to Assess Vulnerability. A diagram representing the Hazard, Vulnerability and Risk Assessment process is provided in Figure 13.

1. Identify city elements at risk
2. Develop indicators based on exposure and fragility for social, economic and environmental dimensions of the city
3. Mapping elements at risk:
 - Identify vulnerable groups and their locations;
 - Spatial analysis of vulnerability elements; and
 - Produce maps that show the spatial configurations of city elements.
4. Quantifying / assessing vulnerability elements in each disaster:
 - Assessing vulnerability for weighted overlay process in risk assessment
5. Prepare vulnerability dimension maps

Table 5: Process to Assess Vulnerability

Risk Assessment

The risk is the result of identifying hazards, vulnerabilities and capacities of a particular system. This can be illustrated by:

$$Risk = \frac{Hazard \times Vulnerability}{Capacity}$$

Capacity demonstrates the combination of the strengths, attributes and resources available within a community, society or organisation that can reduce the level of risk, or the results of a disaster. The risk assessment comprises three steps: the hazard assessment, the vulnerability assessment and the capacity assessment.

1. Validation of hazard assessment and hazard maps by stakeholders.
2. Validation of vulnerability of social, economic and environmental values.
3. Capacity assessment of the city using selected indicators.
4. Amalgamation of hazards, vulnerability and capacity assessments, with spatial analysis.
5. Preparation of social, economic and environmental risk maps for flood, droughts and strong winds.
6. Preparation of composite flood, drought and strong winds maps through weighted overlay of spatial analysis.
7. Formation of multiple risk area maps for the Maritim Pattu PS by combining composite disaster maps.

Table 6: Risk Assessment Process

Capacity Assessment

The capacity assessment is the final step and it addresses the ability to face and respond to the impacts of hazards. The capacity assessment may include physical, institutional, social or economic means as well as skilled personal or collective attributes such as leadership and management at city level. The availability of early

warning systems, local knowledge, hazard forecasting technologies and backup plans are important elements of the capacity assessment. The capacity assessment documents the existing assets of a community in a project area that increase, or decrease the ability to cope while responding to a hazard.



Detailed hazard mapping with the stakeholders

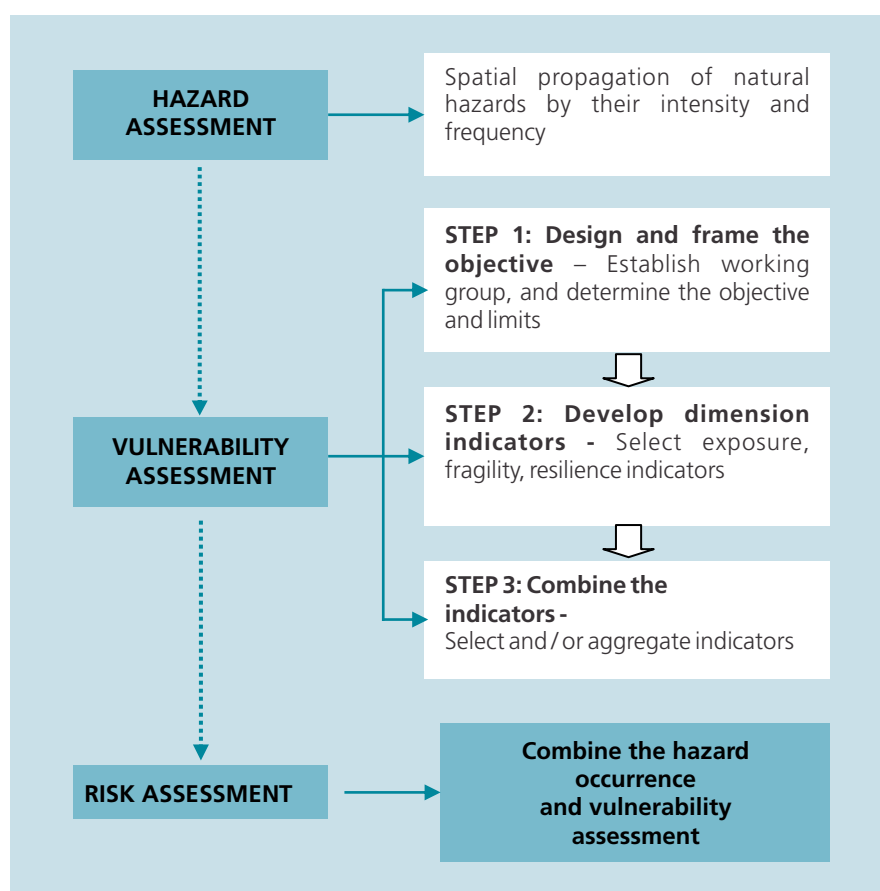


Figure 13: Vulnerability and Risk Assessment Methodology

3.2 Community Hazard Assessment

Community hazard mapping was conducted through workshops that included GN officers, UDA officers and other Local Authority officers working in collaboration with the community. Locations of different hazards, according to their nature of occurrence, were demarcated by communities on the base maps during the stakeholder workshop conducted in the Maritim Pattu PS area. The locations identified were then visited by the project team who conducted further informal interviews with both community groups and individuals.

Droughts, floods, tsunami, strong winds and lightning were recorded as the main hazards affecting the Project Area. They have caused significant loss to life and property on a number of occasions over several years. The area was severely affected by the 2004 tsunami heavy loss to life and property. It was noted that the communities are alert to the hazards that they regularly

face. Figure: 14, 15 and 16 show the Hazard Maps identified by the community for drought, floods and tsunami. Since it is difficult to determine lightning-prone locations through the existing data, hazard maps were only prepared for flood, droughts and strong wind hazards.



Community consultation and validation

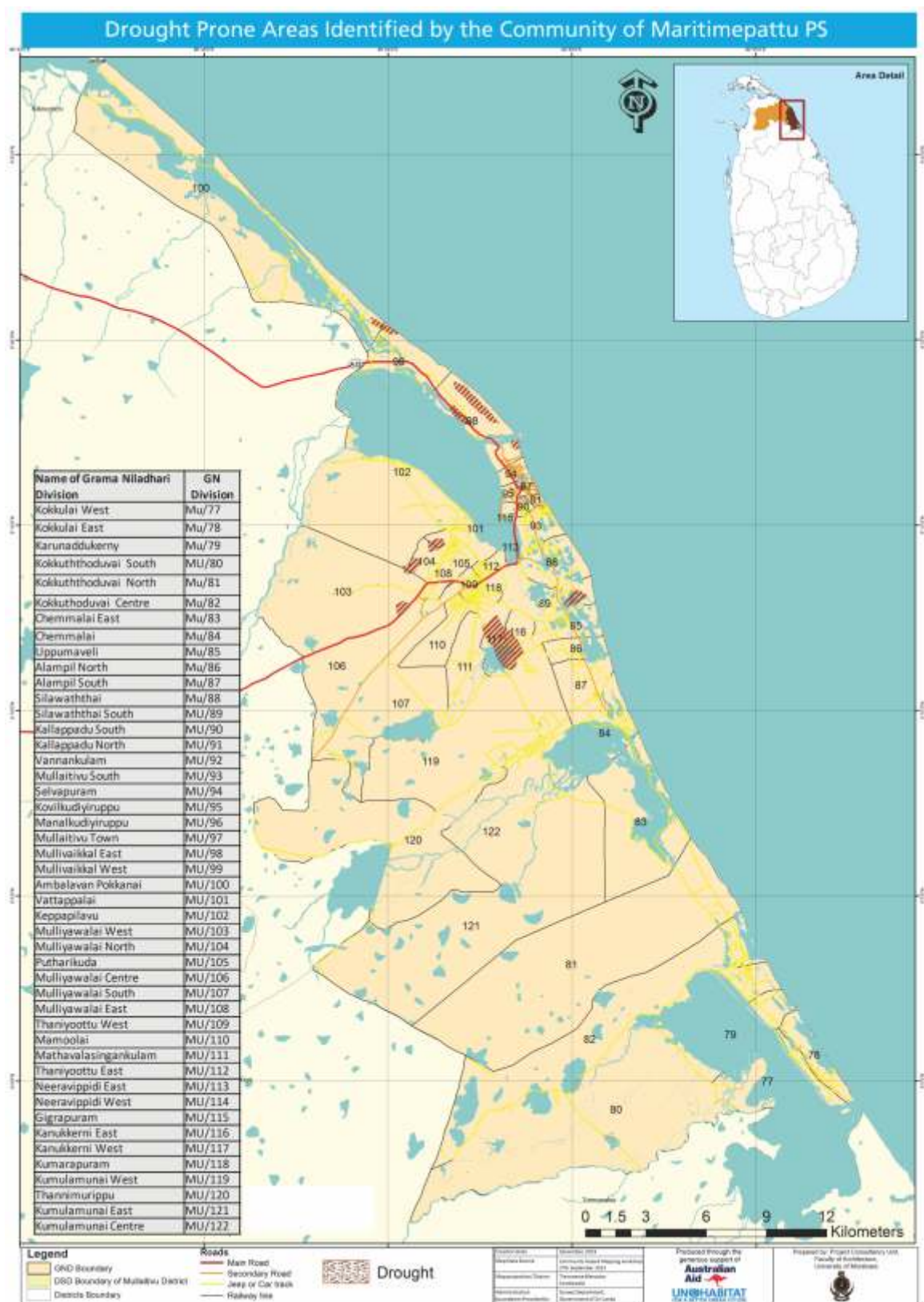


Figure 14: Drought Hazard Map developed by the Community

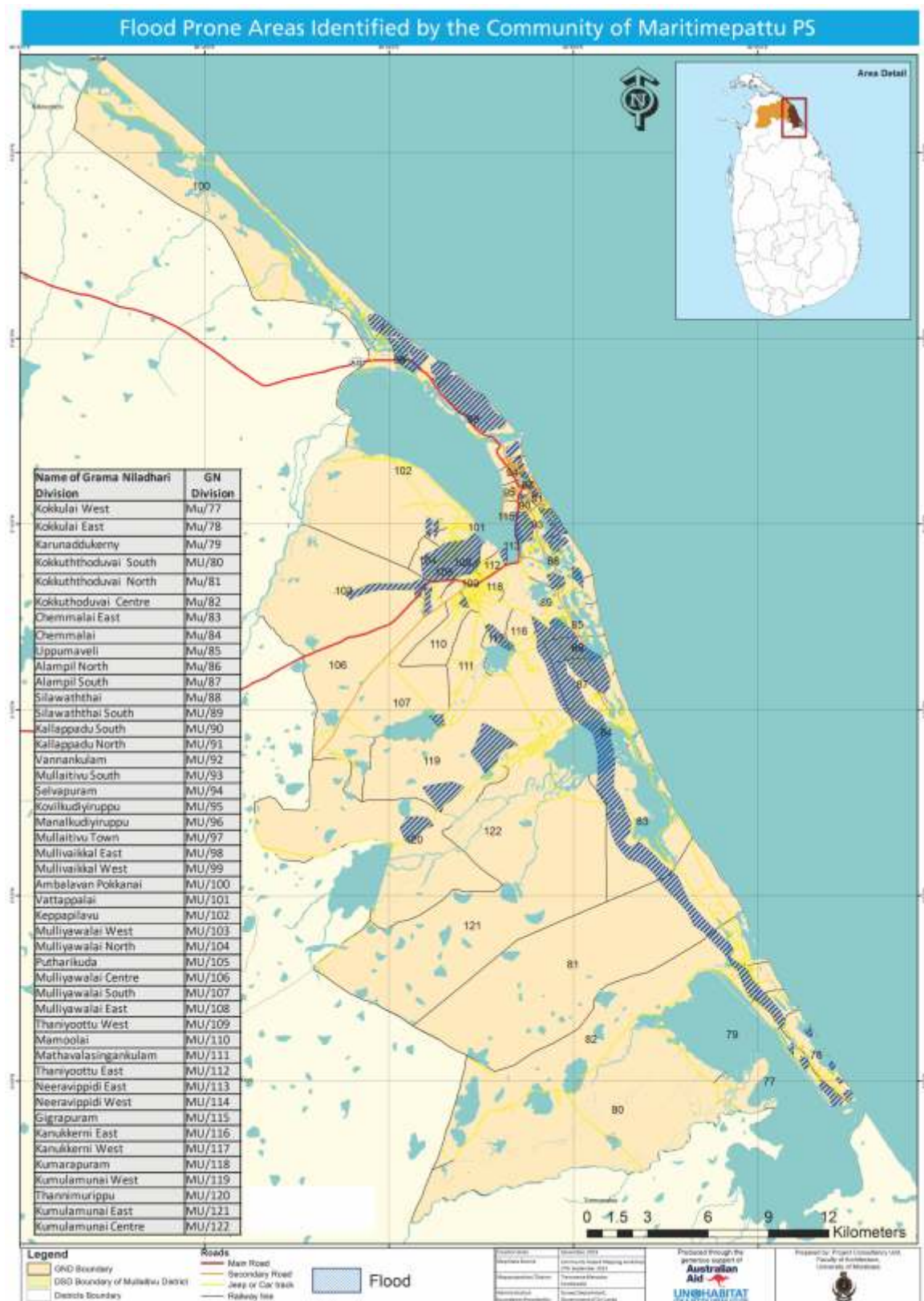


Figure 15: Flood Prone areas identified by the community

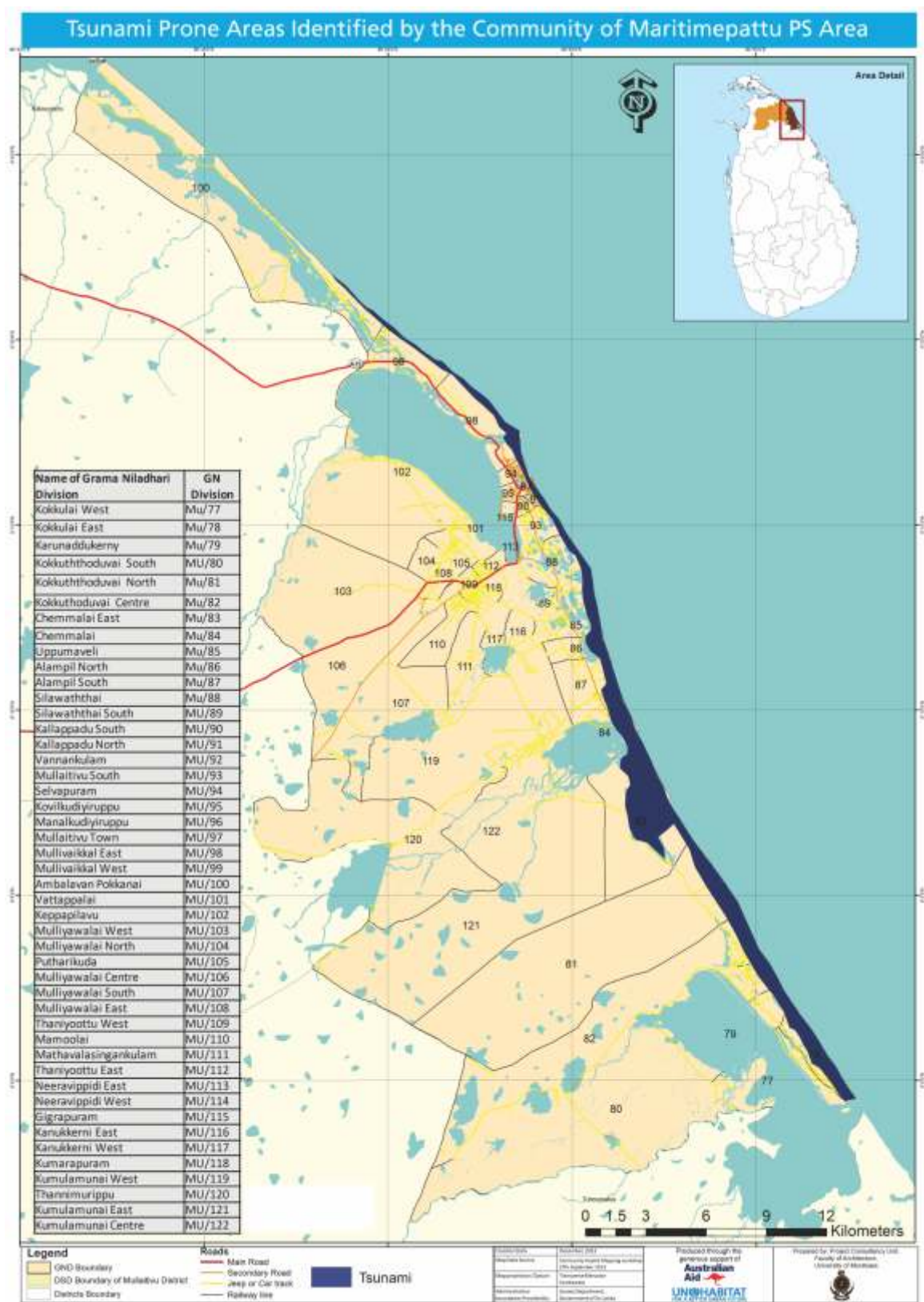


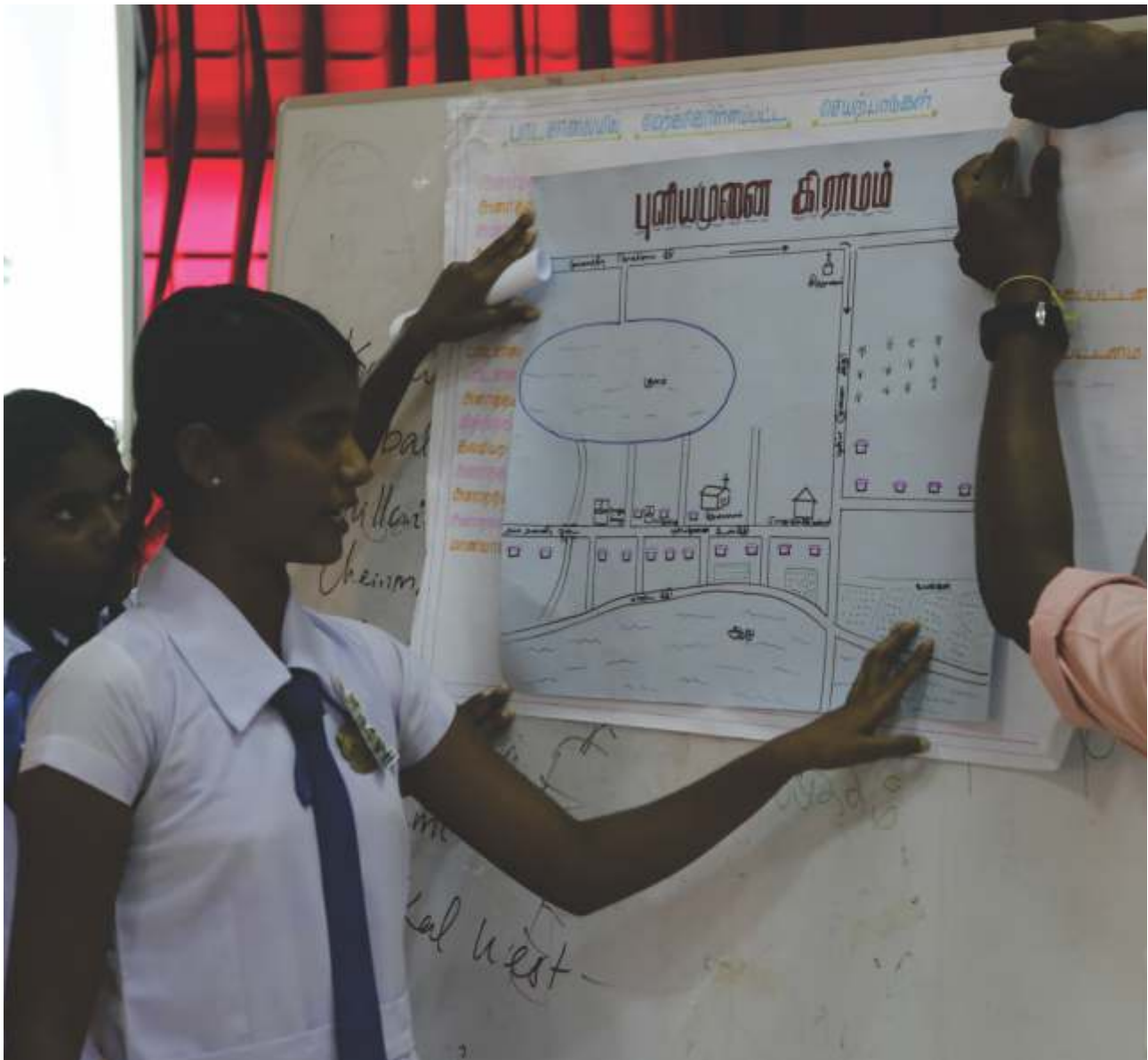
Figure 16: Tsunami Prone areas identified by the community

3.3 Detailed Hazard Mapping

The hazard types were identified and their locations mapped. Following detailed analysis, a rating of 'high', 'moderate', 'low' and 'not affected' was assigned. This approach combines the hazard assessment and the technical assessment by using information from the community and stakeholders with hazard inventory data. The secondary data collected was from the DMC,

National Building Research Organization (NBRO), Urban Development Authority, and the Department of Irrigation. Using this information the maps of disaster prone areas were developed using Arc GIS software.

The detailed hazard maps prepared are presented below in the following order: Figure 17: Drought Hazard Prone Areas Map; Figure 18: Flood Hazard Prone Areas Map. As risk mitigation measures are improved, the maps need to be updated regularly to reflect the changes.



Students preparing community hazards maps

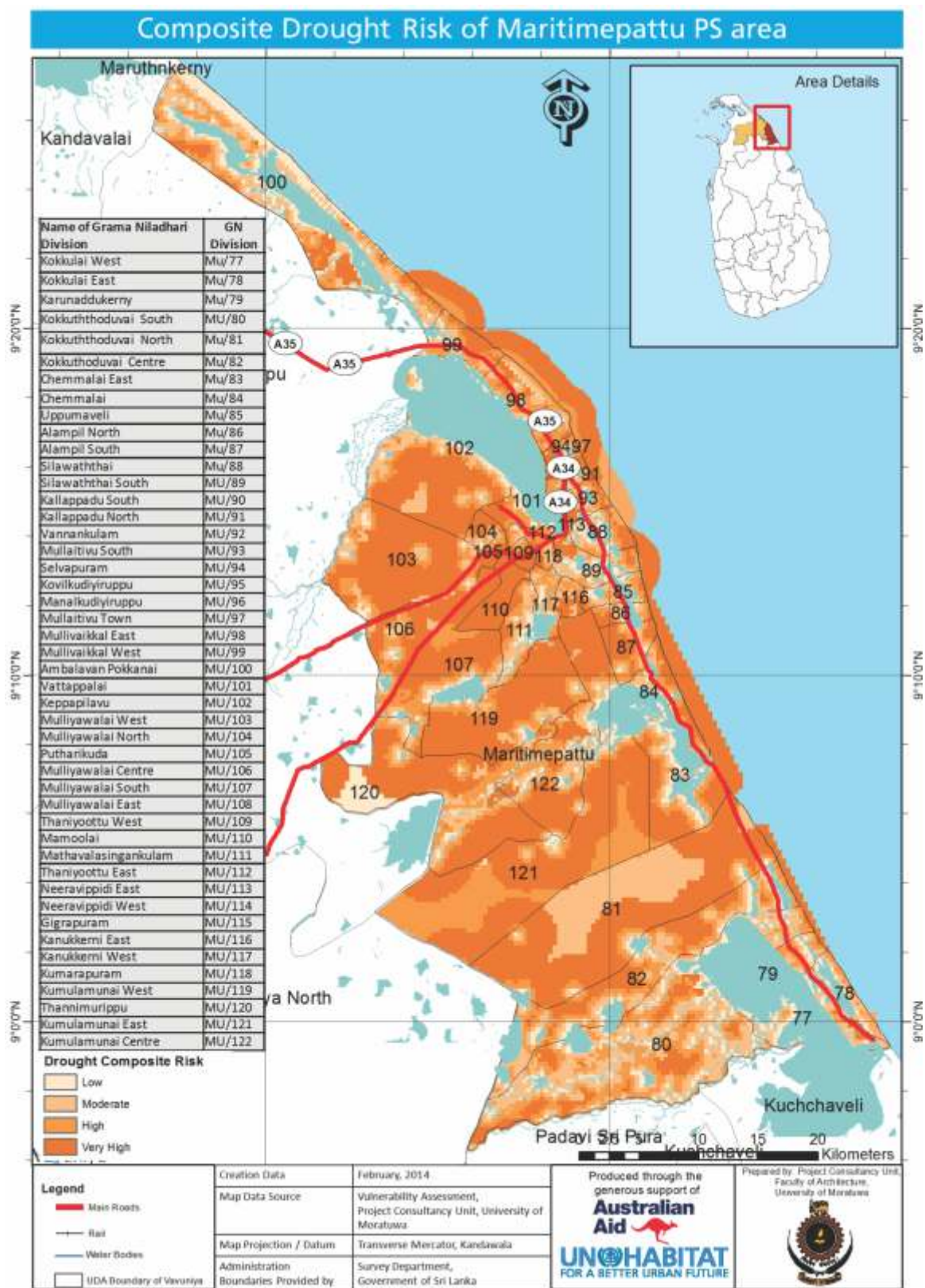


Figure 17: Drought Hazard prone area of Maritimpeattu PS

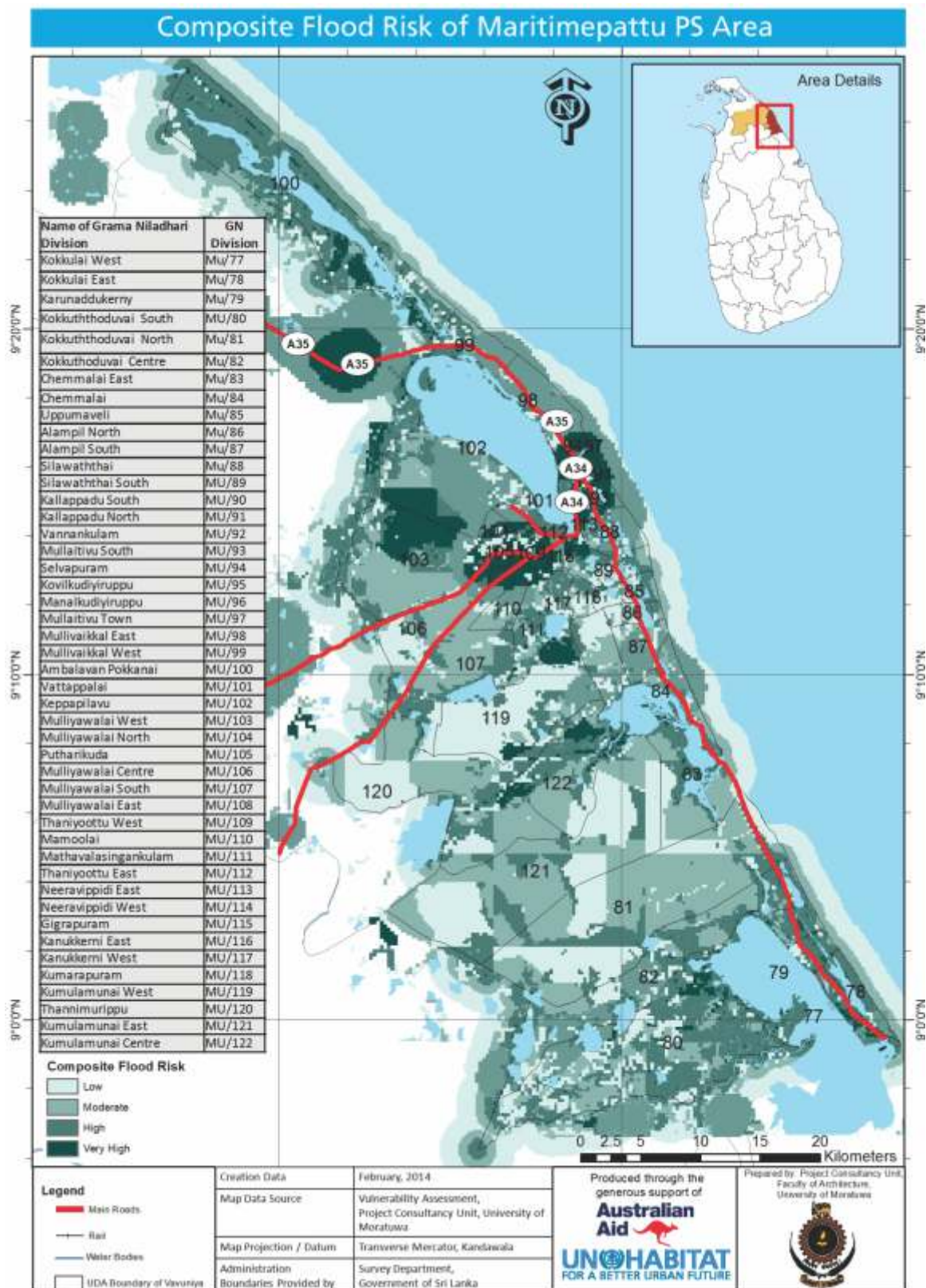


Figure 18: Flood Hazard prone area of Maritimé pattu PS

3.4 Vulnerability and Risk Assessment

The selection of criteria for the vulnerability and risk assessment combined the research conducted, the community hazard mapping results and the results of interviews, using a questionnaire, to establish vulnerable elements for each hazard and to assign values to those

elements. Table 7 outlines the hazards, the vulnerability dimensions and the elements at risk. From this process, the social, economic and environmental vulnerability levels were mapped against a classification system of 1 to 5, ranging from low to very high (see Annexure B). These maps are provided in Figures 19 - Figure 21.

Hazard	Vulnerability Dimension	Elements at Risk
Flood	Social	Built-up area (residential)
		Population
		Children
		Disabled population
		Elderly population
		Women
		Public gathering places and buildings (schools, hospitals, government buildings)
	Economic and Infrastructure	Built-up Area (commercial and industrial land)
		Agricultural Land
		Agricultural Employment
		Low income population
		Bridges
		Road Network
	Environment	Parks
		Shrubs
		Forest
Drought	Social	Built-up area (residential)
		Children
		Population without access to improved water access
	Economic	Agricultural land
		Home gardens
		Agricultural employment
		Low income population
		Unemployment rate from labour force
	Environmental and Bio-physical	Soil (water holding capacity)
		Forest
		Marshes
		Parks

Table 7: Hazard, Vulnerability and Risk Considerations

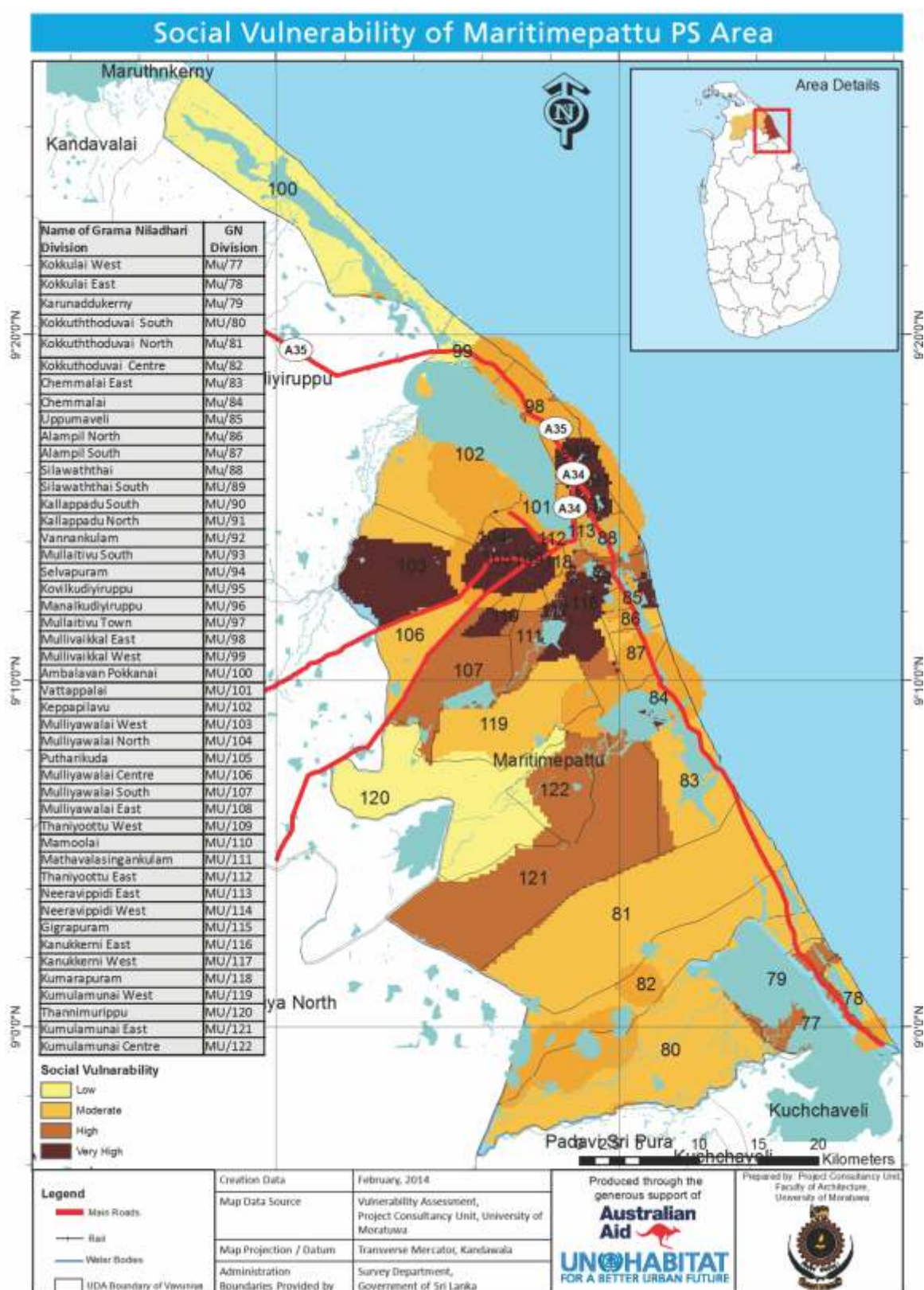


Figure 19: Social Vulnerability of Maritimpattu PS Area

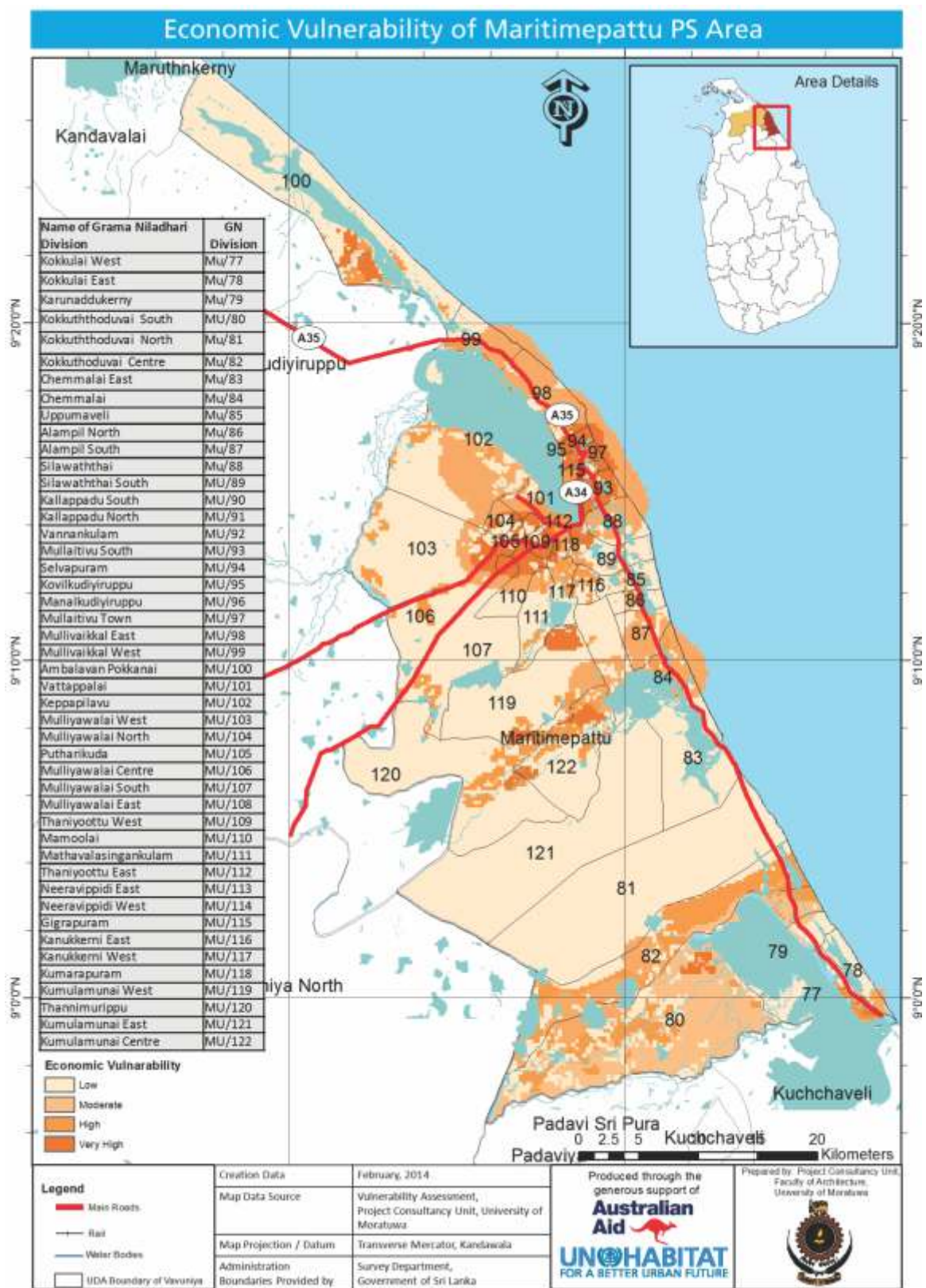


Figure 20: Economic Vulnerability of Maritimpeattu PS Area

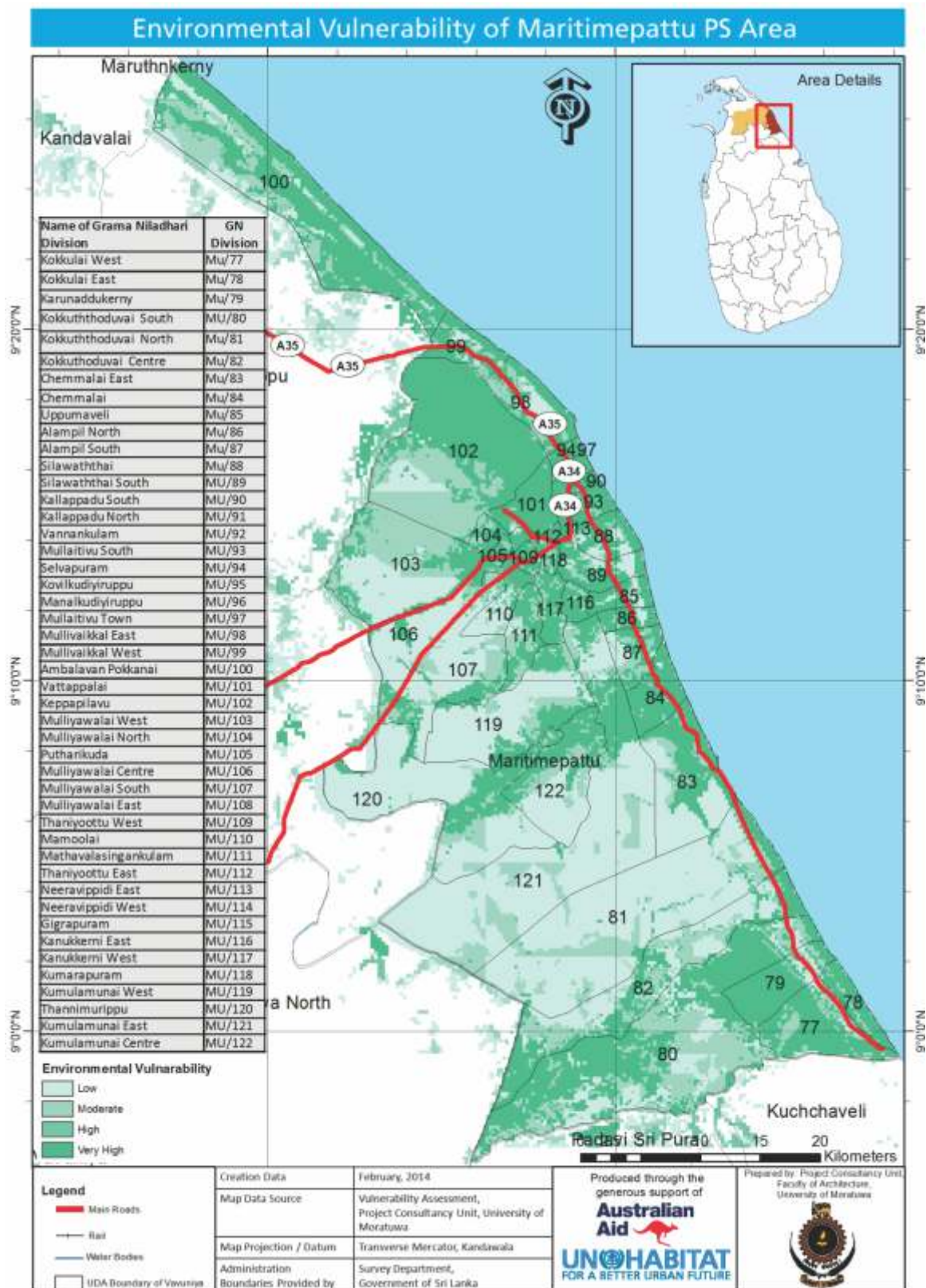


Figure 21: Environmental Vulnerability of Maritimepattu PS Area

3.5 Capacity Assessment

Standard, yet specific indicators for capacity assessments have been established in A Framework for

Social Adaptation to Climate Change: Sustaining Tropical Coastal Communities and Industries.¹⁹ These indicators assisted in forming the set of indicators used to evaluate the capacity of the area.

Factor	Indicator
Economically active population	Percentage of population comes under the 14-60 age group category
Access to financial subsidies	Percentage of families receiving Samurdhi
Educated population	Passed G.C.E O/L, G.C.E. A/L, Degree or Higher
Secure employment	Percentage of population involved in government, defence, education and private sector employment
Access to safe drinking water facilities	Percentage of houses with access to safe drinking water
Access to proper sanitary facilities	Percentage of houses with access to proper sanitary facilities
Access to health facilities	Service area of the Health Centres
Access to electricity	Percentage of houses with access to electricity
Permanent houses	Percentage of permanent houses

Table 8: Capacity Assessment Factors and Indicators

The capacity assessment was conducted at the Grama Niladhari Division (GND) level as that is the smallest dataset available in the Project Area. Community knowledge and information was collected to analyse capacity assessment factors. Several questions were asked from the community regarding the availability of disaster mitigation measures, early warning systems, evacuation places or paths and insurance. The project team has verified the recognized measures through field visits, DMC District Disaster Preparedness and Response Plans and secondary data reports.

People who have more economic strength with permanent sources of income, insurance schemes and financial subsidies, have a greater ability to cope with disasters because of the resources they have access to. People with indigenous knowledge on disasters also have a greater ability to face disasters with minimum losses, compared to those who do not. Access to safe basic infrastructure such as water and sanitary facilities can minimize the secondary effects of disasters. Similarly, a community who has such resources, normally has a higher capacity to prepare for, face, cope with, respond to and recover from disasters.

3.6 Risk Mapping

The risk map was prepared by superimposing the hazard and vulnerability maps. In this assessment, the hazard and vulnerability maps, each comprising four levels of classification – very high, high, medium and low – were prepared. To superimpose the maps, it is necessary to establish the risk levels criteria. A high level of hazard superimposed on high, medium or low levels of vulnerability (or vice versa) is classified as a very high level of risk. A high level of hazard with a medium level of vulnerability is also rated as a high level of risk. Finally a low level of hazard with low-level vulnerability is rated as a low level of risk. If either the hazard or vulnerability is very low, then risk is considered to be very low. This analysis has been performed for flood, drought and storm surge and the results are illustrated in Figure 22: Composite Flood Risk Map and Figure 23: Composite Drought Risk Map.

19 Available from <https://portals.iucn.org/library/efiles/documents/2010-022.pdf> (accessed on 5 August 2014)

The Composite Flood Risk map indicates flood risk areas of the Maritimé pattu Project Area after combining data on flooding with social, economic and environmental vulnerabilities present in the area. According to this composite flood risk map, Mulliyawalai North, Mulliyawalai West, Mulliyawalai East, Thaniyoottu and Kumarapuram GNDs are high and moderate risk areas. The flood risk economic dimension identifies

Selvapuram, Mullaitivu Town, Mullaitivu South and Kallappadu North GNDs as high risk areas, while environmental high risk shows water catchment areas as showing considerable risk in Ambalavanpokkanai, Mulliyawalai South, Kumulamunai Centre and Chemmalai. These are the areas that need to be considered in DRR planning as they show the most vulnerable land area and population.



Water retention pond in Kokkuthoduwai

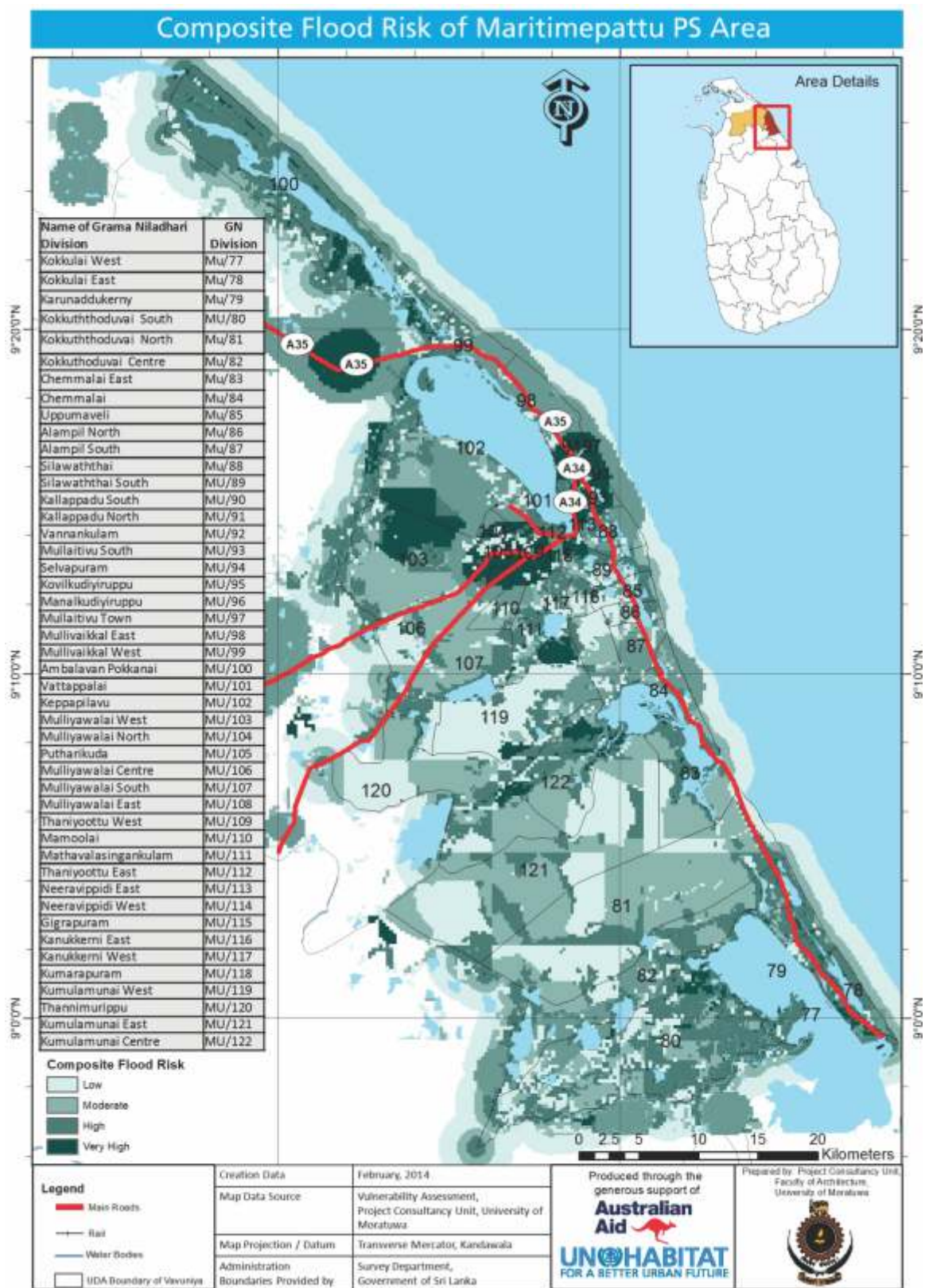


Figure 22: Composite Flood Risk Map

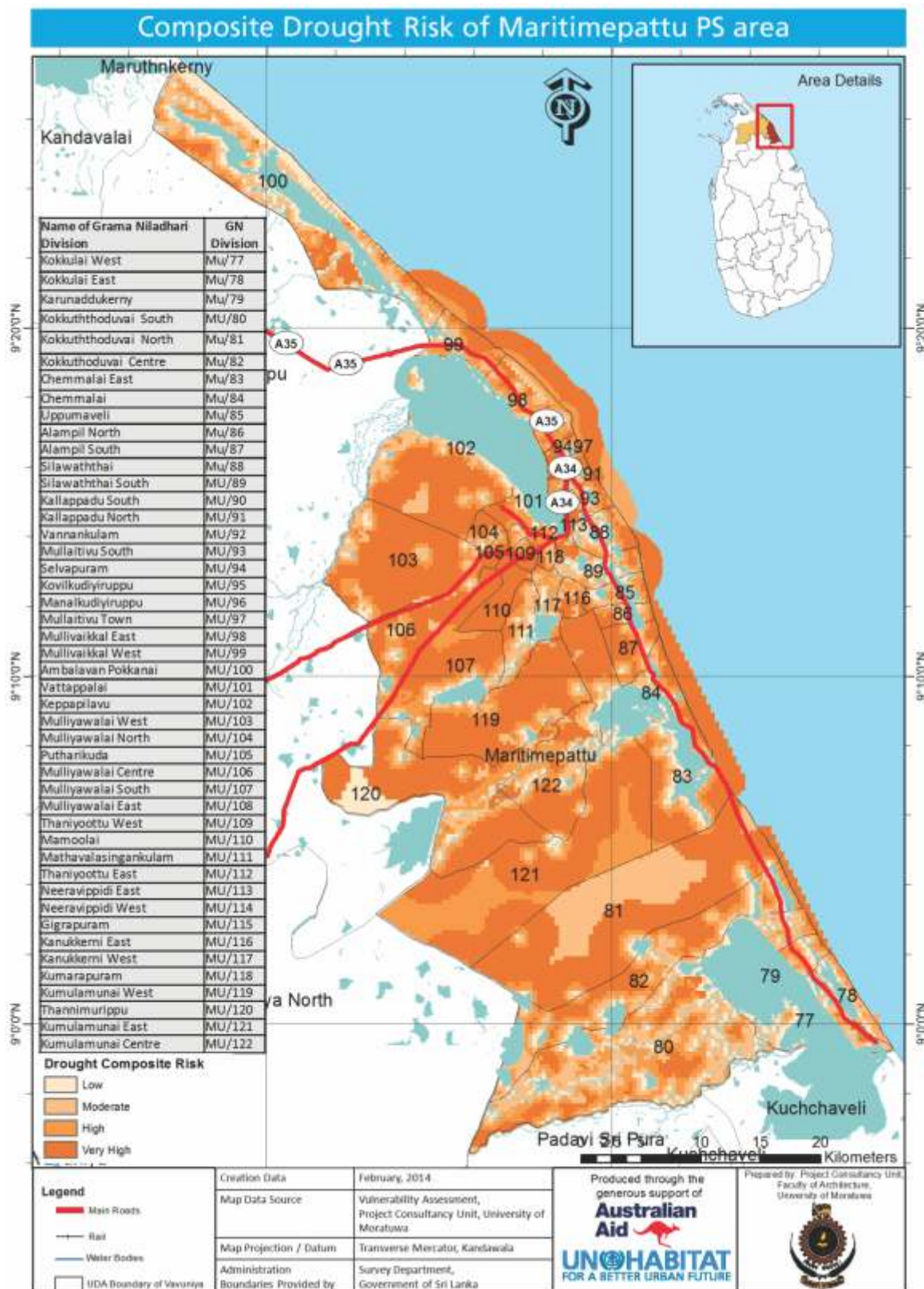


Figure 23: Composite Drought Risk Map

The Composite Drought Risk Area Map of the city shows a large part of the Project Area as under very high and high level risk of droughts, and shows that there is a need for reduction of drought risk in the area.

3.7 Multiple Hazards and Very High Risk Locations

The multiple risk areas are locations which are affected by, and also have the potential to be affected by, more than one hazard. The multiple risks considered are flood, drought and strong winds and the map was produced by overlapping these three composite risk maps. Risk levels were classified as low, moderate, high and very high. This assessment gives equal importance to the three hazards when forming the multiple risk map.

The Multiple Hazard Risk Map shown in Figure 24 identifies the high-risk locations where DRR planning solutions should be focused. This includes eleven very high risk zones.

This map shows high multiple risks in Kallappadu North, Selvapuram, Mullaitivu South, Mullaitivu Town, Mulliyawalai North, Mulliyawalai South, Mulliyawalai West, Ambalavanpokkanai, Silawaththai, Mullaiwaikal East and Mullaiwaikal West areas.

These areas were visited by the project team. They were also the focus of the workshop on the validation of hazard and risk maps and the identification of strategies and action projects which was conducted with GN officers, local political leaders, council members, community leaders, representatives from the identified risk areas, government officials, and NGO representatives.



Interior road in Mulliyawalai with dilapidated culverts

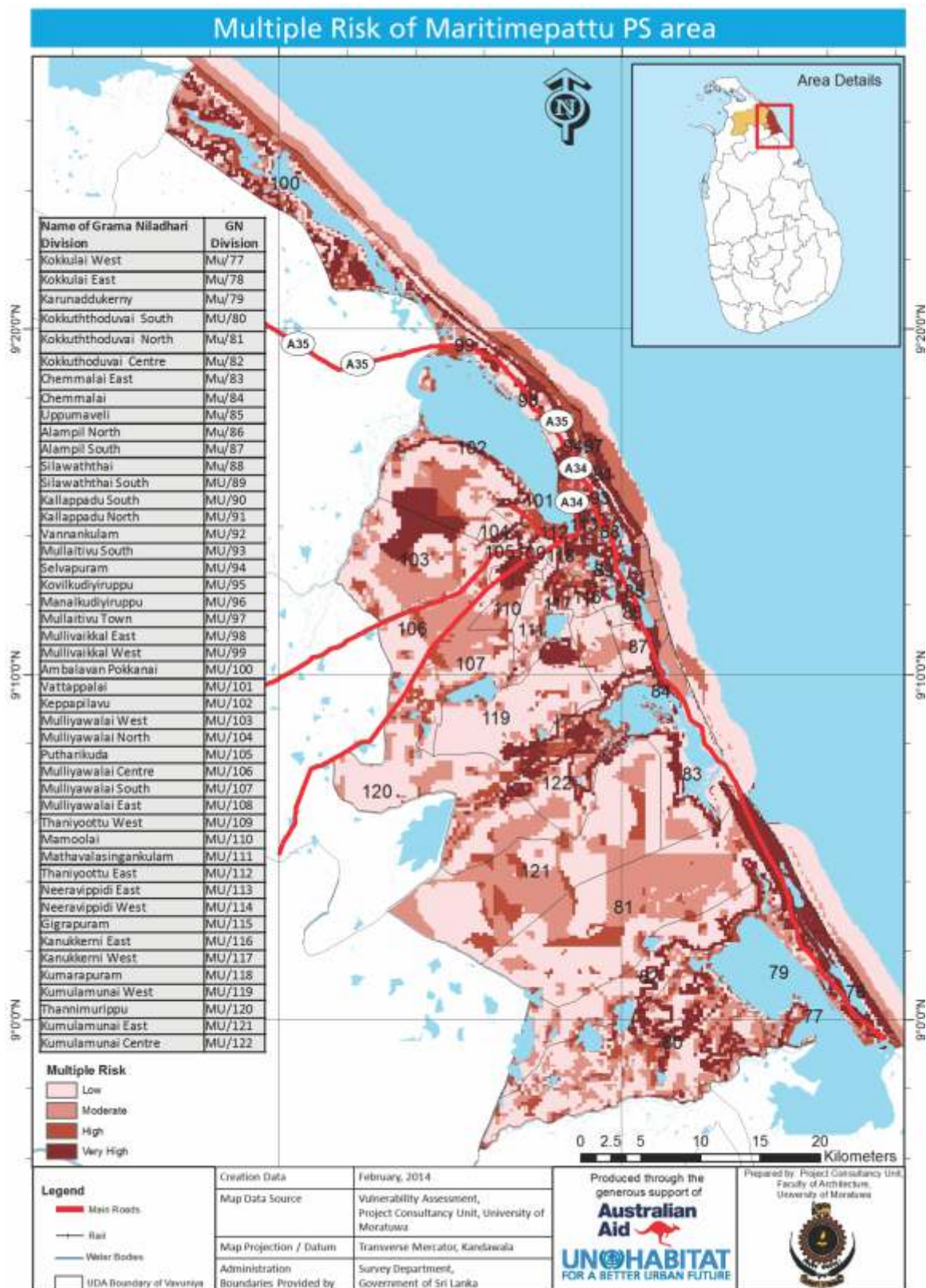


Figure 24: Multiple Hazard Risk Map

3.8 SWOT Analysis

The SWOT analysis assists in decision-making, physical planning, controlling procedures, participation and organisation. The SWOT analysis provides a background to the Strategic Directions in Chapter 4 as it is a bridge between the present situation (“where are we now?”) and the future (“where we want to be after a defined time using available resources”).

Strengths

The strengths will enable the Maritiméattu PS to harness established sustainable trends bringing benefits

to stakeholders as diverse as citizens, institutions, organisations, media and business owners. Strengths are also factors that are crucial to the effectiveness of a DRR system that are advantageous in comparison with other areas of the country. They arise from the geographic location, are inherent in institutional coping capacities, include the resources, economy, city image and identity, culture and awareness, administrative and management process and procedures. Table 9: SWOT Strengths outlines the strengths of the Project Area and its surrounding environment.

Element	Strengths
Location and regional linkages	<ul style="list-style-type: none"> The Mullaitivu city is located strategically and connected to key economic nodes of the North and East (Vavuniya, Trincomalee and Jaffna). Mullaitivu is considered a commercial hub for trading activities in the Mullaitivu District.
City Economy	<p>The city is gaining importance as a fishery agro-economic centre.</p> <p>There is an existing fishery harbour.</p> <p>There is rapid urban growth in the post-conflict period.</p>
Image and Identity	<p>The city is surrounded by natural systems, the Indian Ocean and a chain of lagoons as well as paddy fields and forests.</p> <p>There is new construction and ongoing development along the main arteries, including a hospital, schools and administration services.</p>
Tourism	<p>Availability of attractive and important environmental assets (natural resources), such as the chain of lagoons and forest reserves.</p> <p>The Kokkilai Bird Sanctuary.</p>
Institutional set-up	<p>Presence of a number of government development bodies.</p>
Infrastructure	<p>Reconstruction of main roads and ongoing development on roads such as Kilinochchi to Mullaitivu, Mankulum via Oddusuddan to Mullaitivu “A” class roads and Mullaitivu to Nedunkeni, Oddusuddan to Nedunkeni “B” class roads, which have increased accessibility and connectivity in the post-conflict period. Availability of electricity, and ongoing establishment of other social infrastructure facilities.</p>

Element	Strengths
Urban form	The National Physical Plan has identified Mullaitivu as a Second order city of the region Development along main linear roads provide easy access to the public Linear development along the main road leads to higher accessibility The commercial development is concentrated along the main arteries Land is available for horizontal development
Hydrological system	Chain of lagoons A natural and cascade hydrological system and seasonal streams Interconnected hydrological system with the sea
Vegetation pattern	Rich forest cover, marshy lands and available land for paddy fields

Table 9: SWOT Strengths

Weaknesses

Weaknesses of the disaster management system of Maritimipattu PS can be measured in terms of disadvantage, lack of coordination with development initiatives and governance mechanisms, low adaptation and development capacities, weak institutions,

authorities and legislative gaps. The lack of regional cohesion, shortage of resources and capacity, vulnerability, frequency of disasters and time frames for preparedness and recovery also exacerbate hazards. Table 10: SWOT Weaknesses provide details of the weaknesses identified in the SWOT.



Inundation due to Nayar river overflow at Murippu Road

Element	Weaknesses
Institutional	<ul style="list-style-type: none"> • Lack of coordination between central, provincial and local governments on development initiatives • Lack of database management systems among institutions • Lack of coordination and resource sharing mechanisms among institutions • Lack of training and expertise to implement and monitor guidelines and regulations • Overlapping jurisdictions between UDA, CCD, CEA, DMC, MC, Forest Department, PS etc. • Lack of technical knowledge about disasters and other software by the government and regional offices (GIS, Remote sensing etc.)
Location and Regional linkages	<ul style="list-style-type: none"> • Poor interior road conditions
Infrastructure	<ul style="list-style-type: none"> • Topographical and geomorphologic features are not considered when designing the drainage network • Drainage network is limited only to a particular area and the culverts do not have the capacity to discharge water • Interior roads are in poor condition, unpaved and without proper drainage • Absence of pipe-borne water within the city • Many people use wells for drinking water and these wells are situated far away from residences/houses • Poor conditions of housing (many houses are still semi-permanent and temporary structures)
Hydrological system	<ul style="list-style-type: none"> • Lack of a major river system or perennial streams • Water table decreases in dry periods
Disaster	<ul style="list-style-type: none"> • No proper training for the community on DRR • Lack of community mobilisation initiatives on DRM • Lack of proper database management in DRR /DRM • Lack of preparedness and infrastructure facilities to face disasters • Absence of evacuation routes for disaster periods
City Economy	<ul style="list-style-type: none"> • The agriculture and animal husbandry sector faces a number of problems: <ul style="list-style-type: none"> • Low Productivity • Low level of technological innovation • Inadequate credit facilities • Poor access to local and international markets. This has led to high poverty level of the people • The conflict resulted in: <ul style="list-style-type: none"> • Destruction of facilities • Abandonment of irrigation systems
Urban Form	As a coastal area, it is vulnerable to sea erosion

Table 10: SWOT Weaknesses

Opportunities

Opportunities can stem from external situations such as a stable political atmosphere, the innovation of new technologies, the development of new business sectors and markets. The willingness of foreign partners to invest in a variety of fields such as information, disaster projects, funding or exchange programmes. The opportunities are presented in Table 11.

Element	Opportunities
Urban form	<p>The National Physical Plan of the Northern Province expects to establish Mullaitivu city by 2030 as a:</p> <ul style="list-style-type: none"> • Local Service and Administrative Centre • Gateway to national tourist destinations • Fishery-based activity and trading centre • Health services hub with a District Hospital
City economy	<p>The Northern Province Regional Plan 2030 identifies the Mullaitivu (Maritimepattu) area as a priority agriculture area. Details are as follows:</p> <p><i>In the Animal Husbandry and Agriculture sector:</i></p> <ul style="list-style-type: none"> • Encouraging diversification of crops in Mullaitivu. Consideration should be given to the promotion of organic agriculture • Develop food processing facilities in Mullaitivu <p><i>In the Aquaculture and Fisheries sector:</i></p> <ul style="list-style-type: none"> • Convert fishery harbours into modernized Marine Resource Harbours in Mullaitivu. Facilities are to include ice plants, cold storage, freezer rooms, fuel storage and communication facilities • Promote and develop aquaculture-based industries including a fish-breeding centre in Mullaitivu. These industries comprise seaweed farming, sea bass farming, sea cucumber farming, oyster/mussel culture, and ornamental fish farming <p>(The Northern Province Regional Plan 2030 proposes strategies to increase the standards of living of the people and their economy. A consequence of this will increase the adaptive capacity of the people to cope with disasters.)</p>
Proposed Projects	<ul style="list-style-type: none"> • The Disaster Resilient City Development Strategies for Sri Lankan Cities Project <p>Government's ongoing post conflict recovery projects.</p>
Tourism	<p>The Northern Province Regional Plan 2030 proposes the following areas to be developed for specific tourism sectors:</p> <ul style="list-style-type: none"> • The area immediately south of Mullaitivu as a tourism destination whilst protecting and promoting the sanctuaries, lagoons and marine habitats along the coast to Trincomalee • The Departments of Forestry, Wildlife and Coast Conservation to jointly develop an East Coast Master Plan to preserve the chain of lagoons and bird sanctuaries south of Mullaitivu, including the Nayaru and Kokkilai Lagoons for conservation purposes

Table 11: SWOT Opportunities

Threats

Threats refer to external negative pressures and dangers to the future of the Mullaitivu Project Area as a sustainable, healthy and resilient area. The threats are presented in Table 12 SWOT Threats

Element	Threats
Disasters	<ul style="list-style-type: none"> • Temperatures across the country have been increasing over the past 100 years and the rate of increase has accelerated in recent decades • The North East Monsoon is the system most likely to be adversely impacted by climate change, with rainfall predicted to decline both in quantity and duration • Scientists believe that sea-levels will continue to rise and that the frequency and severity of extreme weather events (such as flash flooding) will increase
Institutional setup	<ul style="list-style-type: none"> • Lack of financial availability for development in the national context
City Economy	<ul style="list-style-type: none"> • Increase in cost of living in the national context

Table 12: SWOT Threats

The SWOT analysis provided a number of ideas for future planning. Collating the results around the elements as presented in the four SWOT tables highlighted the breadth of opportunities for targeted planning interventions within the Mullaitivu Project Area. A number of common issues also emerged which require immediate action and clearly relate to developing Mullaitivu as a resilient city. These are discussed further in the Core Problem Analysis.

3.9 Core Problem Analysis

The problem analysis identifies the key issues and potential facing the Project Area in order to shape the strategic directions which are discussed in the following chapter.

Core Problems

Economics, Social Development and DRR

- The high level of poverty and unemployment rate undermines attention towards disaster management awareness and the adaptive capacity of the community; and
The agriculture and animal husbandry sector faces a number of problems in terms of productivity, technological innovation, credit facilities and access to local and international markets.

Governance and Unplanned, Uncoordinated Development

- Relatively poor levels of commitment among relevant responsible authorities and individuals on planning and conducting fund raising activities pertaining to disaster management;
Overlapping jurisdictions between UDA, CCD, CEA, DMC, MC, Forest Department and PS;
Lack of technical knowledge on disasters and lack of access to GIS/Remote sensing software in the government and regional offices;
Lack of integration of all stakeholders; and
Lack of database management systems among institutions.

Infrastructure Development Concerns

- Drainage network is limited only to a particular area and the culverts do not have adequate capacity for discharging water;
Interior roads are in a poor condition, unpaved and without proper drainage facilities;
Absence of pipe-borne water results in many people using wells for drinking water. The wells are often situated far away from houses; and
Poor conditions of housing (most of the houses are semi-permanent and temporary structures).

Capacity to face disasters

- No proper training for the community on DRR;
- Lack of community mobilisation initiatives on DRM;
- Lack of proper database management in DRR Management;
- Lack of preparedness and infrastructure facilities to face disaster; and
- Absence of evacuation routes for disaster periods.

Environmental Concerns

- Lack of major river system or perennial streams;
- Water table decreased drastically in dry periods;
- Coastal area vulnerable to sea erosion; and
- Climate change, including changes to the timing of the North East Monsoon, changes to rainfall quantity and duration, as well as sea-level rise and the frequency and severity of extreme weather events (such as flash flooding).

Core Potential

Focus of Attention

- The government and the public are focusing attention on the development in the area; and There is national and international attention focused on the progress of development of the area.

Natural resource availability

- Natural resources within the area, which consists of different eco-systems such as rich forest cover, marshy lands, shrub land, plantations and water bodies. The city is surrounded by natural systems – the Indian Ocean and chain of lagoons and paddy fields and forests;
- Availability of land for paddy cultivation; and
- Chain of lagoons, natural and cascade hydrological systems, seasonal streams and an interconnected hydrological system with the sea.

Strategic location

- The Project Area is located strategically and connected to main economic nodes of the North and East (Vavuniya, Trincomalee and Ampara) of the country and considered as the commercial hub for trading activities of Mullaitivu District.

Infrastructure development in progress

- After the conflict, main roads were rebuilt and ongoing developments such as Kilinochchi to Mullaitivu, Mankulam via Oddusuddan to Mullaitivu “A” class roads and Mullaitivu to Nedunkeni, Oddusuddan to Nedunkeni “B” class roads, have increased accessibility and connectivity;

Availability of electricity facilities, ongoing establishment of other social infrastructure facilities; Land is available for horizontal development; The city is gaining importance as a fishery and agro-economic centre; and Availability of a fishery harbour.

Linkages to National Plans

- The National Physical Plan of the Northern Province 2030 expects to establish Mullaitivu as a second order city which includes the following functions: a local service and administrative centre, a gateway to national tourism destinations, fishery-based activities and a trading centre, a health services hub with a district hospital.

The SWOT analysis revealed the gaps that must be addressed in order for Mullaitivu to become a disaster resilient city. The core problem analysis helped to focus the key areas for intervention and these are developed into themes under the strategies developed in Chapter 4.



Nayar Lagoon

3.10 Conclusion

This chapter has provided the key results from the hazards, vulnerability, risk and capacity assessments that were undertaken and validated through community workshops. This information was then integrated with the baseline research to identify risk levels, and this process culminated with the multiple hazards composite risk map for the Maritimé pattu Project Area.

The SWOT analysis and the core problem analysis assisted in identifying issues and themes to shape a response that built on the strengths already present in the Project Area. The objective is to make Mullaitivu a resilient town. The strategic directions were identified thereafter and are discussed in further detail in Chapter 4.



Strategic Directions



The baseline study, hazard, vulnerability, risk and capacity assessments, SWOT and the Core Problem Analysis all provide a solid and valuable foundation for formulating the city's vision and disaster resilient strategies. They include substantial input from stakeholders including the public, as well as community groups, city employees and council members. The first three chapters have shown that Maritimpattu PS is an urban development area, which has a unique geographical character with a moderate level of environmental sensitivity and some extent of disaster vulnerability.

Mullaitivu has been earmarked as having potential for future development; this, however, must be managed in a planned way ensuring that resilience and DRR are driving principles. The PS has to develop two important tools to manage hazards: disaster resilience strategies and strategic urban planning incorporating DRR. Place-based planning will shape the future of Maritimpattu by concentrating on making places people centred, with urban character, instead of focusing only on land use and infrastructure development.

Five strategic directions have been developed for the Maritimpattu PS area as follows:

1. Enabling the City's Physical Environment and its Land Use Management for Risk Sensitive Development;
2. Creating Empowered and Capable Communities;
3. Enhancing the Safety and Well-Being of Citizens;
4. Building Resilient Communities with Social Networks, Information Management and Sharing; and
5. Promoting Proactive Disaster Management through a Risk Reduction Programme.

This Plan was prepared based on the following concepts:

Hazards and risks have been identified and considered in the planning process. This includes local and site-specific assessments of risks;

Development activities should be located in areas with little or no likelihood of hazards, thereby avoiding or minimising the risk. Development activities include transport and utility infrastructure as well as residential and other buildings;

Development should be permitted in hazardous areas only when there are no alternative and reasonable sites available which meet the objectives of proper planning and sustainable development. These developments must adhere to special design regulations to mitigate their risk;

Only selected land uses should be allowed in hazardous areas; and

A precautionary approach should be applied to reflect uncertainties in hazard datasets, risk assessment techniques and the difficulty in predicting future climate scenarios. Development should be designed with careful consideration of future changes including climate change and flood risk so that future occupants are not subject to unacceptable risks.

The strategic directions cannot be implemented by the local authority or other relevant institutions alone – they must coordinate with each other, and ensure community participation to develop the sustainability of the DRR initiatives in the city.

4.1 Vision and Strategic Directions

This Disaster Risk Reduction and Preparedness Plan for the Maritimpattu Urban Development Area provides a framework for managing disaster risks by adopting structural and non-structural mitigation measures. These measures have been designed to be incorporated with the UDA's Urban Development Plan for Maritimpattu. Monitoring and updating the plan will be crucial to ensure actions identified are implemented correctly.

The vision of the Plan is as follows:

“Sustainable and resilient development that preserves and nurtures the unique natural environment combined with a secure and healthy living environment for citizens and visitors.”

The delivery of this vision will make Mullaitivu a resilient, liveable city that harnesses the skills of the local population. A resilient Maritimpattu PS will consist of good quality roads with effective drainage systems, neighbourhoods where people have access to basic facilities and well-designed and maintained public areas. There will be affordable, sustainable housing that has been designed to survive hazards.

The strategic directions and the reasoning behind each are outlined in Table 13: Strategic Directions and Rationale.

Strategic Directions	Rationale
1 – Improving the Physical Environment of the City and its Land Use Management for Risk Sensitive Development	Mullaitivu is a growing city therefore attention must be focused on planning and regulating land use to ensure that the development in the city will create a future disaster-free environment.
2 – Creating Empowered and Capable Communities	With Mullaitivu becoming more developed and urbanised, the demand for water for drinking, agriculture and other land use activities is increasing, and as it is a drought prone area, measures to counter this are important. Furthermore, social protection measures or safety nets through health services, livelihood generation, microfinance, and insurance are also important.
3 – Enhancing the Safety and Wellbeing of Citizens	Communities need to be prepared for hazards and disasters. Holistic preparedness activities are critical to mitigating the impact of disasters. Making the vital infrastructure secure can reduce the likelihood of loss of life, as well as mitigate damage to or destruction of property and infrastructure. Communities that receive early warning, that are able to react immediately and are well trained and ready to respond, and can respond considering different cultural, social and psychological norms will minimise the impact of the hazards and enhance their capacity to respond and rebuild. While there is progress in relation to early warning systems and new technologies for communicating timely messages, more needs to be done to ensure communities receive and interpret information and take appropriate action.
4 – Building Resilient Communities with Social Networks, Information Management and Sharing	DRR will be promoted, supported and sustained by factors such as strong community networks, alternative financial facilities, technical support and community-based information systems. Having knowledge and understanding of hazards and risks is of little use, unless the information can be translated into relevant controls and mechanisms for dealing with them. Planning approaches that anticipate likely risk factors and the vulnerability of the population can reduce future impacts of disasters. Greater disaster resilience can be achieved through learning, innovating, and developing skills and resources at the individual, community and institutional level that can be applied to responding to and recovering from a wide range of disasters.
5 – Promoting Proactive Disaster Management through a Risk Reduction Programme	Changing climate trends and its impacts can be understood through a continuous planning approach with proper monitoring and responsibility sharing mechanisms. Data and information pertaining to the planning process (including hazard and vulnerability mapping) also need to be updated regularly. Tools, institutional mechanisms, and monitoring systems are needed for this activity. Thus, a policy framework for DRR must be developed and implemented including strengthening and tracking progress through specific and measurable indicators.

Table 13: Strategic Directions and Rationale

4.2 Strategic Directions, Strategies and Action Projects

The five strategic directions improve environmental, social and economic conditions, by strengthening the community, local technical officials and development initiatives. This section outlines the strategies and actions behind each Strategic Direction. Each Strategic Direction consists of a number of strategies and action projects. Further details on selected action projects are provided in Chapter 5: Action Projects.

4.2.1 Improving the Physical Environment of the City and its Land Use Management for Risk Sensitive Development

The strategies and action projects to implement this Strategic Direction are outlined in Table 14: Strategic Direction 1 – Strategies and Action Projects.

Strategy 1: Rehabilitate the existing irrigation tanks and canal system, and drainage system to manage flood, drought and sea erosion.
Action Project 1: Drainage Master Plan and Drainage construction with best management practices (Kallappadu South GN Division).
Action Project 2: Rehabilitation of tanks of Udayarkaddu, Thamararikkulam, Kanukkerny Kulam and Archchiyamurippu Kulam.
Action Project 3: Construction and Reconstruction of culverts, drains and canals. Related Activities: <ul style="list-style-type: none"> Culverts – Mullaiwaikal West, Kumulamunai East and West, Nayadkadhu Road and Vinayagar Road (join to main road); Drain – Vinayagar Road (join to main road), Kumulamunai East and West; Canals – Vattappalai irrigation canal, Uppumaweli canal; and Vinayagar Road (join to main road) – should increase the road height.
Strategy 2: Flood mitigation and protection of vulnerable public areas.
Action Project 1: Riverine development along main hydrological canals and lagoons in Maritimé pattu and apply the urban beautification approach – (Nandikadal, Kokkilai, Maththalan, Nayarú).
Action Project 2: Establishing a green belt along the coastal line and the lagoon.
Strategy 3: Implementation of eco-tourism in the area.
Action Project 1: Promote nature parks (Chemmalai East, Kumulamunai East near the Nayarú Lagoon).

Table 14: Strategic Direction 1 Strategies and Action Projects

4.2.2 Creating Empowered and Capable Communities

Table 15 outlines the strategies and action projects identified to achieve Strategic Direction 2.

Strategy 1: Introduce a horticulture system with rainwater utilisation.
Action Project 1: Discussing the benefits of, and identifying spaces for, horticulture gardens through awareness programmes.
Action Project 2: Introduce and build rainwater harvesting systems in the villages where safe drinking water is lacking in GNDs (Kokkuthoduwai North, Kokkuthoduwai Centre, Kokkilai East, Keppapilavu Model Village).
Action Project 3: Organising competitions for home gardens.
Strategy 2: Promote disaster resilient community housing (soft components and hard components).
Action Project 1: Promote construction of safe housing and community infrastructure (identified moderate risk areas – Mullaiwaikkal East, West, Selvapuram, Mullaitivu Town, Mullaitivu South, Kallappadu North etc.).
Action Project 2: Improve agricultural and fisheries support services: <ul style="list-style-type: none"> • Introduce incentive scheme/s for vulnerable communities; • Subsidiary inputs; • Affordable and appropriate credit facilities and market infrastructure; and • Special programmes to enhance productivity in agriculture and fisheries

Table 15: Strategic Direction 2 – Strategies and Action Projects

4.2.3 Enhancing the Safety and Wellbeing of Citizens

Table 16 outlines the strategies and action projects identified to achieve Strategic Direction 3.

Strategy 1: Protect vital facilities.
Action Project 1: Ensure schools and hospitals are safe places and upgrade their infrastructure. Also provide drinking water facilities for Vattappalai Maha Vidyalaya.
Action Project 2: Reconstruct the bridges including increasing the height of Vadduvakal bridge.
Strategy 2: Introduce an early warning system.
Action Project 1: Develop a methodology for forecasting potential disasters and introduce a mechanism to make people aware of such disasters.
Action Project 2: Training programmes for Flood Forecasting and Early Warning Centres (FFEWC) and Zonal Early Warning Centres (ZEWC).
Strategy 3: Facilitate smooth transport and movement in disaster periods.
Action Project 1: Develop an evacuation plan by incorporating the existing evacuation places and routes.

Table 16: Strategic Direction 3 – Strategies and Action Projects

4.2.4 Building Resilient Communities with Social Networks, Information Management and Sharing

Table 17 outlines the strategies and action projects identified to achieve Strategic Direction 4.

Strategy 1: Develop integrated experience sharing mechanisms.
Action Project 1: Capacity building awareness programmes.
Action Project 2: International and national experience sharing.
Action Project 3: Creation of knowledge teams with disaster management skills.
Action Project 4: Provide disaster preparedness guide books.
Strategy 2: Empower community level organisations by providing access to technology and knowledge for vulnerability reduction.
Action Project 1: Provide disaster recovery equipment and material.
Action Project 2: Develop a cooperative disaster recovery donation system.

Table 17: Strategic Direction 4 – Strategy and Action Projects

4.2.5 Promotion of Proactive Disaster Management through Risk Reduction Programme

Table 18 outlines the strategies and action projects identified to achieve Strategic Direction 5.

Strategy 1: Develop a continuous monitoring and evaluation system.
Action Project 1: Continuously updating the assessments, evaluation and monitoring systems.

Table 18: Strategic Direction 5 – Strategy and Action Project

4.6 Conclusion

The strategic directions that have been identified assist in linking and strengthening DRR in the Maritimpattu PS. They also support the priorities and tasks that are identified in the HFA and are designed to assist each city become more resilient (refer to Annexure A: Linking the Strategic Directions to the HFA). Promoting an

integrated economic, social, psychological, physical and environmental approach in all aspects of the PS operations, such as infrastructure, governance, disaster risk management and social services will assist in reducing the impact of hazards and will enable communities to prepare for, prevent and respond to hazards.



Action Projects



Action Projects

The action projects detailed in this section are considered priorities and are derived from the strategic directions identified in the previous chapter. All action projects respond to a need identified and many relate to

the areas that have been identified as very high risk in the assessment phase. Table 19 links the strategic directions and detailed action projects provided in this chapter.

Strategic Directions	Strategies	Action Project
Direction 1 – Improving the Physical Environment of the City and its Land Use Management for Risk Sensitive Development	Strategy 1: Rehabilitate the existing irrigation tanks, canal system and drainage system to manage floods, drought and sea erosion.	<p>Action Project 1: Drainage Master Plan and drainage construction using best management practices (Kallappadu South GN Division).</p> <p>Action Project 2: Rehabilitation of tanks in Udayarkaddu, Thamaraiikulam, Kanukkerny Kulam and Archchiyamurippu Kulam.</p> <p>Action Project 3: Construction and repair of culverts, drainage systems and canals. Related Activities: Culverts: Mullaiwaikal West, Kumulamunai East and West, Nayadkadhu Road and Vinayagar Road (join to main road); Drain: Vinayagar Road (join to main road), Kumulamunai East and West; Canals: Vattappalai irrigation canal, Uppumaweli canal; and Increase road height: Vinayagar Road (join to main road).</p>
	Strategy 2: Flood mitigation and protection of vulnerable public areas.	<p>Action Project 1: Riverine development along main hydrological canals and lagoons in Maritimepattu and the application of an urban beautification approach in Nandikadal, Kokkilai, Maththalan and Nayaru.</p> <p>Action Project 2: Establish a green belt along the coastline and the lagoon.</p>
	Strategy 3: Implementation of eco-tourism in the area.	Action Project 1: Promote nature parks in Chemmalai East and Kumulamunnai East near the Nayaru Lagoon.



A tank in Mullaitivu during the dry season

Strategic Directions	Strategies	Action Project
Direction 2 – Creating Empowered and Capable Communities	Sstrategy 1: Introduce a horticulture system utilising rainwater.	Action Project 1: Identify the benefits of and possible locations for horticulture gardens through awareness programmes. Action Project 2: Introduce and establish rainwater harvesting systems in GNDs where safe drinking water is lacking (Kokkuthoduwai North, Kokkuthoduwai Centre, Kokkilai East, Keppapilavu Model Village). Action Project 3: Organise competitions for home gardens.
	Strategy 2: Promote disaster resilient community housing (soft components and hard components).	Action Project 1: Promote the construction of safe housing and community infrastructure (identified moderate risk areas – Mullaiwaikal East and West, Selvapuram, Mullaitivu Town, Mullaitivu South, Kallappadu North). Action Project 2: Improve agricultural and fishery support services: Introduce incentive schemes for vulnerable communities; Promote affordable and appropriate credit facilities and market infrastructure; and Hold special programmes to enhance productivity on agriculture and fisheries.



First aid training for community leaders

Strategic Directions	Strategies	Action Project
Direction 3 – Enhancing Safety and Wellbeing of Citizens and Communities	Strategy 1: Protect vital facilities.	Action Project 1: Ensure schools and hospital are safe and upgrade school and hospital infrastructure (this includes providing drinking water facilities for Vattappalai Maha Vidyalaya). Action Project 2: Reconstruct the bridges (including increasing the height of Vadduvakal Bridge).
	Strategy 2: Introduce an early warning system	Action Project 1: Develop methodology for forecasting potential disasters and introduce a mechanism to improve awareness of hazards. Action Project 2: Training programmes for Flood Forecasting and Early Warning Centre (FFEWC) and Zonal Early Warning Centres (ZEW). Action Project 3: Trainings and awareness programmes for the community.
	Strategy 3: Facilitate smooth transport and movement in disaster periods.	Action Project 1: Develop an evacuation plan by incorporating existing evacuation locations and routes.



Training programmes on capacity development for community

Strategic Directions	Strategies	Action Project
Direction 4 – Building Resilient Communities with Social Networks, Information Management and Sharing	Strategy 1: Develop an integrated experience sharing mechanism.	Action Project 1: Enhance community awareness and coordination. Action Project 2: Share international and national experience. Action Project 3: Build teams with disaster management skills. Action Project 4: Provide disaster preparedness guide books.
	Strategy 2: Empower community level organizations to have access to technology and knowledge for vulnerability reduction.	Action Project 1: Provide disaster recovery equipment and material. Action Project 2: Develop a cooperative disaster recovery donation system.
Direction 5 – Promoting Proactive Disaster Management through Risk Reduction Programme	Strategy 1: Develop a continuous monitoring and evaluation system.	Action Project 1: Continuously update assessments, evaluation and monitoring systems.

Table 19: Detailed Action Projects for the Strategic Directions

All of the above-mentioned projects aim to reduce risk and vulnerability, as well as provide ways to adapt to a potential hazard. Projects were prioritised to focus on the very high and high-risk zones that were identified in Chapter 3. The frequency of the occurrence of hazards and their level of magnitude was also taken into account when selecting areas and action projects. The action projects consider the shifting risks associated with climate change and ensure that the mitigation measures do not move the risk or increase vulnerability to climate change over medium or long term timeframes.

These strategic action projects provide direction for urban managers at all levels, and from different organisations operating within the PS, to facilitate DRR measures that will contribute to sustainable development through inclusive growth. They will also

build the adaptive capacities of communities, increase the resilience of vulnerable sectors and optimise disaster mitigation opportunities. Thus, the effects of hazards will be minimised and people's ability to prepare, respond and quickly return to normalcy following disaster events will be improved. Figure 25: Structural and Non-Structural Action Projects outlines how the project will work towards building a resilient city.

All projects proposed require comprehensive research into the cost-benefits, as well as the environmental and social impacts.

Annexure C provides a table of the approximate cost range, priority level, responsible agencies and duration of the action projects discussed in this chapter.

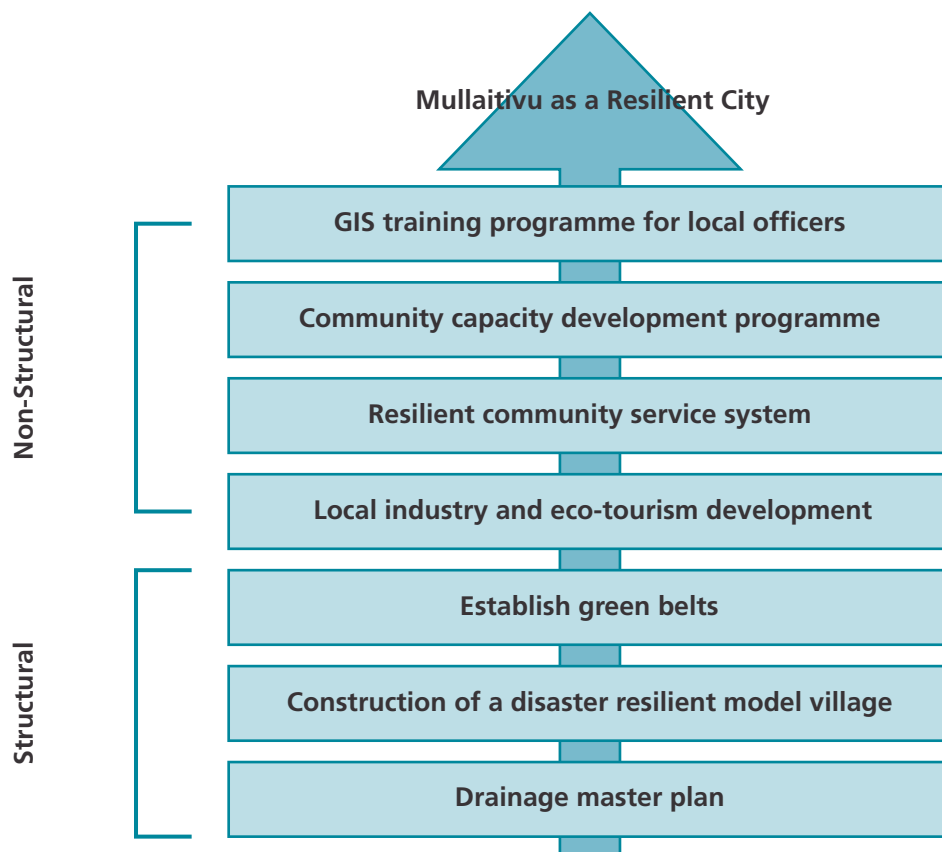


Figure 25: Structural and Non-Structural Action Projects

5.1 Action Projects for Improving the Physical Environment of the City and its Land Use Management Practices for Risk Sensitive Development

The following section outlines details some of the action projects under this strategic direction.

5.1.1 Drainage Master Plan and Drainage Construction

Kallappadu South is one of the GNDs in the Maritim Pattu PS. This area is surrounded by Kallappadu North GND to the North; Silawaththai GND to the South; Mullaitivu South GND, Higrapuram GND and Nanthikadal Lagoon to the west, and the sea on its east.

Kallappadu South GND has flat terrain that is frequently inundated by flash floods annually affecting approximately 120 families. The Kallappadu South GN Division lacks river systems, and the flat geographical formation of this area, coupled with manmade causes,

has resulted in a situation of regular flash flooding. Some of these manmade causes include the absence of drainage systems, new development interventions and ongoing construction that do not follow planning and building guidelines, new road construction without proper drainage systems (especially concrete roads), and existing drainage that is not technically sound. Less than 2% of the roads in the GN Division have a proper drainage system.

As Kallappadu South is part of the town, the drainage network is an important infrastructural facility. The drainage network can reduce storm water flooding from interrupting the city's functions, people's livelihoods and infrastructure operations. A proper drainage network will:

- Support the hydrological functions through an interconnecting hydrological network in the area;
- Reduce stagnant water in the town and prevent waterborne diseases;
- Help to reduce the surface flow of water and minimise the inundation of roads, public areas and other places; and
- Facilitate water flow to major water bodies.

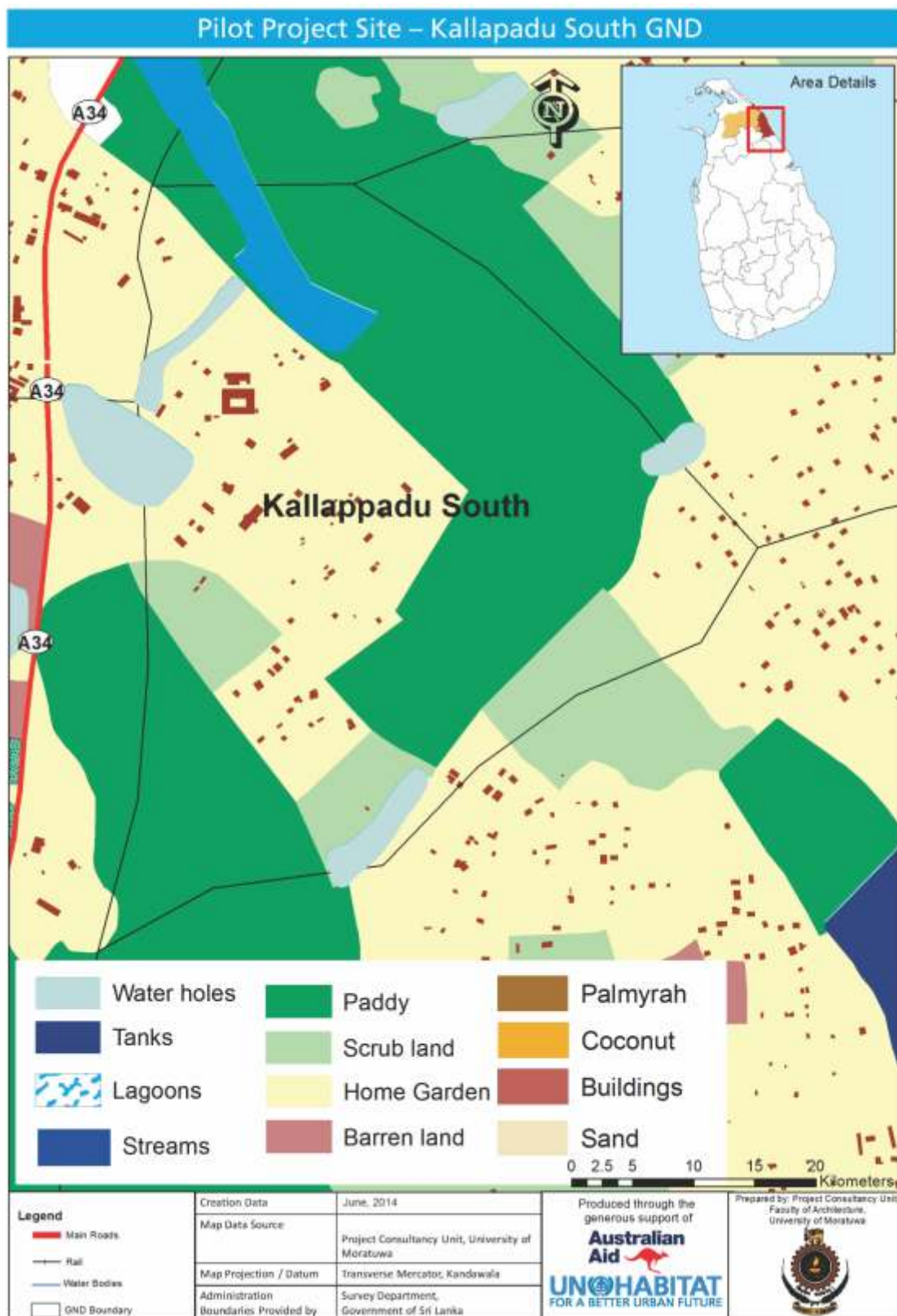


Figure 26: Kallappadu South GND

There are four main objectives in planning a drainage network system in the Kallappadu South GND:

- Identify the existing storm water drainage plan within the Kallappadu South GND;
- Develop a new storm water drainage plan for the area, incorporating the existing drainage pattern;
- Propose recommendations for managing storm water and waste water drainage; and
- Provide a model for the construction of drainage in other areas in the city.

Two major outcomes are planned. The first of which is to propose an effective drainage network by considering the existing drainage network, risk areas, elevation and the requirement of the drainage to systematically reduce water stagnation and the rainwater runoff within the city limits. The second is to prepare an effective database for the drainage network to make the management of the drainage network system in Kallappadu South easier. Please see Annexure C for a draft implementation plan and an outline for physical improvement projects.

Methodology

The methodology applied to the development of the drainage plan is illustrated in Figure 27.

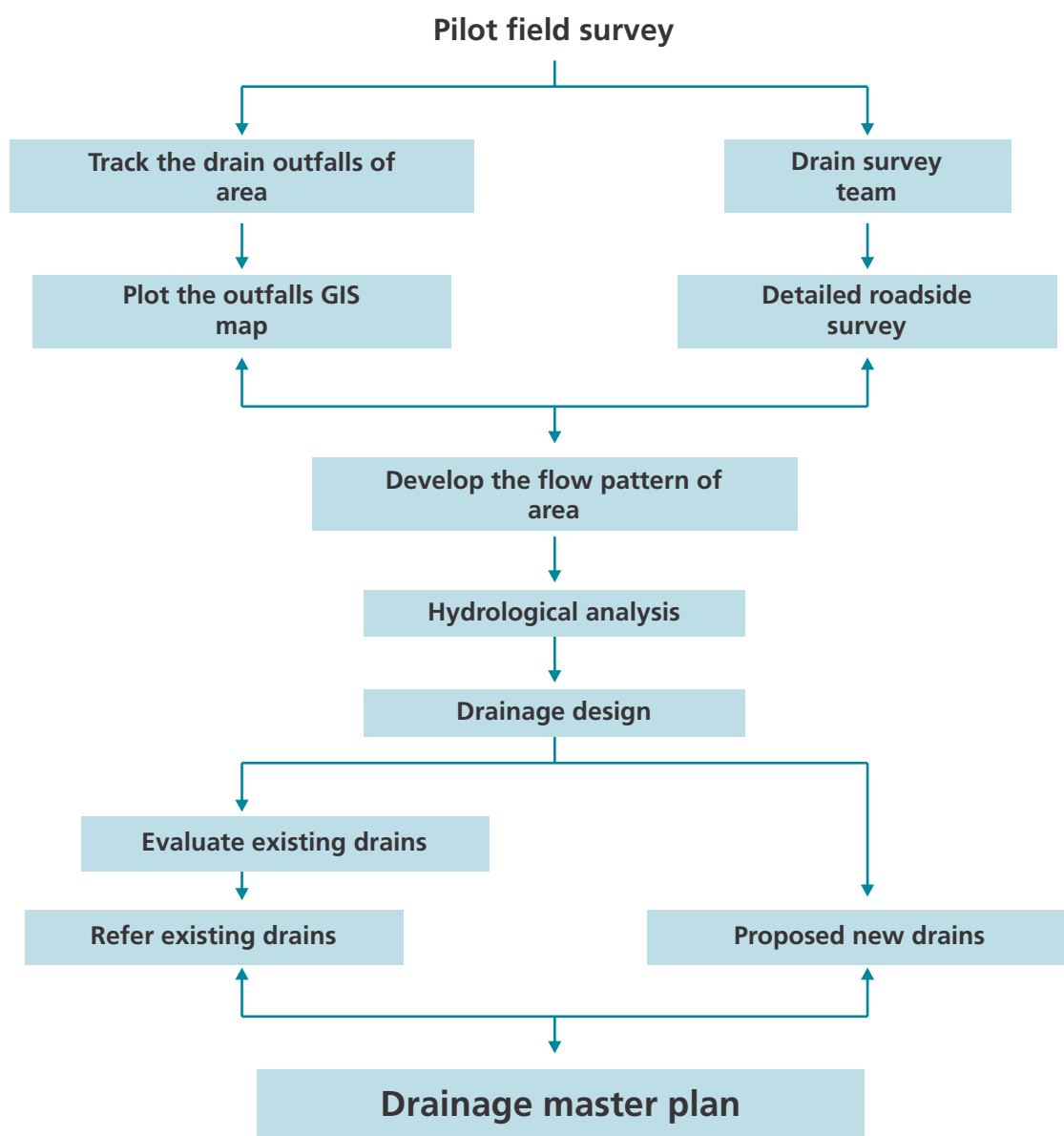


Figure 27: Drainage Master Plan Methodology

Pilot Field Survey and Technical Working Group Meeting

This initial aspect of the field survey includes site visits, measuring the relevant roads, identifying critical flood areas, major outfalls or possibilities for outfalls, and

identifying restrictions and other facts for a further detailed survey. As this step has been already carried out, a technical working group meeting was held afterwards.



Preliminary field visit to identify drainage outfalls

Technical Working Group discussion at DRR Unit, Maritim Pattu PS



Conducting a Field Survey on existing drainage patterns

The field survey consists of three parts:

- Training the survey team;
- Detailed roadside survey including road length, available drainage facilities, roadside usage, provisions for future improvements; and
- Tracking the outfalls of the area – existing outfalls, possible paths for outfalls and canals using GPS.

This component too has been already carried out. The urban area was divided into ten regions and a survey

team covered every road within each region. GPS technology was used to track the path and points.

Recording the data

Record the collected data on a spreadsheet and import to ArcGIS. The recorded data can include:

- a. General description of roads;
- b. Road connectivity;
- c. Details of existing drainage;
- d. Provisions for future improvements of drains;
- e. Land use patterns;
- f. Risk of flooding; and
- h. Tracked outfalls on the GIS map.

Developing the flow pattern of area

The levels measured through a detailed survey should then be outlined on to the geographical map and the surface flow of the area identified. The flow pattern on the map is then plotted.

Hydrological analysis and drainage design

The entire area is divided into sectors derived through the drainage paths (existing and possible). The rainfall data and hydrological data are analysed to calculate the surface runoff for each drain. The drains depth and width as per the volume of runoff to each drain are designed. Culverts and manholes are also designed. Further details on the design process are provided in Annexure D.

Evaluate existing drains

Compare the size of the existing drains with designed output to check the compatibility for future development. If existing drains are compatible with

calculated output then incorporate in the master plan or incorporate a design to ensure future functionality.

Proposed new drains

Outline the proposed drains on the geographical map with detailed design outputs. Existing drains that are not compatible with the calculated output should also be outlined and indicated on the map.

The completed drainage network plan is to be prepared as a separate document. The detailed analysis, the proposed drainage designs and drainage network maps will be detailed in this document.

The drainage system should include Silawathai Thiththakarai, Uppumaweli (Thuundaay North), Ampalavanpokkanai and Vattappalai Road. The embankment near the Vattappalai Amman Kovil needs to be assessed as this area is prone to saltwater intrusion.



Field verification of drainage outfalls using GPS tool

Implementation Schedule

Tasks	Output	Number of Months					
		1	2	3	4	5	6
Tender for Surveyor / GIS Specialist / Engineer to take lead for drainage master plan and construction of drainage segment.	Tender Documents, Tender advertised, Surveyor / GIS Specialist / Engineer Appointed.						
Technical Working Group (TWG) formed. TWG to provide advice to Surveyor / GIS Specialist / Engineer, review master plan drafts and ways for the LA and community to engage on drainage initiatives. TWG will hold frequent meetings to monitor progress.	TWG established and frequent meetings held with a record of minutes maintained.						
Design of comprehensive drainage master plan for Maritimepattu PS.	Maritimepattu PS Drainage Master Plan.						
Identify site and materials required for drainage construction project.	Location Report and Bill of Quantities.						
Procure materials for drainage construction.	Materials needed for the construction and the seeds or plants needed procured in accordance with Bill of Quantities and procedures.						
Implementation of drainage construction.	Drainage minimising the vulnerability of the community						
Community and LA engage on drainage needs and priorities.	Community views and concerns of the community reflected in the Drainage Master Plan and community support priorities identified.						

5.1.2 Construction of new and reconstruction of damaged culverts, drains and canals – Reconstruction of Vinayagar Road [Strategy 1, Action Project 3]

Vinayagar Road is one of the roads that is frequently affected by flooding. The infrastructure surrounding it and haphazard road construction has contributed to this situation. During the monsoon rains, the area gets inundated, and conversely, dries up during the dry period. Most of the area also experiences saltwater intrusion.



Existing Road condition of Vinayagar Road

New Road Design

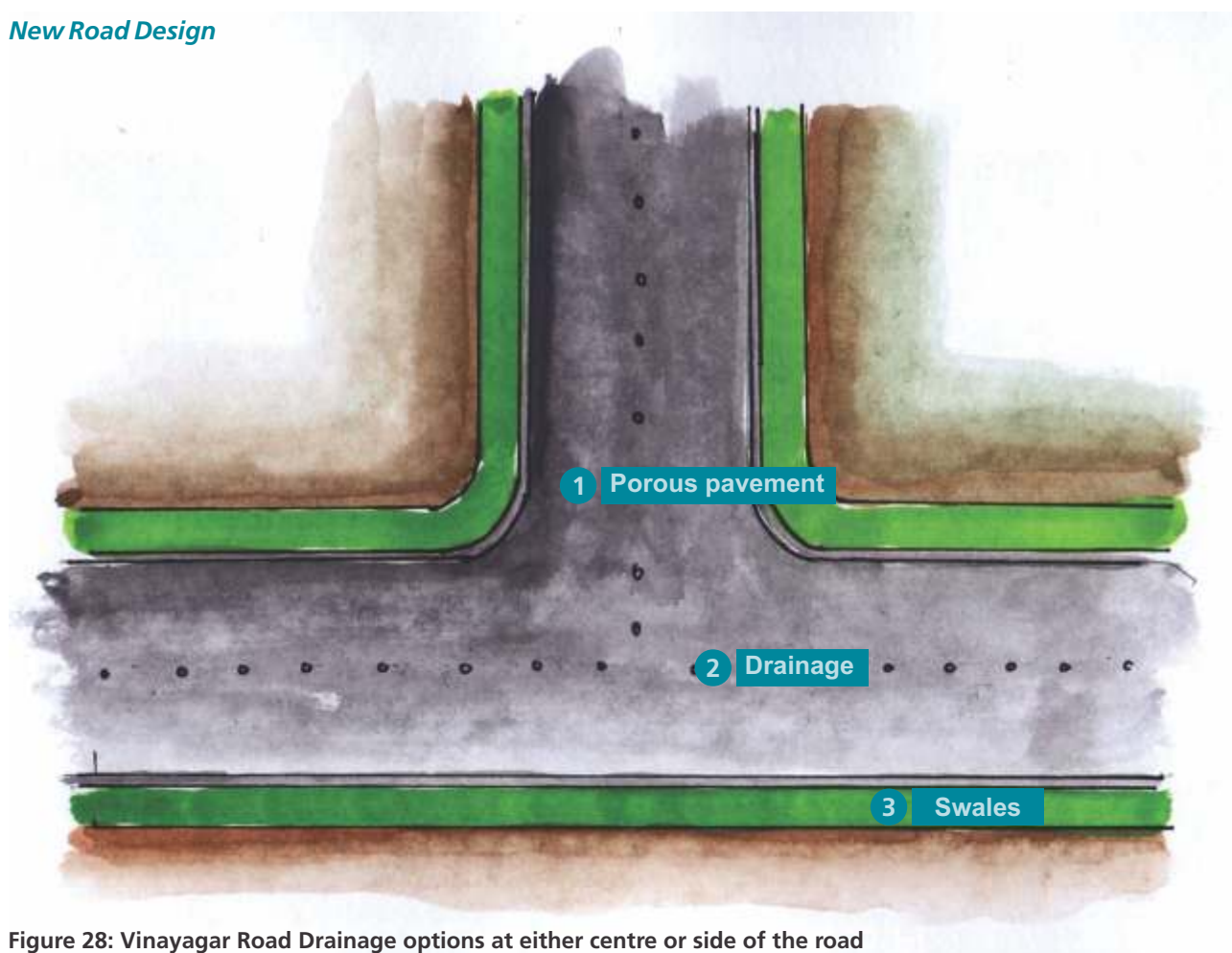


Figure 28: Vinayagar Road Drainage options at either centre or side of the road

Swales

Swales are simple drainage and grassed channels that primarily transport storm water runoff away from roads. They can also be designed to assist in filtering water.

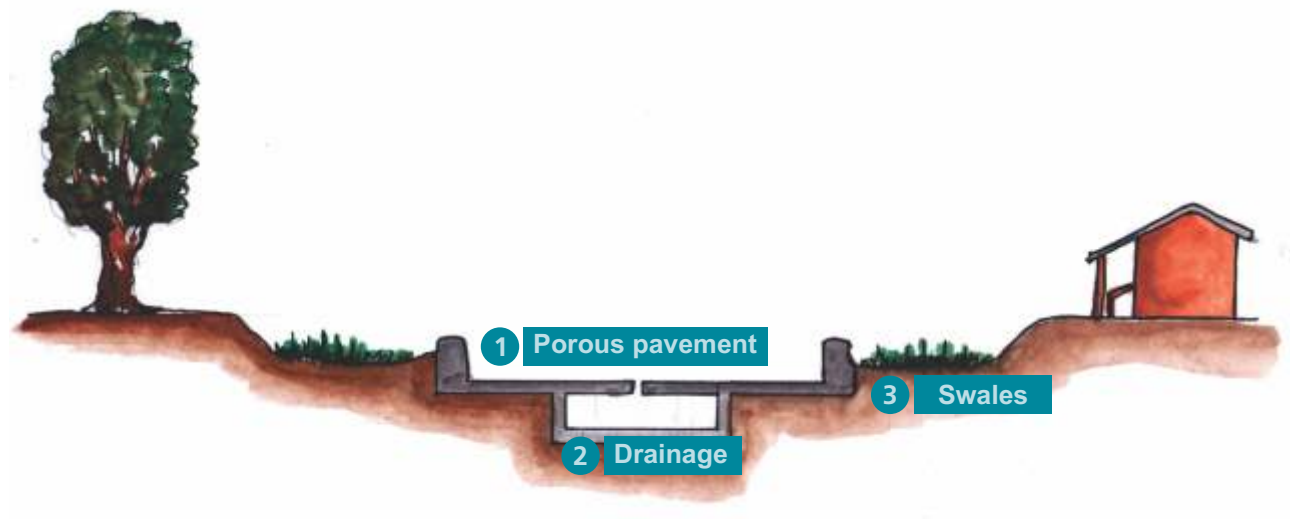


Figure 29: Proposed centre drainage for Vinayagar Road

Drain

Concrete drains carry excess water to the main drains. They can be located alongside the road (Figure 28) or in the middle of the road (refer to figure 28 and 29), and collect runoff water, when the pavement infiltration and the capacity of swales is insufficient to accommodate the runoff volume. There is a lack of land for drainage alongside the Vinayagar Road, and as such the Maritimpattu PS will be required to negotiate for the provision of land for drainage or develop the proposal to locate the drain under the centre of the road.

5.1.3 Action Project: Riverine development along main hydrological canals and lagoons and urban beautification [Strategy 2, Action Project 1]

The Mullaitivu area is scenic with lagoons, sea and forests, which can be carefully managed to be developed in an eco-friendly manner. The proposed urban beautification initiative focuses on preserving and enhancing areas of aesthetic importance and heritage in Mullaitivu. Improving the visual amenity of the area is important when encouraging development, investment and a safer environment, as well as building community identity and pride.

This action aims:

- To protect the lagoons, along with their environmental and heritage values;
Conserve the lagoons for the future; and
Prevent floods as they cause damage, and have become more frequent and intense as a result of the combined effects of climate change and poor infrastructure design and provision.

Improving the urban environment requires partnerships between the local community and the relevant authorities. The Sri Lankan Tourism Board, the Department of Wildlife and Conservation, and the Forest Department will work in partnership to develop environmentally sustainable tourism opportunities in the National Parks, Forestry Reserves and Sanctuaries in the Northern Province. The area immediately south of Mullaitivu is to be developed as a destination for tourism whilst protecting and promoting the sanctuaries, lagoons and marine habitats along the coast to Trincomalee. Figure 30 illustrates how close Nanthikadal Lagoon is to Mullaitivu, as well how it connects to the chain of lagoons north and south. Figure 31 illustrates the proposed boardwalk site at Nayaru Lagoon and Figure 32 illustrates the proposed boardwalk at the Nanthikadal Lagoon.

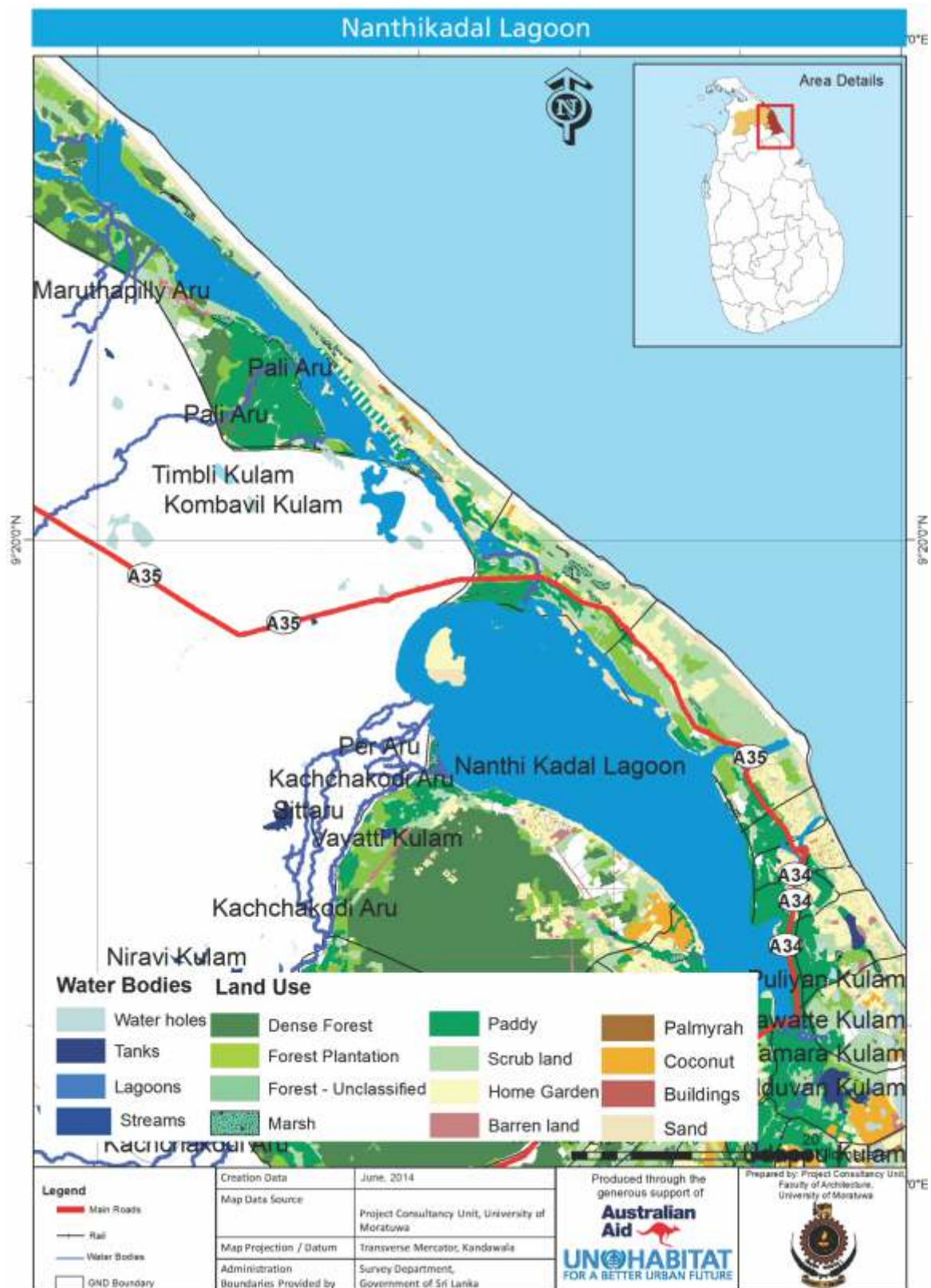


Figure 30: Nanthikadal Lagoon

Construction of the embankment and linear park development

The area near the lagoons of Nayar and Nanthikadal is ideal for a lagoon park. While the flora and fauna must be protected, the opportunity to experience the area can be enhanced with boardwalks, and additional planted trees and shrubs will enhance the beauty of the area. The construction of an embankment along the areas prone to flooding will reduce the likelihood of this hazard occurring.

The lagoon bund can be developed with boardwalks that are well laid out, paved and lit. As Mullaitivu is a generally sunny area, using a solar lighting panel system for lighting would be effective and eco-friendly. Providing sufficient lighting for the night along the boardwalk and for other suitable locations is a priority activity. Figure 33 shows an illustration of the boardwalk and lagoon.



Nanthikadal, one of the major lagoons in Mullaitivu

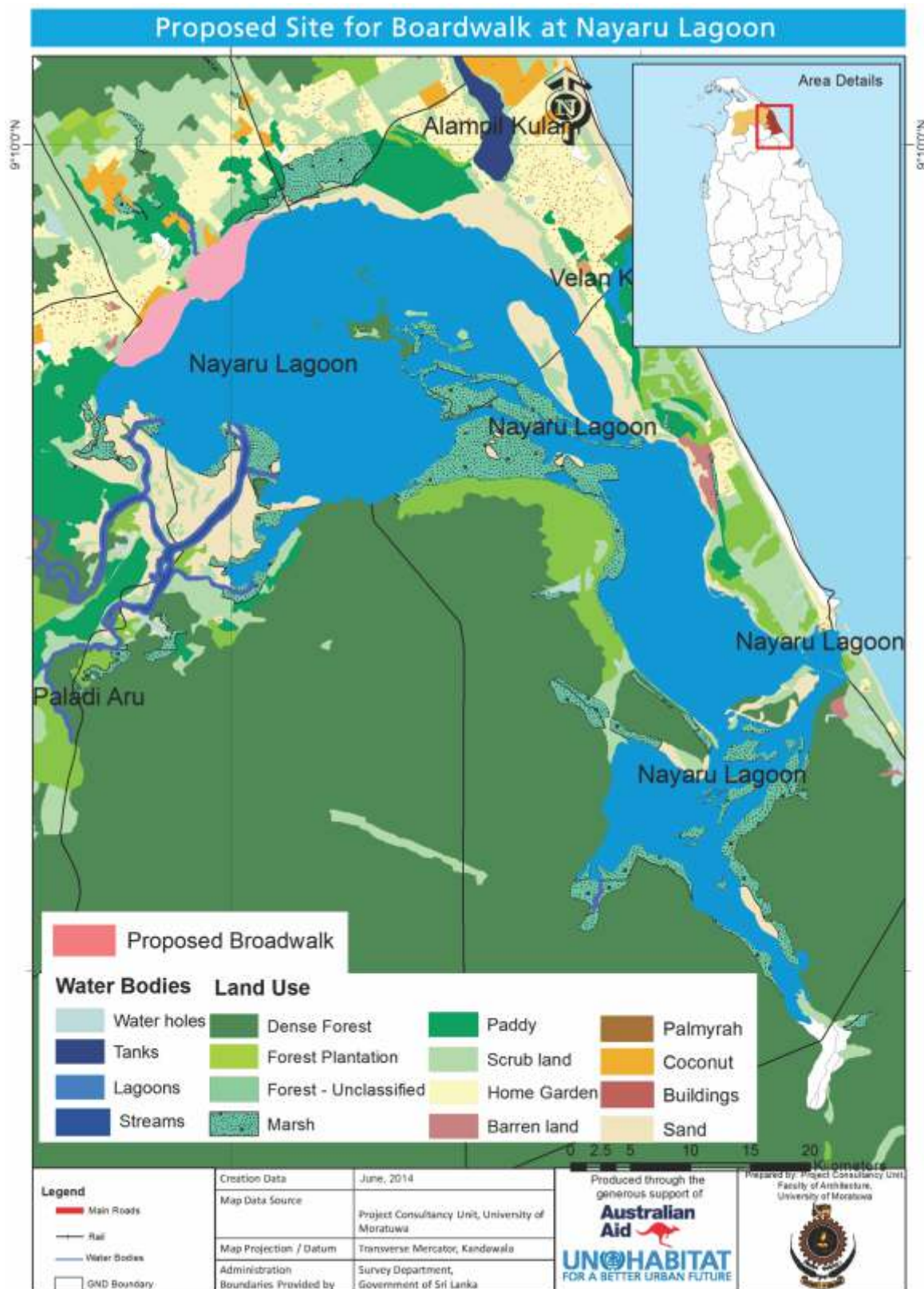


Figure 31: Proposed Boardwalk site at Nayar Lagoon

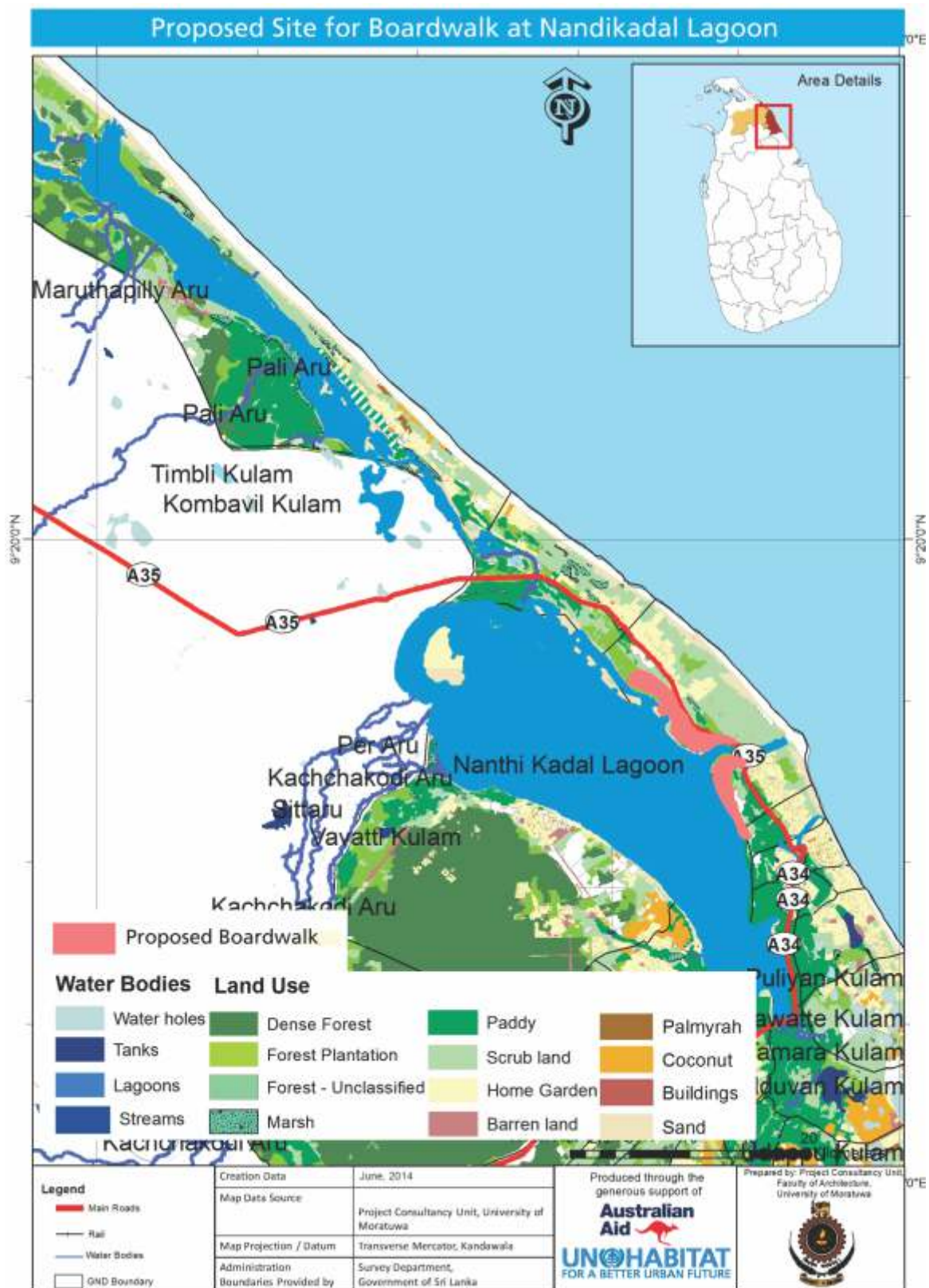


Figure 32: Proposed Boardwalk at Nanthikadal Lagoon



Figure 33: Boardwalk and Lagoon

5.1.4 Coastal green belt²⁰

Shoreline changes induced by erosion and accretion are natural processes that take place over a range of time. They may occur in response to smaller-scale (short-term) events, such as storms, regular wave action, tides and winds, or in response to large-scale (long-term) events such as glaciations or organic cycles that may significantly alter sea levels (rise and fall) which in turn cause coastal land subsidence or emergence. Hence, most coastlines are naturally dynamic and cycles of erosion are often an important feature of their ecological character. Wind, waves and currents are natural forces that easily move the unconsolidated sand and soils in the coastal area, resulting in rapid changes in the position of the shoreline. The Project Area includes Alampil South, Alampil North and Chermmalai GN Divisions as well as Ampalavanpokkanai to Nayar Lagoon and Ambalavanpokkanai to Chermmalai, and Mullaiwaikal East to the Saalai area.

The protective function of coastal systems

Coastal areas with natural protective features can reestablish themselves after natural hazards or long-term changes such as sea-level rise. Coastal greenbelts should:

- Control and stabilise the shoreline by holding and trapping sediments. On sandy coasts this can be achieved by planting coconut trees;
- Minimise the force of devastating storm surges and waves that accompany cyclones and tsunamis;

Provide an amenity and a source of food, materials and income for local communities; and
Benefit biodiversity and create habitat corridors for wildlife that can be used for conservation activities and ecotourism development.

In general, the underlying concepts of establishing a greenbelt are:

Social forestry: This should not be considered as a source of government or private sector revenue, but as a means of supporting sustainable livelihood development among the coastal community.

Eco-development: This is beneficial for conservation activities, educational and recreational opportunities.

Participatory planning, implementation and monitoring: The indigenous knowledge of local communities should be used in decision-making so they receive benefits directly.

Description of the Design

Selection of the vegetation for setting up the greenbelt should take into account the natural protective function of the coastal system as illustrated in Figure 56 and the vegetation that is indigenous to this region. The greenbelt can be up to 150m in width.

20 This whole Action Project justification and action is based on the paper by Gegar Prasetya, Thematic paper: The role of coastal forests and trees in protecting against coastal erosion

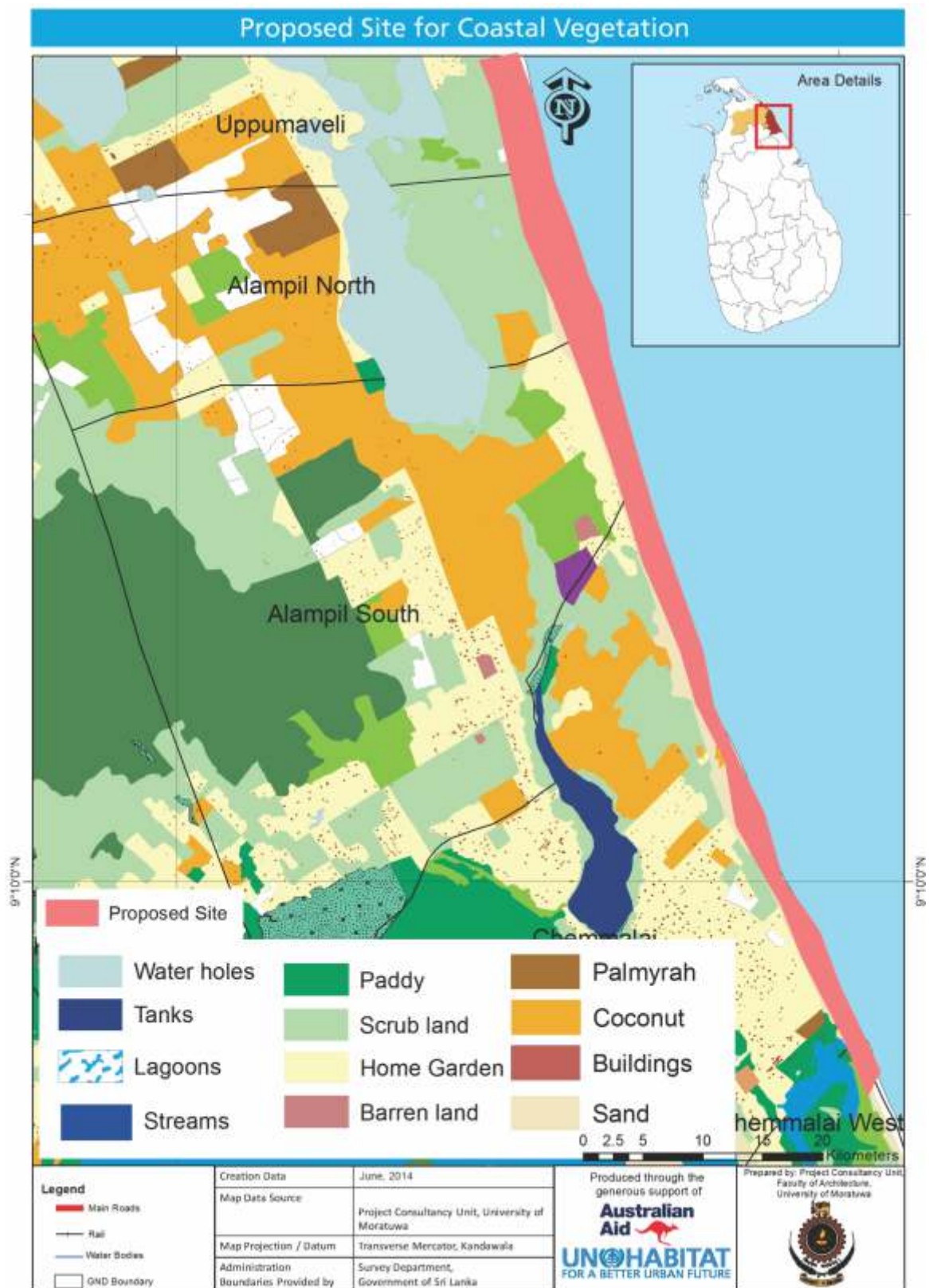


Figure 34: Proposed site for coastal vegetation



Figure 35: Coastal revegetation

Project Outputs

- A greenbelt for the Project Area will protect the local community from the increasing threats of climate change and reduce beach erosion and high-tide inundations;
Provide recreation areas for the community;
The fisher community will have more on-shore protection for their boats and equipment;
Increase local community adaptive capacity through maximising economic returns based on the type of vegetation planted and the services offered along the greenbelt;
Re-inforce coastal ecosystems and enhance coastal bio-diversity; and

Restore natural defense mechanisms against storm surges and strong winds.

5.1.5 Action Project: Promote nature parks

Maritimepattu is currently a growing city. Therefore preserving the existing forest is important through regulated land use. The areas of Chemmalai East, Kumulamunnai East near the Nayar Lagoon Mulliyawalai West and South, Keppapilavu, Kumulamunai West and Centre are suitable areas for nature parks.

1. Promote nature parks

The eco-tourism possibilities were explored in Action Project 5.1.3, however this Action Project builds on these to ensure the protection of important environmental characteristics of the area. The projects detailed below will provide the Maritimepattu PS and the Forest Department, along with other relevant authorities direction to ensure forests are preserved.

Nature parks can be introduced to promote tourism while conserving the forests. More attention to safeguard the existing forest patches will be required to achieve this objective. Figure 36 identifies proposed sites for nature parks.



Palmyrah plantation along a roadside

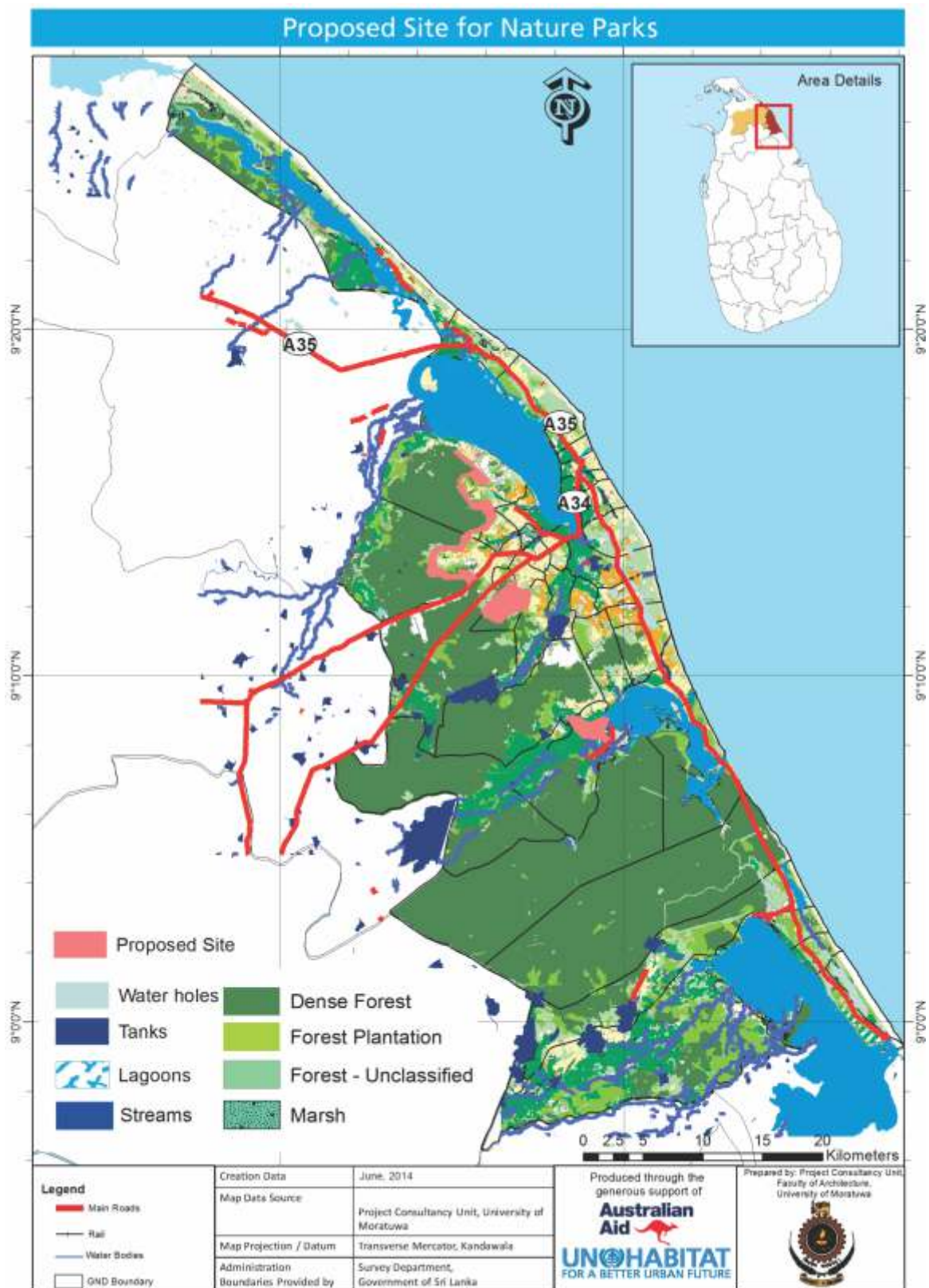


Figure 36: Proposed site for nature parks

2. Conserving forest patches in partnership with local communities

Local communities need to be involved in this proposal. Formalizing traditional rights for local communities, such as the right to collect timber after maturity or the right to obtain water will enable them to continue to use and protect the forest. Local people, who are familiar with the forest, may also be able to obtain employment as guides to the nature park tracks.

3. Establish information and management centres for the nature parks

An information centre needs to be established and forest trails need to be maintained with adequate sanitary facilities constructed in an eco-friendly manner. Visitor fees should be charged. This fee should be affordable but it should be different according to purpose: for example, nature trails would be higher than toilet use, and foreign tourists would be charged higher rates than local tourists.

The fees received from such activities can be used for the conservation of the natural areas of Maritimpattu. Connecting with the Forest Department to carry out these activities is essential.

Sub action 1: Information display and maintenance of trails. The nature trails should feature prominent signage in order to educate the visitors on the flora and fauna of the forest and display the park rules. The signboards must be displayed in English, Tamil, and Sinhala languages. Trail maintenance activity can also provide an opportunity for the local communities to earn some income.

Sub action 2: Reforestation, nurseries and involving local communities. Illegal logging is an issue in the Project Area. However this can be minimized by establishing plant nurseries in the villages adjacent to the forest. Providing plants for the villagers can encourage them to improve these nurseries as an income-generating activity.



Plant Nursery



School Awareness programme

5.2 Action Projects to empower and build the capacity of communities

The following section outlines details on two of the three action projects under strategic direction 2.

5.2.1 Horticulture gardens awareness programmes

Key steps:-

Create awareness through leaflets and posters on the benefits of horticulture garden systems. The benefits include new employment opportunities, alternative income sources, cash crops.

Identifying appropriate sites for the horticulture gardens is a priority. In the Maritimé pattu Project Area residential gardens and office premises have the potential to be horticulture gardens.

In the Maritimé pattu township, the rooftop horticulture garden concept can be applied. Horticulture gardens on rooftops help mitigate salinised ground water, enhance aesthetics, improve property value, and can be developed as an additional income-generating activity. There is also land space available in residential zones as there is a low density population in the Maritimé pattu PS area. Areas that could be targeted in this project include Thannimurippu to Aruumukaththaankulam, Alampil to Thangapuram, Mulliyawalai to Ponnagar and Keppapilavu.



5.2.2 Rainwater harvesting systems in water scarce locations

This project could target Kokkuthoduwai North, Kokkuthoduwai Centre, Kokkilai East and Keppapilavu Model Village where fresh water is scarce. The surface water in Mullaitivu can be saline. A well developed mechanism to store and harvest water for daily consumption is required. Pipe-borne water is still sparse and there is high demand on existing water storage methods. Domestic rainwater harvesting is a very effective and advantageous water management system which can be used in these Project Areas. Rainwater harvesting (RWH) can be used for home gardening and other uses such as landscape irrigation which can benefit the community.

Sub action 1: Introducing rainwater harvesting systems

Through the grama niladhari officer of each area, community awareness programmes can be organised about the benefits of rainwater harvesting. This will encourage investment in RWH systems.

Stored water can be used for both farming and domestic activities. It will reduce the current use of saline water which may have negative impacts on the health of the communities. Further, RWH reduces the need to transport heavy loads of water over long distances.



Space available for home gardening

Sub action 2: Establishing rainwater harvesting systems

This system consists of three basic elements as illustrated in Figure 37:

- A collection area,
- A conveyance system, and
- Storage facility.

RWH is proposed for the domestic level by capitalizing on water from the rooftops of houses, however, it is recommended that water from tiled roofs or roofs sheeted with corrugated steel be used. Roofs with asbestos sheeting or lead-painted surfaces should be avoided.

The conveyance system consists of gutters or pipes that transports the rainwater falling on the rooftop to storage vessels. The guttering which is placed around

the eaves of the roof, enable water to flow from the roof into the storage. The gutter can be timber, galvanised sheet, plastic, aluminum or fiberglass, in order to avoid adverse effects on water quality.

Finally the storage tank should be constructed of an inert material such as reinforced concrete, fiberglass, or stainless steel. The down-pipe should be made rotatable, so that the first run-off water can be diverted from the storage tank as this water may contain waste such as bird droppings, leaves, twigs and other vegetable matter, as well as dust and debris. This first run-off water can be stored in another tank to be used for other purposes, such as home gardening. The area gets high rainfall during the north-east monsoon season and the guttering and down-pipes should be sized so they will be capable of carrying the peak volume of water during high intensity storms. Figure 38 illustrates the whole system in operation.

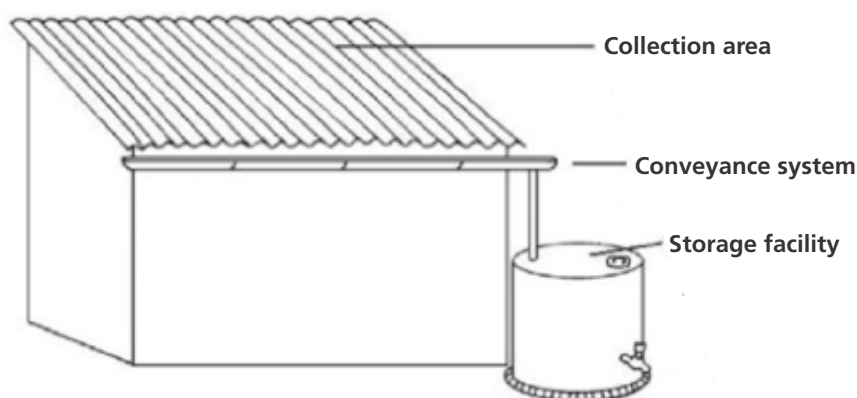


Figure 37: Basic elements of rain water harvesting system

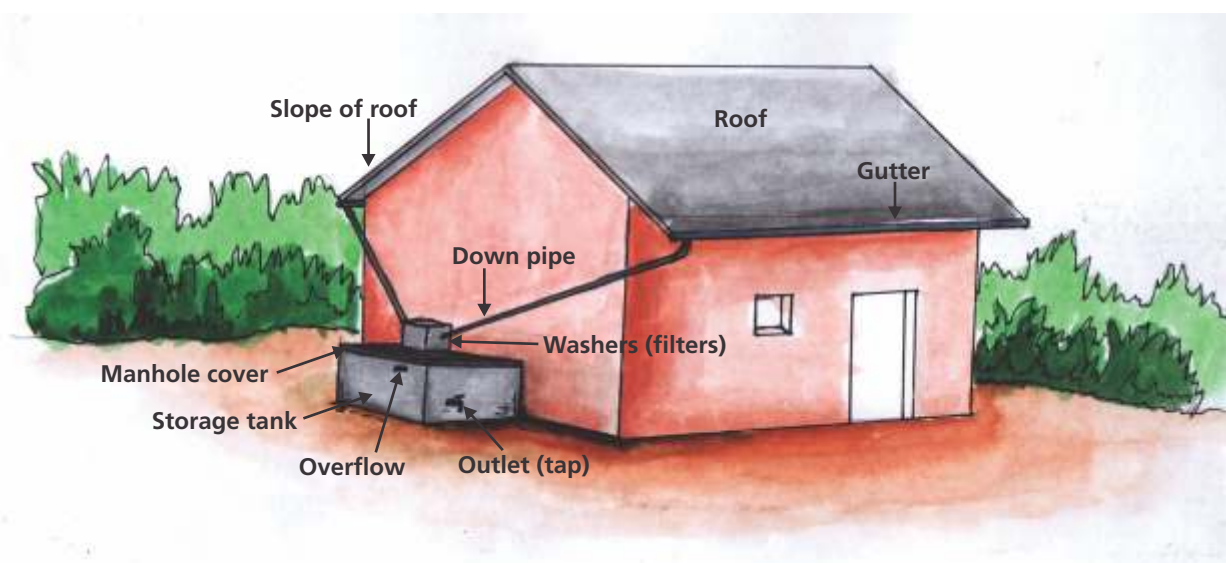


Figure 38: Rainwater Harvesting System

5.3 Action projects to enhance the safety and wellbeing of the citizens

The following section outlines some of the action projects under strategic direction 3.

5.3.1 Reconstruct and improve bridges

The Vadduvakal Bridge is a well known bridge and connects the northern part of the Maritimé pattu PS to the city. This bridge is regularly affected by floods and connectivity north of Mullaitivu is not possible by direct road. The bridge is not high enough for the flood water levels, and the bridge is also not wide enough to allow two vehicles to pass at the same time. Figure 39 outlines

how important bridges are in Mullaitivu and the images below show the current condition of the bridge.

This action project includes the removal and replacement of the concrete box culverts that supports the Vadduvakal bridge.

The project objectives include:

- Improve the height to minimise the impacts of flooding;
- Provide uninterrupted bicycle and pedestrian facilities on the bridge;
- Reinforce the existing bridge to meet current bridge structure standards; and
- Remove the damaged elements of the existing bridge.



Poor condition of Vadduvakal Bridge

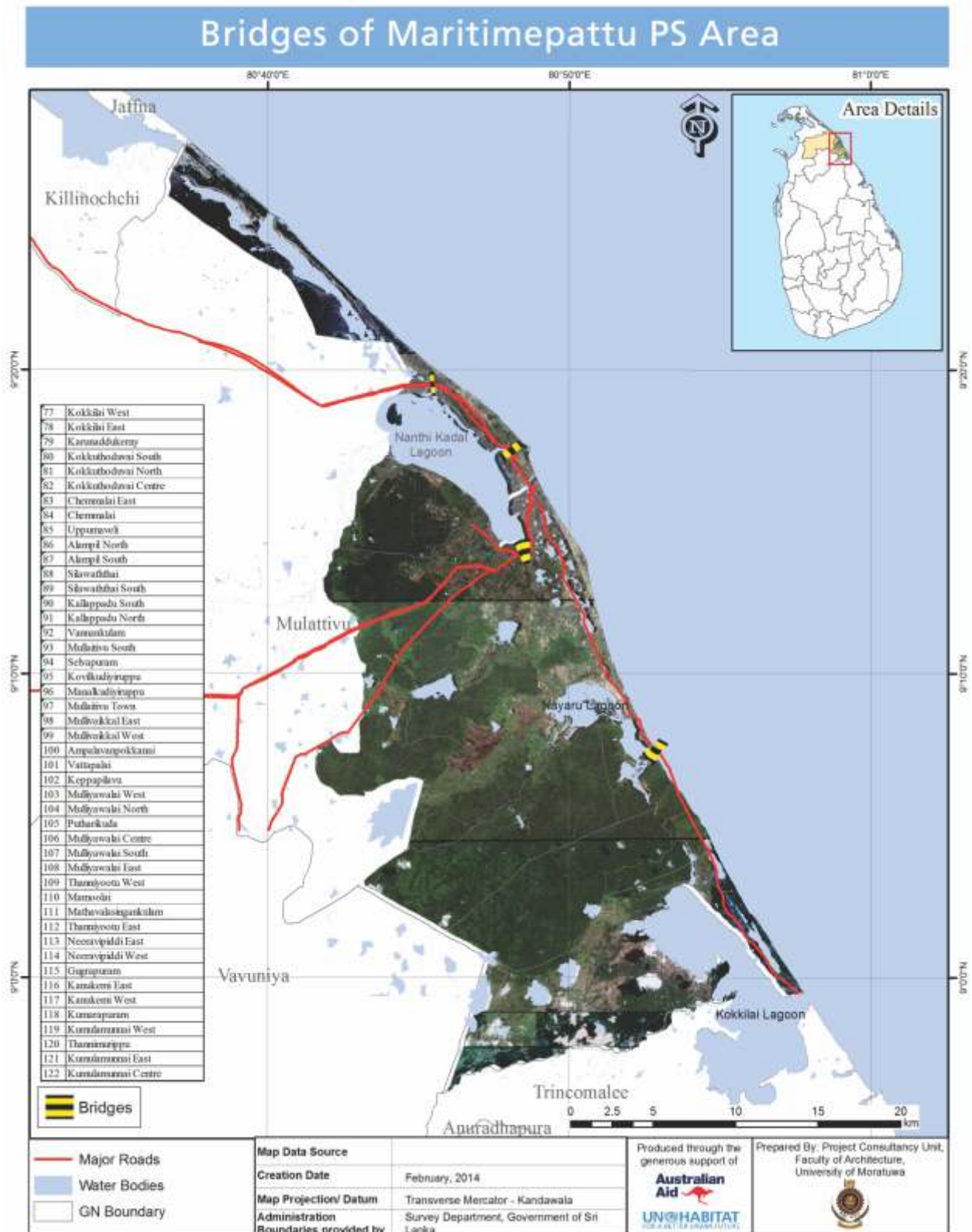


Figure 39: Bridges of Maritimepattu PS

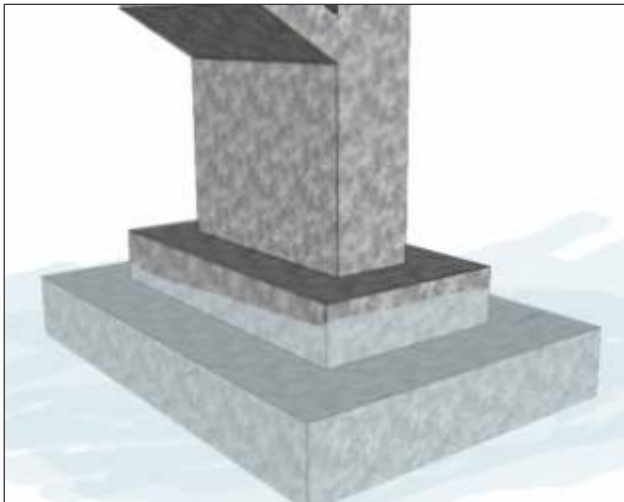


Figure 40: Depth of footings

Reconstruction of the bridge:

(i) Increase Footing Depth²¹

The depth of the pier and the abutment footings of the bridge should be extended below the expected depth of lagoon bed scour or to bedrock. The expected depth of scour depends on the flood flow velocities along the footing and the nature of the lagoon bed materials. Figure 40 provides an image of the footings proposed.

Effectiveness:

- Very effective, particularly when flood flow velocities are relatively high.
Consider flow deflectors, debris deflectors, or replacing multi-spans with a single span for maximum effectiveness.

Limitations:

- The depth of pier and abutment footings may be limited by lagoon bed characteristics.

(i) Install Flow Deflectors²²

Install "V" shaped flow deflectors on piers and abutments to reduce flow velocities and protect footings from scouring. Install a concrete collar on lower section of piers immediately above the footing. Also extend lower sections of abutments and the wing walls, if present. This will assist in deflecting flood flows away from the piers and abutments, and will eliminate stream bed scour along and under them. An example of this design is provided in figure 41.

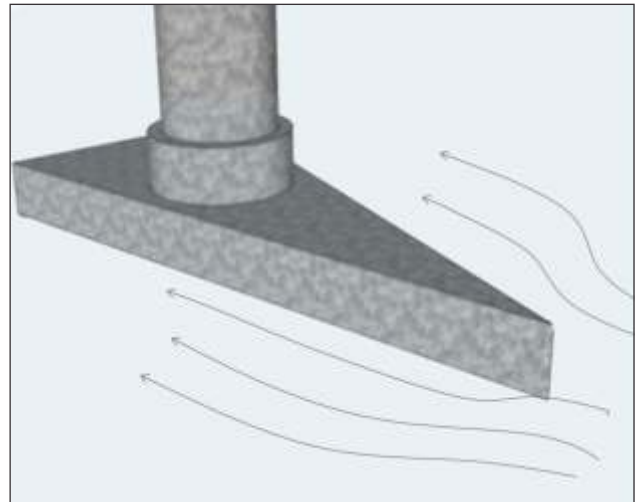


Figure 41: "V" shaped flow deflectors on piers

Effectiveness:

- Flow deflectors are very effective, particularly for flood flows with high velocities;
Pier collars and abutment sub-walls are moderately effective; and
Pier collars and extended abutment and wing walls may provide additional protection from impact of rocks and debris.

Figure 42 provides a schematic view of the reconstructed bridge.

Other bridge projects to be investigated include increasing the height of the Sinna Aru bridge, and providing a footpath and pedestrian safety barrier on the Vadduvaakal bridge.



Figure 42 A: Proposed bridge

21 This section draws from the Federal Emergency Management Agency, Web-based Handbook , Chapter 3: Bridges, D. Scour (Piers & Abutments). Retrieved from: <http://www.conservationtech.com/FEMA-WEB/FEMA-subweb-flood/01-06-FLOOD/3-Bridges/D.Scour.htm>
22 ibid



Figure 42 B: Proposed bridge and the surrounding area

5.3.2 Develop an early warning system and provide appropriate training

An Early Warning System (EWS) provides updates on emerging dangerous circumstances and this information can reduce the risks involved by enabling people to take necessary preparedness measures in a sufficient time period. An EWS emphasizes prevention, mitigation and preparedness and it develops the capacity of a community to respond prior to disasters. The EWS should be people-centered and well integrated into the decision-making processes.

In this context, this strategy will provide the following benefits:

- Identification of the flood risk using updated information as early as possible, thereby providing sufficient time to take necessary actions;
- Reduce casualties and damage;
- Enable people to leave the danger zone and move to a safe location;
- Enable people to transfer moveable items to safer zones; and
- Avoid or reduce the impact of the hazard on the community.

Community Based Early Warning System (CBEWS) should be designed, operated and maintained by the communities themselves. While establishing the system, the community will explore external support from other communities, organisations and institutions. It is essential that the community develops and maintains

close coordination and links with these stakeholders. The CBEWS²³ for flooding in Mullaitivu PS is based on the following processes, which are then explained in more detail:

- Step 1: Preparation for response;
- Step 2: Observations and monitoring;
- Step 3: Communication and dissemination; and
- Step 4: Follow up, review and sustainability.

Step I: Preparation for Response

Since this is a Community Based Early Warning System, it is essential to prepare the community to manage the system. This includes:

- Training programmes for the community members who will assist with operating the Flood Forecasting and Early Warning Centre (FFEWC) and Zonal Early Warning Centres (ZEWC); and
- Training, awareness raising and campaign programmes for the community.

5.3.3 Training programmes for Flood Forecasting and Early Warning Centre and Zonal Early Warning Centres

As these FFEWC and Zonal EWC are operated by selected people in the community, there is a need to conduct training programmes as follows:

- Operation and maintenance of equipment;
- Forecasting floods using selected models;
- Functionality of the Early Warning Communications Network;
- Gain relevant knowledge regarding hazards and corresponding vulnerabilities;
- Provide spatial information on risks, social, economic and environmental vulnerability and types of hazards in the area; and
- Past experiences on responses to flood hazards.

5.3.4 Training, awareness raising and campaign programmes for the community

All stakeholders will be provided with the relevant knowledge and capability to respond when a flood occurs. Thus the stakeholders need to be aware of the following:

- Hazards, risks and vulnerability levels – stakeholders will be provided with information on hazards, risks and social, economic and environmental vulnerabilities. This information will primarily be in the form of maps;
- Past experiences of responses to floods;
- Capacities of community and responsible agencies;

²³ The CBEWS described here draws from the experience from Nepal. Mercy Corps and Practical Action, 2010. "Establishing Community Based Early Warning System: Practitioner's Handbook". Sanepa Chowk, Lalitpur, Nepal. Retrieved from: <http://practicalaction.org/media/view/9765> (accessed August 2014).

Observation and monitoring of hazards with indigenous knowledge;
Methods to communicate and disseminate warnings within the community;
Clearly understanding the warning information; and
How to prepare and respond to each warning level within a given period of time.

5.3.5 Supporting aspects of Early Warning Systems

Forming Flood Forecasting and Early Warning Centres

The FFEWC is responsible for forecasting floods and passing early warnings to the community and other agencies. The centre should be operated by trained people from the Project Area.

The centre requires modern technological equipment such as computers and modems. It needs to maintain a database and requires taking regular measurements of data. In the rainy seasons, the data will need to be collected much more frequently (hourly, or even up to every ten minutes). On other days, daily data needs to be recorded. By using flood forecasting models the flood warning levels can be obtained.

If the analysed data depicts that there is a flood situation, the FFEWC should inform the ZEWC via telephone calls and email messages to pass warning signals. Another set of messages needs to be sent to other agencies that are in the Early Warning Communication Network.

The FFEWC should be responsible for:

- Updating databases (flood level, damages – property / livelihood);
- Updating flood hazard maps;
- Mobilising necessary materials or items such as phone, hand mike, siren, traditional equipment, boat, inner tube, rope, life jackets etc.;
- Coordinating between gauge stations and rainfall measuring stations;

Maintaining monitoring devices; and
Maintaining collaboration within all levels of the community.

The ZEWCs are responsible for giving warning signals according to the messages forwarded from FFEWC. The ZEWC can also be operated by trained people from the community. The centre can be equipped with sirens (hand operated) and hand microphones for giving warning signals directly to the community. An example of warning levels is illustrated in Table 19.

An essential part of the FFEWC is continuous observation of hazards throughout the rainy seasons. In principle, the observation must be round-the-clock every day of the week during the rainy season. However, if the weather forecast predicts no rain within the next few days, it may be sufficient for the monitoring stations to remain on standby until the next rainfall. In case of a flash flood situation the rainfall intensity and quantity must also be observed.

Tools and Equipment for Flood Monitoring

Water level gauges

The most reliable way of predicting floods is to observe the water level using water gauges. This can measure flood water coming from upstream, as well as immediate increases in the local area. A minimum setup consists of one upstream gauge and one downstream gauge. The lead time (the time flood takes to travel from upstream to downstream) can be identified by correlating the data from these two gauges. More precise and reliable information can be obtained to increase the warning time by establishing more than one upstream gauge.

For downstream and community monitoring three coloured poles can be established. The warning alert levels may differ according to the colours, explained sample warning system is shown in Table 20: Warning Messages and Actions Required.




Warning Level	Level 1 – Green Alert, Standby "Ready" 	Level 2 – Yellow Preparation "Get set" 	Level 3 – Red Evacuation "Go" 
Precondition	One sound of the siren, long pause (repeated)	Two consecutive sounds of the siren, long pause (repeated)	Continuous sounds of the siren

Table 19: Warning Levels and Actions Required




Warning/ Alert Level	Level 1 – Green Alert, Standby "Ready" 	Level 2 – Yellow Preparation "Get set" 	Level 3 – Red Evacuation "Go" 
Precondition	Heavy up-stream rainfall warning level 1	Water level in river increased	Water level in river increased
Warning Messages	Possibility of flood	Flood is inevitable within defined hours	Flood coming any time

Table 20: Warning Messages and Actions Required

Rainfall devices

Simple and low cost devices need to be provided to measure the rainfall. The CBEWS management committee is responsible for the maintenance of these devices.

The gauge stations and rainfall measuring stations are responsible for taking the daily measurements. The measurements need to be uploaded to the FFEWC data base.

Communication and Dissemination

The following tools and equipment can be used for communication and dissemination of early warning information:

- Telephones and e-mail messages;
- Wireless radios;
- Sirens (hand operated);
- Hand microphones; and
- FM radio and television stations.



Low cost rainfall measurement devices



Flood observation points (flood level gauges)

Forming an Early Warning Communication Network

The information gathered during observations and monitoring of flood level (using gauges and rainfall devices) needs to be communicated to the residents of the flood prone areas and to the DRR stakeholders. Thus, implementing a proper communication network is essential. An example network is provided in Figure 43.

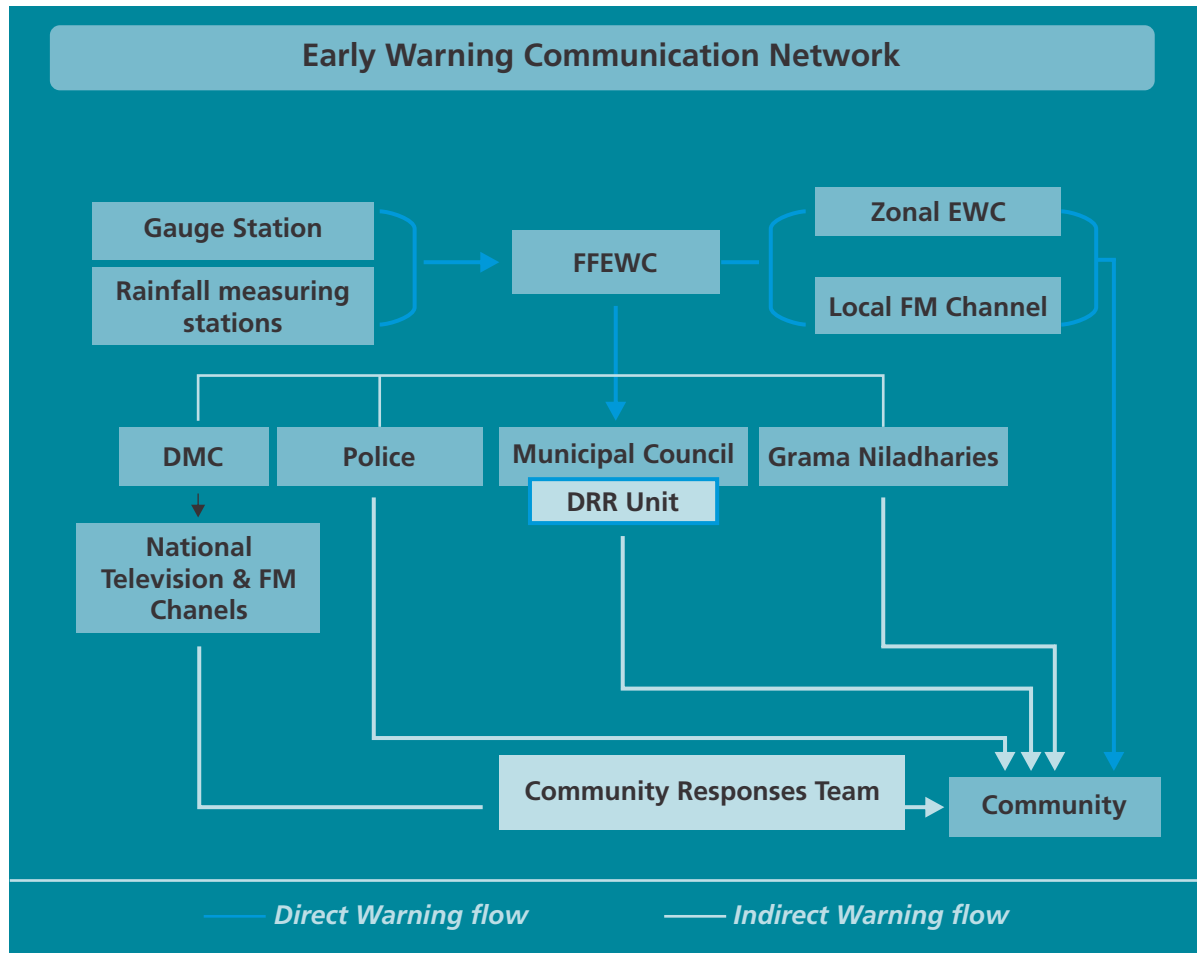


Figure 43: Early Warning Communication Network

According to the proposed network the gauge stations and rainfall measuring stations are responsible for taking the measurements and uploading those measurements to the FFEWC database. According to the analysed data, the FFEWC will then identify whether there will be a flood situation or not. If there is a flood situation the message should be conveyed to the ZEWC and local FM channels, and they in turn are responsible for issuing warning signals to the community using the variety of methods outlined above.

The FFEWC should also pass the warning messages to the DMC, police station, PS and Grama Niladaries. A DRR Unit within each of these establishments/

authorities should inform the community about possible flooding and take other designated actions to deal with the disaster situation. The DMC should inform the community about the disaster situation through national television and FM Channels.

A well functioning communication network will enable each responsible party to take required action in a timely manner, for example, issue a warning, assist the community to reach safe locations, provide safety equipment, supply food and shelter. The community can respond quickly and take preventive actions assisted by proper communication.

Follow-up, Review and Sustainability

It is necessary to maintain the Early Warning System and learn from experiences and changes to the situation and environment. Sustainability of the EWS depends on organisational and technical sustainability. Accordingly, it is important to have follow-up and review meetings with the participation of all the partners of the EW communication network. The technological and organizational barriers, challenges and further improvements required need to be identified to maintain sustainability.

The overall objective of regular meetings is for all partners of the CBEWS to revisit the plans and ensure that the system will function optimally.

The following items need to be discussed in the review meeting:

- Revisit overall plan, assessing whether the plan is sufficient for response;
- Agree upon the roles and responsibilities of the parties involved in the CBEWS;
- Update important data focusing on the most vulnerable groups such as women, pregnant and lactating mothers, elderly, children and people with disabilities;
- Clarify the communication and dissemination systems;
- Repair and maintain equipment; and
- Ensure the community is aware of the evacuation plans, signage and location of shelters/evacuation areas

The overall objective of a post-disaster meeting is to assess the effectiveness of the systems and the response of the stakeholders at the time of a flood. The following items need to be discussed in the review meeting:

- Review positive experiences;
- Document learning;
- Refine the roles and the responsibilities of the various stakeholders;
- Update important data;
- Analyse the areas for improvement of the early warning system;
- Visit the flood affected areas and observation stations and check the condition of the equipment; and
- Update the EWS system and share it with communities and stakeholders.

5.4 Action Projects to enhance the resilience of communities

Enhancing the capacity of communities to prepare for and respond to disasters and ensuring that there are relief networks surrounding them are factors that can assist in minimising vulnerabilities especially in post-disaster situations. Community coordination is key and ensuring that there is strong, clear coordination in place prior to any event is key. This section provides details on the two strategies – developing integrated experience sharing mechanisms, and secondly, empowering community level organisations to access technology and knowledge for reducing vulnerability. There are five action projects that will support these two strategies.

1. Community awareness and coordination;
2. Sharing international and national experience;
3. Disaster recovery equipment and materials; and
4. Develop a cooperative disaster recovery donation system.

Some of these actions are discussed below.

5.4.1 Community Awareness and Coordination

Ensuring that community awareness programmes reaches the whole community, including vulnerable groups, is a necessary starting point when deciding on the appropriate channels and messages to be delivered. Establishing the messages to issue, and refining the details of the messages will follow for each identified group. Participatory processes are beneficial because engaging the community will ensure indigenous knowledge is tapped, and communities will be enabled to act and understand how their actions can have implications in times of disaster. Preparedness programmes need to be clearly understood so there is no miscommunication during a hazard. Community awareness messages need to be consistent, clear, location specific and repeated regularly to ensure actions become second nature. Warnings must be acted upon promptly. However warnings must be issued only if there is cause for real concern about an imminent hazard.

Properly implemented community education campaigns result in increasing awareness, improving understanding, increasing acceptance and influencing

behaviour change. Women must be included in training programmes. Enhancing and utilising their knowledge and expertise in mobilising communities, and thereby reducing risks is critically important to the success of any disaster preparedness system. Ensuring grassroots women's organisations, and women, have full access to information and decision-making in prevention and preparedness strategies is a core element of this project. Different community groups must be identified and training targeted towards their specific needs. Resource groups must be identified and coordinated with to ensure that they understand their role in an emergency situation. Links with the DMC must be established to ensure they know their role and understand the resources that other groups can provide in support. Community mobilisation officers in organisations working in the area can help ensure that there is clear coordination of disaster relief activities.

Educating school children is also an effective way of reaching the entire community: children can act as messengers and educate their parents, families, neighbours and communities about DRR. School teachers are therefore a very important element who need to be targeted. Conducting a properly targeted school education programme will enable the children to understand risk and consequence.

School targeted campaigns could include:

- Awareness raising on hazards and their subsequent effects;
- Workshops on preparedness including swimming lessons, first aid and search and rescue training;
- Training programmes on emergency response and handling equipment;
- Exhibitions on disaster management, preparedness and response;
- Communication skills;
- Leadership programmes and recovery training (including psycho-social recovery);
- Participatory environmental management projects and shramadana campaigns; and
- Resilient school chains that link the DRR activities between schools.

This project is anticipated to last one year and cost between 1-2 million rupees to implement. The project will benefit any community recovering from disaster. The community mobilisation officers will be responsible for the implementation of this project. Community organisations, non-governmental organisations and government authorities working within this sector will also benefit with coordination being increased.

5.4.2 Sharing international and national experience

National and international experience sharing will help communities address knowledge gaps and understand new techniques and practices. The DMC, MPS and NBRO should take a leading role organising experience sharing programmes. Three strategies to practice knowledge are discussed below.

Face-to-face meetings

This strategy includes attending meetings, workshops or forums at the global, regional or national levels. Partners may range from NGOs and INGOs who operate within Sri Lanka, to organisations such as the Asian Disaster Preparedness Center and the United Nations Office for Disaster Risk Reduction. Such events can enhance knowledge sharing and understanding best practice.

Communities of practice

Communities of practice encourage participants to exchange and work together beyond and between occasional face-to-face meetings. Digital communications assists with connections, to be continued regardless of geographic location.

Publications and multi-media

Writing and publishing (including video and audio) will enable messages to reach a wide audience. Case studies, modules and toolkits are examples of ways the written word can enhance knowledge sharing.

5.4.3 Provide disaster recovery equipment and materials

Strong and efficiently organised DRR networks enhance social capital and are invaluable in times of danger. The network should ensure vertical and horizontal connectivity between all groups.

Effective emergency stand-by capacity is a critical component of DRR and this includes monitoring systems as well as human, physical and logistical resources. A core group should be formed including MPS staff and provide the basis of a stand-by roster for rapid deployment in case of an emergency. This core group should be committed and participate in simulation exercises. This team should be complemented by similar teams from the regional and national levels. They should have

immediate access to communications materials (satellite phones, GPS, support services) as well as vehicles that may be necessary in any emergency response.

Response materials, equipment and some support services need to be provided by responsible authorities. Materials may include first aid, safe water, food, cooking utensils, clothing or housing (ranging from tents to roofing sheets or nails).

5.4.4 Develop a cooperative disaster recovery donation system

A cooperative disaster recovery donation system will be established under MPS to act as a contingency fund for response and management following disasters. This will include financial donations as well as physical items (food, clothing, household items), and in-kind contributions such as labour.

The cooperative disaster recovery donation system should be managed by the MPS and will be responsible for the following:

1. Establish administrative structures and responsibilities, for disaster logistics and donation management operations;
2. Establish methods and procedures relating to donations including different categories (such as kind, type, and quantities) of donations;
3. Establish administrative procedures for accounting for donations;
4. Identify a disaster donations management team from within the MPS staff;
5. Establish methods and procedures for educating the public on where and how they can volunteer for post-disaster work;
6. Provide a system for distributing any donations remaining following the conclusion of the disaster recovery operations; and
7. Provide the opportunity to review and improve the established system.

A community DRR fund is proposed for the high-risk areas, and contributions can be sourced from a monthly membership fee from households located in the high-risk zones. The contributions can be monetary, goods or services. Charities and not for profit organisations operating in the respective areas can also be approached for funds. The MPS can assist in developing the fund and connecting to other potential funding sources such as local businesses. A line of micro credit for DRR improvements to housing could be an additional feature of the fund.



Disaster Resilient Construction training to masons, artisans and carpenters

5.5 Actions to ensure a continuous monitoring and evaluation system

Continuous assessment, evaluation and monitoring of DRR Projects will enable programmes to be implemented and ensure that they are responding to the needs identified in the most appropriate way. Continually updating data will enable:

- Review of the very high hazard locations;
- Evaluation of the action projects;
- Changes to be made to the plan to reflect changes in risk level and locations; and
- Review of the governance framework around the plan.

The MPS has a very important role in the assessment, evaluation and monitoring process. Indicators will need to be developed to enable proper assessment, evaluation and monitoring.

5.6 Conclusion

Chapter 5 provided some details on how the Project Area can move towards becoming resilient through specific and targeted action projects.

A resilient city is a place where the community has the ability to adapt to disasters and respond quickly for the betterment of society as a whole. This chapter has provided details on projects that are achievable and will have direct positive impacts on the citizens. Community participation in the disaster resilient city development initiatives provides some solutions for mitigating disaster risk and developing the capacity of the community. Institutional setup and frameworks are required to capitalise on the ability of the community.

The strategies proposed will assist in enabling the MPS Project Area to face disasters with improved resilience while the social empowerment strategies are particularly focused around enabling the community and ensuring DRR is part of their daily life. MPS is at a critical stage in development, and prudent, strategic choices will enable the city to flourish for future generations. Good governance and commitment to promoting DRR will strengthen the development of MPS as a resilient area.



Conclusion



Conclusion

In 2005, at the World Conference on Disaster Reduction, 168 countries adopted the Hyogo Framework for Action 2005-2015 for building the Resilience of Nations and Communities to Disasters as an ambitious programme of action to significantly reduce disaster risk.

In this context the Disaster Resilient Development Strategies for Sri Lankan Cities Project was established. The Mullaitivu Disaster Risk Reduction and Preparedness Plan is an attempt to put the HFA into action.

This report firstly explains the project in the context of Sri Lanka and the Maritimpattu Project Area, then demonstrates the methodology and explains a resilient city. Several analyses of Maritimpattu from different perspectives to identify hazards, vulnerabilities, major constraints and the potential opportunities were conducted. The HFA and stakeholder consultation shaped the assessments which were developed into the five strategic directions.

The strategic directions form the basis for action projects. The action projects elaborate on the proposed DRR plan for MPS and suggest strategic actions, both structural and non-structural, to minimise disaster risk and improve the adaptive capacity to achieve a resilient, sustainable and healthy city.

These projects, when implemented will achieve a substantive reduction in disaster losses by promoting the idea of a holistic and integrated economic, social, psychological, physical and environmental approach where all aspects of the city, such as infrastructure, governance, disaster risk management and social services, are treated as inter-related and equally important. This will increase resilience and improve the current situation for the population of the Maritimpattu PS.

References

- Abdulrahim, M.A., Ifabiyi, I.P., and Ismaila, A. (2013). Time Series Analysis of Mean Monthly Rainfall for Drought Management in Sokoto, Nigeria. *Ethiopian Journal of Environmental Studies and Management*, 461-470.
- A Framework for Social Adaptation to Climate Change Sustaining Tropical Coastal Communities and Industries. N.A. Marshall, P.A. Marshall, J. Tamelander, D. Obura, D. Malleret-King and J.E. Cinner. IUCN Climate Change and Coral Reefs Working Group June 2010
- Birkmann, J. (ed.) (2006). *Measuring Vulnerability to Natural Hazards*. Tokyo: United Nations University Press.
- Census of Population and Housing 2012, Department of Census and Statistics, Sri Lanka
- Climate Change Adaptation Framework of Sorsogon City, 2009
- Cutter, S., and C. Finch. 2003. Social vulnerability to environmental hazards. *Social Science Quarterly* 84(2): 242–261.
- Cutter, S., J. Mitchell, and M. Scott. 2000. Revealing the vulnerability of people and places: A case study of Georgetown
- District Disaster Profile, Disaster Management Center, 2011, 2009
- Federal Emergency Management Agency, Web-based Handbook, Chapter 3: Bridges, D. Scour (Piers & Abutments). Website: <http://www.conservationtech.com/FEMA-WEB/FEMA-subweb-flood/01-06-FLOOD/3-Bridges/D.Scour.htm>
- Fuchs, S., Heiss, K. and Hübl, J. (2007) Towards an empirical vulnerability function for use in debris flow risk assessment, *Natural Hazards and earth system sciences*, Copernicus Publications on behalf of the European Geosciences Union
- Gomas, C. (2010). LLAMPEC International (Pvt) Ltd. Retrieved from LLAMPEC International (Pvt) Ltd website: <http://llampecinternational.com>
- Gegar Prasetya, Thematic paper: The role of coastal forests and trees in protecting against coastal erosion. Retrived from FAO website <http://www.fao.org/docrep/010/ag127e/ag127e09.htm>.
- Hazard Profiles of Sri Lanka. (n.d.). Retrieved from Hazard Profiles of Sri Lanka: <http://www.hazard.lk>
- Heinz Center. 2000. The hidden costs of coastal hazards: Implications for risk assessment and mitigation. H. John Heinz II Center for Science, Economics and the Environment. Washington, DC: Island Press.
- Inderjeet, K., and Sabita, S. (2008). Seasonal Arima Model for Forecasting of Monthly Rainfall and Temperature. *Environmental Research And Development*, 506-514.
- Kim, C.-I. (2001). A Study on the Development and Applications of Wavelet Transform Based Forecasting Models in Power Stations.
- Madduma Bandara, C.M. (1985) Catchment ecosystems and village tank in the dry zone of Sri Lanka. In: Lundquist et al. (eds.) *Strategies for river basin development*. D. Reidel Publishing Company, Germany, 99-103 pp.
- Mercy Corps and Practical Action, 2010. "Establishing Community Based Early Warning System: Practitioner's Handbook". Sanepa Chowk, Lalitpur, Nepal. Website: <http://practicalaction.org/media/view/9765> (accessed August 2014)
- Meteorological Records, 1957- 2013, Meteorological Department of Sri Lanka
- Natural Disasters and Adaptive Capacity by Jeff Dayton-Johnson, 2004 Research programme on: Market Access, Capacity Building and Competitiveness, OECD
- Panabokke, C.R. (1999) The small tank cascade systems of the Rajarata: their setting, distribution patterns and hydrography. Mahaweli Authority of Sri Lanka, Colombo, Sri Lanka.

Panabokke, C.R., Sakthivadivel, S. and Weerasinghe, A.D. (2002) Small tanks in Sri Lanka: evolution, present state and issues. International Water Management Institute, Colombo, Sri Lanka.

Papathoma, K., Neuhäuserl, B., Ratzinger, K., Wenzel, H. and Dominey-Howes, D. (2007) Elements at risk as a framework for assessing the vulnerability of communities to landslides, Published by Copernicus Publications on behalf of the European Geosciences Union

Resource Profile of Maritiméattu DS Division, 2011, Planning Department of Maritiméattu Divisional Secretariat

South Carolina County. *Annals of the Association of American Geographers* 90(4): 713–737.

Warner, K. 2007. Perspectives on social vulnerability: Introduction. In *Perspectives on Social Vulnerability* (K. Warner, Ed.). Source Publication 6/2007. Bonn: UNU Institute for Environment and Human Security

Wisner, B., P. Blaikie, T. Cannon, and I. Davis. 2004. *At risk: Natural hazards, people's vulnerability and disasters*. London: Routledge

Annexure A – Links to the Hyogo Framework for Action

HFA Tasks	Local Indicators HFA Priority for Action 1 – Making Risk Reduction a National and Local / City Priority	Tools	Application in this Plan
HFA Priority for Action 1 – Making Risk Reduction a National and Local / City Priority			
Task 1: Engage in multi stakeholder dialogue to establish a foundation for Disaster Risk Reduction	A local/city multi- sectoral platform for disaster risk reduction is functioning Political commitment	Multi-stakeholder dialogues; and management information system.	Prepared Stakeholder Inventory
Task 2: Create or strengthen mechanisms for systematic coordination for DRR	Community participation and decentralized functions are ensured throughout the local authority	Stakeholder engagement mechanisms; and local platform for DRR.	Conducted stakeholder workshops and focused on group discussions for effective community participation
Task 3: Assess and develop the institutional basis for DRR	Policy instruments and tools to support national institutional and legal frameworks Legal and regulatory system	Development plan; land use plan; physical plan Budget allocation for DRR; Disaster management ordinance; Building code; Fire code; Zoning ordinance; and Specific ordinances (e.g. flood, heritage). Specific ordinances (e.g. flood, heritage).	Addressed in Strategic Direction 1,3,4,5
Task 4: Prioritise DRR and allocate appropriate resources HFA Priority for Action 2 – Improving Risk Information and Early Warning	Dedicated and adequate resources are available to implement disaster risk reduction activities within the local authority	Disaster risk management office; disaster coordinating council.	Addressed in Strategic Direction 5.

HFA Tasks	Local Indicators HFA Priority for Action 1 – Making Risk Reduction a National and Local / City Priority	Tools	Application in this Plan
HFA Priority for Action 2 – Improving Risk Information and Early Warning			
Task 5 Establish an initiative for community risk assessment to combine with country assessments	Local risk assessments based on hazard data and vulnerability are available and utilized	Hazard/risk mapping; Hazard assessment; Risk assessment; Community profiling; Community watching and resource mapping; Town watching; and Resource assessment.	Completed hazard & risk mapping; hazard assessment; risk assessment
Task 6 Review the availability of risk-related information and the capacities for data collection and use	Local / city and community systems	Risk assessment (including software) Vulnerability and capacity assessment Population and census data Building inventory; Infrastructure inventory; Cadastral survey; Property tax data; Economic data; Hazardous material location data; and Hazard monitoring system.	Completed the Vulnerability Assessment and Risk Assessment; Incorporated census, economic and cadastral survey data.
Task 7 Assess capacities and strengthen early warning systems	Local warning system for major hazards	Early warning systems; Flood markers; and Fail-safe systems (e.g., power back-ups, equipment redundancy, on-call personnel).	Addressed in Strategic Direction 3

HFA Tasks	Local Indicators HFA Priority for Action 1 – Making Risk Reduction a National and Local / City Priority	Tools	Application in this Plan
Task 8 Develop communication and dissemination mechanisms for disaster risk information and early warning	Local / city disaster related activities to monitor regional / trans boundary risks Good coordination between the scientific functions and the emergency functions of government	Risk assessment (including software); Vulnerability and capacity assessment; Population and census data; Building inventory; Infrastructure inventory; Cadastral survey; Property tax data; Economic data; Hazardous material location data; and Hazard monitoring system.	Addressed in Strategic Directions 4 and 5
HFA Priority for Action 3 – Building a culture of safety and resilience			
Task 9 Develop a programme to raise awareness of DRR consistent with that of the country	Effective programme or strategy for public awareness and skills development	Disaster awareness programme; Information, education and communication (IEC) campaigns; Indigenous and local knowledge; City / town information centres; and Instructional materials.	Done through stakeholder workshops
Task 10 Develop or utilise DRR training for key sectors based on identified priorities	Availability of education material and relevant training on disaster risk reduction Skills, knowledge, attitudes, and motivation	Disaster preparedness relevant school curricula; Training programmed / network; Online courses; Support of dialogues; Information exchange; and Coordination and stakeholder	Training programme for local technical officers and house builders with the technical support of relevant organisations- already done by UN-Habitat

HFA Tasks	Local Indicators HFA Priority for Action 1 – Making Risk Reduction a National and Local / City Priority	Tools	Application in this Plan
Task 11 Enhance the compilation, dissemination and use of DRR information	Access to information management and sharing on disasters Documentation on multi- risk assessments and disaster experiences, especially lessons learned Access to multi-resources	Disaster information system and inventory; Disaster awareness programme; Cost-benefit analysis; Risk analysis; Risk evaluation; and Websites, databases and online platforms.	Project documents will be published on UN-Habitat website Addressed in Strategic Directions 4.
HFA Priority for Action 4 - Reduce Underlying Risk Factors			
Task 12 Incorporate DRR in environmental management	Policy, planning, operational interface between among disaster risk reduction, environmental management and climate change	Environmental impact assessment; and Reforestation and other environmental mitigation measures.	Addressed in Strategic Direction 1 and 2
Task 13 Social needs; Establish mechanisms for increasing resilience of the poor and the most vulnerable	Linkages between policy, institutional and operational approaches to social development and disaster risk management structures and approaches Commitment to ensuring health and wellbeing: integration of DRR in health and food policies	Poverty alleviation programme; Vulnerability and capacity assessment; Participatory rapid appraisal; Community-based disaster preparedness / management approach; Informal settlements policy; Health care delivery system; and Food Policy.	Addressed in Strategic Direction 2, 3 and 5

HFA Tasks	Local Indicators HFA Priority for Action 1 – Making Risk Reduction a National and Local / City Priority	Tools	Application in this Plan
Task 14 Physical Planning: Establish measures to incorporate DRR in urban areas and land- use planning	Codes and standards for buildings, land use planning, are in place alongside effective compliance structures and mechanisms	Fire code; Building code; Structural code, standards, and construction practices; Land use planning techniques; Zoning; Development controls, open space planning, designation of hazardous areas; Geographic Information System (GIS); Retrofitting; Critical facilities strengthening programme; Resettlement / in situ improvement; Risk sensitive land use planning; and Environmental risk impact assessment.	Addressed in all Strategic Directions
Task 15 Structure: Strengthen mechanism for improved building safety and protection of critical facilities	Risk-sensitive development planning and implementation	Risk sensitive land use planning; and Environmental risk impact assessment.	Addressed in all Strategic Directions

HFA Tasks	Local Indicators HFA Priority for Action 1 – Making Risk Reduction a National and Local / City Priority	Tools	Application in this Plan
Task 16 Economic Development: Stimulate DRR activities in production and service sectors	Policy and implementation of DRR as part of economic development	Local economic development plan; Inventory of critical facilities and infrastructure; Risk evaluation; Sector specific critical facilities plans; Insurance; Reinsurance; Micro-finance; Crop insurance; and Cluster approach.	Addressed in Strategic Directions 1, 2 & 3
Task 17 Financial / economic instruments: Create opportunities for private sector involvement in DRR	Implementation of DRR through economic development	Micro-finance; and Crop insurance.	Addressed in Strategic Directions 1, 2 & 3
Task 18 Disaster recovery: Develop a recovery planning process that incorporate DRR	Recovery Plan Use of collaborative instrument and mechanisms to reinforce and sustain mitigation and preparedness measures	Recovery plan; Legal instruments; Collaborative mechanisms: task force, committee, sectoral work group; and Memorandum of agreement, memorandum of understanding.	Addressed in Strategic Direction 4

HFA Tasks	Local Indicators HFA Priority for Action 1 – Making Risk Reduction a National and Local / City Priority	Tools	Application in this Plan
Task 19 Review disaster preparedness capacities and mechanisms	Strong policy, technical and institutional capacities and mechanisms for disaster risk management at the local / city level	Disaster plan; Recovery plan; Networks for preparedness; and SAR equipment.	Addressed in all Strategic Directions
Task 20 Strengthen planning and programming for disaster preparedness	Disaster preparedness plans and contingency plans are in place at the local, city and community levels, and regular training drills and rehearsals are held to test and develop response programmes Integration with emergency response and recovery Procedures are in place to exchange relevant information during hazard events and disasters and to undertake post event reviews. Local, city government and community have capacity to deal with disaster recovery. The role of communities and volunteers is recognized while principles of accountability of government and other stakeholders are adopted.	Disaster preparedness plan; Contingency plan; Drills and simulation runs; Early warning system and devices; Evacuation procedures; SOPs; Relief funds; Support for agriculture and livestock losses; Funds for recovery; Fiscal policy measures; Damage and needs assessment; Matrix of on-going initiatives, programmes and plans; and Reconstruction needs assessment.	Addressed in Strategic Direction 1, 4

Table A 1: Links to the HFA through this Plan

Annexure B – Evaluation Form: Significance of the Impact on Elements at Risk in Hazard Events

The values for the significance levels were taken using the table B1 below as a guide.
The values and ranks will be used in the Vulnerability Assessment.

Judgment		
Quantitative Value	Qualitative Value	Description
5	Very highly Vulnerable	The element is very highly Vulnerable in a particular hazard event
4	Highly Vulnerable	This element is highly Vulnerable moderate Vulnerable in a particular hazard event
3	Somewhat Vulnerable	This element is somewhat Vulnerable in Vulnerable in a particular hazard event
2	Low Vulnerability	This element is low or moderately Vulnerable in a particular hazard event
1	Not Vulnerable	This element is not Vulnerable in a particular hazard event

Table B1: Vulnerability Evaluation Judgement Guidance

This table uses a method called the Likert Scale and it illustrates judgments and descriptions to assign values for elements according to the vulnerability to hazards. The Likert Scale is a technique for measuring different attitudes towards a statement by asking the respondent to indicate their preference in a series of short statements on a given range of responses. It can analyse general attitudes or opinions of respondents (Ginige 2005).

Elements at Risk- Evaluation Table Summary of Analysis: Evaluation of the Vulnerability Value of Elements at Risk

The table below shows the results for the social, economic and environmental evaluations.

Element	Flood	Drought	Strong winds	Tsunami	Lightning	Storm Surge
Social Elements						
Disable persons	4	2	4	5	2	1
Senior citizens	4	2	4	5	1	1
Children	4	2	3	5	1	1
Women	3	2	3	5	1	1
Schools	3	2	3	4	1	1
Residential houses	5	5	5	5	2	3
Religious places	4	3	4	4	2	2
Public gathering places	4	3	4	4	1	2
Government buildings	4	3	2	3	1	2
Economic Element						
Bus/Train terminals	3	2	3	4	1	3
Fishery ports	2	1	4	3	3	3
Livestock	4	2	2	4	1	3
Industries	4	1	2	3	1	1
Commercial buildings	3	1	2	3	2	1
Roads	5	1	2	3	1	2
Bridges	4	1	2	3	1	1
Machinery and electronics	4	1	1	2	5	3
Plantations	3	4	2	2	2	3
Paddy fields	3	5	1	2	1	4
Home gardens	3	4	2	2	1	3

Element	Flood	Drought	Strong winds	Tsunami	Lightning	Storm Surge
Fishing boats	2	1	5	3	3	2
Ground water pipes	1	1	1	1	1	1
Electricity poles	1	1	3	1	4	1
Telecommunication structures	1	1	3	1	5	1
Food stock	2	2	1	1	1	1
Environmental Elements						
Solid waste dumping sites	3	1	1	3	1	4
Forests	3	3	3	2	1	2
Marsh	3	3	3	1		1
Play grounds /parks/parking plots	4	1	1	1	1	1
Toilet pits	3	1	1	1	1	1
Other (please specify)						
Bio Physical						
Water holding capacity of the soil	1	5	1	5	1	4
Ground water table (Depth and capacity)	3	4	1	4	1	3

Table B2: Vulnerabilities and Hazards – Scores

Annexure C - Draft Implementation Plan, Physical Improvement Projects

Table C1 lists the action projects where activities have been identified, a cost range provided, priority levels assigned and the agency / agencies responsible for implementation identified. An estimated duration is also provided.

Action Project	Activities	Approximate Cost range (million LKR)	Priority level	Responsible Agencies	Duration
Drainage Master Plan and Drainage Construction with best management practices (Kallappadu South GN Division)	Comprehensive drainage survey; Modify the existing drainage system; Design new drainage plan; Incorporate with BMPs & road layouts; Evaluate the condition of existing drainage facilities; and the Construction of gaps.	5- 9	High	Maritimepattu PS	6 months
Reconstruction of Vinayagar Road	Demolishing existing road construction; Detail road designing; and Construction.	1-1.5	Moderate	Maritimepattu PS RDA	2 months
Riverine development along main hydrological canals and lagoons in Maritimepattu and apply urban beatification approach	Site investigation and preparation of landscape plan; Removing existing uses; Plant trees; and Set up management and maintenance systems.	3-5	Moderate	Sri Lankan Tourism Board Department of Forestry Maritimepattu PS RDA UDA	1 year
Planting the green belt along the coastal line (Alampil North, South and Chermalai)	Site investigation and preparation of landscape plan; Removing existing uses; Planting trees and plant nursery; and Management.	5-10	High	Maritimepattu PS Department of coast conservation CEA	1 year

Action Project	Activities	Approximate Cost range (million LKR)	Priority level	Responsible Agencies	Duration
Promote nature parks – (Chemmalai East, Kumulamunnai East near to the Nayar Lagoon)	Survey and mapping of existing forest; Establishment of information management centre; Construction of basic infrastructure; Maintaining plant nursery; and Conducting awareness programmes.	5-10	High	Maritimappu PS Department of coast conservation CEA	1 year
Promote nature parks – (Chemmalai East, Kumulamunnai East near to the Nayar Lagoon)	Survey and mapping of existing forest; Establishment of information management centre; Construction of basic infrastructure; Maintaining plant nursery; and Conducting awareness programmes.	5-8	Moderate	Sri Lankan Tourism Board Department of Forestry Maritimappu PS NPPD	1 year
Introduce horticulture system with rainwater utilization)	<ul style="list-style-type: none"> Conduct awareness programme; Provide subsidiary for seeds, fertilizer and materials; Conduct competitions; and Organise school awareness programmes. 	5-10	Moderate	Irrigation Department Maritimappu PS Agrarian Service Department	1 year
Reconstruct the Bridges – Vadduvakal Bridge	Planning and designing; Demolishing existing canal; and Reconstruction.	8-10	High	RDA Maritimappu PS Department Forest Department of cost conservation	6- 12 months

Table C1: Action Project Implementation

Annexure D – Hydrology Analysis and Information for Drainage Master Plan

The analysis and designing process of drains are broadly categorized as:

- Hydrology analysis
- Hydraulics design

Under the hydrology analysis, the surface runoff to the drains is estimated. The hydraulic designs determine the dimensions of the drains. The calculations start the process from minor drains and up to final outflow drains.

A hydrology analysis is carried out referring to the rational formula:

$$Q = 0.0028CiA \text{ - Rational Formula (EQ 2.1)}$$

Where

- Q = Peak discharge (m³/sec)
 C = Runoff Coefficient (Table 2.1)
 i = Rainfall Intensity (mm/hour) (IDF curves)
 A = Drainage area (Hectares)

Hydraulics designs were carried out using the Manning equation, as expressed by the UOM:

$$Q = A (K R^{2/3} S^{1/2}) \text{ - Manning Equation (EQ 2.2)}$$

$$R = A/P \text{ (EQ 2.3)}$$

Where

- Q = Discharge
 K = Conversion factor (1.486)
 R = Hydraulic radius (m)
 S = Hydraulic slope
 n = Manning roughness coefficient
 Table 2.2
 P = Wetted perimeter (m)

Area Description	Runoff Coefficient C
Downtown	0.70-0.95
Neighbourhood	0.50-0.70
Single-Family	0.30-0.50
Multiunits, detached	0.40-0.60
Multiunits, attached	0.60-0.75
Residential (suburban)	0.25-0.40
Apartment	0.50-0.70
Light	0.50-0.80
Heavy	0.60-0.90
Parks, Cemeteries	0.10-0.25
Playgrounds	0.20-0.35
Railroad yard	0.20-0.35
Unimproved	0.10-0.30
Asphaltic and concrete	0.70-0.95
Brick	0.70-0.85
Roofs	0.75-0.95
Flat, 2 percent	0.05-0.10
Average, 2-7 percent	0.10-0.15
Steep, 7 percent	0.15-0.20
Flat, 2 percent	0.13-0.17
Average, 2-7 percent	0.18-0.22
Steep, 7 percent	0.25-0.35

Table D1: Runoff Coefficient

Surface Material		Manning's Roughness Coefficient - n
1	Asbestos cement	0.011
2	Asphalt	0.016
3	Brass	0.011
4	Brickwork	0.015
5	Cast-iron, new	0.012
6	Clay tile	0.014
7	Concrete – steel forms	0.011
8	Concrete – finished	0.012
9	Concrete – wooden forms	0.015
10	Concrete – centrifugally spun	0.013
11	Copper	0.011
12	Corrugated metal	0.022
13	Earth	0.025
14	Earth channel – clean	0.022
15	Earth channel – gravelly	0.025
16	Earth channel – weedy	0.03
17	Earth channel – stony, cobbles	0.035
18	Floodplains – pasture, farmland	0.035
19	Floodplains – light brush	0.05
20	Floodplains – heavy brush	0.075
21	Floodplains – trees	0.15
22	Galvanized iron	0.016
23	Glass	0.01
24	Gravel	0.029
25	Lead	0.011
26	Masonry	0.025
27	Metal – corrugated	0.022
28	Natural streams – clean and straight	0.03
29	Natural streams – major rivers	0.035
30	Natural streams – sluggish with deep pools	0.04
31	Plastic	0.009
32	Polyethylene PE – corrugated with smooth inner walls	0.009 - 0.015
33	Polyethylene PE – corrugated with corrugated inner walls	0.018 - 0.025

Surface Material		Manning's Roughness Coefficient - n
34	Polyvinyl Chloride PVC – with smooth inner walls	0.009 - 0.011
35	Steel – coal-tar enamel	0.01
36	Steel – smooth	0.012
37	Steel – new unlined	0.011
38	Steel – riveted	0.019
39	Wood – planed	0.012
40	Wood – unplanned	0.013
41	Wood stave	0.012

Table D2: Manning Roughness Coefficient

Input data

For Rational Formula		
C	Runoff coefficient	
i	Rainfall Intensity	mm/hour
A	Drainage area	hectares
q1	Run off from inlet 1	m3/sec
q2	Run off from inlet 2	m3/sec
q3	Run off from inlet 3	m3/sec
q4	Run off from inlet 4	m3/sec
q5	Run off from inlet 5	m3/sec
q6	Run off from inlet 6	m3/sec
q7	Run off from inlet 7	m3/sec
q8	Run off from inlet 8	m3/sec
q9	Run off from inlet 9	m3/sec
q10	Run off from inlet 10	m3/sec
	Type of Channel	Open or closed

Table D3: Rational Formula units of measurement

For Manning Equation

	k	Unit conversion factor	
	n	Manning coefficient	
Open channel	B-a	Allowable width	m
	S	Slope to be produced	
Open channel	y	Wetted depth	m Start from b/2
Closed channel	r	Radius	m

Table D4: Manning Equation Information

Output Template

Q 1	Run off to drain from adjacent land	0	m ³ /sec
Q2	Run off to drain from inlets	0	m ³ /sec
Q	Run off to drain		0m ³ /sec
y	Wetted depth (Open channel)	0	m
D	Depth of Open Channel		0m
D'	Diameter of Pipe		0m
b	Breadth for calculation		-0.3
Q m (Open flow)	Discharge flow rate from manning equation	0	m ³ /sec
Qm (Pipe flow)	Discharge flow rate from manning equation	0	m ³ /sec
	D	0	m
	D'	0	m
Implemented Parameter	B	0	m

Table D5: Output Template

