PPHJ 2030

POLISI PEMBANGUNAN HIJAU JOHOR

Johor Climate Change (Flood Mitigation) Policy 2030

Policy

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Johor Climate Change (Flood Mitigation) 2030


MAJU
JOHOR

Table of Contents

Preface

Johor Climate Change (Flood Mitigation) Policy 2030

Assalamualaikum warahmatullahi wabarakatuh and Greetings,

With heartfelt gratitude, I would like to express my appreciation to all parties who have contributed to the development of the **Johor Climate Change (Flood Mitigation) Policy 2030**. This document reflects the Johor state government's commitment to addressing the increasingly urgent challenges of climate change, particularly in reducing the risks and impacts of flood disasters. As a state frequently exposed to the threat of flooding, this mitigation effort is a strategic step to ensure the safety and well-being of the Johor's people, as well as the continued progress of the state's development.

This policy adopts an integrated approach to flood risk management, focusing on the development of flood-resistant infrastructure, such as flood retention ponds, smart drainage, and efficient flood control systems. These initiatives aim to minimise flood-related damages while promoting sustainable and safe development across the state. By leveraging modern technology and utilising accurate weather forecasting, Johor strives to set an example in flood disaster management for both Malaysia and the region. In addition, this policy emphasizes the sustainable management of water resource, including efforts to enhance the capacity of natural water retention and restore coastal ecosystems and mangrove forests. This commitment to ecological preservation is vital not only in addressing floods but also in bolstering the state's resilience to the broader impacts of climate change.

Another key aspect of this policy is to raise community awareness about climate change adaptation. Through educational initiatives and community engagement, the people of Johor will be better prepared to face flood disasters and gain a clear understanding of the mitigation measures provided by the government. By fostering collaboration among the public sector, private sector, and communities, Johor can strengthen the state's resilience to climate change while protecting the quality of life for its residents.

I believe that the implementation of this policy will lead Johor toward a safer and more sustainable future. With close cooperation and continuous efforts, we can make Johor state not only a state resilient to flood disasters but also excels in climate change management. May this effort serve as the foundation for the sustainability and well-being of current and future generations.

Thank you.

Yang Amat Berhormat Dato' Onn Hafiz bin Ghazi
Chief Minister of Johor

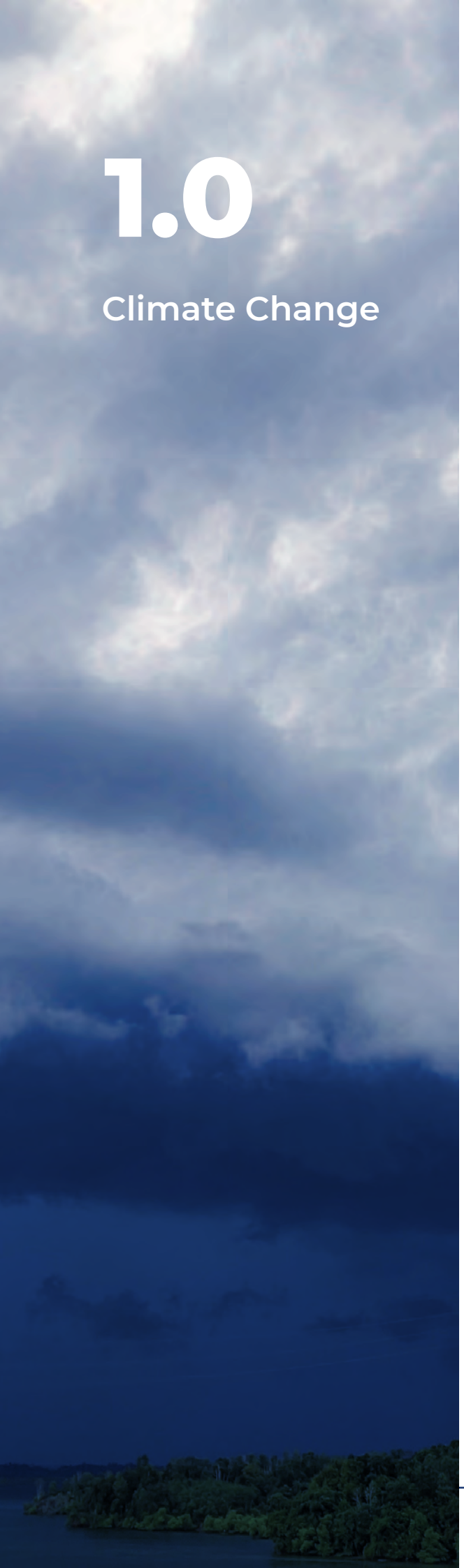
List of Abbreviations

AI	Artificial Intelligence
APM	Malaysian Civil Defence Force
ARI	Average Recurrence Interval
BAKAJ	Johor State Water Regulatory Body
BPEN	State Economic Planning Division
CBDRM	Community-Based Disaster Risk Management Programme
CCF	Climate Change Factor
EM-DAT	Emergency Incident Database
ESCP	Erosion and Sediment Control Plan
ESG	Environment, Social, and Governance
ETS	Electric Train Services
EWS	Early Warning System
FIA	Flood Impact Assessment
GCRF	Global Challenges Research Fund
GIS	Geospatial Information System
HORAS	Hybrid Off-River Augmentation System
IoT	Internet of Things
IPCC	Intergovernmental Panel on Climate Change
IPT	Higher Education Institution
IRBM	Integrated River Basin Management
ISF	Improvement Service Fund
JAS	Department of Environment
JBIOCC	Johor Bahru Integrated Operations Control Centre
JBPM	Malaysian Fire and Rescue Department
JKR	Public Works Department
JMG	Department of Minerals and Geoscience
JPA	Public Service Department of Malaysia
JPBD	Department of Town and Country Planning
JPS	Department of Irrigation and Drainage
JS-SEZ	Johor-Singapore Special Economic Zone
JUPEM	Malaysia Survey and Mapping Department
KM	Planning Permission
KSAS	Environmentally Sensitive Areas
LCP	Development Proposal Report
MBIP	Iskandar Puteri City Council
MBJB	Johor Bahru City Council

METMalaysia	Malaysia Meteorological Department
MSMA	Urban Stormwater Management Manual for Malaysia
NADMA	National Disaster Management Agency
NAHRIM	National Hydraulic Research Institute of Malaysia
NBS	Nature-Based Solutions
NGO	Non-Governmental Organization
NWS	National Weather Service
UN	United Nations
PBT	Local Authorities
PDT	Permodalan Darul Ta'zim
PISMA	Drainage Master Plan
PPS	Temporary Shelter Center
PRAB	National Flood Forecasting and Warning Programme
PTG	Land and Mines Office
PTNJ	Johor National Parks Corporation
RKK	Special Area Plan
RTB	Flood Mitigation Plan
RTS	Rapid Transit System
SDG	Sustainable Development Goals
SMART	Stormwater Management and Road Tunnel
SPAH	Rainwater Harvesting System
SUK	Government Secretary
SUK BKT	Secretary of Local Government
TAPS	Off-River Storage
TLK	Parking Facilities
TOD	Transit-Oriented Development
UKBS	Uniform Building By-Laws
UTM	Universiti Teknologi Malaysia
WMO	World Meteorological Organization

Executive Summary

The Johor Green Development Policy (PPHJ) 2030, specifically the Climate Change (Flood Mitigation) sector, is prepared to describe the state's strategic direction in managing flood risk through a holistic, integrated, and sustainable approach. This policy emphasizes enhancing the effectiveness of flood management by employing a more systematic and comprehensive approach, involving strategic collaboration among the government, private sector, and the community. Four key strategies have been identified for climate change adaptation and flood mitigation in Johor. The flood monitoring and early warning system is being strengthened through advanced technology, ensuring that accurate and timely information reaches authorities and the public, thereby improving the efficiency of early responses to flood threats. Additionally, flood risk management has been improved through impact assessments on development projects and strengthened governance of rivers and drainage management to ensure preventive measures are more effectively implemented. Flood mitigation measures are further reinforced through the adoption of Nature-Based Solutions (NBS), which help enhance resilience to climate change impacts. This policy also prioritizes building community capacity and economic resilience, enabling the people of Johor to handle flood disasters more effectively. The policy out lines short, medium, and long-term action plans aimed at reducing economic, social, and infrastructural impacts and risks of flood disasters in Johor by 2030. The implementation of climate change initiatives (flood mitigation) supports Johor's sustainable development efforts while ensuring the continued well-being of its people.



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Climate Change

Climate change refers to continuous changes in the average conditions or variation in climate over an extended period. This phenomenon is driven by various natural factors such as solar cycles and volcanic eruptions, as well as human-induced factors like changes in atmospheric composition and land use. Rising global temperature and prolonged droughts caused by climate change have significantly disrupted rainfall distribution patterns, leading to flood disasters. High temperatures increase evaporation rates, which can result in droughts in some regions, resulting in dry soils that lose their ability to efficiently absorb water. Intense rainfall over short durations often leads to rapid water flow and sudden overflow, triggering flash floods. Additionally, rising global temperature due to climate change have significant impacts, including more frequent heavy rainfall, high-intensity and slow-moving storms causing floods, prolonged dry spells leading to droughts, and rising sea levels that contribute to coastal erosion and flooding.

1.1 Global Impact of Climate Change

According to the World Meteorological Organization (WMO) report, Asia has experienced a faster rate of warming compared to the global average, with a warming trend nearly twice that of the global average between 1961 and 1990. A global temperature increase of 2°C has led to extreme heat events. The latest report by the Intergovernmental Panel on Climate Change (IPCC) report in from 2022 indicates that global temperatures rose by approximately 1.09°C between 2011 and 2020, with a 50% chance of exceeding 1.50°C in the near future.

The global rise in temperature and warming trends have the potential to trigger severe natural disasters, such as more frequent and extreme floods, as well as prolonged droughts worldwide. Food security is becoming increasingly critical, as highlighted by the situation in India, which has been significantly affected by prolonged drought conditions.

The average global sea level rose approximately 1.3 mm/year from 1901 to 1971, with a minimum increase of 0.6 mm/year and a maximum of 2.1 mm/year. Between 1971 and 2006, this rate increased to to 1.9 mm/year, ranging from a minimum of 0.8 mm to a maximum of 2.9 mm/year. However, between 2006 and 2018, the average global sea level rise accelerated further to 3.7 mm/year, with a minimum of 3.2 mm/year and a maximum of 4.2 mm/year.

1.2 Climate Change in Malaysia and Johor

The escalating climate change crisis has emerged as a significant global threat, including for Malaysia. Malaysia's geographical features, characterized by high humidity and diverse terrain, make it highly susceptible to the impact of climate change. Johor, located in the southern region of Peninsular Malaysia, is exposed to excessive and unpredictable rainfall, increasing the risk of frequent flooding. The impact of these floods not only damages infrastructure and disrupts local communities but also adversely affects the economy, social well-being, and the environment.

The National Hydraulic Research Institute of Malaysia (NAHRIM) predicts that over the next 30 years, Malaysia will experience rising average annual rainfall and temperature due to climate change. Projections indicate that surface temperatures in Malaysia may increase by 1.9°C to 2.1°C. Additionally, NAHRIM' s report highlights that average sea level in Johor are expected to rise by up to 0.23 m by 2050 and 0.70 m by 2100. Consequently, addressing climate change-induced flooding in Malaysia requires immediate attention and appropriate action. This policy addresses challenges and impacts of climate change (Figure 1).

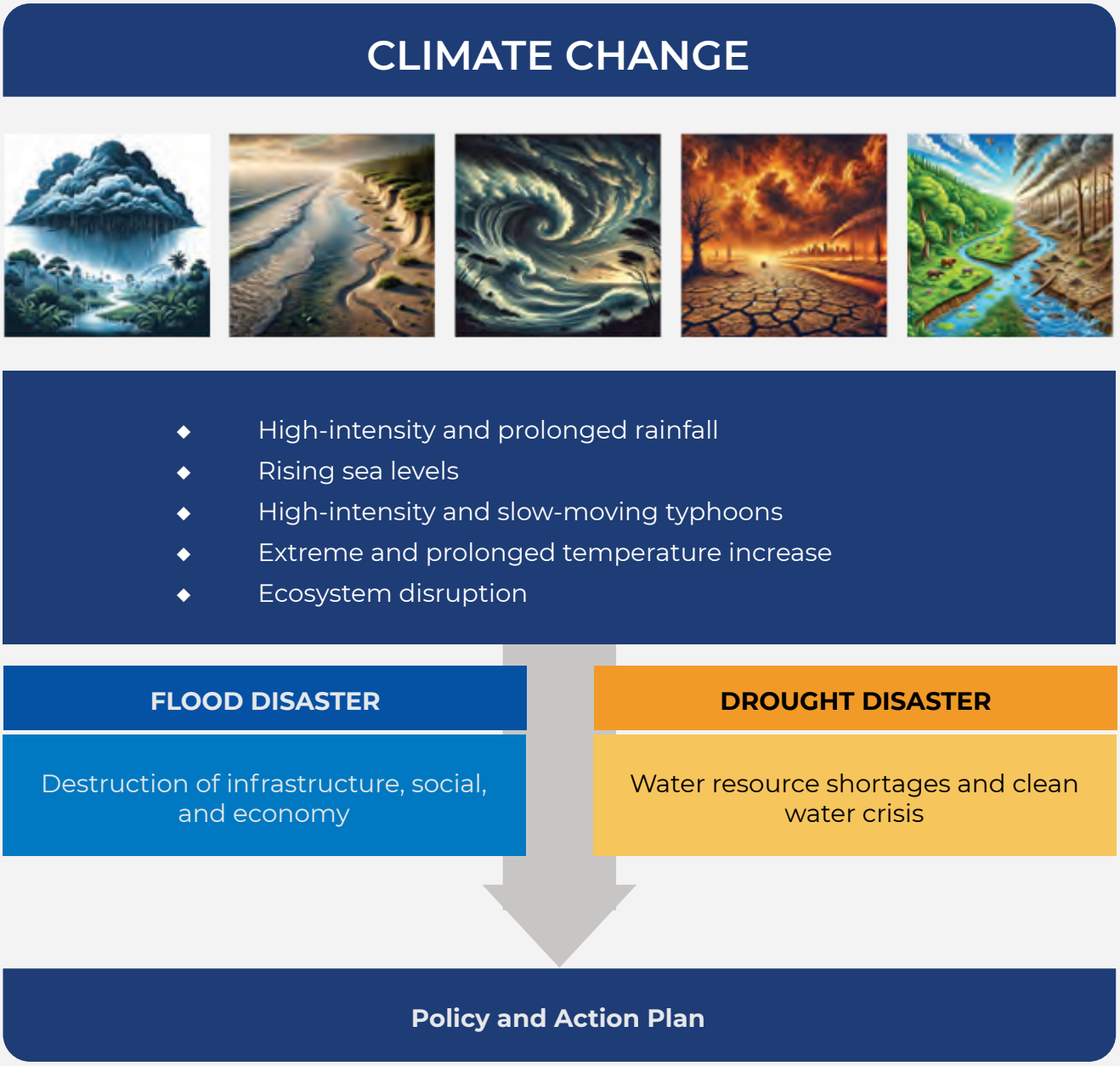


Figure 1: Impact of climate change in producing policy

According to a study conducted in 2024 by Universiti Teknologi Malaysia (UTM) through the Water Security and Sustainable Development Hub - Global Challenges Research Fund (GCRF) project, an analysis of the annual average rainfall patterns in Peninsular Malaysia and Johor shows a significant increase over the period from 1981 to 2022 (Figures 2 and 3).

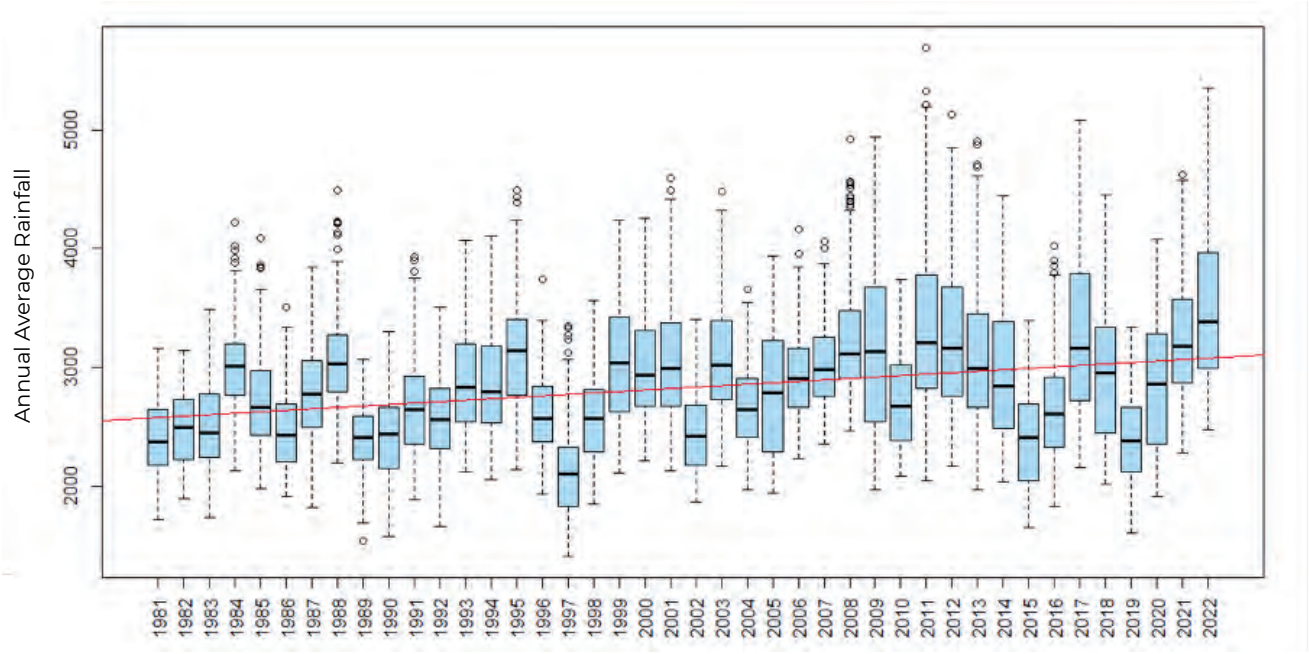


Figure 2:
Trend of annual average rainfall from 1981 to 2022 in Peninsular Malaysia

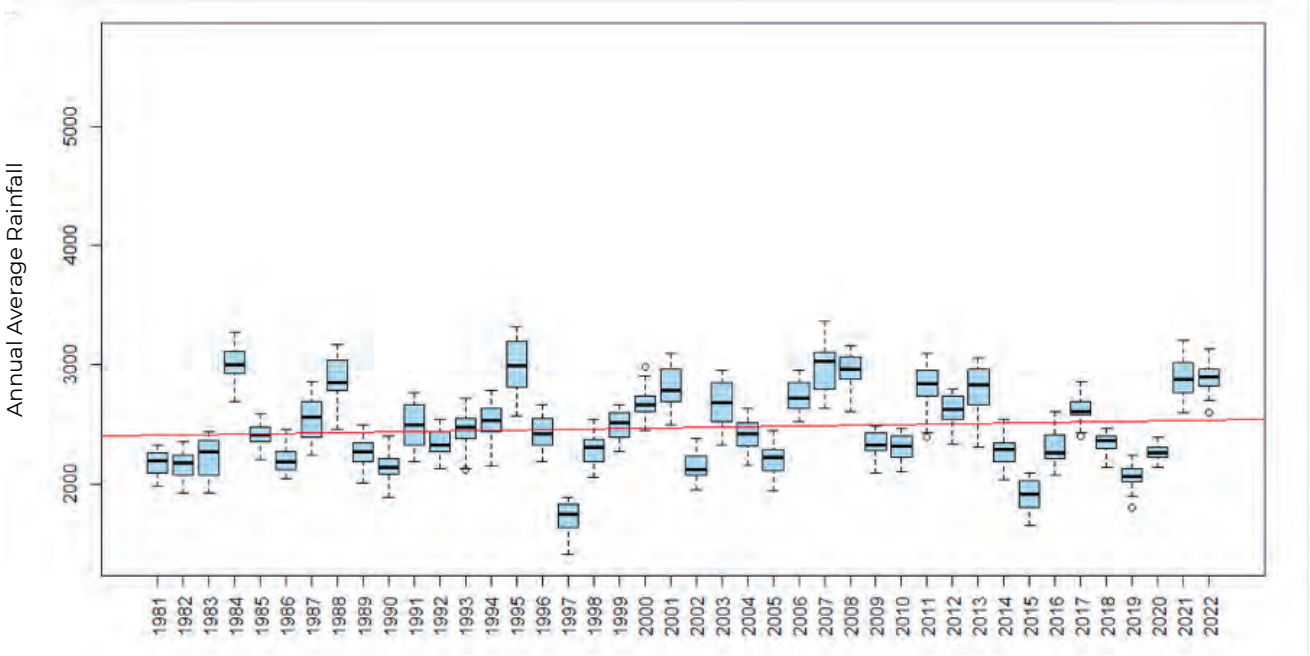
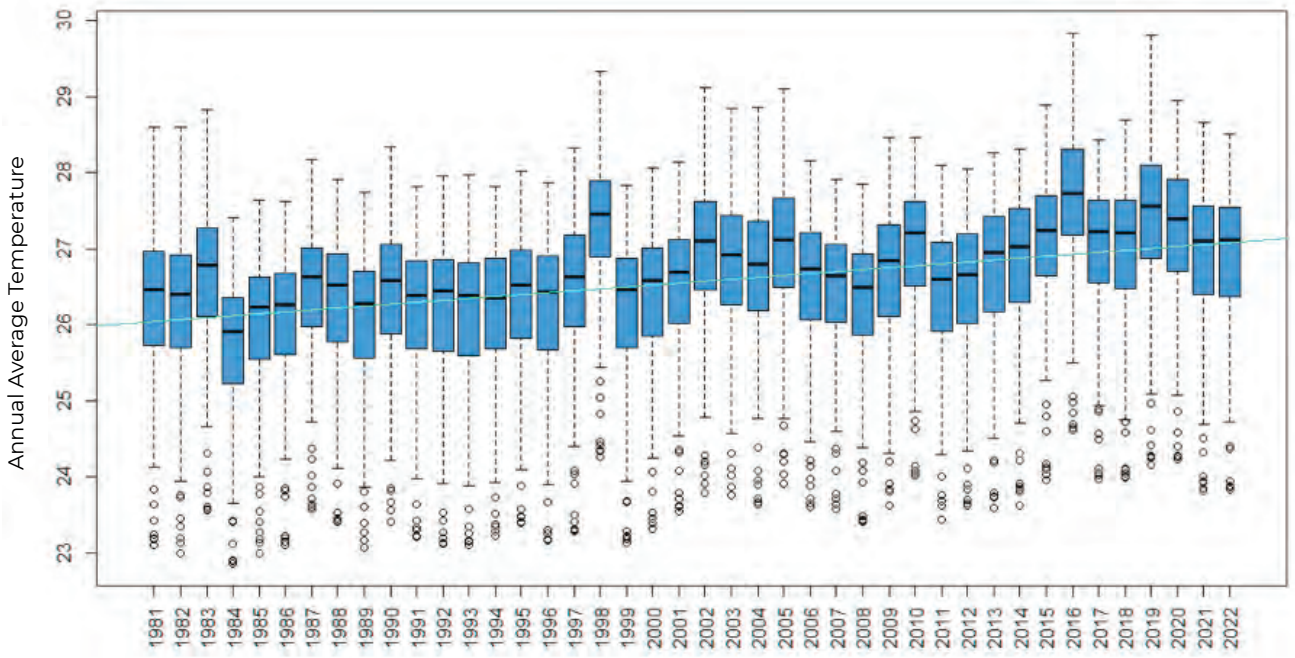


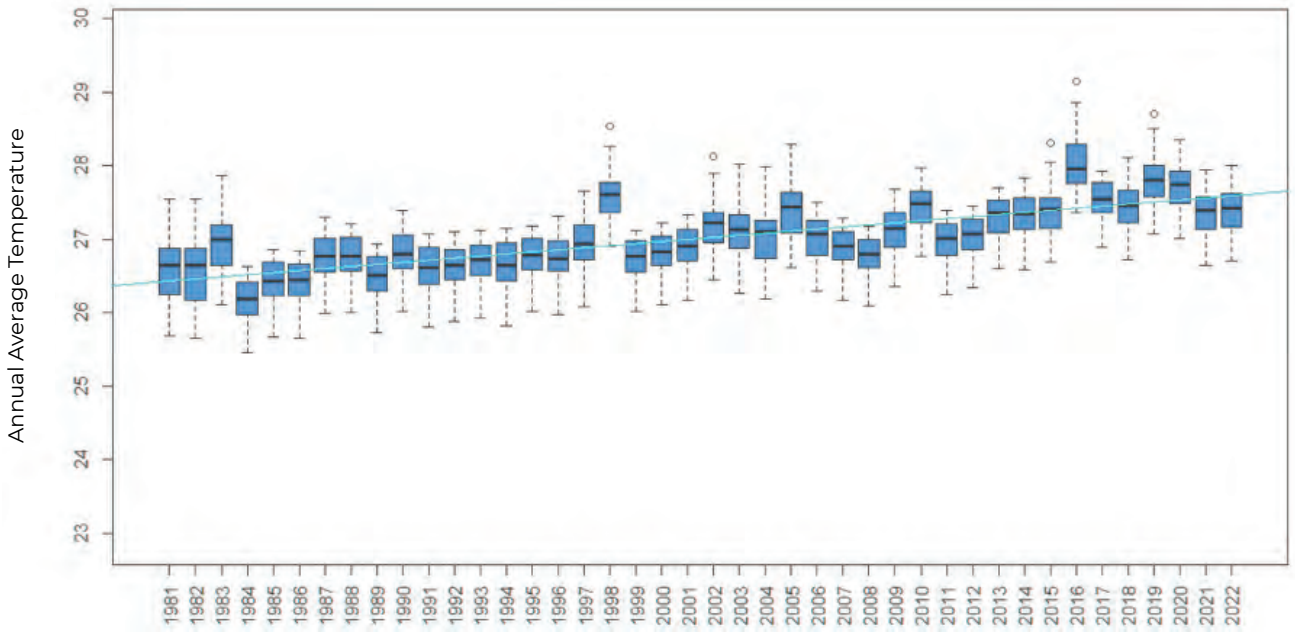
Figure 3: Trend of annual average rainfall from 1981 to 2022 in Johor

The same goes for the temperature trend, which clearly shows an increasing trend in Peninsular Malaysia and Johor (Figures 4 and 5).



Source: Water Security and Sustainable Development Hub - GCRF

Figure 4: Annual average temperature trend from 1981 to 2022 in Peninsular Malaysia



Source: Water Security and Sustainable Development Hub - GCRF

Figure 5: Annual average temperature trend from 1981 to 2022 in Johor

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Flood Overview

Floods can be categorized into various types, including fluvial and pluvial floods. A fluvial flood refers to flooding that results from a river overflowing when its water level rises beyond the river's capacity. A pluvial flood occurs when the drainage system is unable to handle excessive rainfall, causing water to accumulate on the surface. In general, there are four (4) types of floods that frequently happen in Malaysia which are monsoon floods, flash floods, coastal floods, and standing water floods.

Types of floods can be distinguished based on the duration of occurrence, rainfall intensity, and geographical factors of an area, as follows:

i. Flash flood:

Occurs due to heavy rainfall over a short duration, causing water levels to rise rapidly but recede quickly.

ii. Coastal flooding:

Occurs when heavy rainfall coincides with a tidal surge, causing coastal areas to flood.

iii. Monsoon flooding:

Occurs due to continuous or prolonged heavy rainfall during the monsoon season causing in floods that recedes slowly.

iv. Ponding flood:

Occurs in low-lying areas with poor drainage, causing to water stagnating for an extended period.

Flooding can occur due to high-intensity or prolonged rainfall. They can also happen when a high-tide phenomenon coincides with heavy rainfall. The Average Recurrence Interval (ARI) refers to the average time between occurrences of a specific magnitude of rainfall over a given period at a particular location. It represents the number of years predicted before a rainfall event of a certain magnitude happens again. For example, rainfall with a 50-year ARI has a probability of occurring once in 50 years. A higher ARI value indicates greater rainfall intensity. However, the calculation of ARI depends on probability analysis and recorded rainfall data. In the era of climate change, high-intensity rainfall is expected to increase, leading to more rainfall events that exceed historical records.

Developed countries such as the Netherlands apply a higher ARI value exceeding 1,000 years in their infrastructure design to ensure resilience against extreme weather events.

The Netherlands is known for its high flood resilience system, given that around 26% of its land area is below sea level.

Equipped with an advanced water management and flood resilience system, the Netherlands has effectively reduced flood risks. On the other hand, Japan, which frequently experiences more severe natural disasters, applies an ARI of over 200 years in its flood-resistant infrastructure design. Meanwhile, Singapore continues to adopts the standard ARI value of 100 years for its flood mitigation system designs.

In Malaysia, the Urban Stormwater Management Manual (MSMA) serves as the primary guideline for designing drainage system. The drainage system design is divided into two types: minor drainage, which applies an ARI of up to 10 years, and major drainage, which applies an ARI of up to 100 years. In the implementation of Flood Mitigation Plans (RTB), the Climate Change Factor (CCF) must be considered as a proactive measure to mitigate the effects of climate change, which is expected to increase the rainfall intensity and cause more frequent and extreme flood disasters in the future. Therefore, applying the CCF in drainage design is crucial to more effectively reduce flood risk in the future.

2.1 Global Flood Situation

Flooding has now become a major threat to society and development prospects worldwide. Several current trends indicate a significant increase in flood risks in the future. A study conducted by Nature Communications in 2022 found that 1.81 billion people, or 23% of the global population, are directly exposed to floods occurring once in 100 years. Additionally, according to statistics released by Visual Capitalist in 2022, more than half of the population in the Netherlands (58.7%) and Bangladesh (57.5%) are exposed to flood risks. Countries such as Vietnam (46%), Egypt (40.5%), and Myanmar (39.9%) are also listed among those with high flood risks based on the percentage of their exposed population (Figure 6).

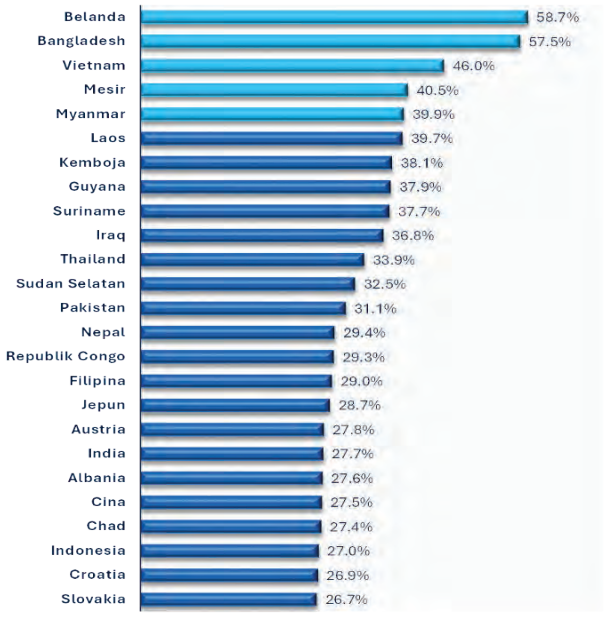


Figure 6: Countries with flood risk percentage based on exposed population

According to the Netherlands Environmental Assessment Agency (PBL), the Netherlands is situated in a delta, with an estimated 59% of its land surface exposed to flood risks, including 26% of the area that is below sea level. The construction of flood defence barriers was implemented to reduce the risk of flooding after the major flood event in 1953. Following severe floods in the 1990s, the Netherlands shifted from structural mitigation to more NBS, such as strengthening water governance, stakeholder participation, flood prevention, and coastal protection. Additionally, the Netherlands has developed a Solutions for Emergency Flood Protection portfolio, which encompasses measures at all stages: before, during, and after flooding.

2.2 Flood Situation in Southeast Asia and Malaysia

In 2023, according to the Emergency Events Database (EM-DAT), 79 disasters related to hydrometeorological hazards were reported in Asia; of this total, 52 incidents, or more than 80%, were associated with floods and storms. According to statistics released by Visual Capitalist in 2022, the Southeast Asian region alone accounted for more than two-thirds of the world's population exposed to flood risk, totaling 1.24 billion people. Figure 7 presents flood risk statistics based on the population exposed to flooding in several Southeast Asian countries, according to 2022 data, excluding Malaysia.

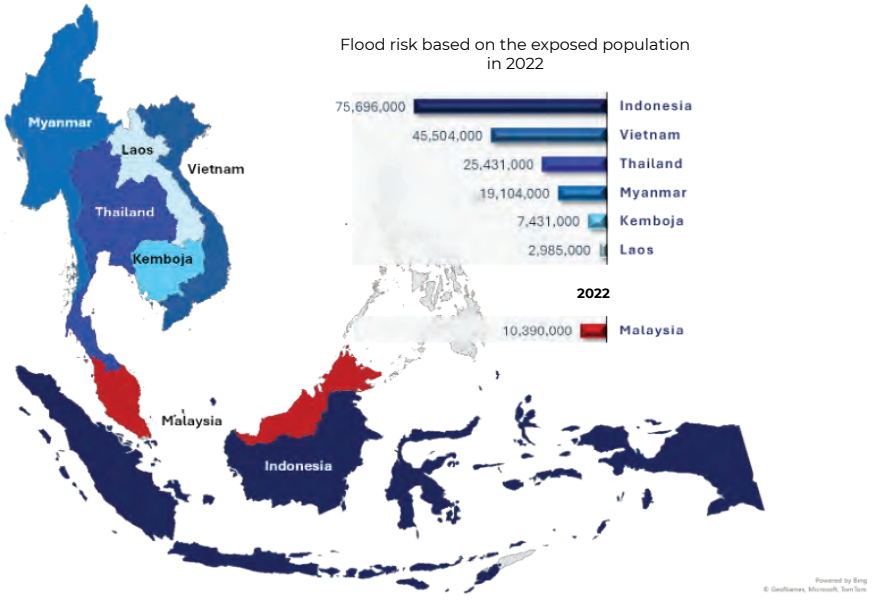
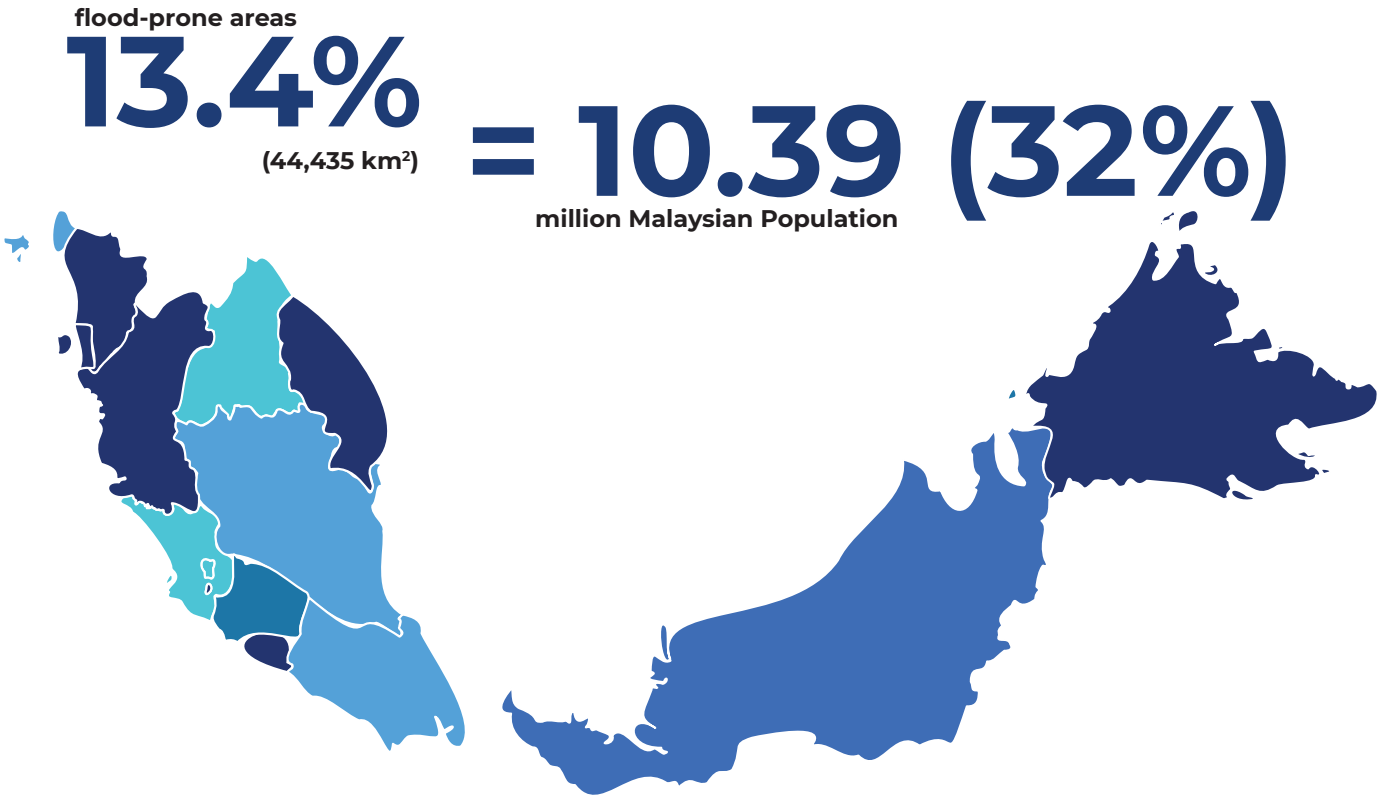


Figure 7: Flood risk based on the exposed population in Southeast Asia

According to a study conducted in 2020 by the Department of Irrigation and Drainage (JPS), titled Updating of Condition of Flooding and Flood Damage Assessment in Malaysia, an estimated **13.4%** of Malaysia's land area, equivalent to **44,435 km²**, is at risk of flooding, affecting approximately **10.39 million (32%)** of the Malaysian population. The report indicates a significant increase in the number of flood disasters by district across Malaysia and the highest daily rainfall averages by year. According to the latest JPS report (January-October 2024), Malaysia recorded 836 flood events, with significant floods defined as occurrences exceeding a 10-year return period and involving recorded rainfall of more than 60 mm/ hour or river overflow. Analysis shows that 59% of these disasters were flash floods, 34% were monsoon floods, 5% were ponding floods, and 1% were coastal floods. The primary causes identified were prolonged heavy rainfall (39%), river overflow (28%), and internal drainage issues (13%).



According to the annual report by JPS, flooding disasters occur due to several key factors. One major factor is continuous heavy rainfall, which causes a sharp increase in surface runoff. This situation is likely due to the existing drainage system being unable to accommodate the volume of water, leading to overflow into surrounding areas. Prolonged rainfall also results in river overflow due to high sedimentation on the riverbed.

Another factor contributing to flooding disasters is land-use changes due to rapid development in local areas. This development reduces permeable surfaces and increases surface runoff. Construction within river reserve areas also narrows river flow. The phenomenon of tidal fluctuations colliding with water flow from upstream can trigger flooding. Additionally, flooding disasters occur more frequently in low-lying areas.

2.3 Flood Situation in Johor

Johor is one of the states in Malaysia that frequently experiences flooding disasters each year. These floods are not limited to urban areas but also affect rural areas. Based on Malaysia's Annual Flood Report by JPS from 2006 to 2022, Johor has shown a critical trend in several districts. Among the districts with high flood frequency are **Johor Bahru (108 incidents), Kota Tinggi (52 incidents), Batu Pahat (78 incidents),** and **Pontian (47 incidents),** involving monsoon floods, flash floods, and coastal floods (Figure 8).

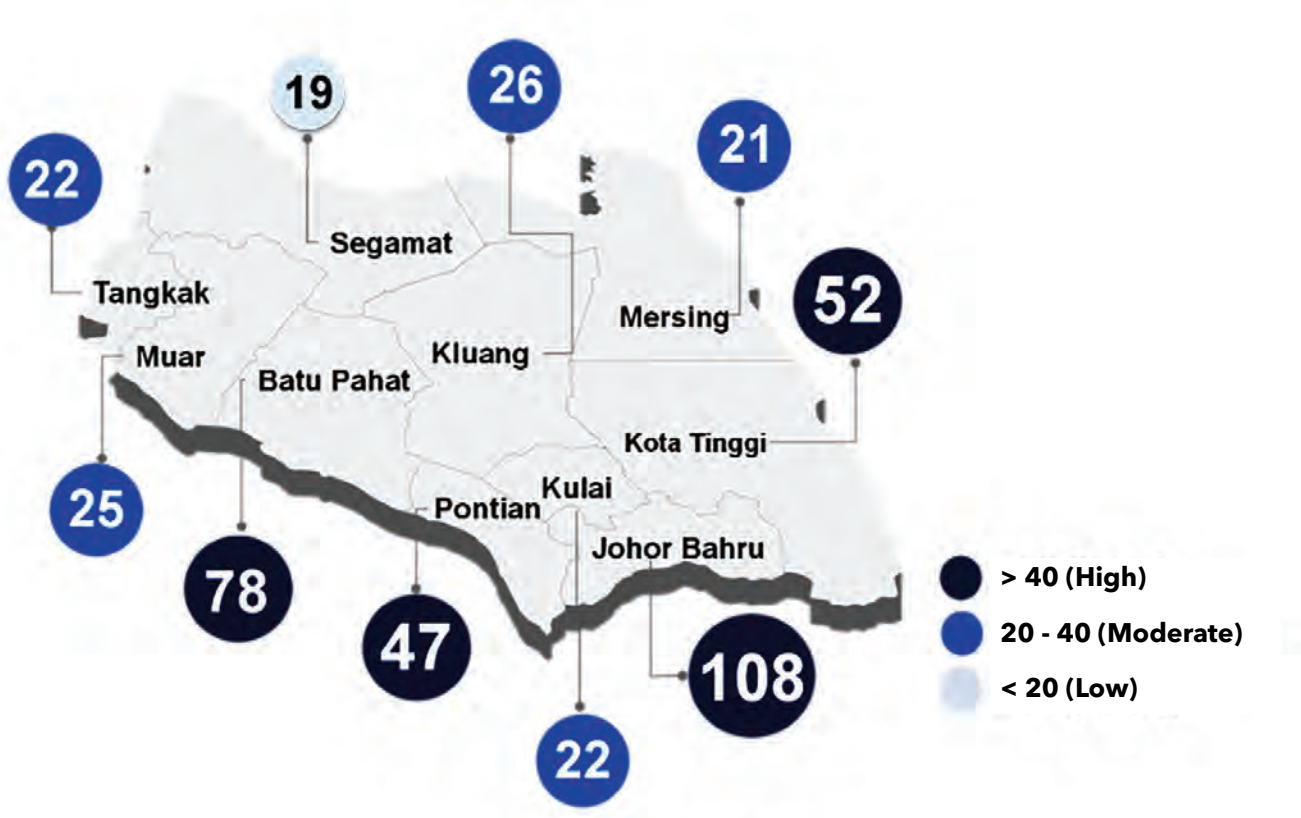


Figure 8: Frequency of flood incidents in Johor by district from 2006 to 2022

Meanwhile, in other districts such as Segamat, Mersing, Muar, Kluang, Kulai, and Tangkak, flood incidents have also been recorded, with the potential to become more critical in the future.

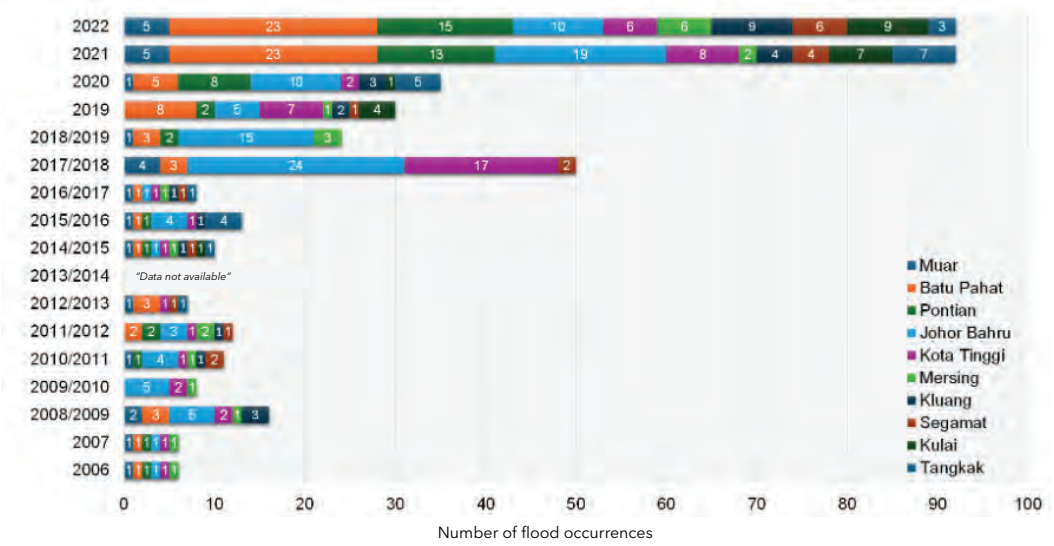


Figure 9: Frequency of flood occurrences in each district by year

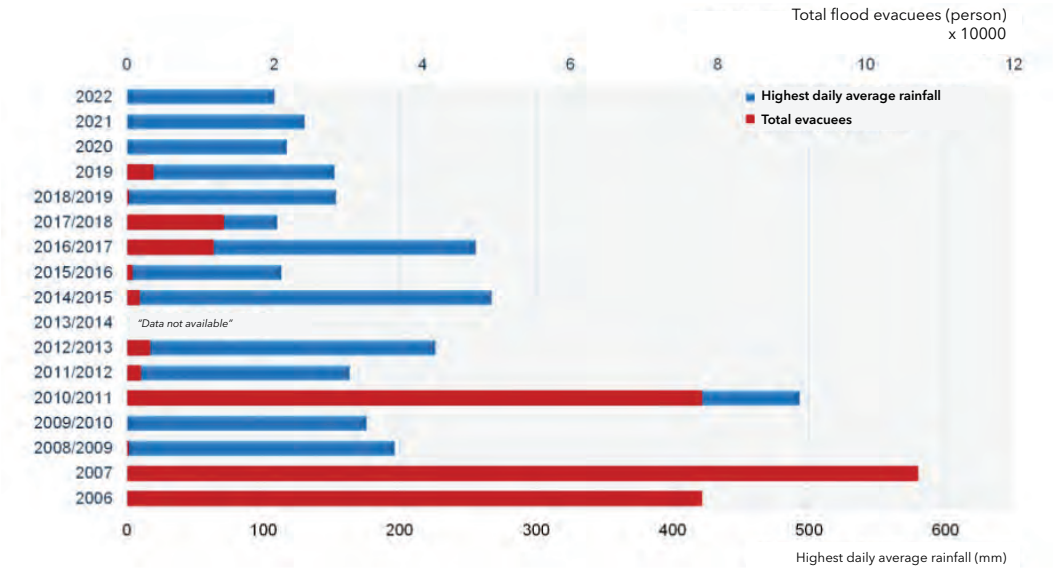


Figure 10: Total flood evacuees and highest daily average rainfall by year

The rapid development in Johor now includes economic zone developments such as the Johor-Singapore Special Economic Zone (JS-SEZ) and Transit-Oriented Development (TOD). TOD maximizes the integration of housing, business, and recreational spaces within easy access to public transportation. One of the key projects is the Johor Bahru-Singapore Rapid Transit System (RTS), which involves integrated property development applying the TOD concept in the Johor Bahru metropolitan area. Additionally, development is expected to expand around main station networks of the Electric Train Service (ETS), currently being developed across four major districts: Segamat, Kluang, Kulai, and Johor Bahru. However, rapid development in Johor, such as JS-SEZ and TOD, may increase flood risks if comprehensive risk analysis and flood mitigation measures are not integrated into these development plans.

2.3.1 Flood Hotspots in Johor

An area will be categorized as a flood hotspot if it has experienced flooding at least three (3) times within the past three (3) years. Based on the annual flood reports by JPS (since 2006) and information from the Local Authorities (PBT), several hotspot locations in each district of Johor have been identified, as shown in Figure 11 and Table 1. Frequent flooding in Johor's 10 districts is primarily caused by three main factors: natural phenomena, infrastructure weaknesses, and land-use changes. Prolonged heavy rainfall, high tides, and low-lying areas increase flood risks. Infrastructure issues like shallow drainage systems, clogged waterways, and poor river maintenance contribute to water overflow. Additionally, unplanned development without proper drainage systems disrupts natural water flow, making areas near rivers and low-lying roads more vulnerable to flooding.

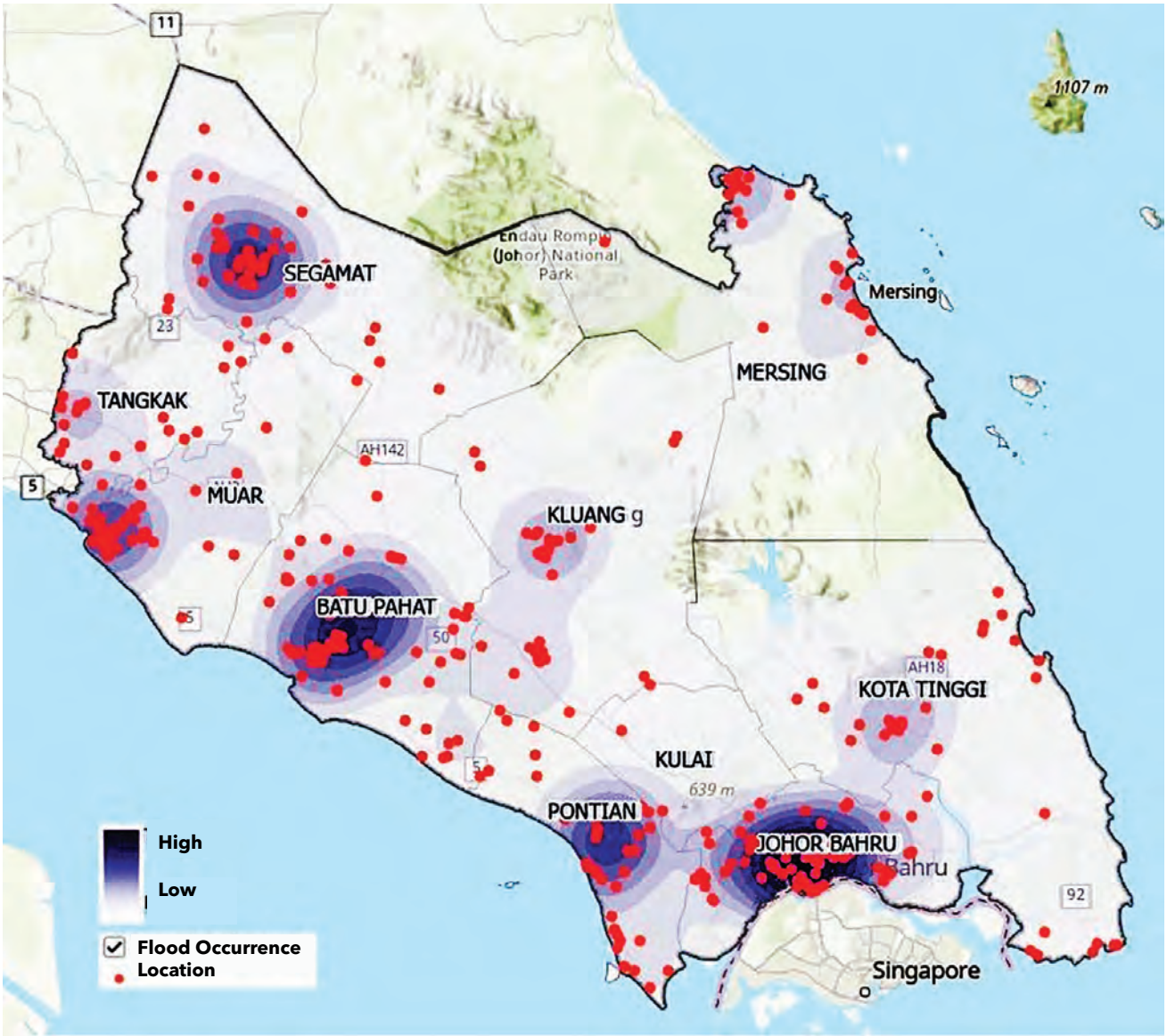


Figure 11: Heatmap of flood hotspots in Johor districts

Table 1: Flood hotspots for each district in Johor

DISTRICT	FLOOD HOTSPOTS		
Johor Bahru (52 Locations)	1. Wisma Persekutuan 2. Kg. Bukit Dagang 3. Kg. Baru Gelang Patah 4. Kg. Paya Mengkuang 5. Kg. Mohd Amin 6. Jln. Ayer Molek 7. Jln. Kolam Air 8. Kg. Laut Skudai 9. Kg. Tuah Jaya 10. Jln. Gelang Patah – Lima Kedai 11. Kg. Melayu, Kangkar Pulai 12. Taman. Damai Jaya 13. Kg. Pasir 14. Kg. Pulai 15. Kg. Sentosa Barat 16. Kg. Sentosa Damai 17. Jln. Masai Kong Kong 18. Kg. Sri Serdang 19. Kg. Maju Jaya	20. FT17 Lebuhraya Pasir Gudang (Persimpangan Bertingkat Bandar Seri Alam/Taman. Rinting) 21. Kg. Dato Sulaiman Menteri 22. Kg. Melayu Pandan 23. Kg. Plentong Baru 24. Kg. Sg. Tiram 25. Kg. Batu 20 26. Kg. Oren 27. Kg. Paya Kenangan 28. Kg. Kangkar Tebrau 29. Kg. Pasir Tebrau 30. Kg. Baru Muafakat 31. Taman. Syed Idrus 32. Persimpangan Jln Bandar & Jln Nikel 33. Taman Lily Jasmine / Taman Tampoi Indah	34. Kg. Usaha Jaya 35. Kg. Syahbandar 36. Kg. Ubi Baru 37. Kg. Sc 38. Kg. Paya Sg Reda 39. Kg. Desa Pinggitan 40. Kg. Sg Penderam 41. Kg. Perigi Acheh 42. Kg. Wawasan 43. Kg. Melayu Baru 44. Kg. Bukit Tempurung 45. Kg. Pok 46. Kg. Pekajang 47. Kg. Tiram Duku 48. Kg. Pendas Baru 49. Kg. Sepakat 50. Kg. Sg. Rinting 51. Taman Rinting 52. Kg. Bukit Pulai
Kota Tinggi (37 Locations)	1. Bandar Kota Tinggi 2. Kg. Mawai Lama 3. Kg. Sg. Berangan 4. Taman Aman 5. Kg. Baru Sg. Mas 6. Taman Mawai 7. Kg. Lepau 8. Kg. Kelantan 9. Kg. Panti 10. Lorong Bahagia, Kg. Lukut 11. Batu 25 Jln. Johor 12. Kg. Rantau Panjang 13. Taman Kuso & Taman Kemang	14. Kg. Sri Delima 15. Kg. Sri Jaya 16. Kg. Sg. Telor 17. Kg. Sepak Hulu 18. Kg. Sepak Hilir 19. Kg. Temenin 20. Kg. Batu 4 21. Jln. Kota Tinggi - Pengerang (Sg. Mas) 22. Kg. Semanggar Dalam 23. Kg. Semanggar Luar 24. Sg. Telor 25. Kg. Baru Sg. Telor 26. Kg. Bukit Raja 27. Taman Bayu Damai	28. Parit II, Kg. Gembut 29. Kg. Perpat 30. Jln. Kerapu, Sedili Besar 31. Jln. Sedili - Kota Tinggi 32. Kg. Hj. Jambi 33. Bandar Penawar 34. Kg. Jawa 35. Taman Kota Mas 36. Jln. Limau Kupas, Taman Kota Jaya 37. Jln. Remia 7, Taman Kota Jaya
Batu Pahat (52 Locations)	1. Kg. Sengkuang 2. Kg. Parit Hj. Yusof 3. Kg. Parit Khalil 4. Kg. Parit Semarang 5. Parit Bintang 6. Taman Batu Pahat 7. Kg. Sg. Suloh 2 8. Kg. Sg. Suloh 9. Kg. Parit Hj Kamisan 10. Kg. Parit Awang 11. Kg. Temehel 12. Peserai Kecil 13. Taman Nira 14. Parit Doby Jln. Kenangan 15. Parit Johar 16. Kg. Dalam Peserai 17. Jln. Pantai, Kg. Muhibbah 18. Kg. Talang Bunut 19. Kg. Parit Hj Salleh	20. Kg. Solok Wan Moh 21. Taman Cempaka Putih 22. Taman Pelangi 23. Taman Sri Wangsa 24. Kg. Parit Hj Ali 25. Parit Hj. Sidek, Parit Besar 26. Parit Jayus 3 & 4 27. Parit Air Putih 28. Kg. Sg. Sedi 29. Parit Kuari 30. Kg. Baru Sri Gading 31. Simpang Lima 32. Jln. Besar Parit Sulong-Muar 33. Kg. Pinggir Sri Wangi 34. Rancangan Sri Wangi 35. Sri Bengkal 36. Parit Olak Batu	37. Parit Jambol 38. Parit Ulong/sulong 39. Kg. Parit Simis 40. Kg. Parit Warijo Laut 41. Parit Lintang Warijo Laut 42. Kg. Parit Lapis Basri 43. Parit Basri Laut 44. Parit Sejagong 45. Parit Rahiban 46. Parit Lintang Warijo Darat 47. Kg. Parit Basri 48. Kg. Parit Basri Darat 49. Kg. Parit Singgahan 4 Dalam 50. Kg. Sri Jasa 51. Kg. Parit Singgahan Luar 52. Kg. Parit Tegak

DISTRICT	FLOOD HOTSPOTS		
Pontian (24 Locations)	1. Kg. Parit Ramunia 2. Kg. Paya Embun 3. Parit Puteri Menangis 4. Kg. Tampok Laut/Lapis 5. Parit Haji Ariff 6. Kg. Parit Abdul Rahman 7. Lorong Mohsen 8. Parit Wak Jabir	9. Lorong IKBN Pulai Sebatang 10. Kg. Penerok 11. Parit Haji Yasin 12. Parit Basilam 13. Kg. Sri Gambut 14. Kg. Melayu Bukit Panjang 15. Kg. Jasa Sepakat 16. Kg. Melayu Raya	17. Parit Selangor 18. Kg. Parit Pasir 19. Kg. Ulu Pulai 20. Parit Lanchang 21. Kg. Kurnia 22. Kg. Maju Jaya 23. Parit Mastar 24. Kg. Moleh
Muar (83 Locations)	1. Bandar Muar 2. Jln. Bakri 3. Kg. Sg. Tui 4. Pekan Bukit Kepong 5. Kg. Paya Redan 6. Kg. Bukit Bendar 7. Taman Kepong 8. Kg. Sg. Meda 9. Felda Maokil 10. Kg. Sawah Laku 11. Felcra Bukit Kepong 12. Kg. Jawa Lenga 13. Sg. Berani 14. Pekan Lenga 15. Lenga Batu 30 16. Kg. Lenga Batu 23 17. Kg. Sebasu 18. Kg. Sawah Renchong 19. Kg. Liang Batu 20. Renchong 21. Kg. Gombang Sg. Menchil 22. Kg. Paya Ronggang 23. Kg. Lenga 24. Kg. Baru Lenga 25. Kg. Raja Pagoh 26. Kg. Sari Baru 27. Kg. Panjang Sari 28. Kg. Paya Lempah 29. Kg. Parit Bugis	30. Kg. Sg. Ranggam 31. Kg. Sri Meranti 32. Kg. Sri Makmor 33. Kg. Selancar 34. Kg. Semeriot 35. Kg. Jayor 36. Kg. Raja Bukit Kepong 37. Kg. Tulang Gajah 38. Kg Parit Bugis 39. Kg. Melayu Panchor 40. Kg. Brohol 41. Kg. Olak Sepam 42. Pekan Panchor 43. Kg. Tanjung Olak 44. Kg. Jawa Panchor 45. Kg. Semaseh Panchor 46. Parit Shariff 47. Parit Othman 48. Parit Mesjid 49. Tanjung Mas 50. Kg. Kenangan TDI 2 51. Sabak Awor 52. Jln. Ismail 53. Kg. Kelantan 54. Parit Tiram 55. Jln. Dato Hj. Hassan 56. Jln. Bakariah 57. Jln. Khalidi 58. Jln. Sakeh	59. Jln. Salleh 60. Parit Zin 61. MRSM Bakri 62. Parit Wahid 63. Parit Amal 64. Parit Bakar 65. Pekan Parit Jawa 66. Kg. Parit Shafiee 67. Kg. Parit Salman 68. Kg. Paya Lebar 69. Kg. Parit Yaakup 70. Kg. Parit Samad 71. Parit Hj Zain 72. Batu 15 Air Hitam 73. Sg. Grisik 74. Taman Temiang Murni 75. Taman Sg. Abong Sutera 76. Taman Sg. Abong 77. Taman Sri Treh 78. Taman Sri Bakri 79. Taman Mas Ria 80. Taman Desa Temiang 81. Jln. Hospital 82. Jln. Batu Nampak 83. Taman Sri Terap
Kluang (37 Locations)	1. Taman Fajar 2. Kg. Sri Lukut 3. Kg. Bentong Luar/ Dalam 4. Kg. Contoh 5. Kg. Pucur 6. Kg. Peroh 7. Perumahan PPRT Yap Tau Sah 8. Kg. Palembang Lama 9. Kg. Palembang Baru 10. Kg. Tengah Dalam 11. Kg. SC 12. Kg. Sembrong Dalam 13. Batu 4 Jln. Kluang – Mersing 14. Kg. Baru, Jln. Paloh 15. Kg. Semberong Kecil	16. KOA Tanah Runtuh 17. Persimpangan Taman Saujana, Jln Batu Pahat 18. Kg Muhibbah, Paloh 19. Kg. Batu 6 20. Kg. Sg. Rambai 21. Kg. Sri Ampangan 22. Kg Parit Kassan 23. Kg. Isnin Maarof 24. Kg. Sg. Linau 25. Kg. Kolam Air 26. Kg. Parit Hassan 27. Kg. Parit Ibrahim Majid 28. Jln. Senda, Pekan Renggam	29. Kg. Tenggah, Renggam 30. Jalan Talapia, Taman Indah Jaya 31. Jalan Teratai Dan Jalan Kg. Melayu 32. Taman Ilham 33. Jalan Canggai, Kg. Dato' Abdul Rahman Yassin 34. Lorong 2, Kg. Baru 35. Jalan 2/18, Taman Sri Kluang 36. Jalan Kolam Ikan, Kg. Melayu Chamek 37. Jalan Niyor

DISTRICT	FLOOD HOTSPOTS		
Mersing (22 Locations)	1. Kg. Air Tawar 2. Kg. Semaloi 3. Kg. Asli Peta 4. Kg. Asli Labong 5. Kg.Semanyir 6. Kg. Padang Endau 7. Kg. Sri Pantai 8. Kg. Baru Jemari	9. Kg. Bahgia 10. Kg. Pangkalan Batu 11. Kg. Air Merah 12. Kg. Sri Lumpur 13. Taman Sri Bayu 14. Kg. Sawah Dato' 15. Kg. Air Papan Tengah 16. Kg. Tenglu	17. Kg. Air Papan 18. Teluk Buih 19. Padang Ragut Bkt Tekedai 20. Simpang Penyabong 21. Kg. Bukit Pasir 22. Kg. Paya Tinggal
Tangkak (65 Locations)	1. Kg. Seberang Gajah 2. Kg. Seri Makmor 3. Kg. Sialang Dalam 4. Kg. Parit Gelugor 5. Taman Harmoni 6. Kg. Gelugor 7. Parit Idrus 8. Kg. Parit Rawang 9. Kg. Ayah Samad 10. Kg. Merbau 11. Kg. Parit Ponorogo 12. Kg. Pengkalan Besar 13. Kg. Parit Pulai Darat 14. Lorong Penghulu Long 15. Kg. Tanjung Gading 16. Kg. Tanjung Agas 17. Parit Bunga 18. Kg. Sri Makmur 19. Kg. Pangkalan Kota 20. Parit Timin 21. Sg. Senduk 22. Kg. Parit Pulai 23. Parit Dahlan 24. Kg. Telok Rimba	25. Kg. Baru, Kebun Baru 26. Taman Sri Jaya 27. Taman Sri Jaya 2 28. Taman Ledang 29. Jln Rajawali 8, Tg. Gading, Kesang 30. Jln Garuda 4, Taman Garuda 31. Kg. Merigi 32. Kg. Durian Condong 33. Kg. Pengkalan Kota 34. Kg. Penchu 35. Kg. Kurnia Sakti 36. Kg. Kundang Hulu 37. Kg. Felda Sri Jaya 38. Kg. Melayu Kundang Hulu 39. Taman Bakri Kundang Hulu 40. Kg. Parit Surau 41. Kg. Parit Tepi 42. Kg. Parit Tunggol 43. Kg. Parit Sawah 44. Kampung Hujung Tambak	45. Ladang Lanadron 46. Kg. Parit Pelampung 47. Kg. Parit Raja 48. Kg. Bukit Rahmat 49. Kg. Parit Bengkok 50. Kg. Sg. Senduk 51. Kg. Sawah Ring 52. Kg. Sengkang Batu 18 53. Kg. Sg. Jaya 54. Kg. Parit Babok 55. Kg. Sri Gelam 56. PUSPEN Muar 57. Kg. Telur Bakong 58. Kg. Kolam 59. Kg. Parit Pulai Hujung 60. Kg. Sri Jaya 61. Kg. Simpang Lima Darat 62. Kg. Parit Bunga Raya Hujung 63. Kg. Pulau Penarik 64. Kg. Sabak Sena 65. Kg. Tg. Gading Barat
Segamat (46 Locations)	1. Kg. Jawa 2. Kg. Melayu Raya 3. Kg. Paya Dalam 4. Kg. Paya Lang 5. Bukit Siput 6. Kg. Usahajaya 7. Kg. Bangas 8. Kg. Paya Lebar 9. Kg. Mensudut Lama 10. Mensudut Pindah 11. Kg. Lembah Bakti 12. Kg. Paya Lenga 13. Kg. Tungku Tiga 14. Kg. Pogoh Tengah 15. Kg. Balai Badang 16. Kg. Bukit Senggir	17. Kg. Tandong 18. Kg. Awat 19. Kg. Spang Loi 20. Kg. Padang Kiambang 21. Taman Bintang 22. Taman Gemas Baru 23. Kg. Lubuk Lanjut 24. Kg. Pudu 25. Kg. Kuala Paya 26. Kg. Bukit Tunggal 27. Kg. Tandung 28. Kg. Batu Bakar 29. Kg. Batu Lima 30. Kg. Kuing Patah 31. Kg. Serdang 32. Kg. Pagoh	33. Kg. Seberang Batu Badak 34. Kg. Chodan 35. Kg. Segamat Kecil 36. Kg. Tenang 37. Pekan Ayer Panas 38. Kg. Sekijang 39. FELCRA Sekijang 40. Bandar Segamat 41. Kg. Tengah 42. Jln. Pemuda 43. Kg. Jabi 44. Kg. Gubah 45. Jln. Maryani 46. Kg. Sg. Gatom

DISTRICT	FLOOD HOTSPOTS		
Kulai (34 Locations)	1. Kg. Melayu Bukit Batu 2. Kg. Ayer Manis 3. Kg. Ayer Bemban 4. Kg. Sri Rahmat 5. Kg. Kuala Kabong 6. Kg. Sri Paya 7. Kg. Sg. Siam 8. Kg. Sg. Besoi 9. Kg. Murni Jaya 10. Kg. Sri Muar 11. Kg. Sri Leban 12. Kg. Sg. Sayong 1 dan 2 13. Kg. Melayu Sedenak 14. Kg. Baru Sedenak 15. Kg. Melayu Sengkang 16. Tan Yoke Fong 17. Kg. Pasir	18. Jalan Persekutuan FT001 (Pejabat MARA Kulai) 19. Jalan Persekutuan FT001 (Persimpangan IPD Kulai) 20. Jalan Persekutuan FT001 (Jambatan Bandar Putra -Pejabat Peladang Kulai) 21. Kg. Sri Maju 22. Kg. Jaya Sepakat 23. Kg. Sepakat Baru 24. Jln. Seelong - Ulu Tebrau 25. Jln. Ulu Tebrau - Sg. Tiram	26. Kg. Sri Gunung Pulai 27. Persimpangan Jln. Persekutuan - Persiaran Indahpura 4 28. Taman Aman/ Kg. Jaya Sepakat 29. Jln. Anggerik, Taman Kulai Utama 30. Bulatan Indahpura 2/4 31. Jln. Persiaran Pulaijaya 32. Taman Sri Muhibbah 33. Kg. Pertanian/Separa 34. Taman Desa Idaman

Source: Department of Irrigation and Drainage (JPS) and Local Authorities (PBT).

Integrated River Basin Management (IRBM) and the Drainage Master Plan (PISMA), developed by JPS, are two key approaches for effective and sustainable flood risk management. These initiatives play a crucial role in identifying flood-prone areas and formulating appropriate mitigation measures, such as RTB. IRBM emphasizes an integrated approach involving multiple parties to maintain ecosystem balance, reduce excessive water flow, and regulate development within river basins. The main objectives of IRBM are to ensure adequate water supply, preserve water quality, reduce flood risks, and enhance environmental well-being. Meanwhile, PISMA focuses on green infrastructure development and natural methods for managing rainwater. This approach aims to reduce urban flood risks and preserve water quality.

Through IRBM and PISMA studies, potential flood areas can be systematically identified using scientific data. This approach involves mapping technology, ecosystem analysis, and the use of hydrological, geospatial, and meteorological data. Data such as rainfall distribution, water flow, land elevation, and land reclamation are collected and processed to develop flood forecasting models. Potential flood-prone areas refer to locations frequently affected by heavy rainfall and extreme weather events. Contributing factors to flood risks include the area's topography, inadequate drainage systems, and climate change. Based on the findings of IRBM and PISMA studies, several areas with potential for flooding have been identified (refer to Table 2).

Table 2: Flood-prone areas and factors causing areas to be categorized as flood-prone in Johor

STUDY	FLOOD-PRONE AREAS	FACTORS CAUSING AREAS TO BE CATEGORIZED AS FLOOD-PRONE
IRBM Sungai Mersing	Kg Tenglu Besar, Kg Benaung, Tmn Nahkoda, Kg Air Papan, Kg Baru Jemari, Kg Air Merah.	• Heavy rainfall • Tidal fluctuations • Urban drain water retention • Slow flood recession rate
IRBM Sungai Pulai	Sg Karang, Tanjung Pelepas, Sg Redan, Jeram Batu, Gelang Patah, Pekan Nenas, Tanjung Bin, Kg Sg. Buntu, Kg Pok Besar, Kg Pok, Kg Ulu Pulai, Kg Parit Pasir	• Heavy rainfall • Low-lying or flat areas near rivers • Poor river system • Inadequate drainage system
IRBM Sungai Batu Pahat	Chaah Baru, Parit Hj. Kamisan, Kg Sri Sepakat, Pt Jayus Laut, Pt Sri Dayong, Sri Medan, Pt Sulong, Pt Tegak, Kg Pt Gantung, Pt Lapis Laman, Kg Pt Jawa, Kg Lapis Maimon, Kg Pt Abd Rahman, Kg Temehel, Yong Peng, Pt Yaani, Kg Cahaya Baru, Kg Pt Khalil, Ayer Hitam, Kg Pt Samion, Kg Pt Semarang, Kg Pt Nipah, Kg Pt Kuari, Kg Pt Londang Laut, Sri Gading, Kg Sengkuang, Pt Besar, Kg Linau, Tmn Banang, Bandar Batu Pahat, Tmn Nira, Jln Rugayah, Jln Mohd Akil, Jln Sultanah, Jln Shahbandar, Jln Rahmat, Jln Pantai, Kg Peserai Kecil, Kg Peserai Simpang Lima Minyak Beku, Kg Sg Ayam, Kg Sg Suloh, Kg Sg Suloh, Jln Tg Laboh, Pt Sri Molek, Kg Baru Senggarang, Kg Pt Bugis	• Heavy rainfall • River overflow • High tide • Low-lying areas • Insufficient drainage system capacity

PISMA Tebrau & Plentong	Kg Ubi, Kg Kangkar Tebrau, Kg Kempas Bahru, Kg Plentong Baru, Kg Saujana Baru, Kg Sri Plentong	• Heavy rainfall • Low-lying areas • Insufficient drainage system capacity
PISMA Pengerang	Sg. Kapal, Parit Jepun, Bukit Pelali	• Poor drainage system • Intrusion of river water into the drainage system • Increase in impervious areas • Insufficient capacity of drains and tributaries. • Low-lying areas

2.3.2 Existing Flood Management Measures in Johor

The state of Johor has established the Select Committee on Climate Change and Disaster Management, which functions to assess and refine laws and regulations related to climate change and flood disaster management. Climate change management, including flood adaptation and mitigation, is a potential approach in realizing policy's vision aimed at empowering communities and making Johor more resilient to climate change impacts. Additionally, several studies have been successfully conducted, with most reaching the stage of detailed design, making them ready for implementation. Among these is the IRBM study, which provides a holistic guideline for flood management, ensuring that all development planning considers river basins comprehensively. Development planning should also take into account appropriate land-use zoning to minimize flood risks, as identified in the IRBM study. This approach is crucial in ensuring that areas surrounding developments are not exposed to flood risks. Table 3 presents the IRBM studies that have been conducted in several river basins in Johor. Table 4 lists some of the RTB projects implemented in Johor, while Table 5 outlines the PISMA studies carried out by JPS in Johor.

Table 3: List of Integrated River Basin Management (IRBM) studies in river basins in Johor

RIVER BASIN	TITLE OF STUDY	YEAR COMPLETED
Sg. Muar	The study on a Blueprint for Integrated River Basin Management (vol 4: IRBM Review of Sg. Muar)	2010
Sg. Muar	The Preparatory Survey for Integrated River Basin Management Incorporating Integrated Flood Management with Adaptation of Climate Change (Vol 2: Muar River Basin)	2011
Sg. Tebrau	Preparation of the Integrated River Basin Management (IRBM) Plan for the Sg. Tebrau, Johor	2019
Sg. Skudai	Preparation of the Integrated River Basin Management (IRBM) Plan for the Sg. Skudai, Johor	2019
Sg. Pulai	Preparation of the Integrated River Basin Management (IRBM) Plan for the Sg. Pulai, Johor	2021
Sg. Batu Pahat	Preparation of the Integrated River Basin Management (IRBM) Plan for the Sg. Batu Pahat, Johor	2021
Sg. Sedeli Besar	Preparation of the Integrated River Basin Management (IRBM) Plan for the Sg. Sedeli Besar, Johor	2021
Sg. Mersing	Preparation of the Integrated River Basin Management (IRBM) Plan for the Sg. Mersing, Johor	2021
Sg. Pontian	Preparation of the Integrated River Basin Management (IRBM) Plan for the Sg. Pontian Besar, Johor	2021
Sg. Johor	Preparation of the Integrated River Basin Management (IRBM) Plan for the Sg. Johor, Johor	2022

Table 4: List of Flood Mitigation Plans (RTB) in river basins in Johor

RIVER BASIN	TITLE OF STUDY	YEAR COMPLETED
Sg. Muar	RTB for the Sg. Muar Basin	2013
Sg. Tebrau	RTB for the Sg. Tebrau dan Sg. Plentong	2013
Sg. Muar	RTB for the Sg. Muar Basin (Phase 2)	2015
Sg. Muar	RTB for the Kg. Sialang Dalam, Tangkak, Johor	2018
Sg. Johor	RTB for the Sg. Kemang, Kota Tinggi	2018
Sg. Muar	RTB for the Sg. Muar	2019
Sg. Batu Pahat	RTB for the Kg. Pt Hj Hashim, Batu Pahat	2023
Sg. Johor	RTB for the Kg. Pasir & Kg. Seri Serdang, Mukim Pulai, Johor Bahru,Johor (Phase 1)	In implementation
Sg. Johor	RTB for the Sg. Johor, Kota Tinggi, Johor (Phase 1, Package 1 & 2)	In implementation
Sg. Muar	RTB for the Sg. Muar, Segamat, Johor (Phase 3, Package 1 & 2)	In implementation
Sg. Segamat	RTB for the Kg. Spang Loi, Segamat, Johor	In implementation
Sg. Batu Pahat	RTB for the Bandar Batu Pahat, Batu Pahat, Johor	In implementation

Table 5: List of Drainage Master Plan (PISMA) studies in Johor

TITLE OF STUDY	YEAR COMPLETED
Drainage Master Plan for the Bandar Pasir Gudang, Johor	2010
Drainage Master Plan for the Tebrau & Plentong, Johor	2019
Drainage Master Plan for the Pengerang, Johor	2022

Among the existing flood management measures in several districts of Johor are the construction of flood walls, the installation of flap gates in drainage systems, the construction of embankments along rivers, and the installation of pump systems. The Johor Bahru City Council (MBJB) has also taken the initiative by launching the Johor Bahru Integrated Operations Control Centre (JBIOCC), which functions as a traffic and crime monitoring centre using 500 closed-circuit cameras installed around Johor Bahru. Additionally, JBIOCC also monitors water overflow within MBJB's administrative areas. Meanwhile, the Iskandar Puteri City Council (MBIP) has conducted a Flood Study and prepared an Urban Drainage Master Plan for its jurisdiction.

Several flood mitigation projects has been implemented under the JPS of Johor Bahru District including initiatives in the Gelang Patah area, focusing on adressing flood issues in Kg. Baru Muafakat and several other locations. Flood walls and pump systems have been installed in the upstream interior areas of Sg. Johor in the Kota Tinggi district. Additionally, a siren warning system has been set up in Kota Tinggi town and Sg. Pemandi. Emergency drills involving the community has been conducted before the monsoon season and the development of a flood hazard map for Kota Tinggi has also been carried out. In Batu Pahat district, two major dams with dual functions as flood mitigation structures and water supply facilities have been developed namely the Bekok Dam and the Sembrong Dam.

In the Segamat district, restoration works on Sg. Labis and its tributaries were carried out in 2010, while the subsequent project, involving the construction of the canal through Sg . Segamat - Sg. Genuang, was implemented in 2012. In Muar district, existing mitigation structures include the integration of flood control within multipurpose dams. These multipurpose dams manage water resources for various uses such as agriculture, drinking water, and industrial use, while simultaneously providing flood protection. Additionally, another mitigation measure in Muar district involves the diversion of water between reservoirs through the construction of channels connecting different drainage systems to release excess water effectively.

The Special Area Plans (RKK) in Johor completed to date include RKK Sg. Skudai, RKK Sg. Tebrau, RKK Persisiran Sg. Batu Pahat, and RKK Sg. Tiram. Each RKK incorporates different flood mitigation measures tailored to the area's specific needs and is align with the Johor Flood Policy. In RKK Sg. Skudai, the primary measure involves the construction of Off-River Storage (TAPS) facilities to serve as additional water storage facility, and the improvement of drainage system to enhance discharge capacity. RKK Sg. Tebrau proposes the development of water retention ponds in several locations such as Kg. Maju Jaya and Seelong Jaya, as well as a flood disaster warning project to improve community preparedness. Meanwhile, RKK Persisiran Sg. Batu Pahat emphasizes on comprehensive flood mitigation projects including the construction of breakwater walls, river mouth dredging, and river conservation efforts to increase drainage capacity. In RKK Sg. Tiram, the measures include river preservation and restoration, the development of a new drainage system, and the construction of suction tanks and pump stations to control water flow during heavy rainfall. Overall, the RKKs in Johor must align with the Johor Climate Change (Flood Mitigation) Policy, which promotes an integrated and sustainable approach to flood risk management.

2.4 Flood Mitigation Measures

Flood mitigation measures involve various strategies and techniques designed to reduce the risks and impacts of flooding. The recommended approaches include structural and non-structural mitigation measures(Figure 12). The implementation of these methods aligns with the Sustainable Development Goals (SDG), specifically: SDG 9 – Industry, Innovation, and Infrastructure, SDG 11 - Sustainable Cities and Communities, SDG 13 – Climate Action, dan SDG 15 - Life on Land.

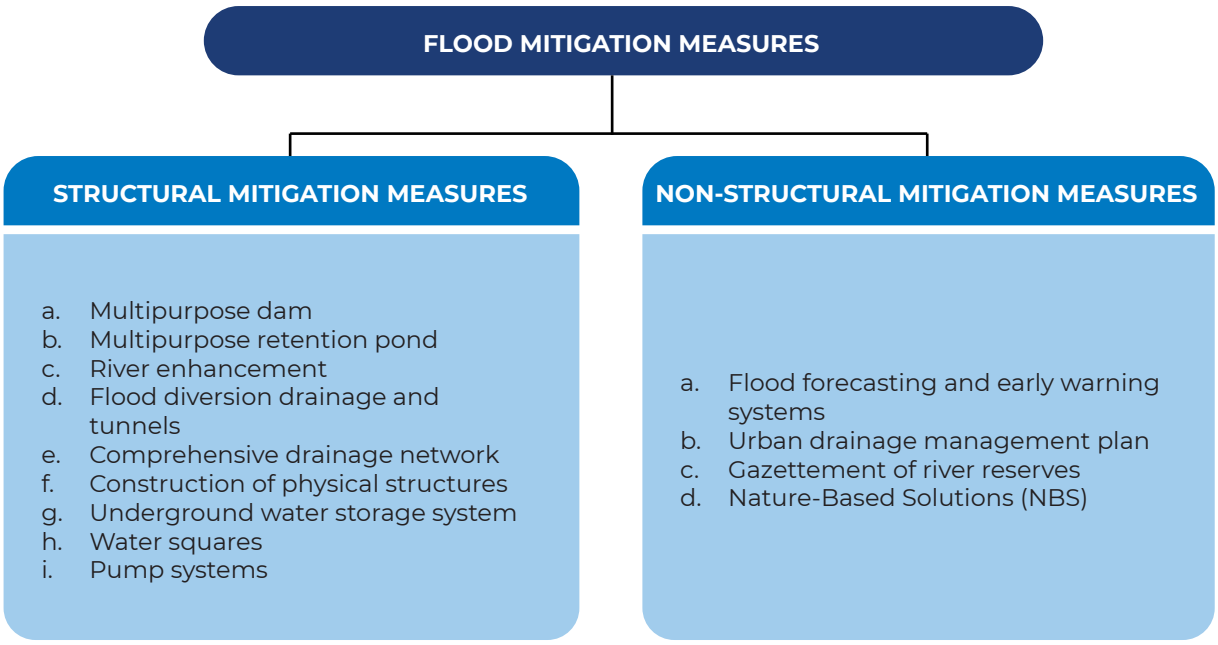


Figure 12: Flood mitigation measures categorized into structural and non-structural approaches

2.4.1 Structural Mitigation Measures

Structural mitigation measures involve the construction of specific infrastructure designed to reduce flood risks, regulate flow rates, and protect communities from the destruction cause by floods. There are eight (8) structural mitigation measures, which include multipurpose dams, multipurpose retention ponds, river enhancement, flood diversion drainage and tunnels, comprehensive drainage networks, construction of physical structures, underground water storage system, water squares, and pump systems (refer Figure 13.

a. Multipurpose dam

- Controls flow and stores excess reservoir water.
- Examples: Bekok Dam, Johor; Kenyir Lake Hydroelelectric Dam, Terengganu; Sg. Perak, Perak.

b. Multipurpose retention pond

- Stores rainwater that is then released slowly.
- Examples: Hybrid Off-River Augmentation System (HORAS) and TAPS in Selangor state.

c. River enchancement

- Involves activities such as widening and deepening rivers.
- Increases the river's capacity.
- Example: Deepening and Widening Project of Sg. Klang, Selangor.

d. Flood diversion drainage and tunnels

- Redirect excess water.
- Examples: Stormwater Management and Road Tunnel (SMART) in Kuala Lumpur, Malaysia; Stamford Detention Tank and Canal in Singapore.

e. Comprehensive drainage network

- The main components of a comprehensive drainage network include surface water management systems, underground drainage systems, and green infrastructure.

f. Construction of physical structures

- Construction of flood walls, installation of flap gates in certain drainage systems, and the building of embankments along rivers.

g. Underground water storage systems

- Constructing underground storage structures for
- areas with limited space.
- Example: G-Cans Project, Edo River in Tokyo, Japan.

h. Water squares

- Developed in urban areas with limited space for water infiltration processes.
- Example: Multipurpose water square with underground infiltration system in Rotterdam, Netherlands.

i. Pump systems

- Pumping water out of low-lying areas, regulating water flow, and supporting irrigation for agricultural areas and dam operations.
- Example: Sg. Kemang Pump House, Johor.

Figure 13: Structural mitigation methods

Based on the IRBM and PISMA in Johor, several structural measures have been proposed for flood-prone areas, including the development of flood walls, construction of embankments, building retention ponds, and installation of flood diversion drainage pipes, among others. The implementation of these measures is expected to significantly reduce the impact of flooding. In addition to enhancing the safety of residents, these initiatives also aim to protect property and public infrastructure in at-risk areas.

2.4.2 Non-Structural Mitigation Measures

Non-structural mitigation measures do not require the construction of physical infrastructure but share the same goal of reducing the risks and impacts of flooding. There are four (4) non-structural mitigation measures, which include flood forecasting and early warning systems, urban drainage management plans, gazettement of river reserves, and NBS (Figure 14).

a. Flood forecasting and early warning systems

- Function to provide information about the potential occurrence of flooding in a specific area.
- Example: National Flood Forecasting and Warning Programme (PRAB) by the JPS Malaysia.

b. Urban drainage management plans

- Include several strategies such as assessment, design, maintenance, and emergency response actions.
- Examples: PISMA in Malaysia; River Basin Management Plan in Europe; Source-Pathway-Receptor in Singapore.

c. Gazettement of river reserves

- Every planned development must consider the river reserves that have been gazetted in accordance with the Planning Guidelines for Industrial Areas 1997 by the Department of Urban and Rural Planning (JPBD).

d. Nature-Based Solutions (NBS)

- Using natural processes and ecosystems to manage flood risks, aiming to mitigate the impacts of flooding while providing additional benefits to the environment and communities.

Figure 14: Non-structural mitigation measures

Examples of flood mitigation methods that can be practiced through NBS are listed in Figure 15.

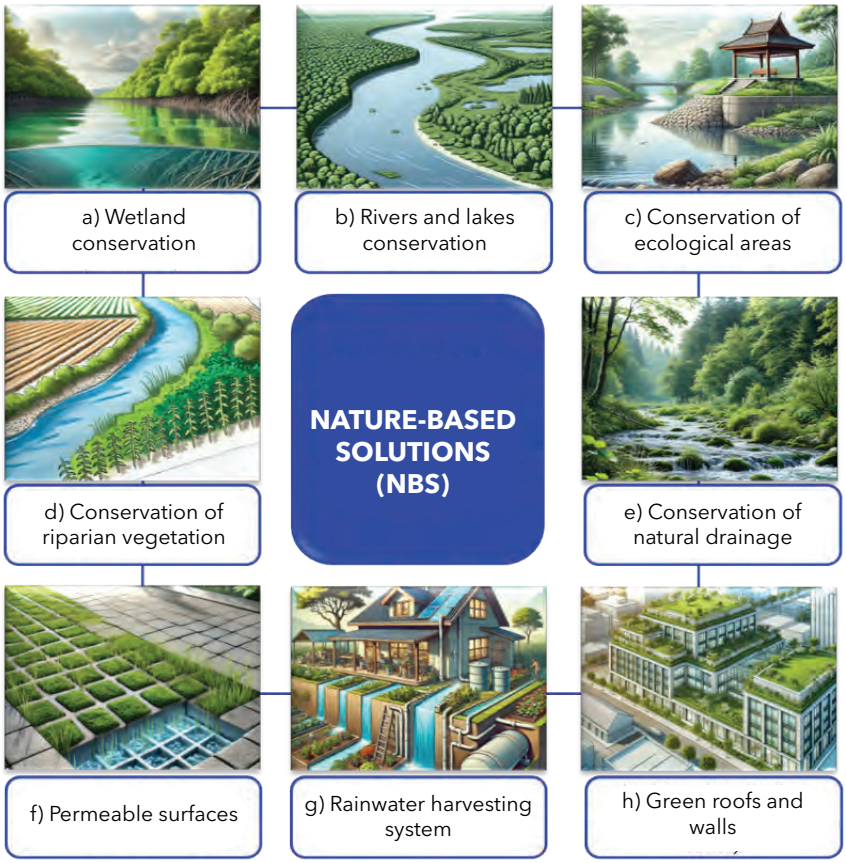


Figure 15: Examples of nature-based solutions for flood mitigation measures

Among the measures proposed under IRBM and PISMA for Johor are conducting preliminary studies at each location before starting construction, carefully planning the necessary actions, gazetting river reserves, and adopting NBS. These measures are designed to minimize potential problems that may arise during construction or in the event of flooding.

3.0 Issues and Challenges

3.1 Governance in Management

Current issues in the climate change sector involve conflicts in governance and overlapping jurisdictions between agencies and local authorities. Here are some examples of issues related to flood mitigation management:

i. Planning approvals for developments in catchment areas often involve river areas governed by different agencies or authorities.

ii. River Basin Management Plans prepared by the JPS are rarely reviewed and often overlooked during the preparation of State Structure Plans and Local Plans.

iii. Governance conflicts in the use of water resources collected in flood retention ponds.

3.2 Development Planning

Land use activities and urbanization contribute to an increase in impervious surfaces, which in turn leads to a rise in the volume of surface water flowing into drainage systems and rivers. Several key issues include:

i. Planning approvals that take into account flood risk analysis by developers for developments in catchment areas. Flood risk analysis should be mandated in line with existing agency guidelines for planning approval.

ii. Special development charges to contribute funds to the state government for flood mitigation projects, accompanied by economic studies to ensure that the charge rates are reasonable and appropriate.

3.3 Flood Water Management and Environmental Effects

Issues related to environmental management and flooding focus on sediment and waste management during construction activities, where sediment can reduce the capacity of drainage systems, rivers, and retention ponds. The impacts of climate change increase the likelihood that the drainage capacity will be lower than its original design capacity. Examples of environmental management challenges related to flooding in Johor are as follows:

i. Stricter enforcement of the Erosion and Sediment Control Plan (ESCP) to regulate sediment accumulation in rivers and retention ponds during development.

ii. Maintenance of structures to monitor water quality levels in retention ponds, especially when it is planned as a water source.

iii. Uncontrolled logging can reduce the resilience of natural vegetation in catchment areas and increase sediment in rivers during heavy rainfall. This accelerates surface water flow into rivers and contaminates them with silt and toxic waste.

iv. The management of wild plants and waste that obstructs the smooth flow of water in drainage systems, requiring regular control and maintenance efforts.

Agricultural water management in the context of climate change is crucial because phenomena such as rising global temperatures, extreme flood and droughts, and changes in rainfall patterns have a significant impact on agricultural systems. Water sources for agriculture largely depend on rainfall and supply from nearby rivers, especially in areas lacking proper irrigation infrastructure. Examples of issues involving agricultural water management and the impacts of climate change include:

i. Managing the use of water from retention ponds and flood reservoirs for agricultural purposes, especially during dry seasons. Insufficient infrastructure can affect the effectiveness of water use for agriculture.

ii. The lack of clear regulations and guidelines regarding the rights to agricultural water supply, as seen in developed countries. Water for agriculture is often provided on an ad hoc basis, while crop damage due to water shortages is not addressed within any regulatory framework.

iii. Unpredictable weather changes and rising sea levels result in increased soil salinity in agricultural areas. This condition damages soil fertility, affects crop yields, and has a negative economic impact on farmers.

3.4 High Cost Diversity

The capital and operational costs for flood mitigation are high and require consistent funding, and are usually borne by the government. These costs include studies, consultations, design, construction, and maintenance of flood protection infrastructure projects. More accurate flood forecasting technologies also incur high costs, as they require the use of the latest technology. Additionally, maintenance costs in flood infrastructure projects are often overlooked or planned as one-off allocations, without a strong long-term financing mechanism. Regular maintenance of drainage systems is crucial to reduce the risk of flooding and maintain the effectiveness of infrastructure.

3.5 Disaster Preparedness

Several key issues related to flood disaster preparedness include:

i. Lack of awareness and education:

Residents in high-risk areas are often not exposed to knowledge about safety measures and disaster warnings. Rural or remote areas face challenges in accessing the latest disaster information due to limited communication infrastructure, including internet and phone coverage.

ii. Community preparedness:

Compared to developed countries like Japan, which have advanced disaster training and warning systems, Malaysia still needs to enhance its community preparedness. Disaster training programmes and simulations should be introduced so that communities are better prepared and understand the actions to take during a flood disaster.

4.0

Existing Policies and Initiatives Related to the Climate Change (Flood Mitigation) Sector

The National Climate Change Policy, approved in 2009, outlines key pillars and strategic actions related to the climate change sector. The Johor Green Development Policy 2030 (PPHJ 2030) for the Climate Change (Flood Mitigation) sector also considers strategies and action plans by referring to existing policies and guidelines from various agencies involved in flood disaster management, such as JPS, the National Disaster Management Agency (NADMA), PLANMalaysia, the Malaysian Meteorological Department (METMalaysia), and other relevant agencies.

The formation of these policies also refers to existing policies at the international, national, and state levels in Johor, as a guide to achieving sustainable solutions (see Figures 16, 17, and 18).

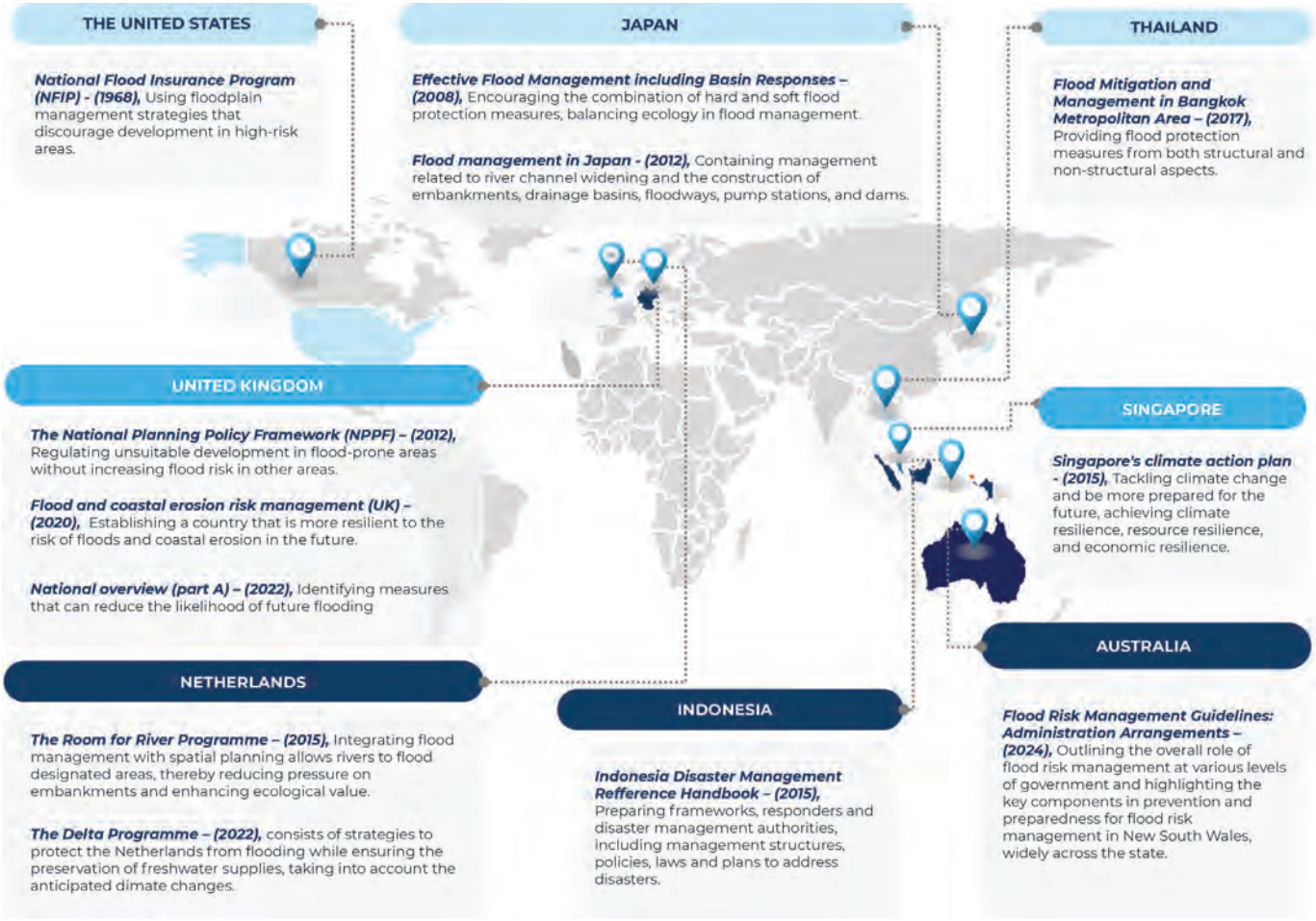


Figure 16: Plans, guidelines, and existing policies in foreign countries

2006

Guidelines for Flood Prevention in Underground Parking

- Establish flood-proofing measures and a flood monitoring and warning system for underground parking areas.

2009

National Climate Change Policy (2009)

- Mainstreaming climate change through wise resource management and enhanced environmental conservation to strengthen economic competitiveness and quality of life.
- Enhancing institutional capacity and implementation to seize new opportunities in reducing the negative impacts of climate change.

2012

National Water Balance Management System (NAWABS)

- A digital/ numerical modeling system for integrated water resource management across entire basins. Includes hydrological models of catchment areas, mixed raw water sources in rivers and drainage systems, water resource structures and schemes, 3D groundwater assessments, water allocation models, and water quality models.

2012

2nd Edition of the Stormwater Management Manual (MSMA)

- Ensures standardized administration, planning, design, and maintenance of stormwater management systems at local, state, and federal levels.

Figure 17: Policies related to climate change in Malaysia


Guidelines for Green Neighborhood Development Planning
· Prepared to assist both government and non-government bodies in planning, designing, and regulating green neighborhood development to reduce carbon emissions.
2012
2017
Johor State Flood Action Plan Study
· Effective and efficient flood disaster management to reduce flood-related morbidity and mortality through the swift, systematic, and cost-effective management of prevention, control, and treatment activities before, during, and after floods.
Iskandar Malaysia Greenhouse Inventory
· This inventory provides essential data to understand the causes of climate change in Johor and mitigation strategies by continuously and periodically monitoring the GHG emissions status in rapidly developing cities/regions.
· Through this effort, the progress of previously implemented actions to reduce GHG emissions can also be tracked.
2017
2020
Johor Sustainable Development Plan 2030 (PPMJ 2030)
· Provides a roadmap for efforts to conserve and protect natural resources in Johor, control pollution, reduce waste, and enhance the use of green and low-carbon technology.

Figure 18: Policies related to climate change in Johor

5.0 Vision and Objective of the Climate Change (Flood Mitigation) Sector

PPHJ 2030 for the Climate Change (Flood Mitigation) sector sets a vision to emphasize preparedness, resilience, and the integration of nature-based solutions are as well as the use of technology, to protect people, property, and the environment from the impacts of climate change and flood disasters. This policy is designed to reduce flood risks in the state of Johor with a holistic, innovative, and integrated approach.

The vision and objectives of this policy are supported by four (4) main strategies planned for implementation in PPHJ 2030 (refer to Figure 19).

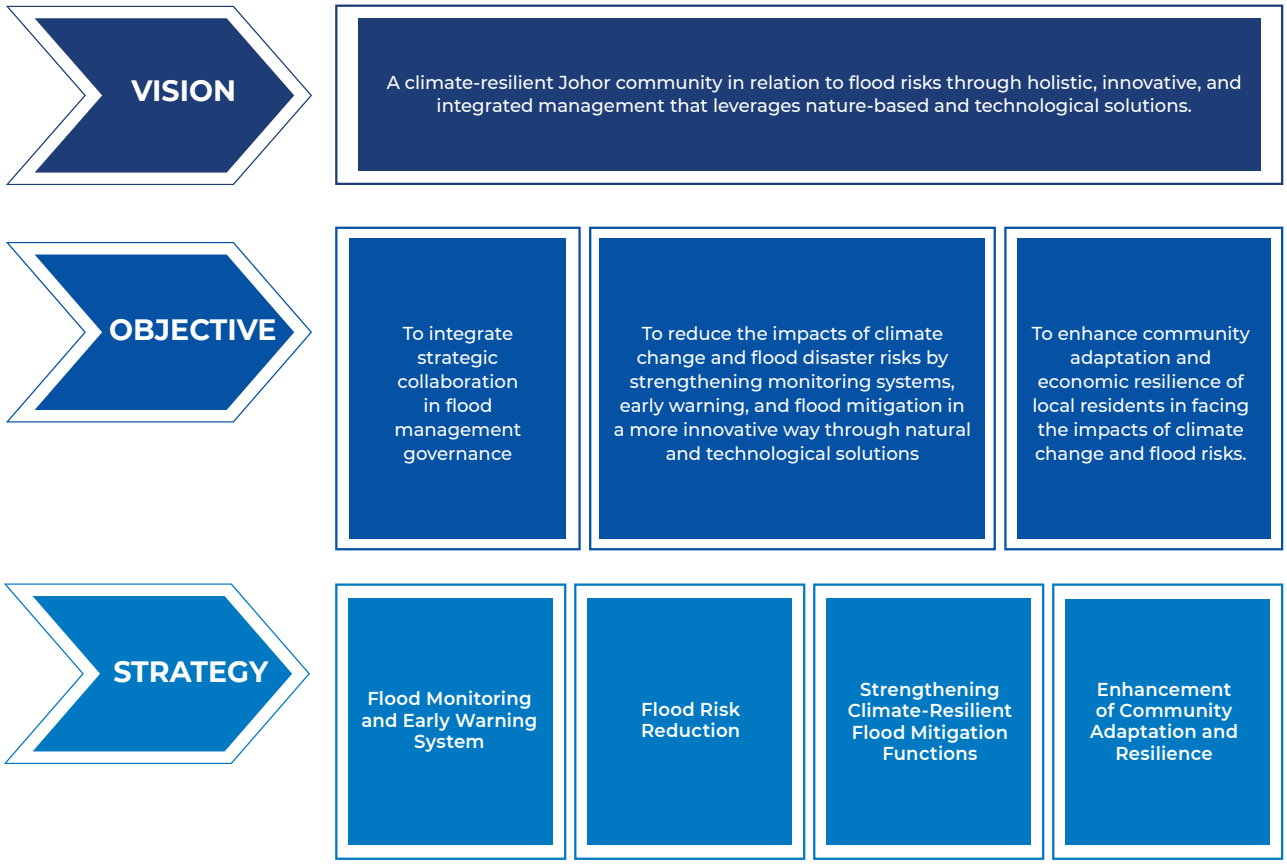


Figure 19: Vision, objectives, and strategies of the Climate Change (Flood Mitigation) sector

Four (4) main strategies, 11 implementation initiatives, and 47 programmes will be implemented comprehensively for climate change mitigation and adaptation in Johor. These strategies act as key catalysts in achieving climate resilience-related objectives. Each implementation initiative under this strategy encompasses various programmes that are more focused on specific activities or projects. Below is a detailed explanation of the relationship between the strategies and the environmental, social, and governance (ESG) principles in Malaysia:

Governance:

The governance aspect is emphasized in strategies 1 and 2, which leverage Internet of Things (IoT) technology and Artificial Intelligence (AI). This includes improvements in inventory systems and databases, more efficient flood risk management, and river and drainage management to ensure effective governance and more efficient responses.

Environment:

Strategies 2 and 3 emphasize environmental sustainability, with the implementation of flood mitigation systems based on NBS, green approaches, and strengthening the integrity of flood mitigation structures. All of these are aligned to ensure the adaptability of the structures to climate change and long-term sustainability.

Social:

Strategy 4 focuses on the social element, aiming to enhance knowledge, skills, and community involvement in inclusive development. This is done to strengthen their preparedness in effectively facing disasters.

6.0

Implementation Timeline

The implementation period for the PPHJ 2030 action plan is divided into three (3) phases as outlined in Table 6. These phases include the short-term (quick win), medium-term, and long-term. Each phase has specific targets, with details on the implementation period and the years of execution listed in the following table.

Table 6: Implementation timeline for the PPHJ 2030 action plan

	TIME FRAME	YEAR OF IMPLEMENTATION
Short (Quick Win)	1 - 2 Years	2025 - 2026
Medium	3 - 4 Years	2025 - 2028
Long	5 - 6 Years	2025 - 2030

7.0 Quick Win Implementation Initiatives

A total of six (6) short-term (quick win) implementation initiatives (IP) have been identified, which can be carried out within one to two years in Johor. The details of each initiative, including targets and detailed implementation, are listed in Table 7.

Table 7: List of strategies and short-term (quick win) implementation Initiatives

STRATEGY	QUICK WIN IMPLEMENTATION INITIATIVES	
S1 : Flood Monitoring and Early Warning System	**IP 2:**	Improvement of high-tech and comprehensive inventory systems and databases.
S2 : Flood Risk Reduction	**IP 1:**	Improve the flood risk management systems.
	IP 3:	Enhance governance in river basin management, rivers, and drainage systems.
S3 : Strenthening Climate-Resilient Flood Mitigation Functions	**IP 4:**	Enhancing the structural resilience of coastal bunds, perimeter drains, and drainage systems to reduce the impact of floods.
S4 : Enhancing Community Adaptation and Resilience	**IP 1:**	Empower the community in disaster preparedness.
	IP 2:	Strengthening the use of adaptation and resilience methods on an individual level in facing floods.

Strategies and Action Plan

Johor Climate Change (Flood Mitigation) Policy 2030

8.0 Strategies and Action Plans for Climate Change (Flood Mitigation) Sector

The Climate Change (Flood Mitigation) Policy in PPHJ 2030 encompasses four (4) main strategies, 11 implementation initiatives, and 47 programmes, as shown in Figure 20.

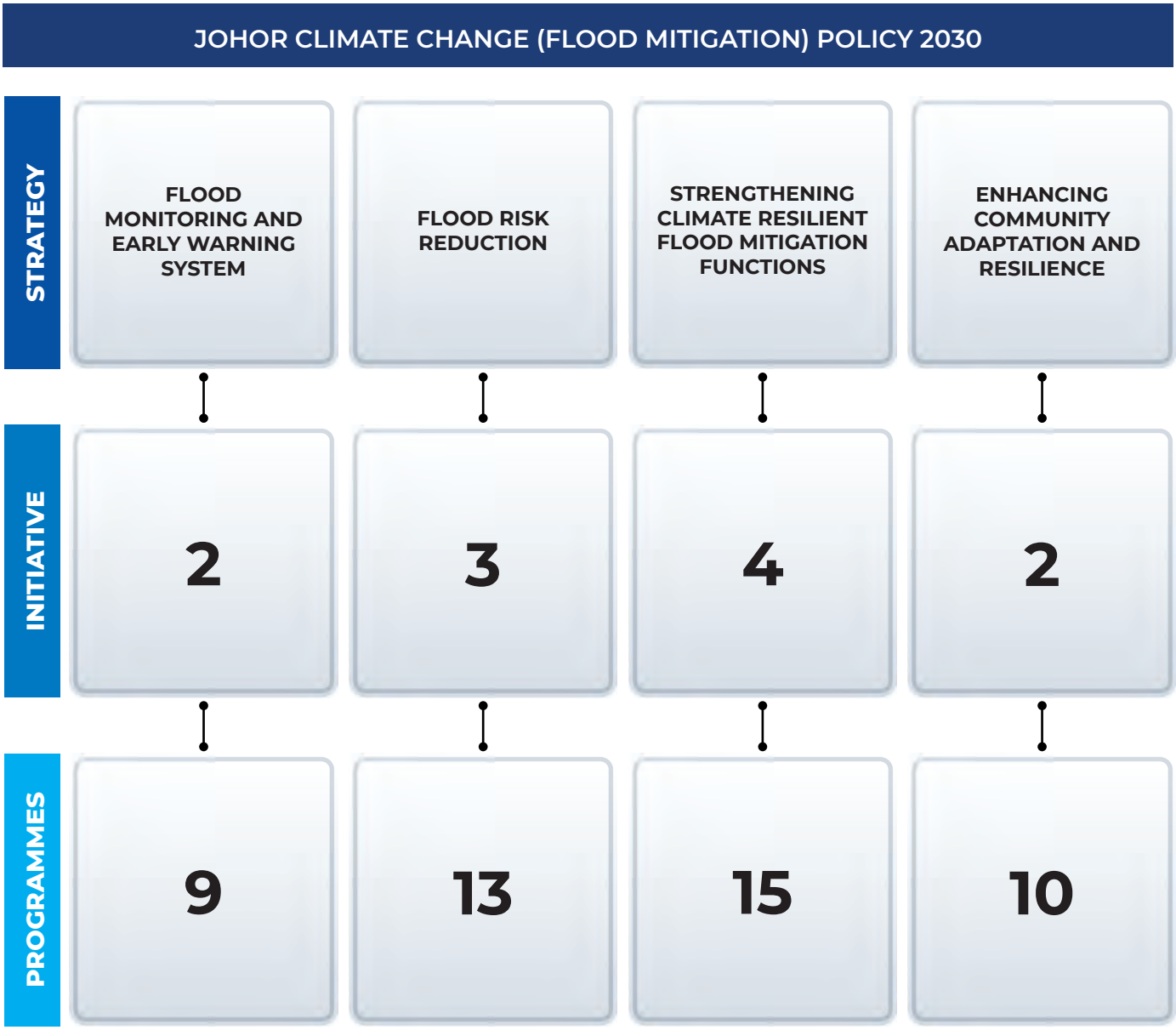


Figure 20: Summary of the Johor Climate Change (Flood Mitigation) Policy 2030

STRATEGY 1

Flood Monitoring and Early Warning System

OBJECTIVE

Empowering the flood monitoring and early warning system by using the latest technology to provide more effective information to authorities and the public. The Flood Early Warning System will be installed by 2030 to enhance preparedness and rapid response to flood disasters in the state of Johor.

IMPLEMENTATION INITIATIVE
1. Establish and integrate a flood monitoring and early warning system that incorporates IoT and AI.
2. Improvement of high-tech and comprehensive inventory systems and databases.

IP 1:

ESTABLISH AND INTEGRATE A FLOOD MONITORING AND EARLY WARNING SYSTEM THAT INCORPORATES INTERNET OF THINGS (IOT) AND ARTIFICIAL INTELLIGENCE (AI)

To ensure the implementation of a more effective flood monitoring and early warning system, the system needs to be more focused and locality-based in high-risk flood areas. In this system's implementation, the use of IoT and AI technologies through the installation of smart sensors that are capable of accurately measuring water levels and flow rates in real-time can improve the efficiency of the flood monitoring system. Additionally, integrating up-to-date weather forecasts from METMalaysia is crucial for ensuring accuracy in localized predictions. This approach ensures that the information provided is accurate and timely, giving authorities and the public enough time to take appropriate action. The effectiveness of the flood early warning system can strengthen community preparedness in flood-prone areas. The maintenance costs of the system should also be considered in long-term planning to ensure the system's continued functionality and effectiveness.

PROGRAMME

- Develop guidelines for the Flood Early Warning System.
- Establish an integrated and centralized flood monitoring and early warning system at the state and district levels.
- Create a centralized and integrated monitoring center for Flood Early Warning System at the state and district levels.
- Develop a smart flood early warning application specifically for the public, providing response information.

- Expand the installation of water level sensors in rivers, drains, and flood hotspots, along with the addition of flood gauge for public monitoring (integrating community monitoring and the new system).

SDG

IP 2:
IMPROVEMENT OF HIGH-TECH AND COMPREHENSIVE INVENTORY SYSTEMS AND DATABASES

The establishment of a Geospatial Information System (GIS) unit in each agency involved, as well as the development of a database system using GIS, is a crucial step to ensure that data from various agencies can be stored and accessed clearly. Inventory and data storage related to flood monitoring and early warning are vital for managing and maintaining a more holistic system. A clear and organized inventory can accelerate the review process by maintenance teams and authorities in identifying the location, status, and condition of assets or drainage systems. This system acts as a support tool for making effective decisions in river basin management. The integration of data display systems for public reference, including flood hotspot locations, Temporary Evacuation Centers (PPS) locations, and flood hazard maps, needs to be developed. This step will increase public awareness and safety, providing them with the necessary information to act appropriately during a flood situation. Additionally, regular training for officers and staff responsible for managing the GIS system should be implemented to ensure they are proficient in operating and using the system. Maintenance costs for the system should also be considered in planning to ensure the database remains operational, regularly updated, and capable of supporting comprehensive flood management needs.

PROGRAMME

- Establish an expert team from departments / agencies / local authorities (PBT) for utilizing advanced technology such as Geospatial Information System (GIS).
- Develop a database system using GIS to enable data from various agencies to be stored and referenced clearly.
- Digitize information on drainage and flood systems for monitoring, maintenance, and early sharing of flood-related information that can be publicly shared.

- Integrate a data display system for flood disaster information, including risk locations, PPS locations, and related information for public reference.

SDG

STRATEGY 2

Flood Risk Reduction

OBJECTIVE

Improve the flood risk management systems through impact and flood potential assessments from development projects, as well as strengthen existing governance in river and drainage management.

IMPLEMENTATION INITIATIVE
1. Improve the flood risk management systems.
2. Conduct a flood impact and potential assessments from development projects.
3. Streamline the governance of river basin, river, and drainage system management.

IP 1:
IMPROVE THE FLOOD RISK MANAGEMENT SYSTEM

The development of risk models and the creation of flood risk maps based on topography, landform, land use, and rainfall distribution are essential in the flood risk management planning process. Effective management of flood plains and risk areas can enhance the function of this system, ensuring that development planning is carried out efficiently. Floodplains are natural water accumulation areas for floods. Encroachment or land-use changes in floodplain areas can expose surrounding areas to flood disasters, which may lead to loss of life. The extent of property damage and loss of life can be reduced if floodplain areas are not developed with physical infrastructure. Floodplains can also be classified as Environmentally Sensitive Areas (KSAS). Existing development plans need to be refined by considering the risks of development in floodplain areas. Additionally, studies on debris flow and identifying locations prone to debris flow are important to provide valuable information in planning flood mitigation strategies.

PROGRAMME

- Develop risk models and update flood risk mapping, including PPS locations, while considering climate change.
- Strengthen land-use control and sustainable activities for coastal and river areas by designating them as KSAS.
- Conduct studies to identify areas at risk of debris flow.
- Ensure that CCF are considered in the design of urban drainage systems.

SDG


11
Sustainable Cities And Communities
13
Climate Action
15
Life On Land

IP 2:
CONDUCT A FLOOD IMPACT AND POTENTIAL ASSESSMENTS FROM DEVELOPMENT PROJECTS

Flood Impact Assessment (FIA) is a systematic evaluation process used to assess the impacts and risks of flooding events in an area before, during, and after a development project. This assessment is essential for identifying the effects of development on flood risks, which can affect the environment, infrastructure, public health, economy, and ecosystems in the area. The implementation of FIA will be subject to specific criteria outlined in the FIA Guidelines. Among the criteria to be considered are the type of development, size or extent of development, responsible parties, and other relevant factors.

FIA not only provides the necessary information to understand the short-term and long-term impacts of flooding but also helps in planning effective mitigation measures. The implementation of FIA will also enhance the accountability of developers in minimizing the impact of their developments on flood risks in the affected catchment areas. Furthermore, through FIA, areas potentially impacted by the development can be identified, and mitigation measures can be implemented.

Major development projects such as the JS-SEZ and TOD must consider the FIA assessment to ensure the implementation of sustainable development. Preventive measures and flood risk management can be planned and executed in greater detail, thereby ensuring continued economic growth without compromising the safety of residents or environmental sustainability.

PROGRAMME

- Develop guidelines for FIA.
- Refine the approval conditions for the Planning Permission (KM) to incorporate FIA.
- Refine the preparation of the Development Proposal Report (LCP) under Section 21A, Town and Country Planning Act 1976 (Act 172) with a focus on flood risk assessment.
- Evaluation of flood impact and risk assessments by relevant agencies.
- Strengthen and monitor the implementation of best practices for erosion and sediment control for development projects.

SDG

IP 3:
ENHANCE GOVERNANCE IN RIVER BASIN MANAGEMENT, RIVERS, AND DRAINAGE SYSTEMS

To ensure more effective river basin, river, and drainage system management, governance improvements need to be carefully planned. Development and sharing of geospatial information related to river reserves and river networks in Johor should be carried out to strengthen water resource management. Additionally, geospatial data of the drainage systems, including urban, agricultural, and rural drainage, should be developed and shared comprehensively.

Regular maintenance of riverbanks and drainage systems must be carried out according to a more comprehensive schedule and appropriate time frames. In efforts to improve the effectiveness of drainage and drainage management under the supervision of the PBT, a review of the rates of the Improvement Service Fund (ISF) under the Roads, Drains, and Buildings Act (Act 133) as well as the rates and implementation methods of the Johor State Drainage Contribution should be conducted.

PROGRAMME

- Implement the development and sharing of geospatial information on river basin reserves and river networks in Johor.

- Implement the development and sharing of geospatial information for drainage systems, including urban drainage, agricultural drainage, and rural drainage.

- Review the rates of the ISF (under the Roads, Drains, and Buildings Act, Act 133) for drainage and trench management under the supervision of the PBT.

- Review the rates and methods of implementing the Johor State Drainage Contribution for drainage and drainage management.

SDG

STRATEGY 3

Strengthening Climate-Resilient Flood Mitigation Function

OBJECTIVE

Strengthen flood mitigation functions through a structured approach based on NBS that are resilient to climate change

IMPLEMENTATION INITIATIVE
1. Expand the implementation of the Rainwater Harvesting System (SPAH) for both new and existing buildings.
2. Expand the use of flood mitigation systems based on NBS in potential areas.
3. Implement the concept of dual-function detention/retention ponds or dams (as flood mitigation and water supply).
4. Enhance the structural resilience of coastal bunds, perimeter drains, and drainage systems to reduce the impact of floods.

IP 1:
EXPAND THE IMPLEMENTATION OF THE RAINWATER HARVESTING SYSTEM (SPAH) FOR BOTH NEW AND EXISTING BUILDINGS

The Rainwater Harvesting System (SPAH) has been used in government and commercial buildings, but its function and application have not been widely expanded. The capacity or volume of harvested rainwater is minimal due to the small catchment areas. The SPAH concept can be further expanded to government buildings, commercial centers, and places of worship.

PROGRAMME

- Ensure the installation of the SPAH in government buildings for internal use (e.g., toilet pumps) and external use (e.g., landscaping/cleaning).

- Review the Uniform Building By-Laws (UKBS) of Johor, 1986 to expand the installation of SPAH to include other types of buildings, including both government and private buildings.

SDG

IP 2:
EXPAND THE USE OF FLOOD MITIGATION SYSTEMS BASED ON NBS IN POTENTIAL AREAS

Nature-based solutions (NBS) are a flood management approach that has been widely implemented in developed countries like the Netherlands. NBS focuses on strategically preserving and restoring natural ecosystems to support conventional infrastructure systems. This approach not only provides more resilient services but, if applied widely, can save water and energy, reduce disaster risks, and improve social well-being. Integrating natural elements into urban planning can offer innovative and sustainable solutions in addressing flood management challenges.

PROGRAMME

- Implement the NBS concept in potential areas with reference to the MSMA.
- Encourage the use of green roofs in both government and private buildings.
- Encourage the use of permeable materials in the construction of public Parking Facilities (TLK) in areas such as in front of shops, office buildings, and roads in urban areas.
- Physically restore floodplains and wetlands for long-term effectiveness.
- Conserve riparian vegetation buffer zones and natural drainage systems.

SDG

IP 3:
IMPLEMENT THE CONCEPT OF DUAL-PURPOSE DETENTION/RETENTION PONDS OR DAMS (FOR FLOOD MITIGATION AND WATER SUPPLY)

The concept of detention/retention ponds for flood control has been widely implemented in Malaysia. The dual-purpose concept (water source and flood control) allows the detention/retention pond area to be used for other purposes, such as an additional water source, playgrounds, or open spaces during dry seasons. A dam is a structure that spans a water flow to block, redirect, or slow down the flow, creating a reservoir, lake, or water impoundment. The construction of dual-purpose dams for flood control and water supply is an initiative in flood management and mitigation.

PROGRAMME

- Conduct studies on existing detention/retention systems and dams for flood control and water supply.
- Ensure that new dams implement the dual-purpose concept (water supply and flood control).
- Encourage the use of wet detention/retention pond concepts with water treatment systems for cleaning and other purposes.
- Implement the dual-purpose concept for TAPS.

- Conduct feasibility studies on coastal reservoirs or barrages for flood mitigation and alternative water sources downstream.

- Build underground storage in high-density development areas.

SDG

IP 4:

ENHANCING THE STRUCTURAL RESILIENCE OF COASTAL BUNDS, PERIMETER DRAINS, AND DRAINAGE SYSTEMS TO REDUCE THE IMPACT OF FLOODS

Many concrete structures and coastal embankments are built along coastlines to strengthen these areas against coastal erosion and sea water overflow. Several locations along Malaysia's coastline frequently experience erosion, flooding, and seawater overflow, despite being protected from monsoon winds due to their geographical positioning. Therefore, innovation in coastal erosion control structures is essential to provide better protection for coastal areas. Coastal bunds also serve as barriers to control sea levels and reduce the risk of overflow. Additionally, maintaining embankment structures, perimeter drains, rivers, and drainage systems is crucial to ensure smooth water flow and minimize the impact of climate change and flood risks. A systematic and comprehensive maintenance schedule should be implemented to ensure these structures are maintained according to set timelines.

PROGRAMME

- Implement the restoration and reinforcement of coastal embankment structures and perimeter drains to accommodate the effects of rising sea levels.

- Carry out regular maintenance work on rivers, drains, and drainage systems.

SDG

STRATEGY 4

Improvement of Community Adaptation and Resilience

OBJECTIVE

Establish programmes or initiatives involving local residents to enhance community capacity to adapt to flood threats/disasters through various implementation measures.

IMPLEMENTATION INITIATIVE
1. Empower the community in disaster preparedness.
2. Strengthen the use of individual adaptation and resilience methods in facing floods.

IP 1:
EMPOWER THE COMMUNITIES IN DISASTER PREPAREDNESS

Providing practical training to communities on the appropriate actions before, during, and after a flood, including evacuation procedures and first aid, is crucial in developing a more alert and prepared society to face flood disasters. Flood Drills are essential to ensure that communities can respond quickly and effectively, saving lives and property.

This initiative also plays a role in reducing risks and losses faced by communities through early actions and proper preparation. Additionally, it helps the community understand flood disaster risks and the necessary actions to mitigate the impact. Through this training, communities are given the opportunity to learn safety measures and preparedness steps, making it easier for authorities and Non-Governmental Organization (NGO) to disseminate accurate and relevant information. Disaster preparedness must be strengthened at all levels, with local community involvement through village heads and chiefs, ensuring that all levels of society act effectively when facing disaster challenges.

PROGRAMME

- Empower disaster preparedness agencies by updating and allocating funds for the purchase of disaster management assets is essential for effective response during emergencies.

- Organize workshops and practical training sessions on disaster risk management, such as Flood Drills, and developing training modules for Community-Based Disaster Risk Management (CBDRM) programmes, involving disaster experts, academics, and authorities, will enhance the capacity of communities and agencies.

- Conduct public awareness programmes on disasters related to early warnings, flood adaptation and mitigation strategies, including environmental care and cleanliness.

- Establish response teams in flood hotspots, consisting of local residents and volunteers.
- Create an effective communication network for information sharing and coordination during a disaster among communities.
- Preparing and raising awareness about the necessary rescue equipment and personal safety measures, such as boats, life jackets, communication tools, and first aid kits.
- Setting up a special endowment fund through donations from the private sector and individuals that will support flood disaster management efforts.

SDG

IP 2:
STRENGTHENING THE USE OF INDIVIDUAL ADAPTATION AND RESILIENCE METHODS IN FACING FLOODS

Strengthening the use of individual adaptation methods in facing floods is important to enhance community involvement in disaster risk management independently and effectively. This initiative aims to help the community become more resilient through training, education, and comprehensive planning. The design of flood-proof homes plays a crucial role in protecting the safety and health of residents, as well as reducing property loss and repair costs after a disaster. The implementation of flood-resistant house prototypes, involving experts in architecture and engineering, along with providing information on protection methods such as flood barriers, can enhance the skills and capabilities of the community in facing flood risks more effectively.

PROGRAMME

- Conduct research on flood-proof house prototypes for the community, involving experts in architecture, engineering, and disaster management.
- Providing and disseminating information related to options and user manuals for self-applied methods such as flood barriers for small-scale flood protection as a preparatory measure.
- Enhance self-sufficiency skills and capabilities in using user-friendly flood barriers that are suitable for house design.

SDG

Conclusion

Johor Climate Change (Flood Mitigation) Policy 2030

9.0 Conclusion

The Johor Green Development Policy 2030 is a policy formed based on the current research approach and information from responsible parties. The policy statement takes into account secondary sources, opinions and views from local authorities, and the results of engagement sessions that have been conducted. Based on the study, four main strategic pillars have been outlined to guide the development of the policy, particularly concerning Climate Change (Flood Mitigation) in Johor. These four strategies emphasize the involvement of various government agencies and local communities in managing the impacts of flooding in a holistic and sustainable manner. Additionally, the strategies consider the use of AI technology and the application of environmentally friendly values that are resilient to climate change in flood management in Johor. The planned initiatives based on these four policy pillars are also aligned with several SDGs, adding value and new dimensions to flood management in Johor. To ensure the effective implementation of this policy at the agency level, progress reports on the implementation of the proposed programmes should be provided to monitor the advancement of this policy.

Action Plan

Johor Climate Change (Flood Mitigation) Policy 2030

10.0 Action Plans for Climate Change (Flood Mitigation) Sector

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation		
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)
					2025-2026	2025-2028	2025-2030
S1 Flood Monitoring and Early Warning System	IP 1 Establish and integrate a flood monitoring and early warning system that incorporates Internet of Things (IoT) and Artificial Intelligence (AI).	P1 Develop guidelines for the Flood Early Warning System.	BPEN	PDT, IPT	/		
		P2 Establish an integrated and centralized flood monitoring and early warning system at the state and district levels.	SUK BKT	PBT, District Office, JPS, ICT Johor, SUK Management		/	
		P3 Create a centralized and integrated flood early warning monitoring center for flood early warning system at the state and district levels.	SUK BKT	PBT, District Office, JPS, ICTJohor			/
		P4 Develop a smart early flood warning application for the public, providing response information.	ICT Johor	Telco Provider METMalaysia, PBT, District Office, JPS, JKR, BPEN, SUK Management		/	
		P5 Expand the installation of water level sensors in rivers, drains, and flood hotspots, along with the addition of water benchmarks flood gauge for public monitoring (integrating community monitoring and the new system).	JPS	METMalaysia, PBT, District Office, JPS			/

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation		
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)
					2025-2026	2025-2028	2025-2030
	IP 2 Improvement of the high-tech and comprehensive inventory systems and databases	P1 Establish an expert team from departments/ agencies/PBT for utilizing advanced technology such as Geospatial Information System (GIS).	SUK BKT	JPS,JKR,JUPEM, METMalaysia, PTG, District Office, PLAN Malaysia, PBT	/		
		P2 Develop a database system using GIS to enable data from various agencies to be stored and accessed clearly.	BPEN	JPS, JKR, JUPEM, METMalaysia, PTG, District Office, PLAN Malaysia, BPEN, ICT Johor	/		
		P3 Digitize information on drainage and flood systems for monitoring, maintenance, and early flood-related sharing that can be publicly accessible.	BPEN	JPS, PBT		/	
		P4 Integrate data display systems for flood-related information, including risk locations, Temporary Evacuation Center (PPS) locations, and relevant information for public reference.	SUK Management	PBT, JPS, BPEN, ICT Johor		/	
S2 Flood Risk Reduction	IP 1 Improve the flood risk management system	P1 Develop risk models and update flood risk maps and PPS locations, while considering climate change factors.	JPS	PLAN Malaysia Johor, IPT		/	
		P2 Strengthen land-use control and sustainable activities for coastal and river areas by designating them as Environmentally Sensitive Areas (KSAS).	PLAN Malaysia Johor	JPS, PBT, JAS, SUK, Forest Department		/	

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation		
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)
					2025-2026	2025-2028	2025-2030
		P3 Conduct studies to identify areas at risk of debris flow.	JPS	JMG, Forest Department, PBT	/		
		P4 Ensure that climate change factors (CCF) are considered in the design of urban drainage systems.	SUK BKT	PBT, JPS	/		
	IP 2 Conducting a flood impact and potential assessment from development projects.	P1 Develop guidelines for Flood Impact Assessment (FIA).	BPEN	JAS, SUK BKT, JPS, PBT, IPT, PDT	/		
		P2 Refine the approval conditions for the Planning Permission (KM) to incorporate Flood Impact Assessment (FIA).	SUK BKT	PLAN Malaysia Johor, PBT		/	
		P3 Refine the preparation of the Proposed Development Report (LCP) under Section 21A, Town and Country Planning Act 1976 (Act 172) with a focus on flood risk assessment.	PLAN Malaysia Johor	JAS, SUK BKT, JPS, PBT, IPT		/	
		P4 Evaluation of flood impact and risk assessments by relevant agencies.	JPS	PBT			/
		P5 Strengthen and monitor the implementation of best practices for erosion and sediment control for development projects.	PBT	JKR		/	
	IP 3 Enhance governance of river basin management, rivers, and drainage systems.	P1 Implement the development and sharing of geospatial information on river basin reserves and river networks in Johor.	JPS	PLAN malaysia Johor	/		

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation		
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)
					2025-2026	2025-2028	2025-2030
		P2 Implement the development and sharing of geospatial drainage system information, covering urban drainage, agricultural drainage, and rural drainage.	SUK BKT	PBT, JPS, PLAN Malaysia Johor, JKR, District Office		/	
		P3 Review the rates of the Improvement Service Fund (ISF) (Roads, Drains, and Buildings Act, Act 133) for drainage and trench management under the supervision of local authorities (PBT).	SUK BKT	PBT, JPS, JKR		/	
		P4 Review the rates and methods of implementing the Johor State Drainage Contribution for drainage and drainage management.	PTG	PBT, District Office, JPS, SUK BKT	/		
S3 Strengthening Climate-Resilient Flood Mitigation Functions	IP 1 Expand the implementation of the Rainwater Harvesting System (SPAH) for both new and existing buildings.	P1 Ensuring the installation of Rainwater Harvesting System (SPAH) for government buildings for internal use (e.g., toilet pumps) and external use (e.g., landscaping/cleaning).	PBT	JPS, SUK Management, JKR		/	
		P2 Review the Uniform Building By- Laws (UKBS) of Johor, 1986, to expand the installation of SPAH to include other types of buildings, including both government and private buildings.	SUK BKT	PBT		/	
	IP 2 Expand the use of flood mitigation systems based on Nature-Based Solutions (NBS) in potential areas.	P1 Implementing the Nature-Based Solutions (NBS) concept in potential areas, referring to the Urban Stormwater Management Manual for Malaysia (MSMA).	JPS	PLAN Malaysia Johor, PBT, JKR, IPT		/	

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation		
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)
					2025-2026	2025-2028	2025-2030
		P2 Encourage the use of green roofs in both government and private buildings	PBT	JKR, PLAN Malaysia Johor, SUK Management		/	
		P3 Encourage the use of permeable materials in the construction of Public Parking Facilities (TLK) in areas such as in front of shops, office buildings, and roads in urban areas.	PBT	JKR, District Office, JPS, PLAN Malaysia Johor		/	
		P4 Physically restore floodplains and wetlands for long-term effectiveness.	State Authority	PBT, JPS, JKR, District Office, Forest Department Johor, PTNJ			/
		P5 Conserve riparian vegetation buffer zones and natural drainage systems	JPS	PBT, District Office,JKR, Forest Department Johor,PTNJ		/	
	IP 3 Implement the concept of dual-purpose detention/retention ponds or dams (for flood mitigation and water supply).	P1 Conduct studies on existing detention/ retention systems and dams for flood control and water supply.	BPEN	BAKAJ, JPS, IPT		/	
		P2 Ensure that new dams incorporate a dual-purpose concept (water supply and flood control).	BAKAJ	JPS, BPEN			/
		P3 Encourage the use of wet detention/retention pond concepts with basic water treatment systems for cleaning and other purposes.	PBT	JPS, BAKAJ, JKR			/
		P4 Implement the dual-purpose concept for Riverbank Water Storage (TAPS).	BAKAJ	JPS, PBT, PLAN Malaysia Johor		/	
		P5 Conduct feasibility studies on coastal reservoirs or barrages for flood mitigation and alternative water sources downstream.	BAKAJ	JPS, PLAN Malaysia Johor, BPEN, IPT		/	

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		P6 Build underground storage in high-density development areas.	PBT	JPS, JKR			/
	IP 4 Enhance the structural resilience of coastal bunds, perimeter drains, and drainage systems to reduce the impact of floods.	P1 Implement the restoration and reinforcement of coastal embankment structures and perimeter drains to accommodate the effects of rising sea levels.	JPS	PBT, District Office		/	
		P2 Carry out regular maintenance work on rivers, drains, and drainage systems	JPS	PBT, District Office	/		
S4 Improvement of community adaptation and resilience.	IP 1 Empowering communities in disaster preparedness.	P1 Empower disaster preparedness agencies by updating and allocating funds for the purchase of disaster management assets	District Office	PBT, IPT, NADMA, JPS, APM, PLAN Malaysia Johor	/		
		P2 Organize workshops and practical training sessions on disaster risk management, such as Flood Drills, and developing training modules for Community-Based Disaster Risk Management (CBDRM) Programmes, involving disaster experts, academics, and authorities.	District Office	PBT, IPT, NADMA, JPS, JKR, JBPM, APM	/		
		P3 Conduct public awareness programmes on disasters related to early warnings, flood adaptation and mitigation strategies, including environmental care and cleanliness	District Office	NADMA, PBT, JPS, JKR, APM, JBPM, IPT, PLAN Malaysia Johor	/		
		P4 Establish response teams in flood hotspots, consisting of local residents and volunteers.	District Office	PBT, NADMA, JPS, JKR, APM, JBPM	/		
		P5 Create an effective communication network for information sharing and coordination during a disaster among communities.	District Office	NADMA, PBT, JPS, IPT, ICT Johor, APM, JBPM		/	

Strategy	Implementation Initiative	Programme	Lead Agency	Supporting Agency	Year of Implementation		
					Short Term (1-2 Years)	Medium Term (3-4 Years)	Long Term (5-6 Years)
					2025-2026	2025-2028	2025-2030
		P6 Preparing and raising awareness about the necessary rescue equipment and personal safety measures, such as boats, life jackets, communication tools, and first aid kits.	District Office	NADMA, PBT, APM, JBPM	/		
		P7 Setting up a special endowment fund through donations from the private sector and individuals will support flood disaster management efforts.	SUK Management	District Office, PBT		/	
	IP 2 Strengthening the use of individual adaptation and resilience methods in facing floods	P1 Conduct research on flood-proof house prototypes for the community, involving experts in architecture, engineering, and disaster management.	IPT	PBT, JKR, JPS		/	
		P2 Providing and disseminating information related to options and user manuals for self-applied methods such as flood barriers for small-scale flood protection as a preparatory measure.	District Office	NADMA, PBT, JPS, IPT	/		
		P3 Enhance self-sufficiency skills and capabilities in using user-friendly flood barriers for house design	District Office	NADMA, PBT, JPS, IPT, APM		/	

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