Flood Hazard Maps: An Update

Ir BIBI ZARINA BINTI CHE OMAR
JABATAN PENGAIRAN DAN SALIRAN MALAYSIA

9 Jun 2014
Introduction
INTRODUCTION

• Flooding is a natural phenomenon and has been occurring for millions of years

• Civilisations started at river valleys and tends to be the most populated thus attribute to the flooding incidences – losses of life and property

• Nowadays, flooding is aggravated by development where natural flood plains (wetlands) are backfilled

• To mitigate the floods engineers have become creative in producing ambitious engineering designs (SMART, 3 Gorges, Dam Thames Barrier)

• Highly advanced computer modelling and effective flood mapping now provide disaster authorities to predict with amazing accuracy where floods will occur and how severe they're likely to be
FLOODS IN MALAYSIA

• Major floods were recorded since 1926, followed by 1949 and 1971.
• 9% (~30,000 sq km) of the total area of the country is prone to flooding.
• ~4.8 million people live in areas prone to flooding.
• Recent floods – 2006, 2007 and in January 2011, some urban areas in Johor - including Segamat, Johor Bahru, Kluang, Kota Tinggi, and Muar - were flooded and completely cut off.
• In this state alone, between 40,000 - 70,000 people were evacuated, and at least two people died in this particular occurrence.
• Both waves of these disasters were considered to be the costliest floods in Malaysia's history, with a total cost of RM1.5 billion.
CHALLENGES IN FLOOD MANAGEMENT

• Floodplains are being developed
• Residents / stakeholders have high expectations and less tolerance towards flooding
• Structural flood management costs is rising
• Non-structural approach has not been well accepted
• Global climate change
FLOOD EVENTS IN MALAYSIA
FLOOD EVENTS IN MALAYSIA
FLOOD EVENTS IN MALAYSIA

Melaka Tengah, Melaka - 27 July 2009

Muar, Johor – 25 June 2010

Hulu Langat, Selangor – 13 March 2009
FLOOD EVENTS IN MALAYSIA

Three states hit, some schools delay start

Kuantan, Pahang - 2 January 2009

The Sungai Lembing Kuantan road is closed to light traffic, but this car is still attempting to get through.

 Kelantan & Terengganu - 20 November 2009

Lebih 8,000 mangsa di Terengganu, Kelantan dipindahkan

Banjir makin buruk

Kelantan & Terengganu - 20 November 2009
FLOOD EVENTS IN MALAYSIA

Kuala Lumpur - 3 March 2010

Sibu, Sarawak – 22 August 2010

Kota Kinabalu, Sabah - 15 January 2010
The Development of Flood Map in Malaysia
Flooded locations were only listed in flood reports.

Flooded areas were marked on the map as a spot and do not signify acreage.

Flooded areas are drawn on a map based on the flooding that has occurred through field observations, satellite images (Inundation map) (historical).

The flood extent are generated by a combination of river basin model and hydrology input using hydrodynamic modelling (Flood Hazard Map) (historical and prediction).
FLOOD MAP LOCATION
FLOOD MAP DEVELOPMENT IN MALAYSIA

2008 MSAN Meeting Result

2009 Cabinet Meeting Result

Procurement of InfoWorks RS and CS Software by JPS

2009 Flood Hazard Maps were included in the scope of the Flood Mitigation Master Plan

2009 In-house Hydrodynamics' Modelling started

2009 2 in-house Flood Hazard Map completed

2009 TOR that specifies Flood Hazard Map was prepared

2010 12 Flood Hazard Maps completed

2010 4 Flood Hazard Map were developed

2010 9 more Flood Hazard Map were developed

2011 Flood Hazard Maps are widely used in the planning of RTB. FHM production continues .........
INTEGRATED FLOOD MANAGEMENT

• Structural Measures
• Land-use Planning Measures
• Flood Preparedness Measures
• Flood Emergency Measures

INTEGRATED FLOOD MANAGEMENT
A NEW APPROACH TO FLOOD MANAGEMENT
Aim to:
- Control and reduce flooding
- Reduce damage and flood losses
- Protect life and people’s property

Structural and Non-Structural Measures

**Structure**

- Flood Mitigation Project
  - Upgrading the river and drainage systems
  - Dam
  - Reservoir
  - Diversion of river
  - Embankment of the river and the beach
  - Pump house

**Environmental Sustainability**

- Floodplain Management
- Flood Forecasting & Warning
- Flood Map
- Land Use Planning
- Education & Awareness Population
- Development Control, MSMA (MSMA)
Flood Map
FLOOD MAP

• Three (3) types of Flood Map.
  i. Flood Inundation Map
  ii. Flood Hazard Map
  iii. Flood Risk Map
Planning of flood mitigation projects

Land use planning by the Local Authority (LA) and the Department Town and Country Planning (JPBD)

Planning and placement of public facilities such as hospitals, schools, police stations, roads, and evacuation centers.

Information and awareness of flood risk to residents and stakeholders

The basis for the preparation of Flood Evacuation Map

The basis for the preparation of Flood Risk Map
FLOOD INUNDATION MAP

a. Process:
- Drawn based on the floods which have occurred
- Ground observations
- Satellite images

b. Output:
- Area and Capacity flood.
a. Process:
✓ Generated through a hydrodynamic modelling using the river basin model with hydrological input

Output:
✓ Flood area
✓ Flood depth
✓ Flood velocity
✓ Flood extent
DATA REQUIREMENTS FOR FLOOD HAZARD MAP DEVELOPMENT

- Catchment Area
- River Allignement
- River Cross Section
- 3D Model Ground Surface
- Structure
- Land Use
- Soil
- Rain
- Road and Cadastral
- Tidal
## List of Completed Flood Hazard Map

<table>
<thead>
<tr>
<th>Year</th>
<th>Johor</th>
<th>Sabah</th>
<th>Melaka</th>
<th>Pahang</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Kluang</td>
<td>Beaufort</td>
<td>Lembangan Sg Melaka</td>
<td>Lembangan Sungai Pahang</td>
</tr>
<tr>
<td></td>
<td>Simpang Renggam</td>
<td>Tenom</td>
<td>Lembangan Sg Kesang</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Batu Pahat</td>
<td>Sook</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Muar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mersing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sg Johor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sg Johor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>Kluang</td>
<td>Beaufort</td>
<td>Lembangan Sg Melaka</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Simpang Renggam</td>
<td>Tenom</td>
<td>Lembangan Sg Kesang</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Batu Pahat</td>
<td>Sook</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Muar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mersing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sg Johor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>Kluang</td>
<td>Beaufort</td>
<td>Lembangan Sg Melaka</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Simpang Renggam</td>
<td>Tenom</td>
<td>Lembangan Sg Kesang</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Batu Pahat</td>
<td>Sook</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Muar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mersing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sg Johor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>Kluang</td>
<td>Beaufort</td>
<td>Lembangan Sg Melaka</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Simpang Renggam</td>
<td>Tenom</td>
<td>Lembangan Sg Kesang</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Batu Pahat</td>
<td>Sook</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Muar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mersing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sg Johor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SUNGAI KEDAH

100 year ARI – existing condition with current land use

100 year ARI – mitigation condition with current land use
SUNGAI KERIAN

50 year ARI – existing condition with current land use

50 year ARI – mitigation condition with current land use
SUNGAI KESANG

50 year ARI – existing condition with current land use

50 year ARI – mitigation condition with current land use
SUNGAI KINTA

50 year ARI – existing condition with current land use

50 year ARI – existing condition with future land use
Flood Risk Map – A Way Forward
“Flood risk is the combination of the probability of a flood event and the potential adverse consequences to human health, the environment and economic activities associated with a flood event.”

Reference: European Flood Directive
• When all flood hazard’s information becomes available it is possible to develop contours which indicate the severity of risk.

• A flood risk map has several direct economic effects, since it causes revision of all planning maps of the area.

• On the positive side, the map initiates the construction of flood loss prevention structures, alerts prospective land and property owners, as well as provides new developing ideas to the local planning authorities.

• Flood risk is the combination of the probability of a flood event and the potential adverse consequences to human health, the environment and economic activities associated with it.
Risk can be assessed using this equation:

\[ R = p_{si} \cdot A_{oj} \cdot p_{oj,si} \cdot v_{oj,si} \]

where,

- \( R \) = risk
- \( p_{si} \) = probability of scenario \( i \)
- \( A_{oj} \) = value at risk of object \( j \)
- \( p_{oj,si} \) = probability of exposure of object \( j \) to scenario \( i \)
- \( v_{oj,si} \) = vulnerability of object \( j \), dependent on scenario \( i \)
FLOOD RISK MAP

Flood Hazard Map + Vulnerability / Indices Map = Flood Risk Map

1) Socio-economic
   - Population
   - Economy activity and asset

2) Environmental issues
   - Agricultural area
   - Industrial and urban area
   - Residential area
FLOOD RISK MAP

a. Process
✓ generated using hydrodynamic modelling methods

b. The combination of Hazard Map
✓ Flood map and Vulnerability/Indices Map

c. Output
✓ Assets zones at Risk
FLOOD RISK MAP

• As the way forward, the objective of flood-risk mapping is to assist local citizens and governments to develop effective methods of reducing flood-related damages in the community over the long run.

• It is clear that the least costly and most effective solution is to adopt a preventive approach which emphasizes longer range planning in flood-prone areas.

• Measures such as zoning by-laws, building codes and subdivision regulations can be used to control and direct land use within the flood hazard areas.

• Flood risk maps, together with supportive material and more detailed technical maps, will be prepared by DID to facilitate the preventive approach.
LAND USE (KOTA TINGGI)
POPULATION (KOTA TINGGI)
ENVIRONMENTAL SENSITIVE AREA (KOTA TINGGI)
Flood Risk Map (Kota Tinggi Town)
Conclusion
CONCLUSION

• For a flood risk management plan to be successful, it needs an integrated participation from various agencies.

• The benefits of the integration of flood risk management into wider development management, urban planning and climate change adaptation are clear.

• It must be recognized that even repeated awareness campaigns, flood warnings and general advice will not always generate the required actions.

• There is a need to strike a balance between structural and non-structural measures in order to gain the most successful long-term flood risk management strategies.

• Understanding the required resources, the best and worst case scenarios is pertinent in making better decisions.
Thank You