Understanding the causes of floods in Penang and seeking solutions

Kam Suan Pheng

29 October 2017

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Flood

… overflowing of a large amount of water* beyond its normal confines, especially over what is normally dry land

**** excessive surface runoff from rainfall***

Flash flood

… a sudden and severe flood

i.e. excessive surface runoff over short time

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Consequences of floods

- Damage of property and possessions
- Disease outbreak
- Loss of lives
- Disruption of public services
- Infrastructure damage
- Massive traffic jams
- Loss of productivity

The great Bangkok flood of 2011

≡ FINANCIAL TIMES

Will Thai floods impact investment?

OCTOBER 21, 2011 by **Ben Bland**

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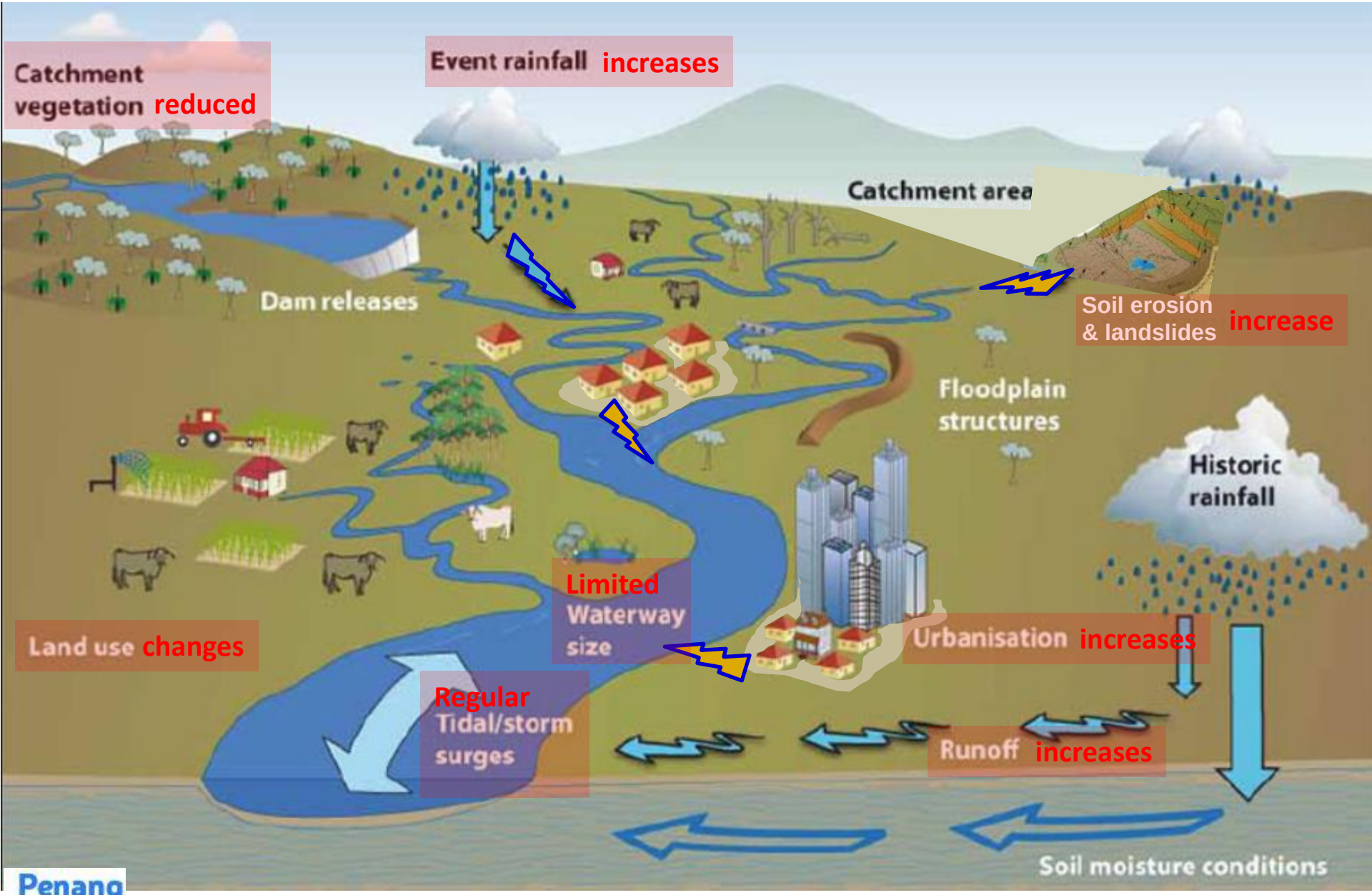

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What causes floods to worsen?

ROOT CAUSES
1. Rainfall increasingly heavy
2. Impermeable surface area expands
3. Eroded soil and landslides increase sediment load in surface runoff
4. Debris clog up waterways
5. Surface flow accumulates downstream
6. Limited capacity to channel off discharge
7. High tides retard discharge to the sea

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What causes floods to worsen?

ROOT CAUSES	IN OTHERS' WORDS*
1. Rainfall increasingly heavy	Increased rainfall with global climate change
2. Impermeable surface area expands	Changing land use from green areas to urban built up areas; Densely developed housing areas lack green space and permeable surfaces
3. Eroded soil and landslides increase sediment load in surface runoff	Cutting hillslopes weakens and exposes soils to erosion
4. Debris clog up waterways	Public apathy: throwing garbage and clogging drains and rivers
5. Surface flow accumulates downstream	Urban drainage is not well planned; contractors do not follow MSMA
6. Limited capacity to channel off discharge	
7. High tides retard discharge to the sea	

* Quoting Prof Dr Chan Ngai Weng, Environmental Management, USM, President of Penang Water Watch

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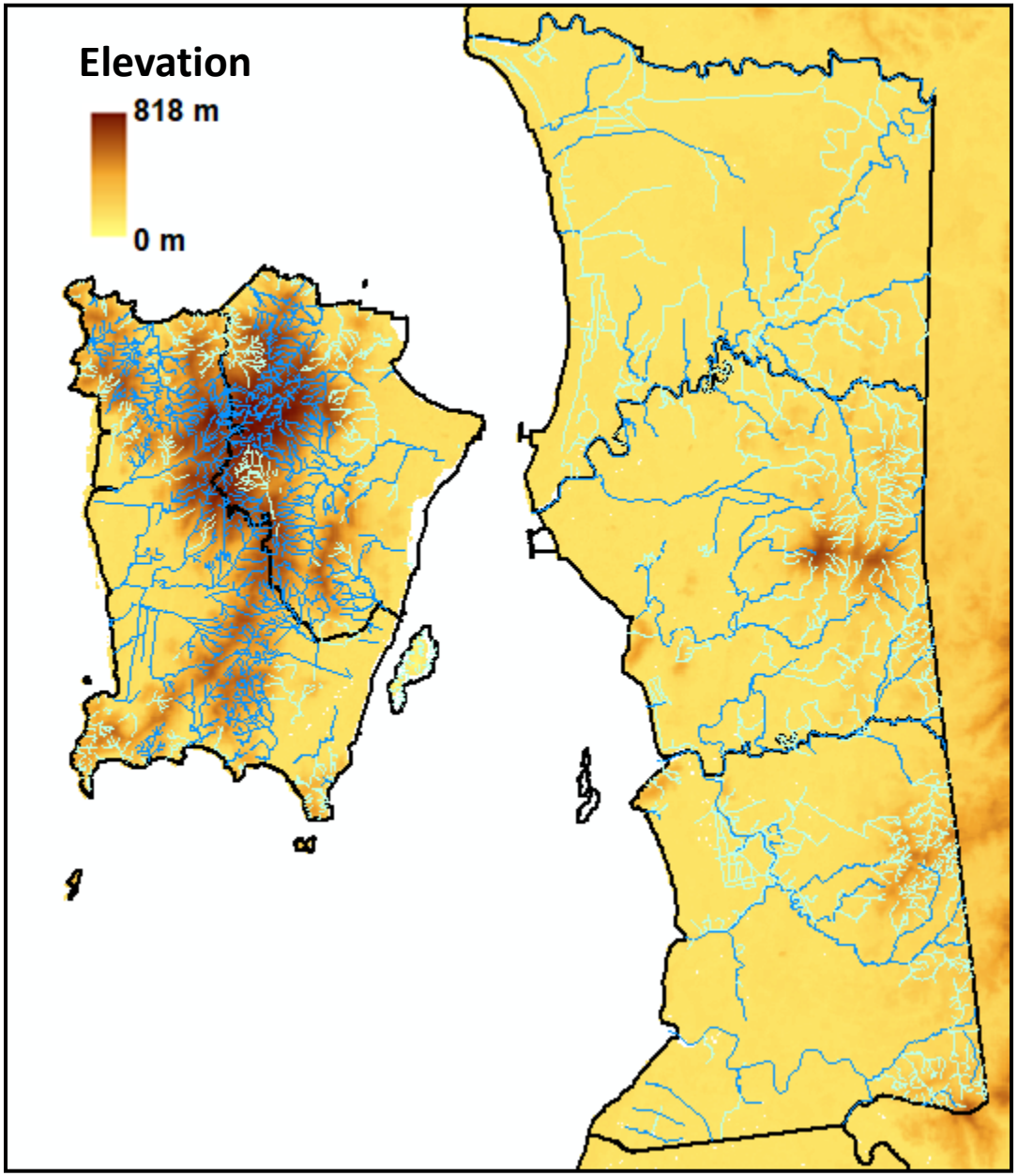
Topography and hydrology of Penang



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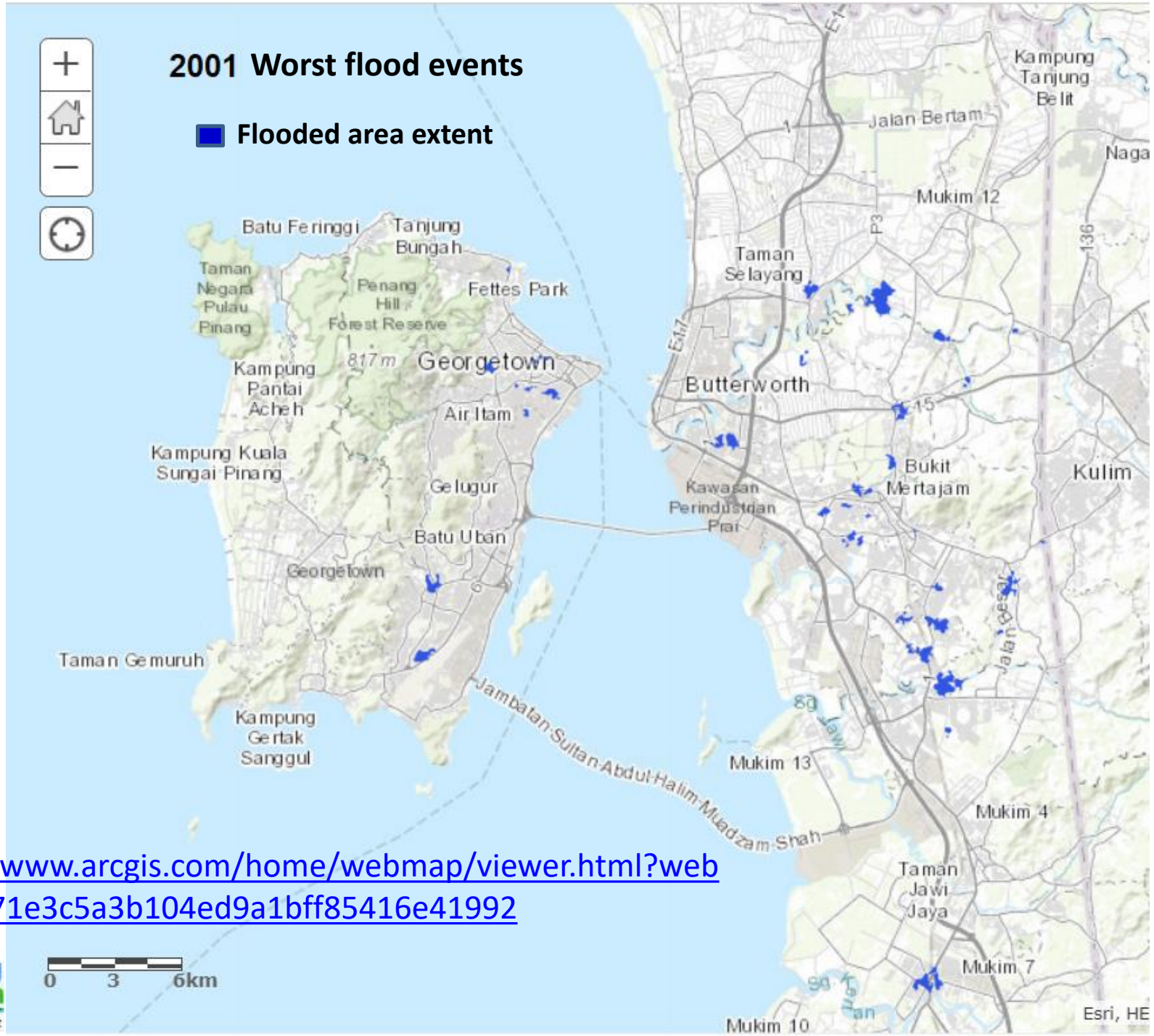
Rainfall and floods in Penang

Rain is the primary and natural source of water, but is rainfall THE cause of floods?



Source:
https://www.arcgis.com/home/webmap/viewer.html?webmap=071e3c5a3b104ed9a1bff85416e41992

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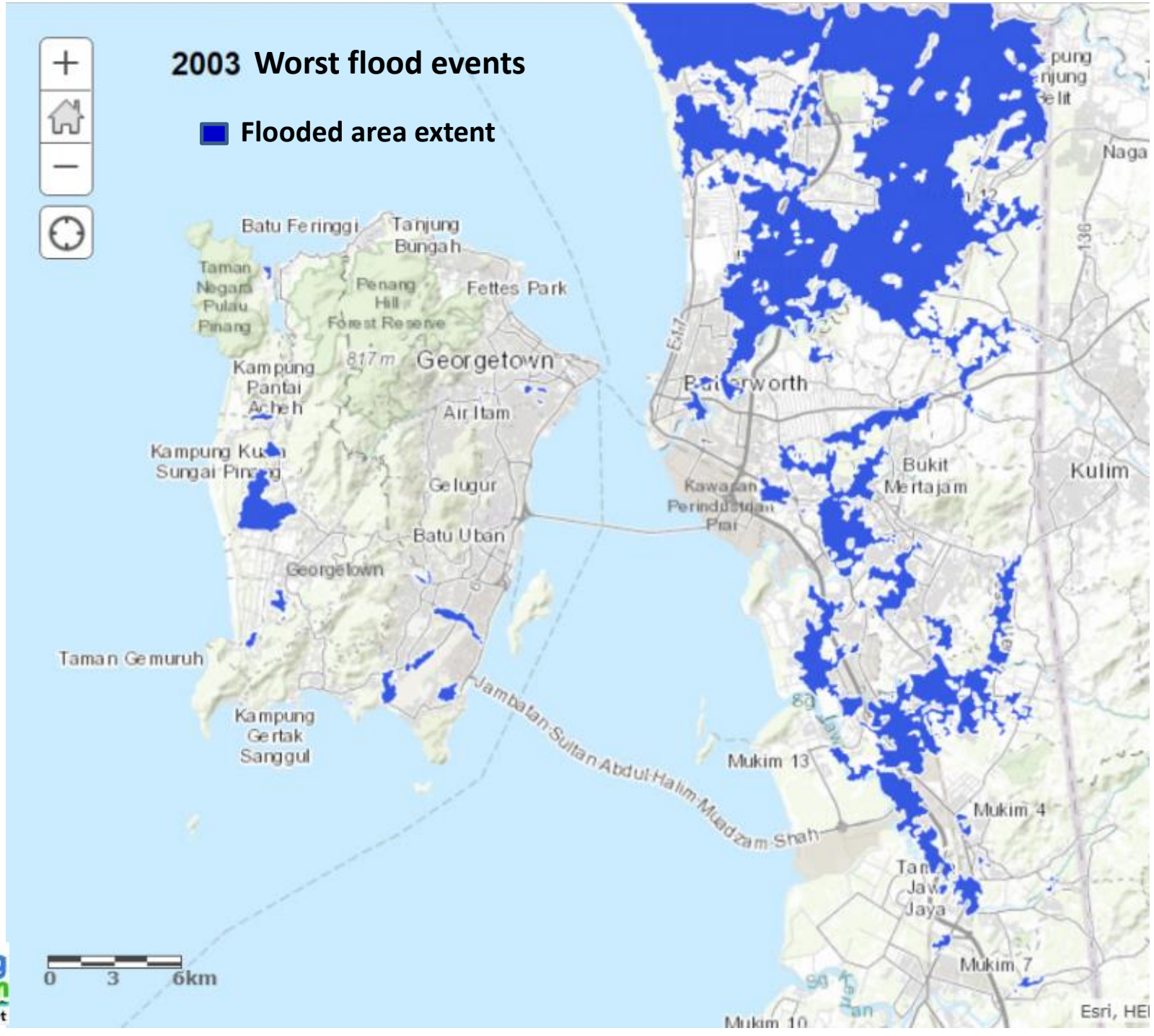

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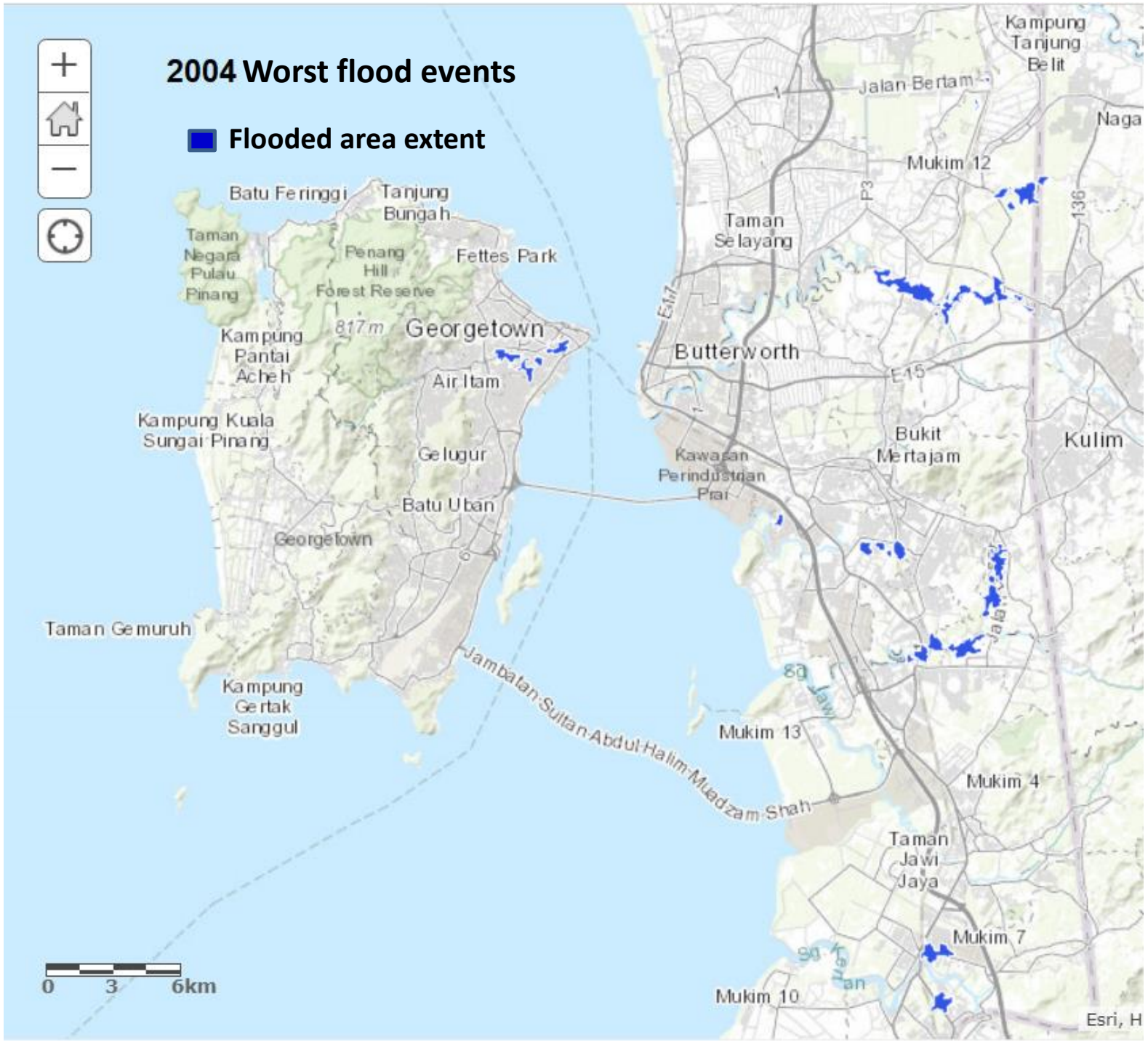

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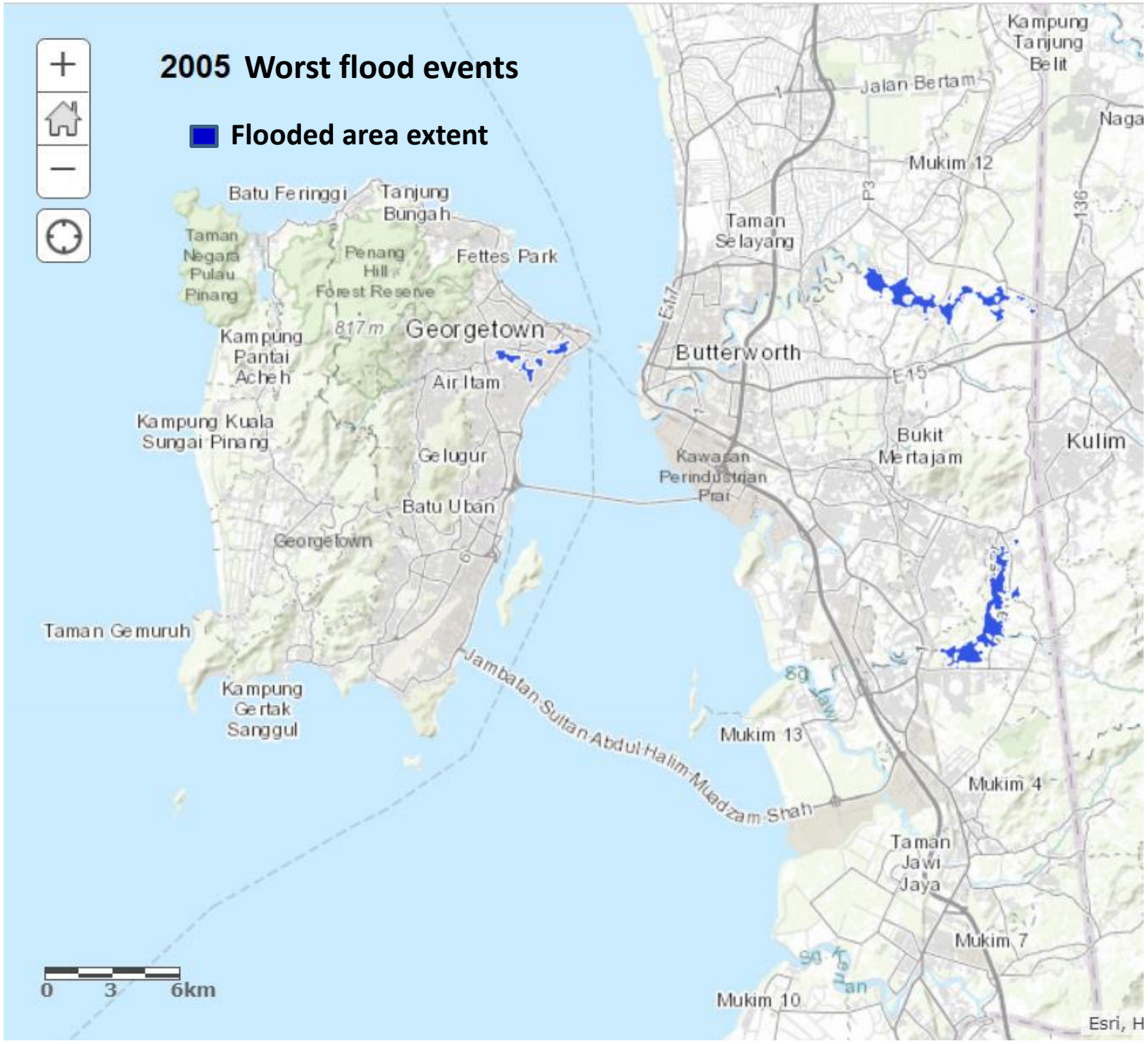
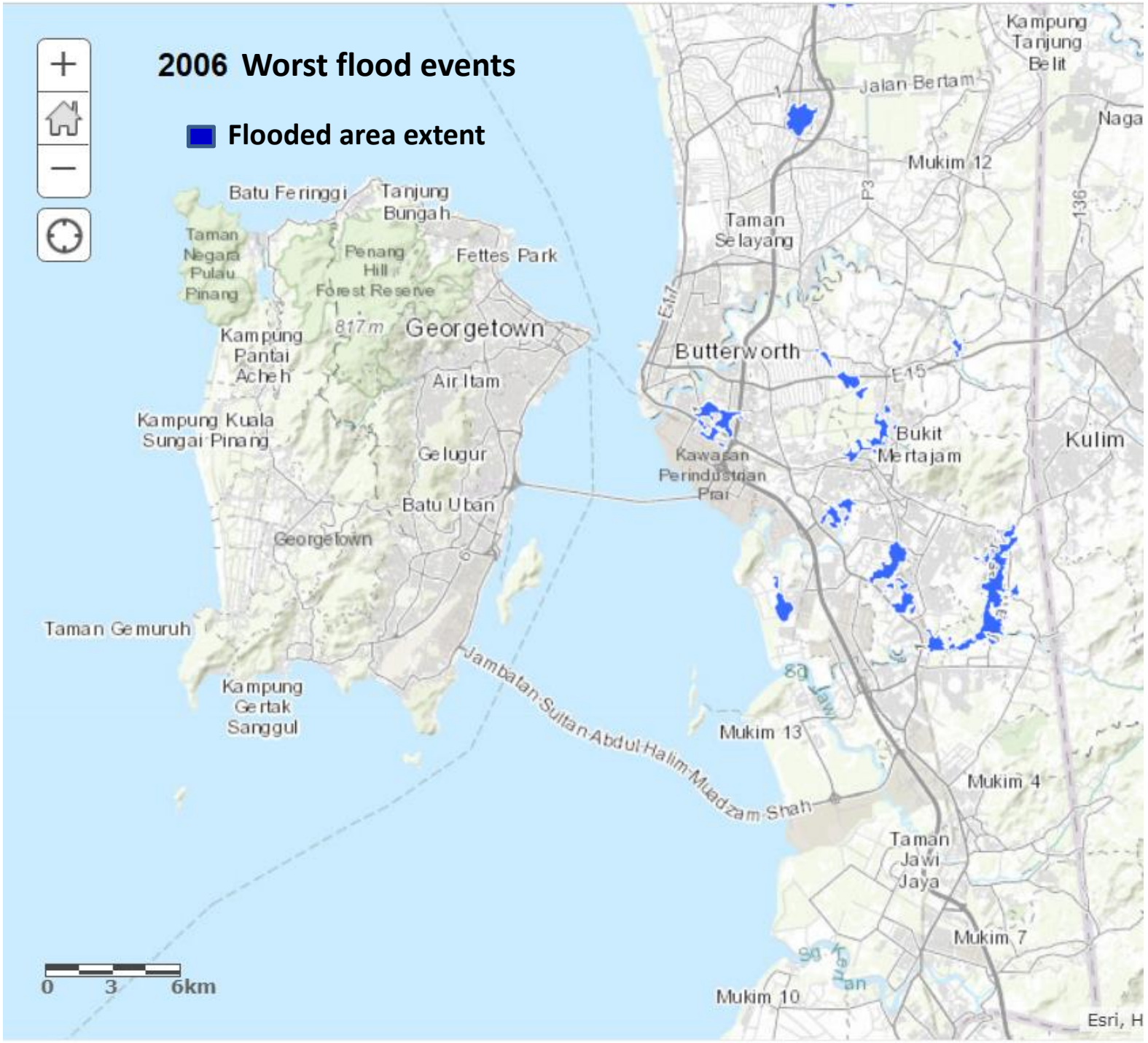

2005 Worst flood events
Flooded area extent
Batu Feringgi
Tanjung Bungah
Taman Negara Pulau Pinang
Penang Hill Forest Reserve
Fettes Park
817m
Georgetown
Kampung Pantai Aceh
Air Itam
Kampung Kuala Sungai Pinang
Gelugur
Batu Uban
Georgetown
Taman Gemuruh
Kampung Gertak Sanggul
Jambatan Sultan Abdul Halim Muadzam Shah
Kampung Tanjung Belit
Jalan Bertam
Mukim 12
Taman Selayang
Butterworth
Bukit Mertajam
Kulim
Kawasan Perindustrian Prai
Mukim 13
Mukim 4
Taman Jawi Jaya
Mukim 7
Mukim 10
0 3 6km
Esri, H



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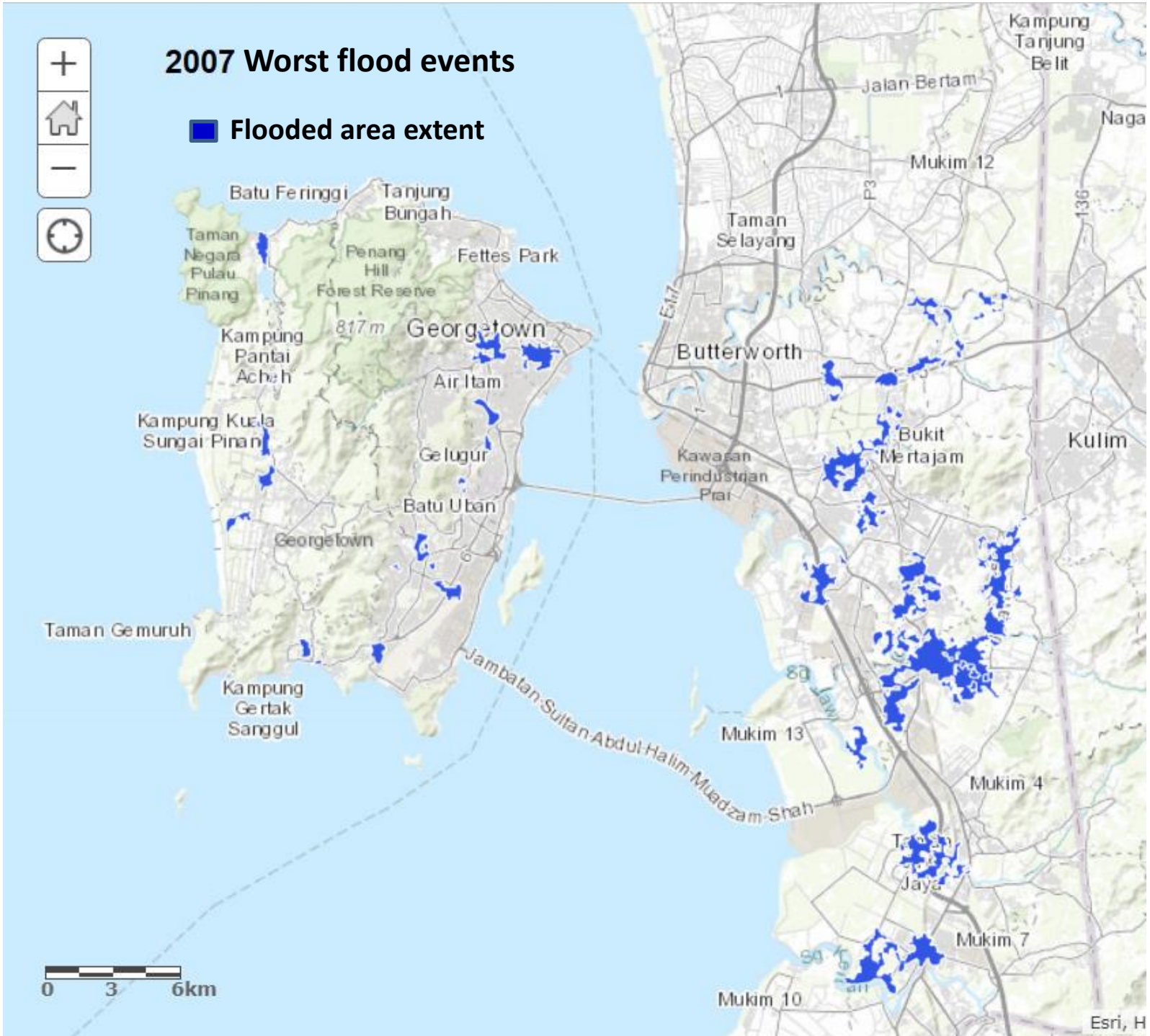

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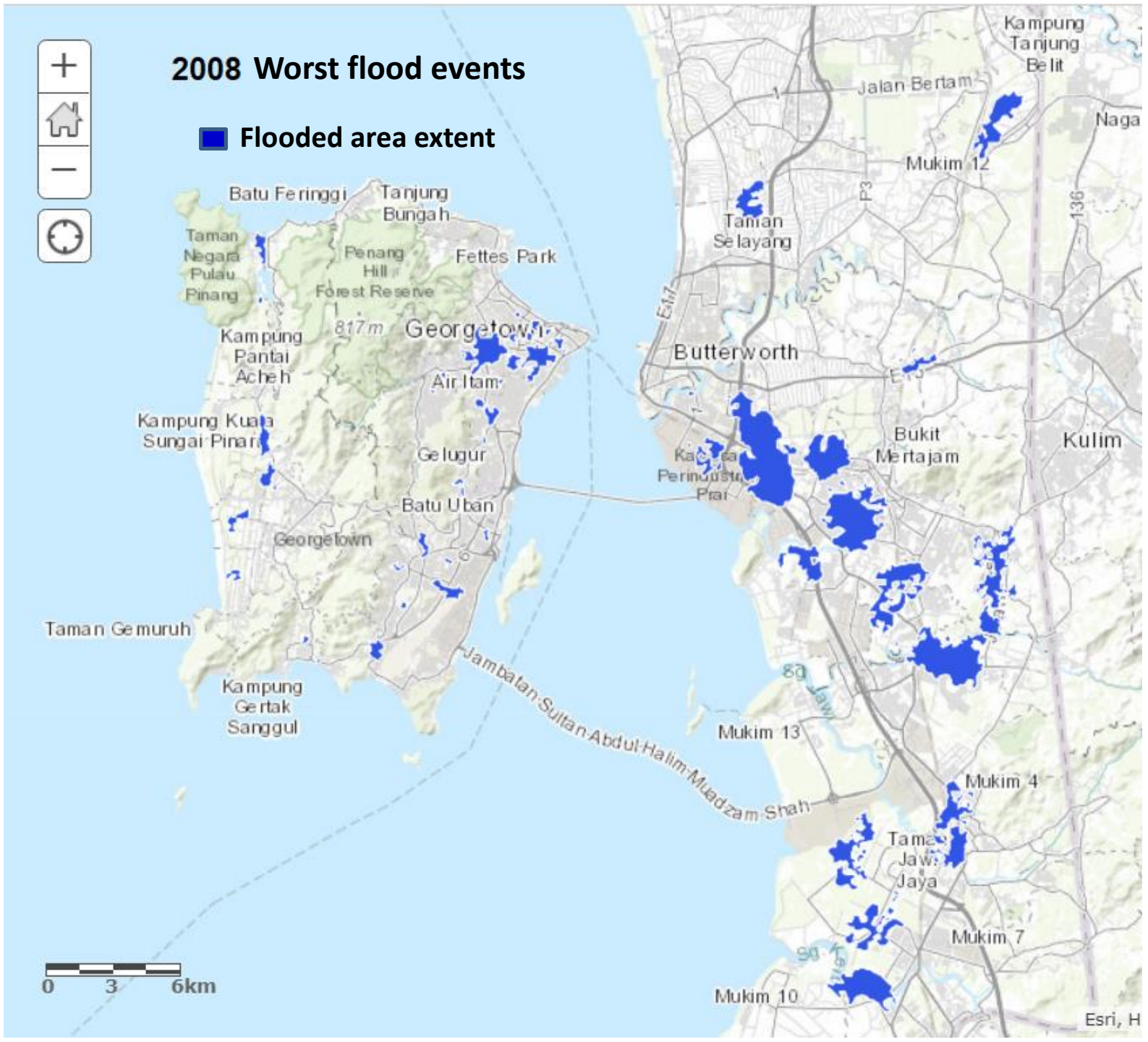

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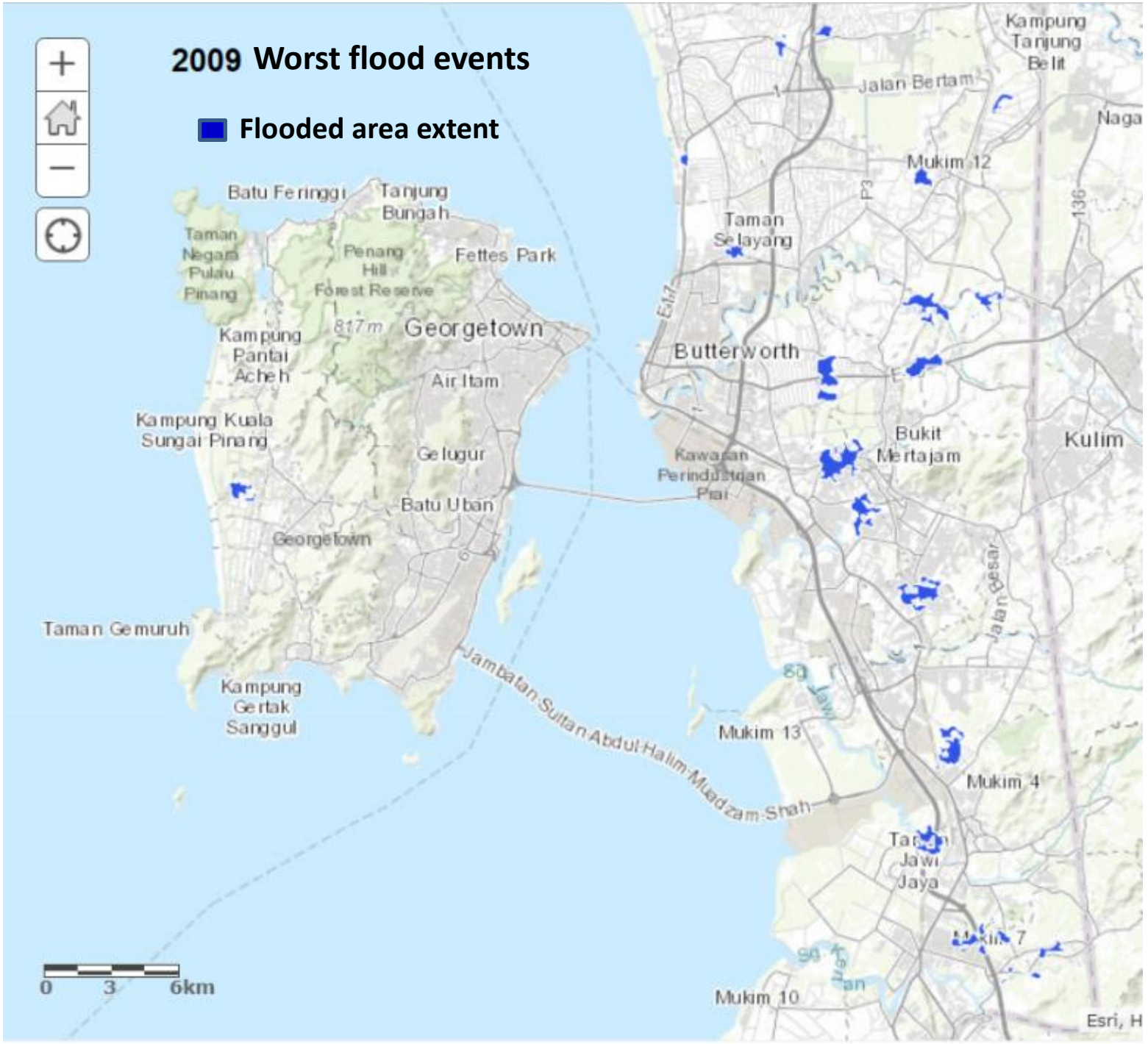

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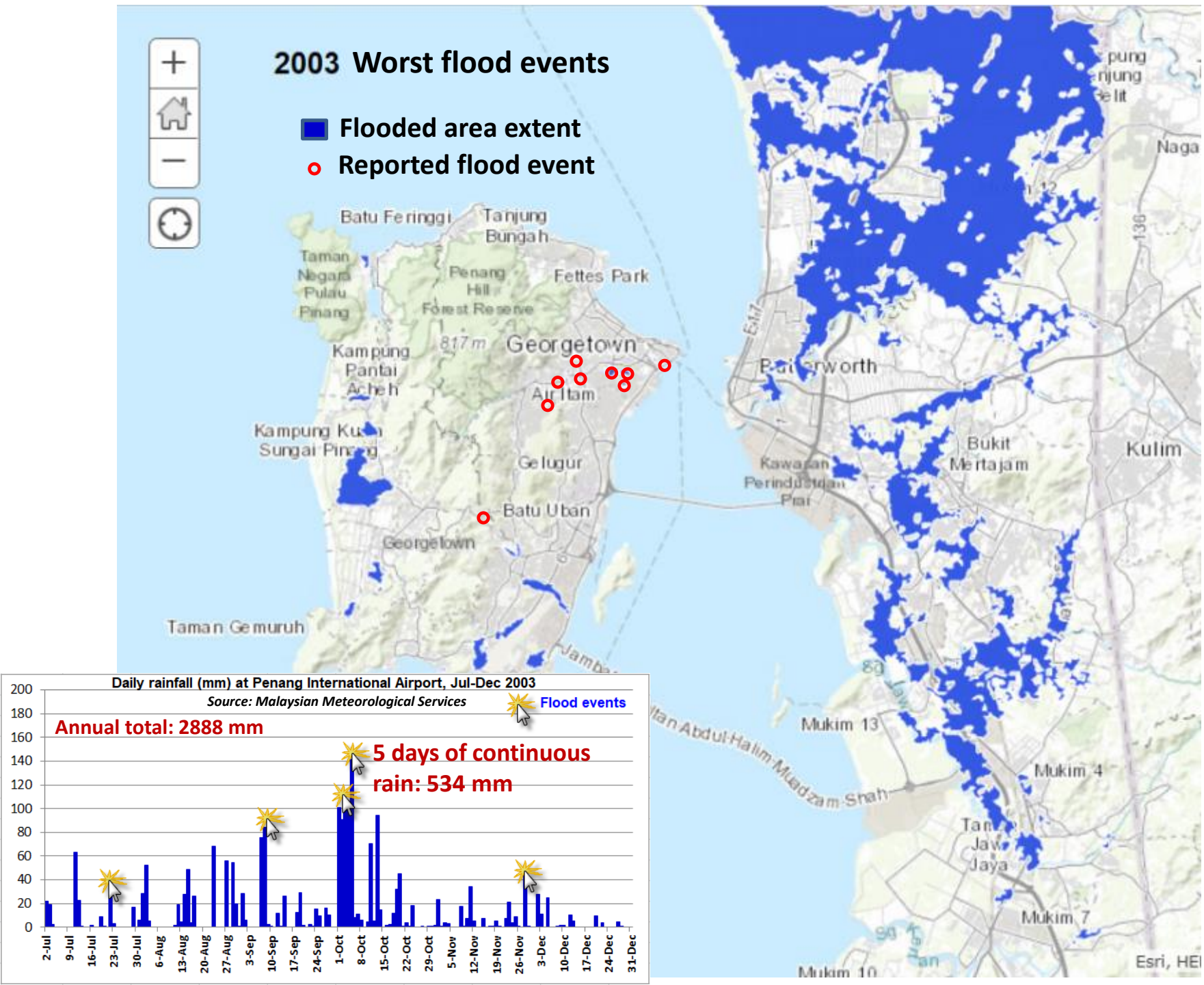
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Batu Uban
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Taman Gemuruh
Kawasan Perindustrian Prai
Bukit Mertajam
Kulim
Mukim 13
Mukim 4
Mukim 7
Mukim 10
Daily rainfall (mm) at Penang International Airport, Jul-Dec 2003
Source: Malaysian Meteorological Services
Flood events
Annual total: 2888 mm
5 days of continuous rain: 534 mm
200
180
160
140
120
100
80
60
40
20
0
2-Jul
9-Jul
16-Jul
23-Jul
30-Jul
6-Aug
13-Aug
20-Aug
27-Aug
3-Sep
10-Sep
17-Sep
24-Sep
1-Oct
8-Oct
15-Oct
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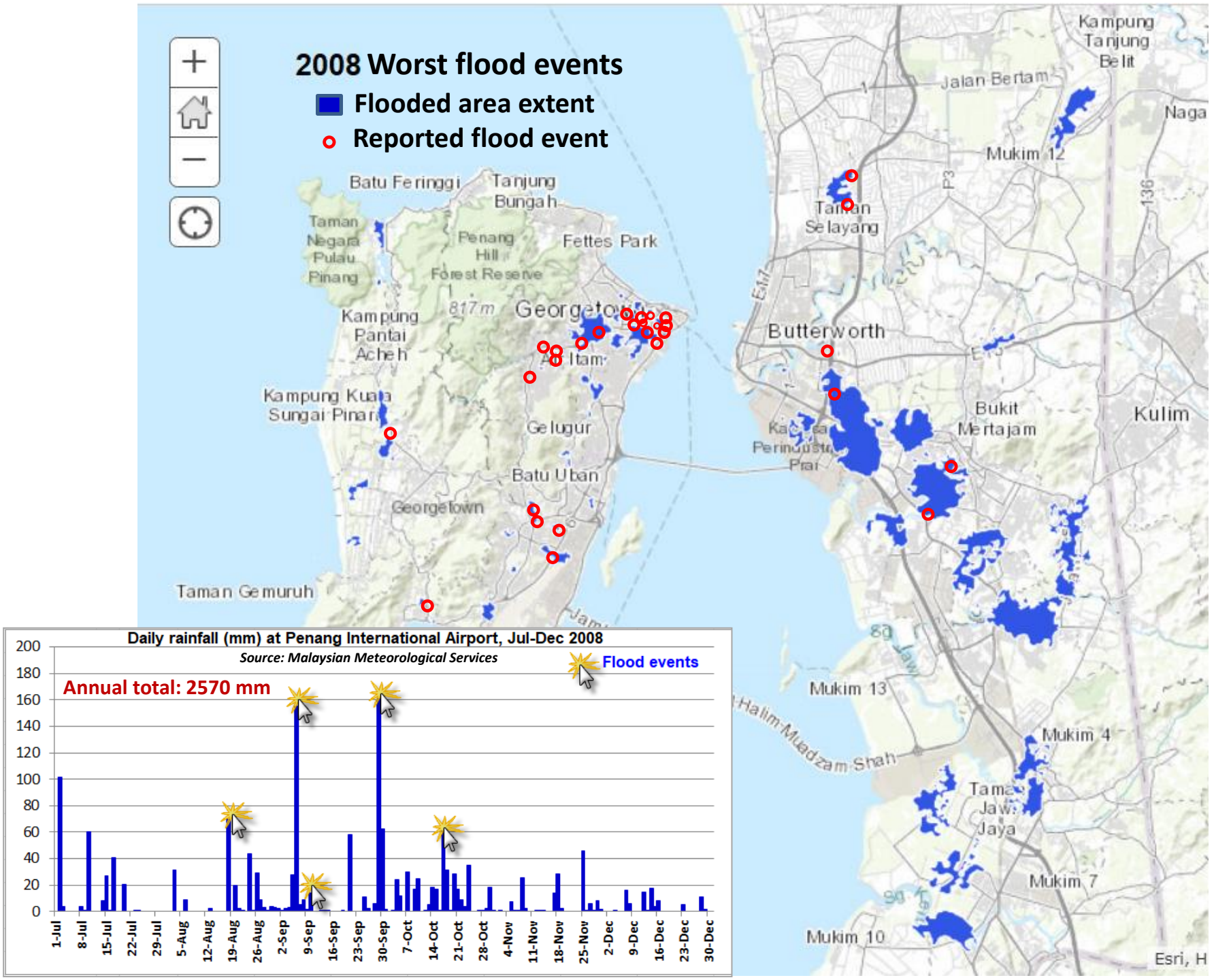
5-Nov
12-Nov
19-Nov
26-Nov
3-Dec
10-Dec
17-Dec
24-Dec
31-Dec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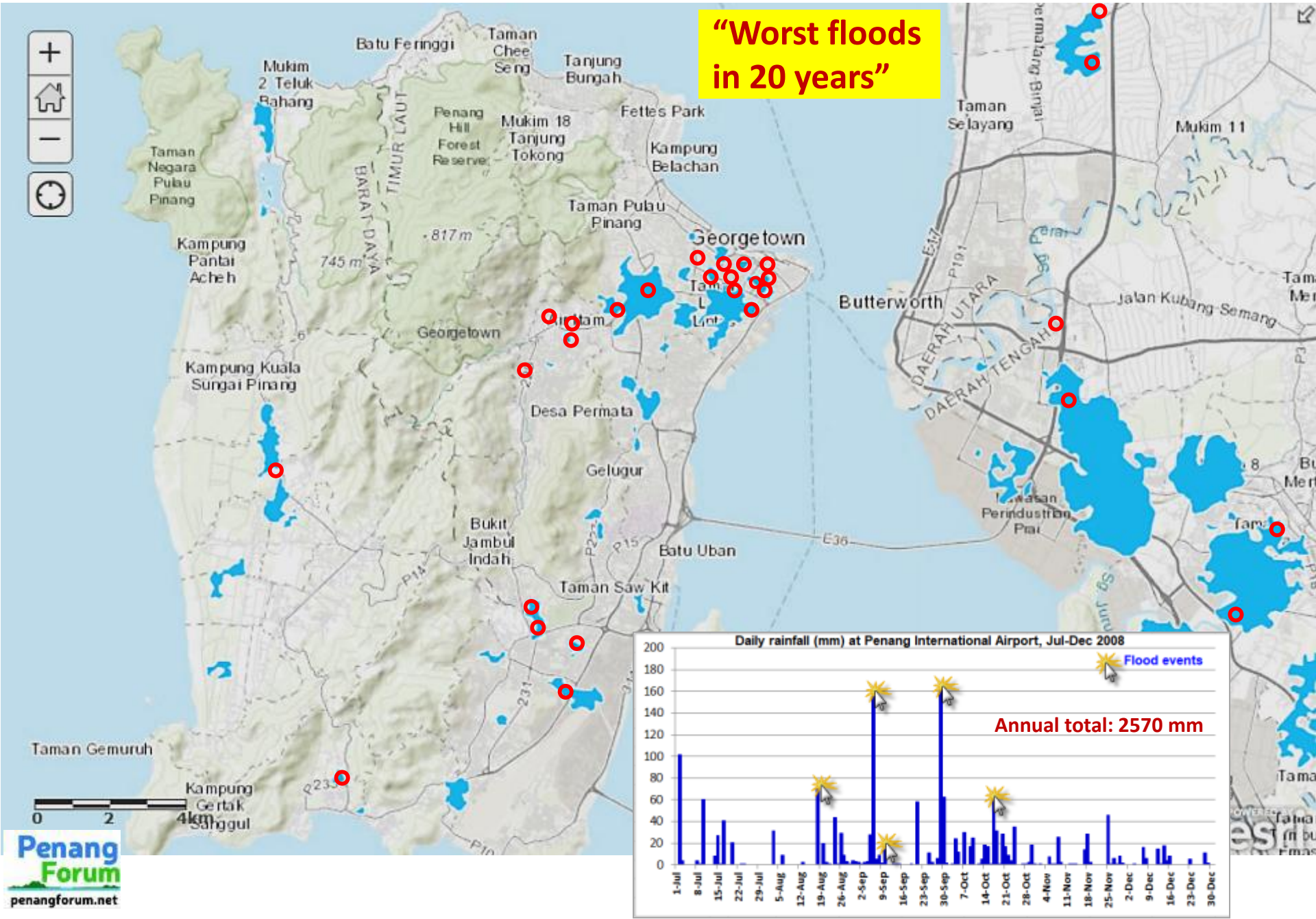
1-Jul
8-Jul
15-Jul
22-Jul
29-Jul
5-Aug
12-Aug
19-Aug
26-Aug
2-Sep
9-Sep
16-Sep
23-Sep
30-Sep
7-Oct
14-Oct
21-Oct
28-Oct
4-Nov
11-Nov
18-Nov
25-Nov
2-Dec
9-Dec
16-Dec
23-Dec
30-Dec

2008 flooded area extent

Reported flood event in 2008



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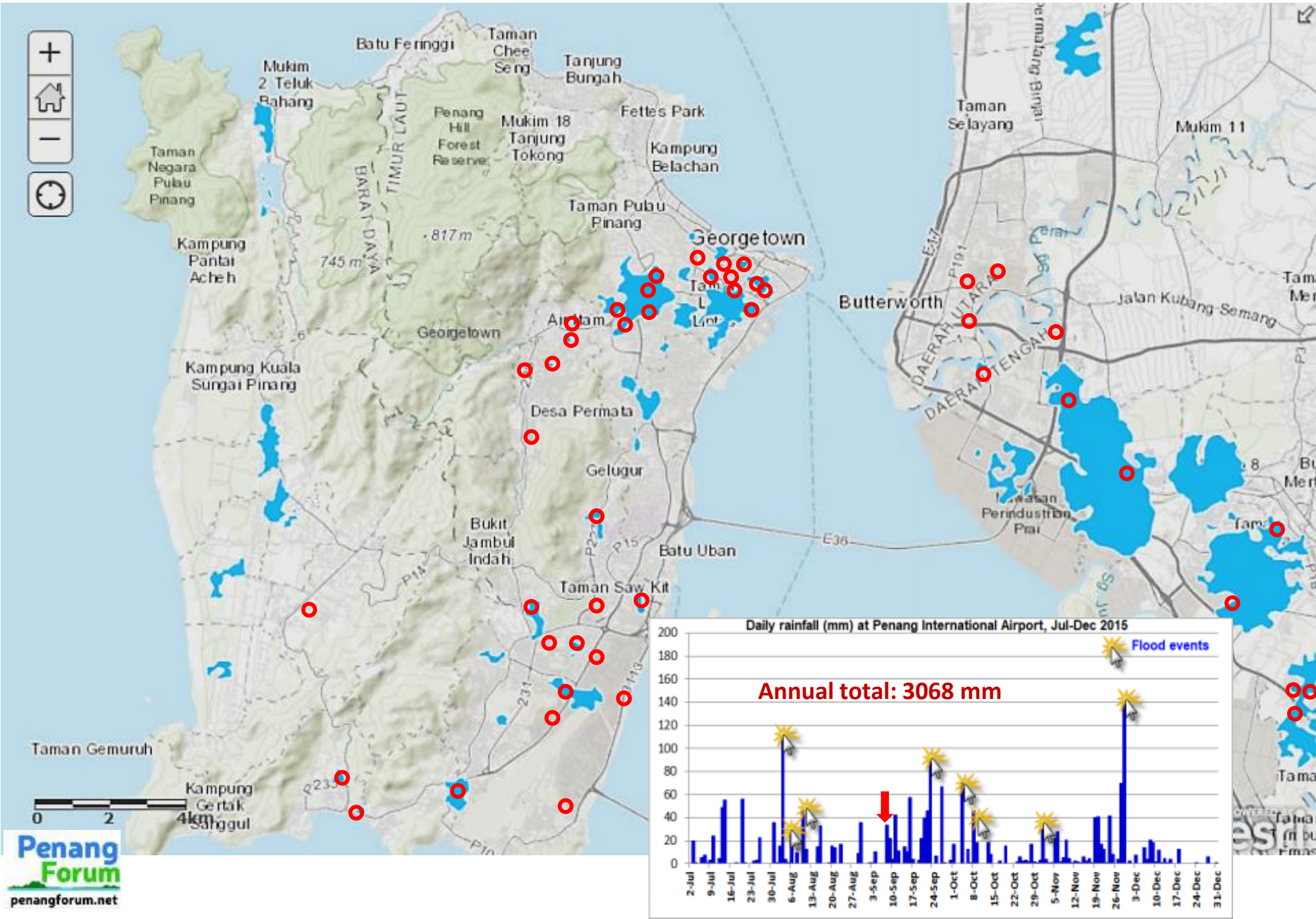
2008 flooded area extent

Reported flood event in 2015



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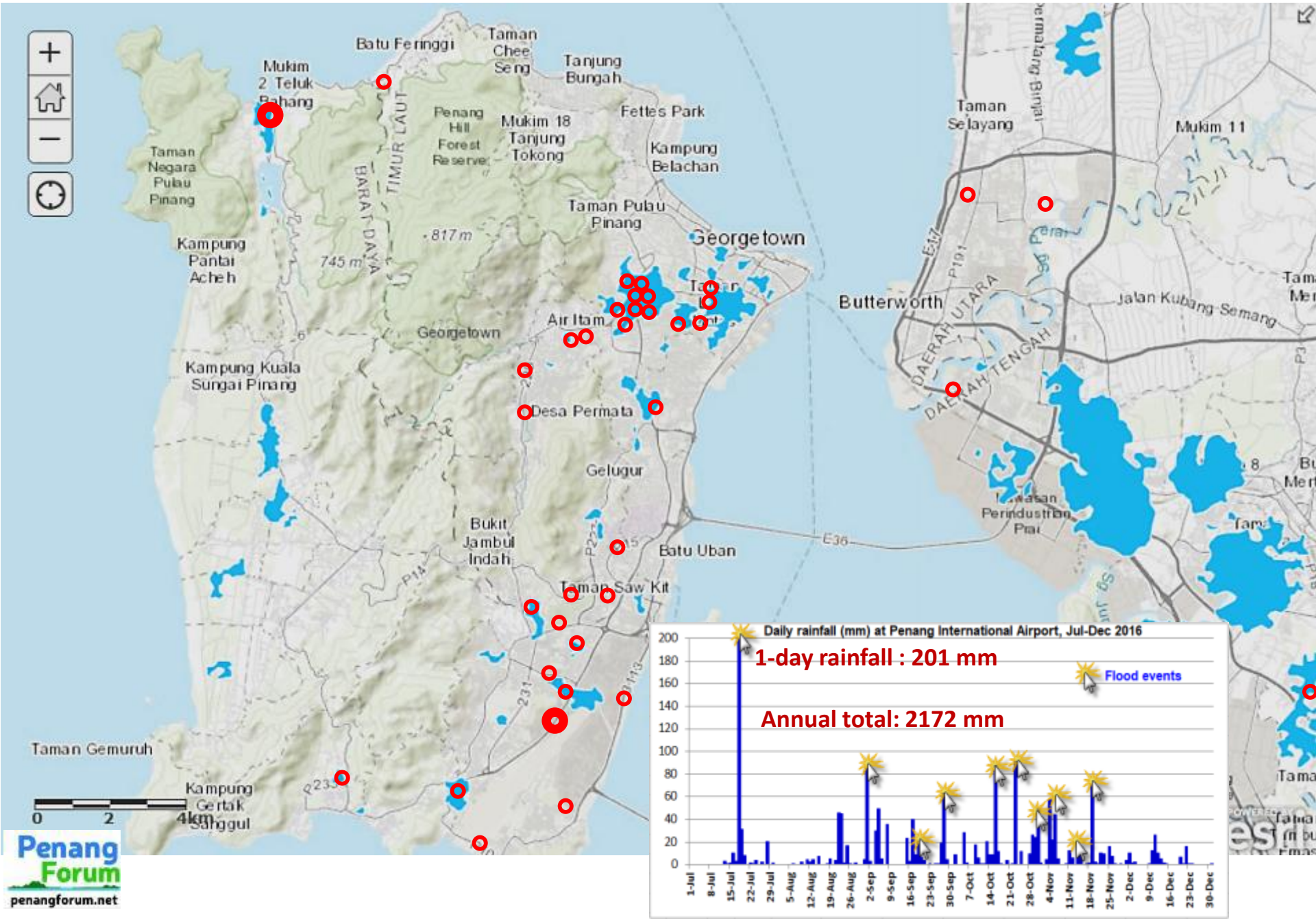
2008 flooded area extent

Reported flood event in 2016



18 July 2016 floods

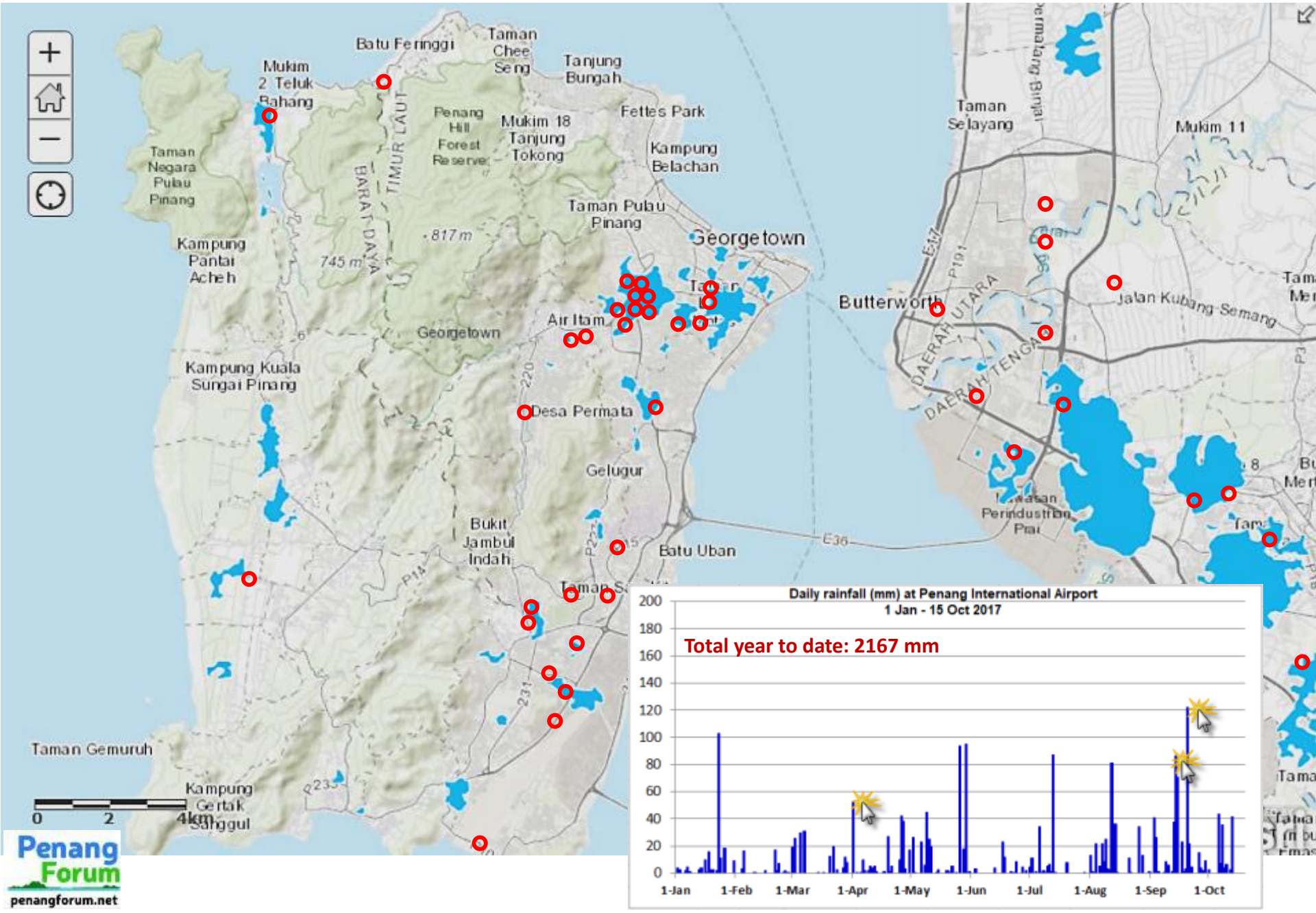
Teluk Bahang

Penang International Airport

Lapangan terbang Pulau Pinang dinaiki air pada 18 Julai 2016. (Gambar: Facebook/Berita Semasa Tempatan)

2008 flooded area extent

Reported flood event in 2017



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2017 floods and landslides

01 Apr 2017

Photo credit: STAR online 01 Apr 2017

15 Sep 2017

Photo credit: Resident of Pearlvue Height

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2017 floods and landslides

15 Sep 2017

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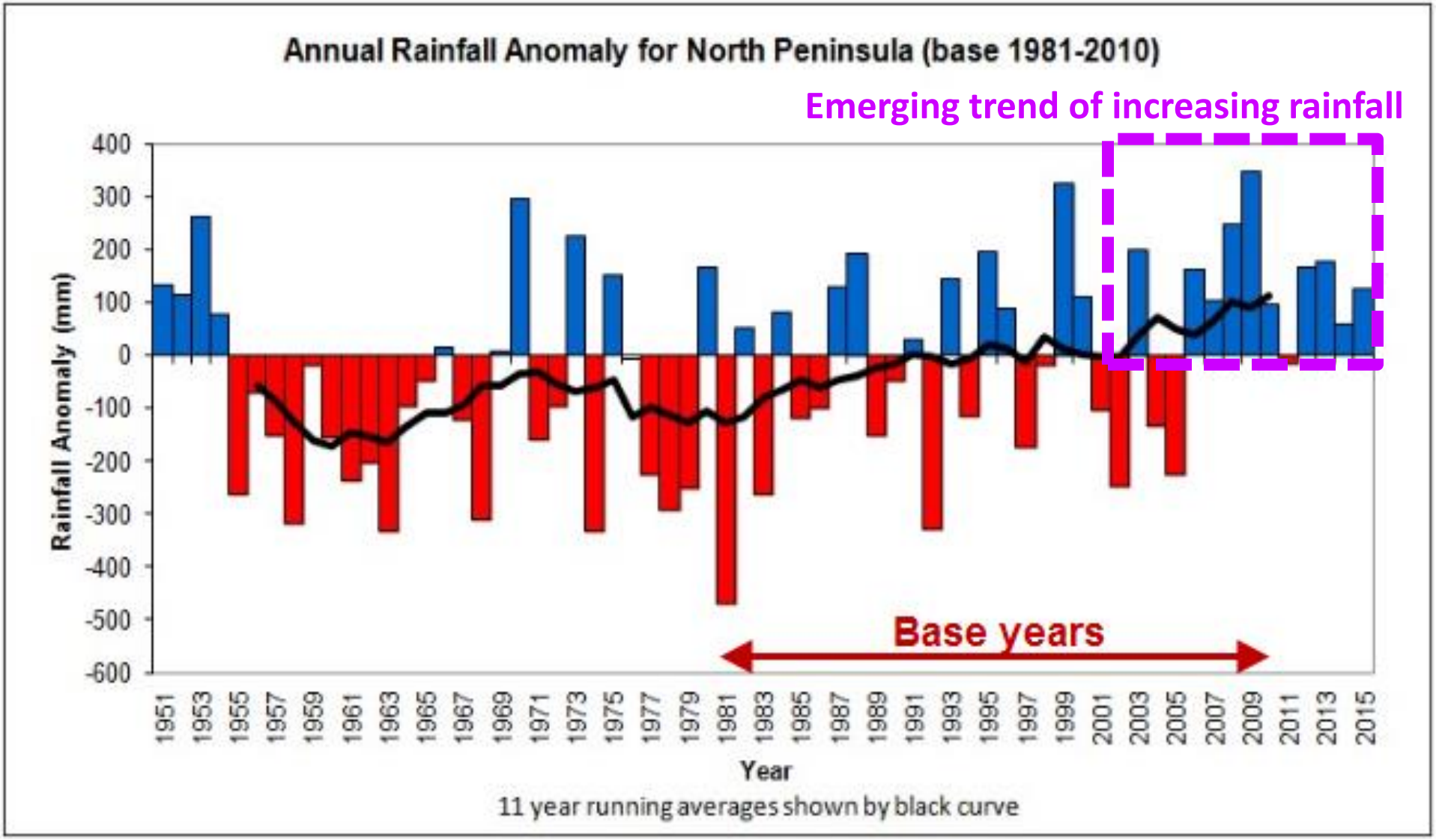
Will the situation worsen?



http://www.met.gov.my/in/web/metmalaysia/climate/climatechange/climatechangemonitoring

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Rainfall and floods on Penang Island

- Flash floods have become more frequent
- Flash flood events are happening at lower rainfall thresholds
- Flooding hot spots have expanded, particularly in Air Itam-Paya Terubong and Relau-Sg Ara
- The flood situation is bound to worsen if climate change brings more rain and more intense rainfall

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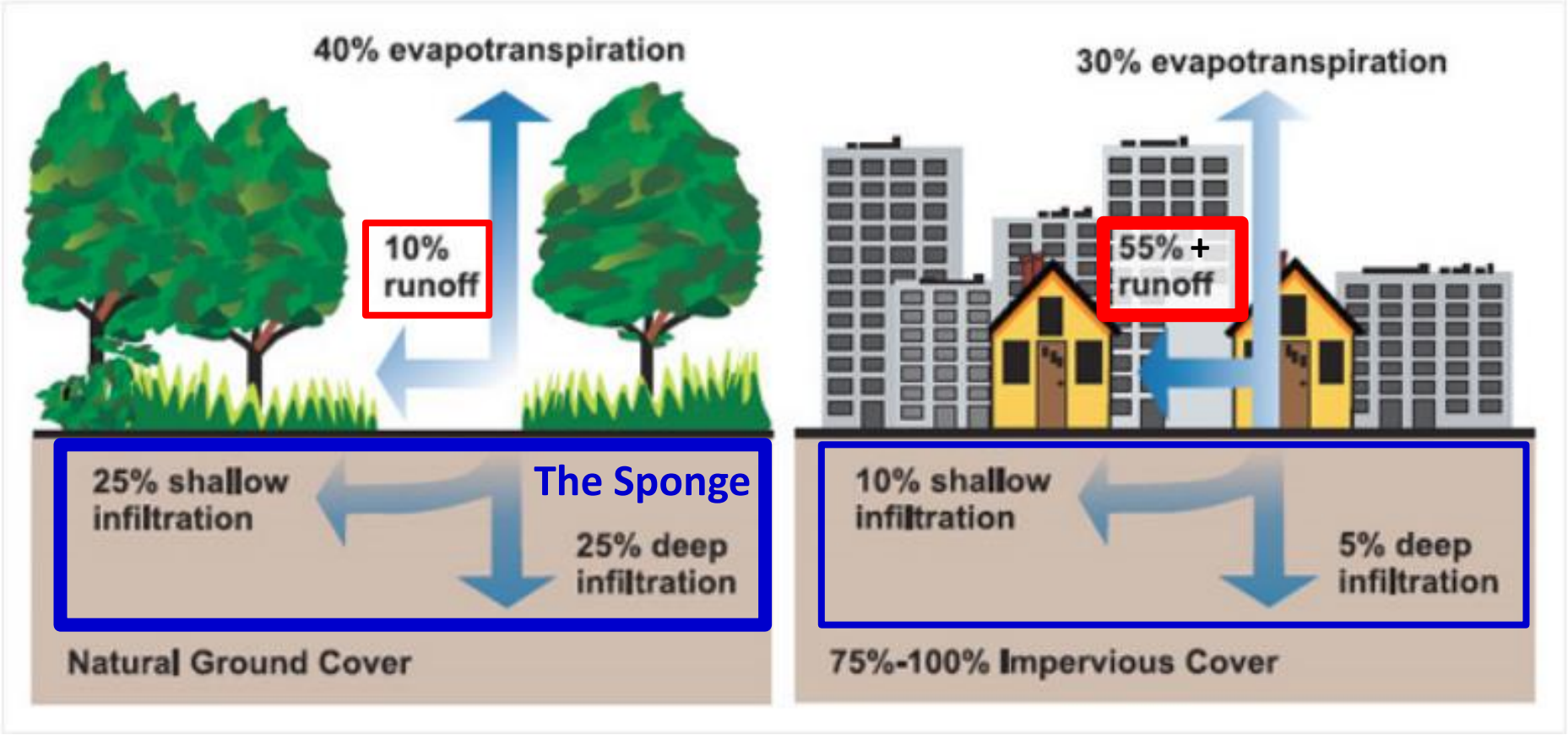
Development and floods on Penang Island

Quoting the late Datuk Ir Kam U Tee, Penang Water Authority GM (1973-90) STAR 24 Oct 2008:

"The floods (*15 Oct 2008*) were caused by conversion of the Paya Terubong and Bayan Baru valleys into concrete aprons that do not retain water. The water immediately flows into the streams causing flash floods even with moderate rainfall. Because of hill-cutting activities, the flowing water causes erosion of the slopes which carries mud and silt into the river beds."



Land use conversion

Thean Teik estate in early 1980s

Farlim today

https://www.thestar.com.my/news/community/2013/09/21/farlim-the-old-tai-kors-place-the-township-that-is-home-to-air-itams-highrise-flats-is-steeped-in-hi/

When we lost the lowland vegetable farms in Thean Teik estate in the 1980s, we not only lost its supply of vegetables but the ecosystem service of the farmlands – the *sponge* that absorbed rainwater

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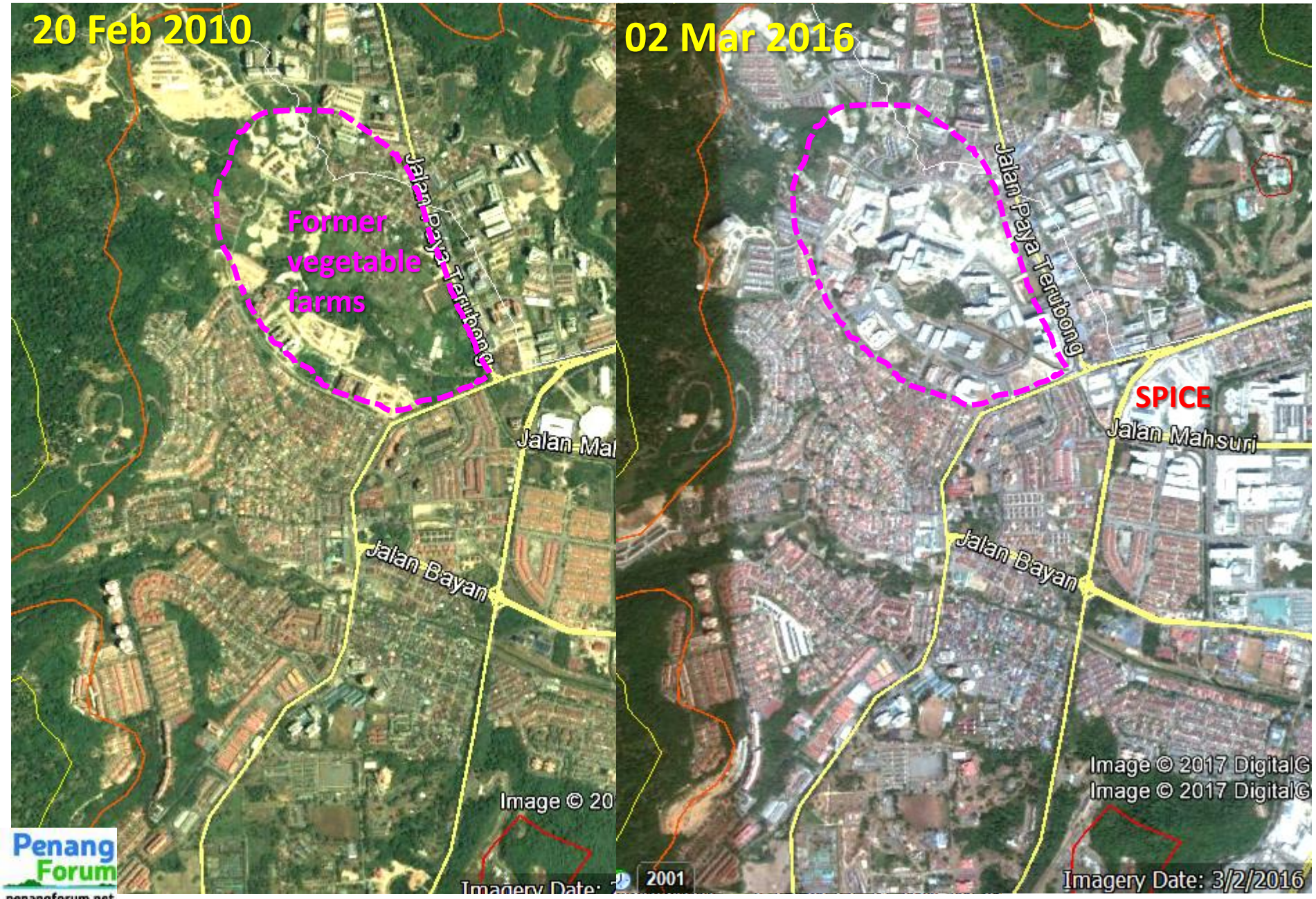
Similarly in Relau in more recent years…



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With vegetable farms moving uphill …

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.. and development creeping upslope…

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And more hill cutting further upslope…

Heavy rains caused landslides and mud flows…

Photos courtesy of Paya Terubong Residents' Association

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… silting up the flood water retention pond at Taman Sri Rambai

… flood waters spilling into Jln Paya Terubong

Photos courtesy of Paya Terubong Residents' Association

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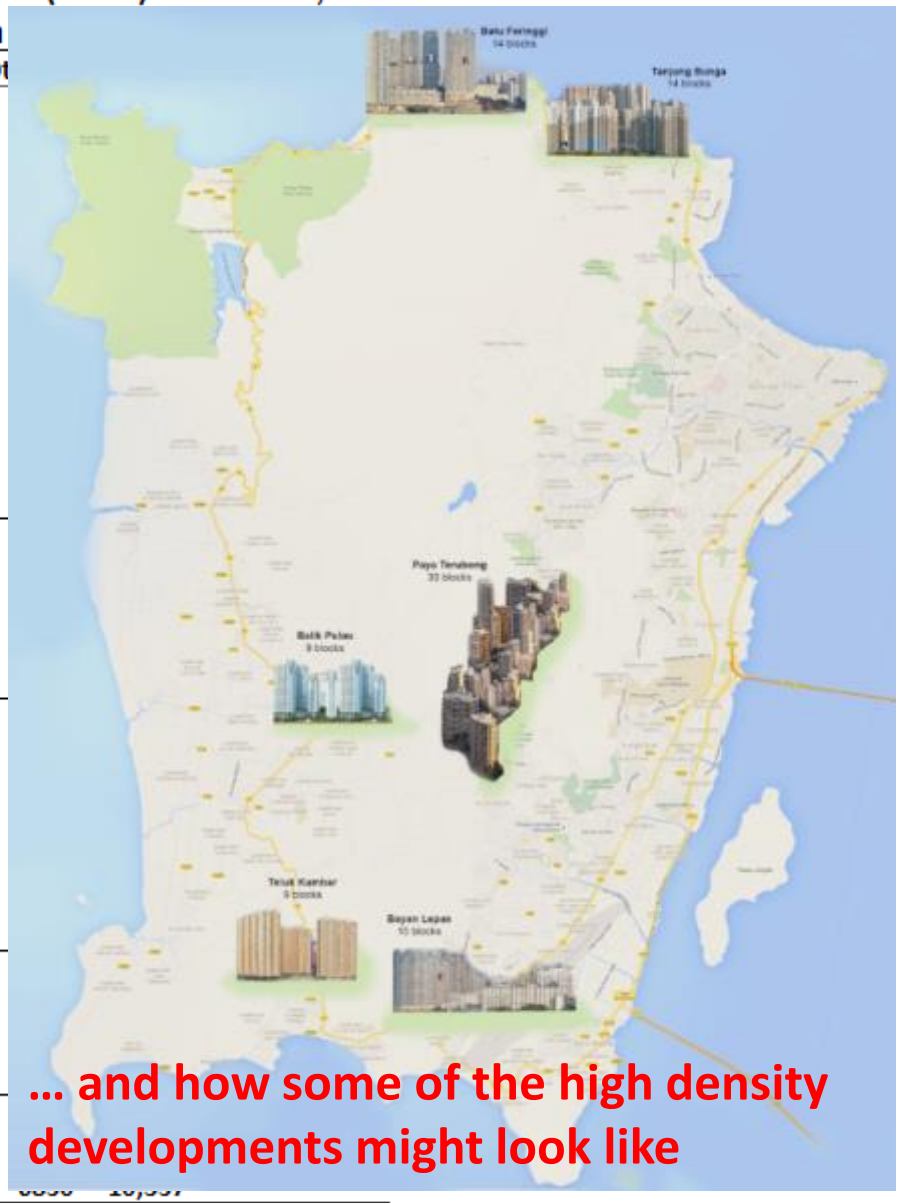
More hill land development projects

High-rise residential development projects on hill land of 76 m (250 ft) and above, and/or on slopes steeper than 25°, approved between

Area	# of blocks & # Storey	# Affordable	# Med Cost	# Low Cost	# Ot
Paya Terubong	5 blocks; 26-30 storey		564		
	1 block; 19 storey				
	2 blocks; 12,13 storey				
	1 block; 24 storey				
	3 blocks; 14,31,37 storey		400		
	1 block; 35 storey				
	3 blocks; 13,16,32 storey				
	1 block 32 storey hotel; 248 rooms				
	1 block; 41 storey				
	2 blocks; 35,45 storey		130		
	1 block; 44 storey				
	21 blocks of high rise				
Tanjung Bunga	5 blocks; 38 storey			500	
	3 blocks; 31-45 storey	390			
Batu Ferringhi	3 blocks; 33 storey				
	11 blocks of high rise				
Balik Pulau	1 block; 16 storey			165	
	4 blocks; 30-36			850	
Telok Kumbar	1 block; 18 storey		96		
	2 blocks; 13-17 storey		412		
	1 block; 24 storey				
	9 blocks of high rise				
Bayan Lepas	13 blocks; 5-16 storey				
	1 block; 13 storey				
	14 blocks of high rise				
Total:	55 blocks of high rise				
	Total number of units	390	1602	1515	

Total: 55 high-rise blocks



… and how some of the high density developments might look like

Source:

List provided by State Exco to ADUN's question in Nov. 2015 Penang State Assembly on approvals given to hill land building projects from 2008-2015

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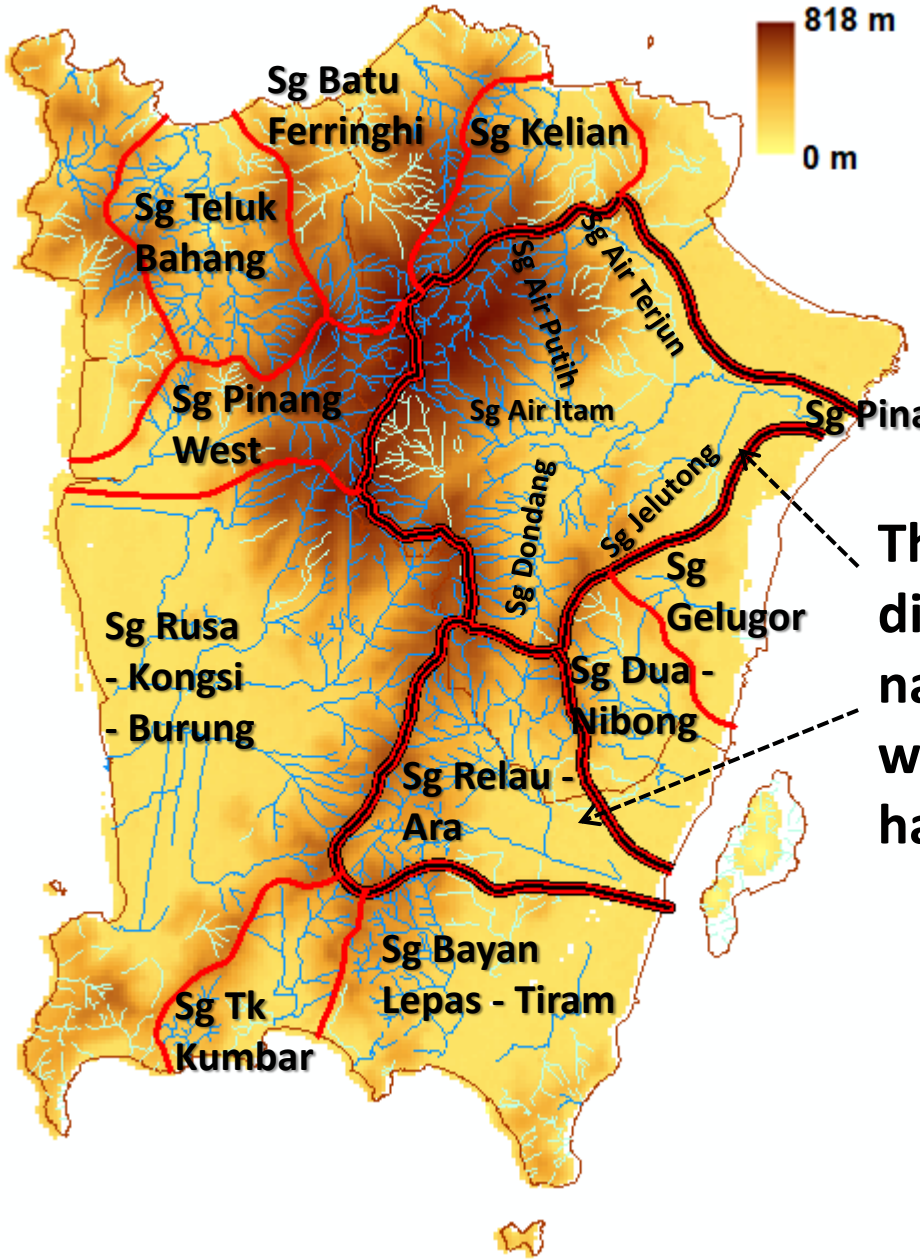
River basins of Penang Island



The two largest river basins discharging eastward, with narrow bottlenecks, are where urban development has become most intense

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How big is Sg Air Itam?

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Sg Pinang East flowing below Scotland Road

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Household debris thrown into waterways…

Civic consciousness at its low; the public also has a role to play

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… and Sg Air Itam overflows

Malaysian Insight pic by Fahmi Hamid, September 15, 2017

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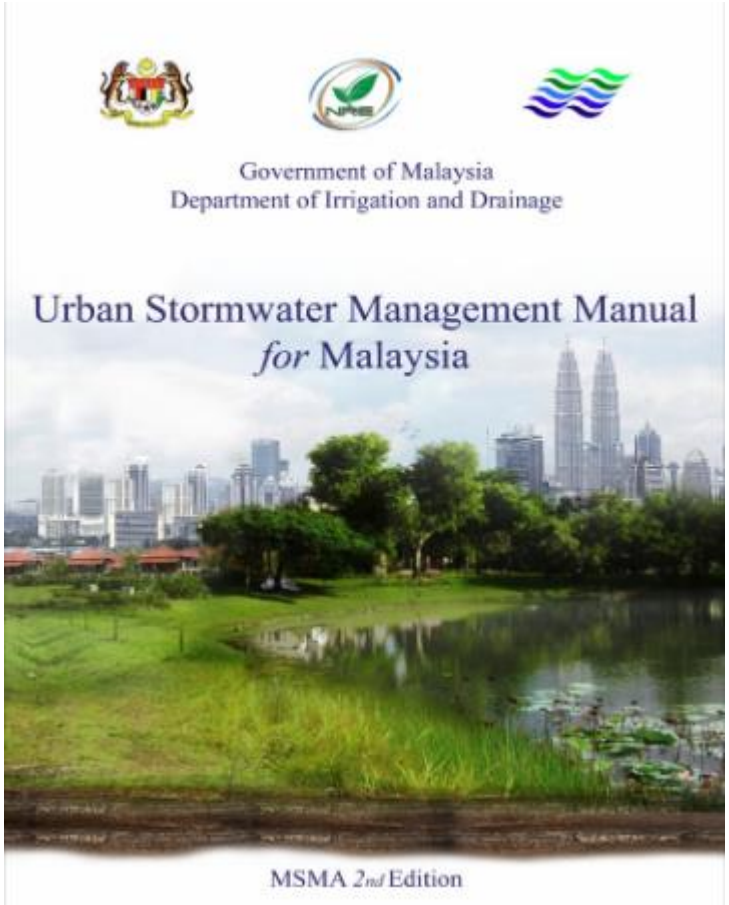
Urban drainage

Urban drainage *(in Penang)* is not well planned; contractors do not follow MSMA (*Manual Saliran Mesra Alam*)

Quoting Prof Dr Chan Ngai Weng, Environmental Management, USM; President of Penang Water Watch
https://sustainablepenang.wordpress.com/2016/11/09/rapid-development-hillslope-cutting-irrefutably-cause-of-penang-flood/



http://redac.eng.usm.my/html/publish/2004_06.pdf

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Feb 2010

What was a 40-m strip of vegetated sheer slope between Julita Apartments and Punchak Terubong

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Mar 2016

Now stand two 33-storey buildings of Pine Residence, wedged into this narrow strip, towering over the Julita apartments

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Towering over Julita apartments…

…with barely 10-ft clearance

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Is this enough drainage from such a big building development…

… flowing into an existing roadside drain?

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What causes floods in Penang?

1. Rainfall increasingly heavy
2. Impermeable surface area expands
3. Eroded soil and landslides increase sediment load in surface runoffs
4. Debris clog up waterways
5. Surface flow accumulates downstream
6. Limited capacity to channel off discharge
7. Exceptionally high tides slow down discharge to the sea

All of the above!

Seeking solutions

MULTI-PRONG:

TACKLE THE ROOT CAUSES…

Flood prevention

… NOT JUST THE SYMPTOMS

Flood mitigation

PREVENTION IS BETTER THAN CURE

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Flood mitigation

Tackling the symptoms

Costly, needs public (state and federal) funds

- **Structural measures: upgrade river, install pumps**
  - **The main focus of flood mitigation**
  - **Reactive, recursive measures**
- **Non-structural measures**
  - **Drainage masterplan for Penang, by district**
  - **Flood warning system**
  - **Flood forecasting system**
  - **Public awareness raising and education**

Ir Sabri Abdul Mulok, Director
Penang Drainage and Irrigation Dept
https://www.facebook.com/pggreencouncil/videos/1455250057863781/

Flood prevention

Tackling the root causes

1. **Proper land use planning and development control**
2. **Environmental, drainage, transportation and social impacts beyond individual development projects**
3. **Stringent protection of hill land and hill slopes**
4. **Stringent monitoring of development projects**
5. **More greening of urban spaces, system of parks**
6. **River bank protection**

- ***Deploy policy and legal instruments***
- ***Adopt environmentally-sensitive and ecologically-friendly structural and non-structural solutions***

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Neighbourhood parks

More of this…

… not this

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River reserves

More of this…

… not this

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Flood water retention ponds

More of this…

… not this

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Waste water treatment

More of this…

Mansor, Lim and Shutes (eds). 2002. Constructed wetlands: Design, management and education. USM Press. 65p

Photo credit: https://wetlandsworkllc.files.wordpress.com/2015/01/pursat-3.png

IWK treatment plant in Batu Ferringhi – Photograph: Malay Mail

… not this

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So that our future generations

do less of this…

cleaning up the mess they inherit

… and more of this

enjoying the gift of rivers as the 'life veins' of Penang

https://www.researchgate.net/publication/319617564_MOBILISING_LOCAL_COMMUNITIES_TOWARDS_INVOLVEMENT_IN_RIVER_MANAGEMENT_LESSONS_LEARNT_FROM_THE_SUNGAI_PINANG_RIVER_COMMUNITY_ENGAGEMENT_PROJECT_IN_PENANG_MALAYSIA

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Just some ideas for a truly

… and the basis for

Demands of the Residents' associations of Penang
i. Stop overdevelopment and the creation of more concrete jungles
ii. Hill-cutting and hill slope development must be stopped. This can be done by the State Government by not approving any further hill-slope and hill land developments
iii. The State Government should immediately amend the 2009 guidelines on 'special projects' to explicitly prohibit all development on hill lands, except if it is for essential public services
iv. Existing exposed and barren slopes and spaces should be rehabilitated and covered to prevent further soil erosion
v. Stern enforcement, effective and deterrent action be taken by relevant authorities including the local authorities on those who clear lands illegally or do not abide by conditions imposed to prevent soil-erosion
vi. Frequent monitoring of hill-slopes by the local authorities
vii. Public declaration by local authorities of hill slopes and areas which are not safe
viii. More tree-planting and creation of green open spaces are needed
ix. Regular cleaning up of drains to free from clogging
x. Introduce local plans now so as to control planning
xi. Ensure that persons in positions of power and responsibility in government are professional, honest, have integrity and experience and are held accountable for their actions
xii. Beef up the enforcement and accountability not just in government agencies but also in professional bodies, like the Board of Engineers Malaysia